LOCAL GOVERNMENT BUDGETING: THE ECONOMETRIC COMPARISON OF POLITICAL AND BUREAUCRATIC MODELS

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LOCAL GOVERNMENT BUDGETING: THE ECONOMETRIC COMPARISON OF POLITICAL AND BUREAUCRATIC MODELS

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The most basic characteristic of any government's budgetary process is the way in which final decision-making responsibility is divided between the political level and the bureaucratic level of government. At a sufficiently aggregate level of budgetary allocation, the politically responsible agent decides the amount of expenditure in each broad category. In contrast, at a more disaggregated level of the budgeting process, the political authority decides only a total amount of expenditure and then delegates responsibility for its allocation among subcategories to the bureaucracy. The interesting econometric problem is to decide whether any given stage in the budget process is an example of the "political" or the "bureaucratic" model. As far as we know, there has been no attempt to solve this type of problem.

The current paper presents a method of deciding this question and then uses it to study local government spending on education. The basis for our

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method is the important difference between the effect of intergovernmental aid that is implied by the political budget model and by the bureaucratic budget model. According to the bureaucratic model, the effect of intergovernmental aid on each category of educational input (e.g., teachers' salaries, books, etc.) depends only on the change in total educational spending induced by the aid and not on the type of aid that causes the change in spending. In contrast, the political budget model implies that the overall expenditure increase is the result of separate decisions on each of the expenditure categories and that the changes in these expenditure categories will depend on the form of the intergovernmental aid. Our method of exploiting this difference is presented in detail below.

This difference in the way in which aid affects the allocation of total educational spending gives potential policy significance to the distinction between the political and bureaucratic models. State grants to local school districts are already widely used to assure that all districts spend at least some specified minimum amount.[1] Courts in a number of states have now ruled that further steps must be taken to reduce the inequality among districts in educational spending or the correlation between educational spending and local wealth.[2] There is evidence that

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[1]For a description of the current system of state block grants to local districts, see Coons, Clone and Sugarman (1970).

[2]The California case of Serrano v. Priest was the first in a series of cases on this point. After the U.S. Supreme Court in Rodriguez v. San Antonia held that educational spending inequality among income groups did not violate the U.S. Constitution, a number of state courts have followed California in interpreting the state constitutions to require a change in educational finance.

matching grants can be a powerful stimulus to local spending and therefore that differential matching grants that are inversely correlated with wealth can be a relatively effective offset to local differences in wealth.[1]

There is, however, no information about the pattern of extra spending on the different categories of educational input that would be stimulated by such matching grants. With a bureaucratic budget process, the additional spending that results from matching grants would be spent in the same way as any other increment to the school budget. This additional spending would therefore satisfy the courts' mandate to offset the expenditure effects of wealth differences. In contrast, with a political budget process, the pattern of spending would depend on the price elasticities of demand for each category of expenditure. The impact of a differential matching grant when the budget process is "political" might therefore be to stimulate spending in a way that fails to offset the expenditure effects of wealth differences. These implications will be explored in detail below.

The first section of this paper presents a formal statement of the political and bureaucratic budget models and discusses the likelihood ratio test that we use to distinguish between them. Our data are described in section 2 and the estimates presented in section 3. The evidence overwhelming supports the political budgeting model. A brief concluding section comments on the implications of these results.

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[1]See Feldstein (1975) for evidence on the effect of a differential matching grant on educational spending. For a more general review of the impact of governmental grants, see the important recent papers by Gramlich (1976) and Inman (1977).

1. Specification, Estimation and Test Procedure

The difference between the political and bureaucratic budgeting models is equivalent to the distinction between a one-stage and a two-stage budget process. According to the political budget model, the level of expenditure on each category of educational input is decided simultaneously. The bureaucratic model begins instead with a political (or higher level bureaucratic) determination of total educational spending; this total is then divided among the individual expenditure categories in a second stage.

Consider first the bureaucratic budgeting model. In specifying this model, we assume only that the politically responsible authority selects the total level of educational expenditure on the basis of prices, intergovernmental aid and the economic and demographic attributes of the community. We shall not develop an explicit derivation of this demand function in terms of utility maximization, median voter preferences, or any alternative theory of political choice.[1] We write simply that

$$T = Y'\alpha + u \tag{1.1}$$

where T is the total expenditure on education in the school district, Y' is the row vector of exogenous variables that determine expenditure, and u is a random normal disturbance.

In the second stage of the process, the bureaucrats take this total expenditure as their budget constraint and select expenditure levels for

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[1] Inman (1977) provides a valuable discussion of these alternative foundations for local government expenditure equations.

each educational input type subject to this constraint. The individual expenditures are therefore a function of this total education budget and of a subset of the variables that influenced the political authority's choice of this total spending level. The restriction to a subset is important. Intergovernmental aid variables and the value of local taxable property should influence the political choice of the total level of spending but will not have a direct effect on how the educational budget is spent.

To emphasize this we rewrite equation 1.1 with the exogenous variables divided into the subset X that influences only total spending and the subset Z that influences both total spending and the individual components:[1]

$$T = X'\beta + Z'\gamma + u. \tag{1.2}$$

With this notation, the second stage bureaucratic expenditure equations can be written

$$E_j = T\lambda_j + Z'\delta_j + v_j, \qquad j = 1,\ldots,J \tag{1.3}$$

where E_j is the expenditure on educational inputs of type j.

The political budgeting model implies that all of the individual expenditures are decided simultaneously and therefore that all of the exogenous variables are relevant for each expenditure decision. This model can therefore be written:

$$E_j = X'\beta_j + Z'\gamma_j + u_j, \qquad j = 1,\ldots,J. \tag{1.4}$$

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[1]The specific variables in these two subsets will be discussed in the next section.

It is clear that the bureaucratic model is formally equivalent to the political model subject to additional constraints on the relation among the β_j's in the different equation corresponding to different expenditure categories. More explicitly, the bureaucratic model implies that the X variables affect each E_j only through T and therefore that the β_j vectors must be proportional to each other, i.e., must differ only by the proportionality factor λ_j. With this proportionality restriction, equations 1.2 and 1.3 imply that 1.4 is equivalent to:

$$E_j = \lambda_j(X'\beta) + Z'\gamma_j + u_j. \qquad (1.5)$$

A procedure developed by Goldberger (1974) and Hauser (1972) provides a computationally efficient maximum likelihood method of estimating the parameters of 1.5 and testing the restriction that the β_j vectors are collinear.[1] We describe this canonical correlation procedure briefly, leaving the interested reader to the original papers for the derivation of the method as a maximum likelihood estimator. The procedure begins by "purging" both the E_j variables and the X variables of the effect of the variables (Z) whose coefficients are unconstrained. We write $E_{j\cdot z}$ for the vector of residuals of the regression of E_j on Z and $E_{\cdot z}$ for the matrix of these and other vectors. Similarly, we write $X_{\cdot z}$ for the matrix of residuals of the regression of X on Z. Let $R = (X'_{\cdot z} X_{\cdot z})^{-1} X'_{\cdot z} E_{\cdot z}$, the matrix of regression coefficients of $E_{\cdot z}$ on $X_{\cdot z}$. Let $U = E_{\cdot z} - X_{\cdot z} R$, the matrix of residuals from these equations, and let $S = U'U$, the covariance matrix of these

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[1]We are very grateful to Gary Chamberlain for suggesting this method of estimation. We follow the Goldberger-Hauser procedure, ignoring the mixed cross-section and time-series structure of our data.

residuals. Finally, let $Q = E'_{.z} E_{.z} - S$, the covariance between the $E_{.z}$ variables and their predicted value $X_{.z} R$. Goldberger and Hauser show that the characteristic vector associated with the largest characteristic root of the matrix QS^{-1} is the maximum likelihood estimator of the vector β of 1.5. Thus we solve

$$(1.6) \qquad (QS^{-1} - \mu I)b = 0$$

for the value of b associated with the largest value of μ and have found the maximum likelihood estimate of β in 1.5. The vector of λ_j's in 1.5 is then given by

$$(1.7) \qquad \lambda = \mu^{-1} RS^{-1} b$$

where μ is the largest characteristic root.

Before turning to the actual estimates, we describe the maximum likelihood test of the restriction in 1.5. This test is based on the determinants of the covariance matrices of the u_j's with and without the restriction. More explicitly, let $\sum_{\hat{u}'}$ be the covariance matrix of the residuals from the unconstrained equations (1.4) and let $\sum \hat{u}''$ be the corresponding matrix for the constrained equations 1.5. The constraint implies that the determinant of the latter matrix is at least as large as the determinant of the former. The usual asymptotic likelihood ratio test can be based on the fact that minus twice the logarithm of the likelihood ratio is distributed as chi square; i.e.,

$$(1.8) \qquad -2 \ln \left\{ \frac{|\sum_{u'}|^{N/2}}{|\sum_{u''}|^{N/2}} \right\} \sim \chi^2(K)$$

where N is the number of observations used to estimate equations 1.4 and 1.5 and K is the number of parameter restrictions imposed in going from 1.4 to 1.5

The covariance matrix of the u_j's for equations 1.4 is obtained directly by estimating these equations by ordinary least squares and then using the residuals to compute the covariance matrix $\sum\hat{u}'$. For equation 1.5, the maximum likelihood estimates of β and the λ_j's are used to calculate the variables $E_j - \lambda_j X'$; the regression of these derived variables on the Z's yield the residuals that are used to calculate the covariance matrix $\sum\hat{u}''$.

2. Data and Specification

We have estimated the equations of the political and bureaucratic budget models with data for 105 Massachusetts school districts. This section describes the data and discusses the specification of the expenditure equations.

The school districts of Massachusetts are particularly suitable for our analysis because of the prevailing system of intergovernmental grants. More specifically, Massachusetts uses a system of differential matching grants in which the matching rate is inversely related to local taxable property per pupil. For the purpose of our analysis, we express the effect of the matching rate in terms of the local district's implied price of educational spending: P is the net cost to the local community per dollar of educational inputs purchased. Although the basic principle of the Massachusetts aid formula implies that the price variable is proportional to local taxable property per pupil, a number of limits and "grandfather clauses" make the correlation only 0.42 in the most recent year in our sample. For those school districts in which a constraint on the amount of aid makes the price equal to one (i.e., eliminates the matching aid), the state provides a block grant.[1]

A further advantage of analyzing the Massachusetts experience is that the current system of intergovernmental aid was only introduced in 1967. Before that, towns received so-called "foundation" block grants designed to insure a mimimum level of expenditure and to relieve local taxpayers of the cost of providing that level of spending. Pooling data for several years

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[1]The system of Massachusetts aid is described briefly in Feldstein (1975) and more fully in Daniere (1969).

to include both the old foundation block grant period and the current matching grant period provides a source of variation in the price variable that is completely uncorrelated with interdistrict differences in taxable property per pupil.

Our sample consists of data for 105 school districts for seven fiscal years: 1965, 1966, and 1970 through 1974. Fiscal year 1974 was the most recent year for what data could be obtained when our analysis began. The three fiscal years in the middle of the sample decade are omitted because disaggregated data on individual input categories is not available for those years. The 105 school districts contain approximately 75 percent of the state population; the remaining districts were generally small and were excluded because data were not available for all the variables or, for a few districts, because of their relation to a regional school system. Because of the political structure of Massachusetts, the 105 school districts in our sample are coterminous with individual cities or towns.[1]

Previous studies of educational expenditure (e.g., Bahl and Saunders, 1974; Feldstein, 1975 and 1977; Gramlich, 1976; Oates, 1974; Stern, 1973) have identified a number of variables in addition to intergovernmental aid that influence local expenditure on education. In describing these variables, it is useful to distinguish between the two classes of variables that are relevant in the bureaucratic budget model: the X variables whose

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[1]The data used in the present study are thus an extension of the sample used in Feldstein (1975) which included the same 105 towns for only two fiscal years and no disaggregation of spending into individual input categories.

relative coefficients are constrained to be the same in all expenditure equations and the Z variables whose coefficients are completely unconstrained. When there is an ambiguity in this assignment, we err on the conservative side by including the variable in the unconstrained Z category. This reduces the likelihood of rejecting the constraint and thus favors the bureaucratic model. Since, as we indicated in the introduction, our evidence leads us to reject the bureaucratic model in favor of the political model, this classification procedure strengthens our conclusion.

The X group contains three variables that influence local expenditure on education but which, once total educational spending was determined, would not be expected to influence the bureaucracy's allocation of the spending.[1] These variables are (1) the price implied by the differential matching grant, (2) the state block grant, and (3) the local taxable property per pupil.[2] Closely related to the third of these variables is the fraction of the property value that is residential; a higher fraction of residential property impoies that local voters will pay a higher fraction of the tax revenue, rather than "exporting" it or seeing it capitalized in industrial and commercial land values.[3] We have included a measure of the

[1]The actual specification of our expenditure equations is nonlinear; the X variables therefore include not only these three variables but also non-linear cross-product terms. We return to this below.

[2]Taxable property per pupil is an estimated market value and not the artificially low assessed value.

[3]The issue is complex because such "exporting" is limited by the long-run mobility of capital and because the tax on residential rental property may also be capitalized. Unfortunately, there is no data on the fraction of taxable residential property that is rented rather than owner-occupied.

the residential share of the tax base among the Z variables rather than the X variables in order to allow for the possibility that a different composition of local property is associated with differences in the social class composition of the population or other factors that might influence the pattern of educational spending.

The Z variables are of three types: (1) measures of relevant economic characteristics of the student population; (2) features of the school district itself; and (3) financial variables that should affect the composition of educational spending. The economic characteristics of the student population include the average family income in the district, the average number of children per family, the percentage of children in the elementary grades, and the percentage of children attending private or parochial schools. Two important characteristics of the school district are included: the total population size of the school district and the recent growth-rate of the number of pupils.

A number of restricted block grants are provided to school districts to pay for such things as transportation or services for low-income pupils. A composite aggregate of such specific block grants is included among the Z variables.[1] As we noted above, the fraction of the local tax base accounted for by residential property is also included among the Z variables. The final variable measures the cost of teaching staff relative to

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[1]Feldstein (1977) discusses the expenditure impact of the federal grants to local governments under the Title I program. Title I aid is not included as a separate variable in the current study because the rates for distributing such aid among local districts makes estimation impossible with data for a single state.

the cost of other educational inputs. This variable is constructed as a weighted average of the consumer price index and of a statewide index of teachers' salaries, reflecting the judgment that it is best to treat intertown differences in teachers' salaries as indicating differences in the quality chosen by the town.

Total current expenditure[1] is divided by Massachusetts educational accounting practice into 14 mutually exclusive categories: (1) teachers' salaries; (2) textbooks; (3) library material and personnel; (4) audio-visual material and personnel; (5) guidance services; (6) psychological services; (7) educational television; (8) principals' offices; (9) superintendent's office; (10) general administration; (11) community services; (12) general non-instructional school services; (13) operation and maintenance of the school plant; and (14) fixed charges assigned to the current account. We define the corresponding E_j variables by converting each of these expenditures to a per pupil amount and deflating to constant 1970 dollars.

In our estimation we have generalized the linear specifications of section 1 to allow the impact of the matching rate price variable to depend on the level of incomes and of taxable property value in the school district. Equation 1.4 thus becomes

$$E_{ji} = [\beta_{1j} + \beta_{2j} INC_i + \beta_{3j} V_i] P_i + \beta_{4j} V_i + \beta_{5j} BG_i + Z_i' \gamma_j + U_{ji} \quad (2.1)$$

[1]Capital expenditure is specifically excluded.

where INC_i is average family income in district i, V_i is taxable property value per pupil, BG_i is the block grant per pupil and P_i is the net cost to the local community per dollar of educational expenditure. A time subscript on each variable is omitted for ease of presentation. The constrained specification of equation 1.5 can be written:

$$(2.2) \qquad E_{ji} = \lambda_j\{[\beta_1 + \beta_2 INC_i + \beta_3 V_i]P_i + \beta_4 V_i + \beta_5 BG_i\} + Z_i'\gamma_j + u_{ji}.$$

Note that although the two equations are nonlinear in the X variables they are linear in the parameters; the estimation and test procedure of section 1 is therefore directly applicable.

3. The Likelihood Ratio Test and Individual Expenditure Elasticities

The likelihood ratio test overwhelmingly rejects the bureaucratic budget model in favor of the unconstrained political budget model. The chi-square test statistic (i.e., minus twice the logarithm of the likelihood ratio) is 172, substantially greater than the critical value of 80 for a one percent significance level with 52 degrees of freedom.[1]

A more detailed analysis of the actual coefficients shows that the political budgeting model is not only statistically superior to the bureaucratic model but also has substantially different implications about the effects of matching grants and of district wealth differences.

Consider first how the models differ empirically in their implications about the impact of matching grants. A matching grant lowers the net price to the school district per dollar of educational spending. The elasticity of each type of educational spending with respect to this price is a useful way of quantifying the difference between the political and bureaucratic models. Because our specification does not assume a constant elasticity, we shall evaluate all elasticities at the sample means of the variables. No special problem is posed by the nonlinear specification of equation 2.1; in the notation of that equation, we calculate the elasticity of E_j with respect to price P in the unconstrained political model as $\eta_j = (\beta_{1j} + \beta_{2j}INC + \beta_{3j}V)P/E_j$ with all of the variables replaced by their mean values. These elasticities and the estimated standard errors are shown in column 2

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[1]Our sample contains 732 observations. The 14 equations each contain 5 X variables; the restrictions thus reduce the number of parameters of these variables from 70 to 18.

TABLE 1

Elasticities of Educational Spending with Respect to Price and Local Property Value: A Comparison of Political and Bureaucratic Models

Expenditure Category	Mean Per Pupil	Elasticity with Respect to Price: Political	Price: Bureaucratic	Property Value: Political	Property Value: Bureaucratic
Teachers	$433.55	-0.53 (0.09)	-0.20	0.19 (0.02)	0.14
Principal's Office	40.66	-0.27 (0.15)	-0.30	0.15 (0.04)	0.21
Superintendent's Office	13.78	0.19 (0.49)	-1.11	0.43 (0.12)	0.77
Text Books	8.40	0.26 (0.30)	-0.28	0.08 (0.08)	0.20
Libraries	8.31	-0.36 (0.35)	-0.63	0.32 (0.09)	0.44
Audiovisual	2.87	-0.63 (0.47)	-0.67	0.37 (0.09)	0.47
Guidance Services	17.09	-0.51 (0.25)	-0.24	0.10 (0.63)	0.17
Psychological Services	1.64	-0.21 (1.10)	-1.54	0.75 (0.28)	1.07
Educational Television	0.22	0.63 (0.84)	0.40	-0.42 (0.21)	-0.28
General Administration	19.49	-0.85 (0.26)	-0.51	0.40 (0.07)	0.36
School Services	45.97	-0.91 (0.20)	-0.24	0.34 (0.05)	0.17
Plant Operation and Maintenance	83.36	-0.56 (0.15)	-0.40	0.33 (0.04)	0.28
Fixed Charges	4.35	-0.86 (0.85)	-0.63	0.39 (0.21)	0.44
Community Services	2.90	-1.60 (0.57)	-0.06	0.33 (0.14)	0.04

Standard errors are shown in parentheses. See text for methods and definitions.

of Table 1. The corresponding price elasticities in the constrained bureaucratic model are calculated as $\eta_j' = \lambda_j(\beta_1 + \beta_2 INC + \beta_3 V)P/E_j$; these are shown in column 3 of Table 1.

Two general characteristics of the estimated price elasticities deserve comment. First, there is substantial variation among the individual price elasticities of column 2. Although most expenditure categories have price elasticities that differ significantly from zero, a few do not. Second, there are large differences between the unconstrained elasticities of the political budgeting model and the constrained elasticities of the bureaucratic model. Even for a major category of expenditure like teachers' salaries, the political budgeting model implies a substantially larger elasticity than the bureaucratic budgeting model.

A similar set of elasticities of expenditure with respect to local property value is shown in columns 4 and 5 of Table 1. Again, the individual property value elasticities vary substantially among the expenditure categories and the estimates differ notably between the constrained and unconstrained models.

More significant than either the price or property value elasticities alone is the relation between them. The bureaucratic model implies that the ratio of the price elasticity to the property value elasticity is the same for every expenditure category;[1] the evidence here indicates that the

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[1]Under the bureaucratic model, the effects of price and value on each expenditure can be decomposed into an effect on total spending and an effect of total spending on the individual category. It is easily shown that the elasticity of E_j with respect to price (η_{jp}) can be written as the product of the elasticity of E_j with respect to total spending (η_{jT}) and the elasticity of total spending with respect to price (η_{jT}). Similarly, $\eta_{jv} = \eta_{jT}\,\eta_{Tv}$. Thus $\eta_{jp}/\eta_{Tv} = \eta_{Tp}/\eta_{Tv}$, the same for all j.

ratio is 1.4. In contrast, the unconstrained estimates of the political model imply very substantial differences in this ratio.

This variation in the ratio of the elasticities has important implications for the use of matching grants to offset the effects of interdistrict differences in property values. As we noted above the landmark case of Serrano v. Priest held that the system of educational finance must not make local educational spending a function of local property values. Feldstein (1975) showed how a formula relating the local matching grant rate to local property value could achieve a zero elasticity of total expenditure per pupil with respect to local property value per pupil. If the bureaucratic model were true, this would also cause the corresponding elasticity for each type of spending to equal zero. In contrast, the political budgeting model and the estimates of Table 1 imply that no simple matching grant could make all of the elasticities simultaneously equal to zero. A grant formula that made the total spending elasticity equal to zero would leave the individual estimates as functions of local property value. This casts serious doubt on the general principle of trying to eliminate the effect of property value on total spending. There are a number of alternative options: setting a matching rate for a particular category like teachers' salaries, using several different matching grants for different types of services, or abandoning the goal of overall "wealth neutrality" in favor of establishing minimum spending standards by category. The appropriate choice among these options clearly lies beyond the scope of this paper.

4. Conclusion

The evidence that we have examined shows quite clearly that the categorical budgets of the Massachusetts school districts are determined by a political process rather than by the bureaucracy of the school system. The pattern of educational expenditure as well as its total is thus directly responsive to the preferences of the electorate. For Massachusetts school districts, the reality of the budgetary process appears to conform to the constitutional description.

The extent to which such political control is characteristic of other areas is currently unknown but is of substantial importance for understanding the working of the democratic process. We hope that the method that we have presented here will be a useful tool for pursuing this question.

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