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ABSTRACT

The school spending model described in this report involves institutions and information based on the following reasoning. Where education spending must be approved by referenda, the school board seeks to obtain as large a budget as possible. Voters have to approve the budget proposal or accept the "reversion" level of spending--that statutorily mandated level of spending that prevails should a referendum fail. Since the budget-setters can use a low reversion level to threaten the voters into accepting higher expenditures, the institutional structure matters in the model. Knowledge of a lump-sum state grant will typically lower voters' desired levels of spending from local sources. Also, larger grants lead to larger reversions and diminish the threat available to the budget-setters. The model, presented in a mathematical formula, was applied to a sample of 111 relatively large Oregon school districts for the 1971-72 school year. The data strongly suggest substantial underperception of state aid. This voter ignorance of state aid had the following effects: total spending was increased by some 30 percent in all districts; and, in the 40 percent of the districts that had reversions below the school closing threshold, the reversion effects and perception effects interacted to boost spending by an additional 15 percent. Three tables and nine references are included. (MLF)

FINAL REPORT

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DYNAMIC ANALYSIS OF SCHOOL SPENDING REFERENDA

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The standard public finance literature on local government spending and especially school spending is based on a median voter model. With knowledge of a voter's income, effective tax price, family size, and, perhaps, a few other variables, we can estimate his desired level of school spending. In the median voter model, if we know the median of these desired levels, we know actual spending. Effectively, it is as if the median voter were dictator. The institutions and communications processes used to make spending decisions are irrelevant. We would get the same outcome if the school board operated as a representative democracy, as in Pennsylvania, or was subject to referendum approval, as in Oregon. Similarly, details of the referendum procedure would not matter. If the voters rejected the school board's proposal, spending might legally be set to zero in some districts, or equal to last year's spending in other districts. But if the median of desired levels is proposed, spending is the same in either case. Similarly, spending should be unaffected by how aware voters were of the amount of state aid received by the school district.

In contrast to this median voter approach, we have developed a model where institutions and information matter greatly. We arrive at this conclusion because we have assumed that the school board or superintendent seeks to obtain as large a budget as possible, or at least a budget substantially larger than that desired by the median voter. In the school finance process, these hypothesized budget-maximizing agents can be viewed as <u>agenda setters</u>. That is, they have agenda control power, because they can control the budget proposal the voters must decide upon.[1]

Our work has its most direct application where education spending must be approved by referenda. In such cases, the agenda control power by budget-maximizers can be interpreted directly as the power to place proposals (either for spending levels or millage rates) on the ballot. Such agenda control affects spending in ways that lead to predictions that are quite distinct from those flowing from the median voter model. Voters typically have to vote on the setter's budget proposal on a take-it-or-leave-it basis, where "leave it" means accepting the <u>reversion</u> level of spending. By <u>reversion</u>, we mean the statutorily mandated level of spending (or millage) that prevails should a referendum (or a series of referenda, if that is permitted) fail. This reversion may be equal to last year's spending or be determined by some formula; it may even equal zero, or -- if not literally zero -- a level of spending insufficient to operate the schools.

Since the setter can use a low reversion level to threaten the voters into accepting higher expenditures, the rules of the game -- the institutional structure -- will matter in our model. Similarly, the setter will have an interest in controlling the information available to the voter. Knowledge of a lump-sum state grant will typically lower voters' desired levels of spending from local sources in two ways. First, the grant represents implicit purchasing power or income to voters. They may want to regard the implicit

[1] Our work in this area is discussed in a series of papers. Romer and Rosenthal (1978, 1979a, 1980) present the theoretical framework for the agenda setter model. Empirical work that contrasts this model with the median voter approach appears in Romer and Rosenthal (1979b, 1982a) and Filimon, Romer, and Rosenthal (1982). Further elaborations and refinements are presented in Romer and Rosenthal (1982b, 1983) and Romer, Rosenthal, and Ladha (1984).

income represented by the grant as fungible, use part of the grant to reduce the local component of school spending, and increase other types of public or private spending. Second, since non-matching grants usually make up part of the reversion, larger grants lead to larger reversions, and diminish the threat available to the setter. Consequently, setters can be expected to minimize citizen information about outside grants -- for example, by failing to include grant information on ballot statements.

Of course, our budget-maximizing model is as extreme a statement about the nature of school finance politics as is the median voter model. We initially adopted it because we saw the politics of school finance as essentially noncompetitive. Nonpartisan school board elections mean that the rough spending preference information usually contained in party labels is unavailable to voters. Election of boards for staggered terms means changes in voter preferences cannot be enacted rapidly. School boards are frequently unsalaried, and board membership is rarely a steppingstone to higher political office. These factors also serve to mitigate the entry of political competitors into school politics. Such a noncompetitive environment suggests that those "interested" in education and desirous of higher expenditures, be they administrators, teachers, or parents, will dominate the school finance process.

We have applied our model to a variety of statistical and empirical tests for the state of Oregon, for the period 1970-1976. At the heart of this work is the study of school spending referenda in a sample of 111 relatively large K-12 school districts for the 1971-72 school year. For that year, the availability of Census data organized by school district made detailed econometric study possible. A major component of our proposed work under this grant was to attempt to extend this econometric work into later years.

Our optimistic view was that, even in the absence of some relevant data, we could test the robustness of key features of our specification.

In order to discuss our work on this problem, we first present the specification, and the benchmark estimates for 1971-72.[2] We begin with a quite standard characterization of a voter's demand for school spending:

$$\ln E_d = \beta_0 + \beta_1 \ln(Y + \tau A) + \beta_2 \ln \tau + \beta_3 \ln S + u \tag{1}$$

where

E_d = "desired" expenditures per student

Y = household income

τ = household's tax price per dollar of per student spending

A = nonmatching ("lump sum") state aid per student

S = number of students in household

u = disturbance term

For systems with a property tax bases, the tax price τ is given by DV/R, where D is total students, V is the household's assessed property value, and R is the total assessed value of taxable property in the district. If matching as well as nonmatching aid is involved, (1) is more complicated. But for our empirical context, we need to consider only lump sum aid.

Suppose the voter is not fully cognizant of the amount aid available. A simple way to capture this possible misperception is to introduce a parameter ρ, which equals 0 if there is <u>no</u> misperception, is positive is there is some misperception. If ρ=1, the voter acts as if there were no state aid available. With this modification, "perceived" desired spending per student becomes:

$$\ln E_p = \beta_0 + \beta_1 \ln[Y + (1-\rho)\tau A] + \beta_2 \ln \tau + \beta_3 \ln S + u \tag{2}$$

[2] For full details on this, see Filimon, Romer, and Rosenthal (1982) or Romer and Rosenthal (1982b).

With median voter models, ρ is set equal to 0, Y is usually measured as median household income, τ is defined with D equal to the median housing value of owner-occupied homes, and S is the number of school age children per family. These data are obtained from the Census.

With the setter model, the empirical specification requires that we take into account the effect of the reversion. The most straightforward case -- and the one that is relevant for Oregon referenda -- is when the reversion is an exogenously specified number. The agenda control model states that a voter will vote in favor of a budget proposal as long as the proposal leaves him at least as well off as the reversion. In Oregon, the reversion consists of a <u>local component</u>, B (which we will express in terms of dollars per student)[3], <u>plus state aid</u>, A. Actual reversion per student is therefore:

$$Q = B + A \tag{3}$$

If state aid is not correctly perceived by voters, then there will be misperception of the reversion as well. The <u>perceived reversion</u> Q_p is given by:

$$Q_p = B + (1-\rho)A \tag{4}$$

As derived in Romer and Rosenthal (1979a, 1982a), with a single referendum, the setter will propose the largest perceived desired expenditure preferred by a majority of voters to the perceived reversion. We have modeled this as a <u>translation</u> of the perceived desired expenditure of the median voter:

$$\ln E_s = \ln E_p + \beta_4 H + \beta_5 \ln Z, \tag{5}$$

where

$$H = 1 \text{ if } Q_p \leq \mu \qquad \text{and} \qquad H = 0 \text{ otherwise}$$

and

[3] Up till the end of the 1970s, in Oregon this was a number based on a formula specified in 1916!

$$Z = \mu \text{ if } Q_p \leq \mu \quad \text{and} \quad Z = Q_p \text{ otherwise.}$$

Thus, the model contains a threshold level μ, below which perceived expenditures are invariant in Q_p. The threshold parameter is assumed known by the voters and the same for all districts. A level of spending below the threshold would be insufficient to operate the schools, and is thus equivalent in voters' eyes to zero spending. Below the threshold, therefore, a "school shutdown" threat is effective, leading to a substantial rise in perceived desired expenditures. Thus, we would expect to find $\beta_4 > 0$. Above the threshold, a slope term β_5 captures the dependence of expenditures on Q_p. With random voter turnout, both positive and negative slopes are consistent with the model (Romer and Rosenthal, 1979a).

The econometrician, of course, does not observe E_s. Instead, we observe actual expenditure per student, E_a, which includes expenditures approved from local sources plus state aid. If a fraction ρ of state aid is not perceived by voters, then E_s will not equal actual expenditures, but will be ρA less than actual expenditures: $E_s = E_a - \rho A$. So the equation to be estimated becomes:

$$\ln (E_a - \rho A) = \beta_0 + \beta_1 \ln[Y + (1-\rho)\tau A] + \beta_2 \ln \tau + \beta_3 \ln S + \beta_4 H + \beta_5 \ln Z + u \qquad (6)$$

In Filimon, Romer, and Rosenthal (1982), we estimated eq. (6), using maximum likelihood techniques, for a sample of 111 K-12 Oregon school districts. We used data for referenda held in the spring of 1971, for the 1971-72 school year. Data on E_a, A, district tax base, and local portion of reversion were obtained from Oregon sources. For Y we used family income; in computing τ we used median value of owner-occupied housing; and for S we used average number of school-age children per household. These latter variables were obtained from the 1970 Census, organized by school district. Results of our estimation are displayed in Table 1.

TABLE 1

Coefficient	Estimate	Estimated Standard Error
β_0	-2.464	1.592
β_1	0.823	0.174
β_2	-0.367	0.055
β_3	-0.270	0.078
β_4	0.151	0.043
β_5	0.184	0.076
μ	211.60	38.40
ρ	0.973	0.203
Log likelihood:	-682.34	

In our 1971-72 sample, total spending averaged about $972 per student. The threshold estimate (μ) is about $212 per student. Controlling for income, tax price, and family size, districts below the threshold spend about 15% more per student than do districts just above the threshold. (This follows from the estimate of β_4 = 0.151.) The estimated value of the perception parameter ρ is 0.97 -- the data strongly suggest substantial underperception of state aid. This voter ignorance of state aid has two effects. First, because state aid is not, as fully informed voters would desire, used partly to reduce local taxes, total spending is increased by some 30% in all districts (for computations, see Filimon, Romer, and Rosenthal, 1982). Second, about 40% of our sample has reversions below the threshold of $212. Nearly all these districts would have reversions <u>above</u> the threshold if there were full perception of state aid. In these districts, then, the reversion effects and perception effects interact to boost spending by an additional 15%.

We proposed under this grant to move our analysis from examining a single year's budget process to a study of budgeting dynamics through most of the 1970s. Unfortunately, census variables used in the 1971-72 estimation are unavailable for these later years. If we were interested in forecasting school expenditures, we would have regarded the lack of information on these key economic and demographic variables as a serious problem. But, we believed at the time of our proposal, if we were primarily interested in learning about the presence of institutional and informational effects, then we may not be so severely handicapped. If the omitted (because unavailable) variables are uncorrelated or only very weakly correlated with the variables in the institutional-informational part of the model, we could still obtain good estimates of the submodel -- viz., the threshold (μ), reversion threat (β_4), reversion slope (β_5), and perception (ρ) coefficients.

To test for such a possibility, we reestimated the model for 1971-72 without using census data. We deleted income (Y), tax price (τ), and average family size (S) variables. Instead, we included a measure of family size based on enrolment data (ADM, or average daily enrolment per family) and total property assessments per student (TCV). The specification was:

$$\ln (E_a - \rho A) = \gamma_0 + \gamma_1 \ln TCV + \gamma_3 \ln ADM + \beta_4 H + \beta_5 \ln Z + u \qquad (7)$$

The definitions of E_a, A, H, and Z remain unchanged.

The results of maximum-likelihood estimation of equation (7) are displayed in Table 2. These results gave estimates of β_4, β_5, μ, and ρ that were very close to those in Table 1. For example, the increase in expenditure due to the reversion threshold was estimated to be 12% rather than the 15% estimated in the full model.

TABLE 2

Coefficient	Estimate	Estimated Standard Error
γ_0	1.109	0.644
γ_1	0.430	0.054
γ_3	-0.008	0.019
β_4	0.125	0.053
β_5	0.187	0.169
μ	208.05	34.22
ρ	0.993	0.180
Log likelihood:	-691.19	

We next investigated whether this stability in the institutional-informational parameters stood up over the rest of the 1970s. Prior to beginning to replicate the estimation of eq. (7) for years after 1971-72, we had to verify and clean up our data set, which had been obtained from the State of Oregon in hard copy (typescript) form and had been entered into computer files prior to the commencement of the grant period. For each year, we checked for merger, suspension, or extinction of school districts. We discovered a number of major data errors that took considerable time to track down and correct. This involved an unanticipated investment of time and other resources during the grant period.

Our attempts to estimate the reversion effects for years following 1971-72 met with disappointment. In attempting to estimate eq. (7) for 1972-73, we ran into serious nonconvergence problems of our maximum likelihood estimation procedure when we attempted simultaneous estimation of all parameters. We traced the problem to instability in the estimates of ρ and μ. We then performed a very large number of grid searches, in which ρ and μ were held constant and optimization was constrained over the other parameters of eq. (7). These searches did not provide us with reliable estimates of the institutional-informational parameters. The likelihood function appeared to be relatively insensitive to variations in these two parameters when they were varied jointly.

Next, we abandoned the specification of eq. (7), and returned to that of eq. (6). Since we did not have data for Y, S, and τ for years beyond 1971-72, we decided to "proxy" these variables for each year by using their values form the 1970 census. Of course, this is a highly questionable approach. But we wanted to see if the instability we found when estimating eq. (7) still appeared.

Unfortunately, the answer is yes. Again, we were not able to obtain full convergence when we attempted to optimize over all parameters simultaneously. Again, we went on to do grid searches, holding ρ and μ constant and maximizing the constrained likelihood over the remaining parameters. We proceeded in this way over a large number of (ρ,μ) pairs for each year from 1972-73 through 1976-77. Table 3 gives the parameter estimates for the "grid search optimum" for each year. Note that these are not true maximum likelihood estimates.

The estimates of the institutional-informational parameters are quite unstable. The signs of β_4 and β_5 vary across the years, and μ and ρ fluctuate considerably. Rather than attempt to rationalize these results, we think the best interpretation is that, given the data at our disposal, the intertemporal replication we had hoped for did not materialize. Although a negative finding, the attempt at replication is an essential part of the scientific process. It is well known in econometric research that many models

TABLE 3

Coefficient	1972-73	1973-74	1974-75	1975-76	1976-77
β_0	-0.236	-0.800	1.355	0.853	1.841
β_1	0.706	0.849	0.632	0.606	0.473
β_2	-0.323	-0.350	-0.281	-0.260	-0.189
β_3	-0.240	-0.161	-0.203	-0.172	-0.260
β_4	-0.095	-0.133	-0.130	0.192	0.128
β_5	0.010	-0.106	-0.098	0.083	0.144
ρ	0.800	0.900	0.700	0.800	0.500
μ	375.0	425.0	500.0	150.0	375.0
Log likelihood	-678.3	-690.3	-713.8	-721.1	-743.6
N	110	110	109	109	110

initially constructed for cross-sections fail to validate in time series. Our findings suggest that one should exercise caution in extrapolating across years the findings from a particular cross-section. Given the lack of relevant census data, much of our further work on the dynamic analysis of school spending referenda was predicated on being able to use non-census "proxies" in non-census years. Our findings show that this is not an appropriate strategy. It is even more to be regretted that the kind of analysis we were able to perform for 1971-72 will be made much more difficult by the lack of a satisfactory 1980 census count arranged by school districts.

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