EFFECTS OF ALTERNATIVE POLICIES FOR ALLOCATING FEDERAL AID FOR EDUCATION TO THE STATES*

Marilyn E. Manser, Thomas H. Naylor, and Kenneth L. Wertz, Duke University

Introduction

Two distinct lines of inquiry have been pursued in the analysis of state and local governmental expenditures. In his recent work, Governmental Problem Solving: A Computer Simulation of Municipal Budgeting, Crecine represents the methodological split as follows:

> The assumption that participants in the budget-making process are passive instruments who will come up with a predetermined solution to the problem of (public) resource allocation...by following economic dictates and service demands... vs. the assumption that budget-makers are organizational decision-makers and problem-solvers who structure complex problems, generate alternatives, and make choices on the basis of some criteria, is a real difference (3, p.20).

The first approach has informed a vast literature which searches among socioeconomic factors such as income and population density for determinants of public expenditures. The second and newer approach has stimulated investigations of the decision-making behavior of public officials.

It is the relevance of much of this latter evidence to states' expenditures for education which the present paper explores. After developing and estimating a model suggesting the manner in which such outlays might be set, we consider via simulation some of the model's normative applications to the problem of allocating federal aid for education among the states.

Development of the Model

As mentioned above, the focal point of this study is the behavior of participants in the budgetary process. It will be offered herein that at least three factors are prominent to the state officials responsible for drafting and approving the budget for a state's expenditures on education: (a) the amount spent on education by the state in the previous year; (b) the amounts spent on education by neighboring states in the previous year; and (c) the amount of federal payments for education to the state in the previous year. All factors will be regarded on a per capita basis. These variables are discussed in turn and in reference to the model (1):

$$(1)\quad S_t^i = a^i S_{t-1}^i + b^i N_{t-1}^i + c^i G_{t-1}^i + E_t^i$$

The superscript i refers to one of the forty-eight coterminous states; the subscript t marks annual steps, t = 1951,...,1965.

(a) Past expenditures by the state, S_{t-1}^i

An entirely rational approach to the allocation of public funds among public uses can be achieved in theory when one possesses a thoroughly defined system of values, certain knowledge of the consequences of a completely defined set of alternatives, and certain knowledge of their attendant costs. In practice, one attempting this comprehensive review of a budget finds "the absence of any single operational measure of efficiency in the public sector, uncertainty as to the result of alternative courses of action, and (one's limited capacity) to process the necessary information," (5). Davis, Dempster, and Wildavsky, following the lead of Wildavsky's work, observe that participants in budgeting, in reaction to the realities above,

> deal with their overwhelming burdens by adopting aids to calculation. By far the most important aid to calculation is the incremental method. Budgets are almost never actively reviewed as a whole in the sense of considering at once the value of all existing programs as compared to all possible alternatives. Instead, this year's budget is based on last year's budget, with special attention given to a narrow range of increases or decreases. Incremental calculations proceed from an existing base, (4, pp. 529-530).

This observation, registered again in Crecine's study (3) of municipal budgeting in three large cities and again in Gerwin's examination (5, 6) of budgeting in a municipal school system, promotes the appearance of past expenditures for education as an ingredient of the decision to be made with respect to current expenditures (7).

Sharkansky's use (14) of past expenditures as an explanatory variable provoked Harlow (8) to assert that while it probably enhanced the prediction of a given state's expenditures, it contributed little to the explanation of why states differ in per capita expenditures at a given point in time to transfer that question to an earlier year. It must be evident that over a long period of time, public officials do not have sole control over the magnitude of public expenditures; extraordinary events such as a prolonged depression or a total war visibly disrupt the stability of the process as it has been described here. Other economic and sociological shifts may also impinge upon public administrators. But the theoretical and empirical work cited above provides important material for the suggestion at least that short run (this study suggests about a decade by implication, though that matter is unclear) differences in per capita expenditures reflect in part short run differences in administration. Or again, it is entirely possible that a governmental budgetary system can operate according to its own devised rules within rather loose constraints presented by external forces until the products of this procedure induce a revision of the constraints (3). Rather than forcing an exclusive choice of the two approaches, the one focusing on socio-economic characteristics and the other on the budgetary process, or designating one as explanatory and the other as predictive, it would seem more advantageous to work towards their union. Perhaps that task can proceed when both modes of inquiry are more fully explicated.

(b) Expenditures in neighboring states, N^i_{t-1}

In lieu of measures of appropriateness (e.g., efficiency) and full examination of alternatives and their costs, another way in which state officials can monitor their actions is by surveying what their colleagues in other jurisdictions are doing. Benson (1) has stressed the influence of the process of comparison upon expenditures for education. Walker's study (16) of the adoption of innovations by state governments also finds the hypothesis of comparison as a decision-making aid to be useful and outlines some of the mechanisms by which competitive and emulative tendencies are spread among administrators from state to state.

Although pertaining to the local level, Gerwin's work provides a striking illustration (6). He discovered that a general increase in minimum salaries for teachers holding a bachelors degree in the Pittsburgh school system was granted only when Pittsburgh had dropped into last place among eighteen major cities in the Northeast (i.e., the systems with which Pittsburgh was most likely in competition for teachers). This decision rule was exercised on four different occasions between 1953 and 1964.

In model (1), the process of comparison is specified as follows:

$$N^i_t = \sum_{j=1}^{48} w^i_j S^i_t$$

where w^i_j equals the fraction of state i's land perimiter that adjoins state j. Portions of a state's boundary which touch the sea or a foreign country are not regarded as contributing to its land perimiter. Naturally if state i does not border on state j, then $w^i_j = 0$. The variable is lagged one period in recognition of the delay which occurs in the perception and availability of this information.

This specification of the comparison process is admittedly primitive, but shall suffice until additional research suggests a superior measure.

(c) Federal payments, G^i_{t-1}

Another occasion for official consideration of a departure from the base of the budget is the receipt of federal funds for education. Although these constitute a rather small portion of the total outlay S^i (about 9.6% in 1965), they do offer some flexibility, as many writers have noted. Because educational grants in aid are largely free of matching requirements (13, 15), administrators may choose to substitute federal funds for state funds; or simply spend the amount received; or expand their own effort by spending additional sums in excess of the aid received ("stimulation"). Since the S^i series are not net of the G^i series, one could identify the probable existence of one of the three alternatives above by examining statistically significant departures of c^i, the estimated coefficient of G^i, from one, although the regression analysis can only suggest, not prove, this interpretation.

The variable is lagged one period, again reflecting the fact that some time is required to accumulate and to evaluate the aid which had been received. In so far as current expectations about federal aid are not based on previous assistance, one would like to account for them; but no satisfactory formulation could be devised.

The specification of model (1), coupled with the nature of grants in aid to education, afford an escape from the brunt of the criticism (13) directed at the use of G^i. On the other hand, it does pose a degree of interdependence between S^i_{t-1} and G^i_{t-1}. Another potentially distortive econometric problem is to be recognized in the presence of the lagged variable S^i_{t-1} in that autocorrelated disturbances may appear. Consequently, a modified version of the Cochrane-Orcutt iterative technique (12) was employed for estimation of the parameters in order to meet this problem.

This section sought to describe an alternative, but not necessarily competitive methodological basis for analyzing state expenditures for education and to develop a model suggested by it and by the theoretical and empirical contributions cited above. The next section reports the outcome of the estimation of the parameters.

Estimation: Results and Discussion

The estimations of model (1) for each of the forty-eight coterminous states, using time-series data,[1] are reported in Table 1. Asterisks denote that the coefficients a^i and b^i are statistically different from zero and the coefficient c^i from one, at the .10 level. For the most part, the coefficients a^i and b^i fall in the zero-one interval, though this result was not at all anticipated for the latter. In two of the four instances in which a^i is negative, it is significantly so, thereby forcing one to reject the model's relevance for those two states. Thirty-eight of the remaining forty-six states find the a^i to be significantly different from zero, which evidence is consistent with the concept of a budgetary base.

Also, more than half of the b^i show significance. This finding is compatible with the operation of the comparison process mentioned earlier, though it does suggest that it is not as widespread as the text has urged. Comments on this head must be tempered, however, by recalling the tentative quality of the specification of N^i.

The estimated c^i cover a broad range. That some are less than zero indicates that the frequently-aired charge (particularly in reference to urban renewal and manpower retraining) of federal assistance tending to constrict the present expenditures of lower governments because the latter shall expect more generous sums in the

Table 1. Regression Results, Model of State Expenditures for Education, by State

State	Regression coefficients a, b, c: a	b	c	Standard Error	R^2
1. Ala.	0.311*	0.719*	1.003	3.074	.959
2. Ariz.	0.997*	0.071	-0.006	5.746	.938
3. Ark.	-0.225	1.120*	-0.418*	2.576	.953
4. Calif.	1.080*	-0.067	0.900	2.517	.977
5. Colo.	1.048*	0.036	0.189	3.180	.981
6. Conn.	0.895*	0.487	-4.977*	2.542	.956
7. Del.	0.304	3.257*	-7.311	16.589	.754
8. Fla.	0.628*	0.392*	0.742	3.822	.919
9. Ga.	0.296*	0.734*	1.474	2.352	.967
10. Idaho	0.717*	0.300*	-1.486*	2.232	.978
11. Ill.	-0.688	0.917*	6.699*	2.496	.967
12. Ind.	0.711*	0.399	1.672	2.635	.982
13. Iowa	0.734*	0.270	0.584	1.973	.979
14. Kan.	0.350	0.774*	-0.345*	2.970	.953
15. Ky.	1.049*	0.274*	-3.225*	3.678	.967
16. La.	1.184*	-0.168	-0.159	4.073	.953
17. Maine	0.954*	0.052	1.829	2.177	.968
18. Md.	0.846*	0.105	1.430	3.651	.948
19. Mass.	0.033	0.493*	2.474	1.766	.952
20. Mich.	0.694*	0.986*	-2.679*	3.310	.966
21. Minn.	0.739*	0.429	0.656	2.329	.987
22. Miss.	0.558*	0.547*	-1.067	4.337	.938
23. Mo.	-0.089	1.127*	-1.254*	2.266	.967
24. Mont.	0.306*	0.632*	1.725	3.951	.931
25. Neb.	0.723*	0.177	0.172	1.697	.939
26. Nev.	0.488*	1.016*	-6.784*	8.578	.899
27. N. H.	0.499*	0.438*	-0.019	2.078	.946
28. N. J.	0.833*	0.189*	-2.709*	2.147	.936
29. N. M.	0.895*	0.309	0.302	9.761	.897
30. N. Y.	1.135*	0.183	-4.646*	2.616	.986
31. N. C.	0.490*	0.555*	2.278	3.530	.951
32. N. D.	-0.577*	1.532*	3.479*	4.596	.947
33. Ohio	0.929*	0.086	-0.097	1.086	.978
34. Okla.	0.581*	0.566*	0.223	3.796	.938
35. Ore.	0.230	0.730*	0.336*	1.907	.992
36. Pa.	0.121	1.426*	-10.440*	3.683	.935
37. R. I.	0.809*	0.301	0.850	4.353	.926
38. S. C.	1.139*	-0.398*	6.430*	6.354	.508
39. S. D.	0.727*	0.181	1.112	2.121	.972
40. Tenn.	0.858*	0.272*	-1.208*	1.055	.992
41. Tex.	1.173*	-0.003	-1.810*	3.751	.932
42. Utah	0.417*	0.468*	2.567*	5.733	.969
43. Vt.	0.605*	0.674*	-0.090	5.243	.936
44. Va.	0.270*	0.663*	-0.268*	1.044	.991
45. Wash.	0.654*	0.792	-0.768*	3.930	.983
46. W. Va.	1.001*	0.050	0.513	2.402	.966
47. Wisc.	0.380	0.246*	3.548*	1.762	.991
48. Wyo.	0.623*	0.424	2.940	8.188	.828

future, may have some merit with respect to educational expenditures. Despite a number of large deviations from one, many of these are not statistically significant at the .10 level, which may be due to the larger sampling variances associated with the mild interdependence of S^i_{t-1} and G^i_{t-1}. Notwithstanding this disappointing feature of the c^i, the model (1) otherwise seems to perform well as judged by the range and significance of many of the estimated parameters and by the generally high R^2. The median value of the latter is .96.

The Policy Alternatives

To this point, our efforts in developing and estimating the model (1) have aimed at description. In the present section the emphasis shifts to a normative application of the model, suggesting the potential of using it, or a refined version of it, to guide federal policymakers in their disbursement of aid to education at the state government level.

Suppose that federal disbursements for education were to occur systematically according to one of the plans listed below. Though political considerations and legislative stipulations will make complete adherence to a single plan impossible, the adopted plan shall serve as a standard to be approximated more closely as the allocators' discretion is increased. Let us assume that the plan which is adopted is the one which seems to promise the greatest effectiveness in stimulating educational expenditures by the states as a group over the planning period in question. Naturally this assumption slights the vector of goals which in fact may be operative; but it also captures much of the intent of the federal grant program. The measure of effectiveness to be used is the ratio of total state educational expenditures to total federal payments to the states for education over a period of n years, the longevity of the plan:

$$Z = \sum_{t=1}^{n} \left(\sum_{i=1}^{48} S^i_t P^i_t \right) / \sum_{t=1}^{n} \left(\sum_{i=1}^{48} G^i_t P^i_t \right)$$

where P^i_t denotes the population of the i^{th} state in year t.

The six allocating schemes that shall be reviewed here are suggested more by the model than by observation of current procedures, although plans 1 and 2 are imitations of the "mark-up" rule of thumb which other observers (4) believe operative in the appropriation of funds to some federal agencies.

Plan 1. This "control plan" calls for annual increases in federal payments to state i at the rate g_i, the average growth rate of G^i for the past five years:

$$G^{i*}_t = (1 + g_i)\, G^i_{t-1}$$

Plan 2. Under this plan, the federal payment to each state is increased by 3% of the control plan payment:

$$G^i_t = (1.03)\, G^{i*}_t$$

Plan 3. Suppose that states that appear to have had their own expenditures for education stimulated by the receipt of federal funds were rewarded with an additional 7% of their control payments, while the remaining states were penalized by 2% of their control payments:

$$G^i_t = (1.07)\, G^{i*}_t \quad \text{for } c^i \text{ greater than 1}$$

$$G^i_t = (.98)\, G^{i*}_t \quad \text{for } c^i \text{ otherwise}$$

Plan 4. This plan is similar to plan 3, but it does not penalize states as long as their expenditures do not appear constricted by additional federal funds:

$$G^i_t = (1.03)\, G^{i*}_t \quad \text{for } c^i \text{ greater than 1}$$

$$G^i_t = (.98)\, G^{i*}_t \quad \text{for } c^i \text{ less than 0}$$

$$G^i_t = G^{i*}_t \quad \text{for } c^i \text{ otherwise}$$

The narrow construction of these plans should make it unnecessary to remark upon the exploratory nature of this research. If more sophisticated variants of plans 3 and 4 were to be considered as policy components in a serious way, then one would want to regard the sampling variances of the c^i in addition to the c^i themselves.

Plan 5. Another interesting heuristic involves awarding additional grants to states whose neighbors seem influenced by the comparison process. To each of the twenty states having at least 60% of its border adjoining states showing significant coefficients b^j, give an extra 6% of the control payment; to the others, give the control payment only.

Plan 6. As a variation of plan 5, award an extra 3% of the control payment to each of the thirty-one states having at least 50% of its boundaries adjoining states showing significant coefficients b^j; to the others, give the control payment only.

Policy Simulations

To test the effects of the six allocation plans on Z, we conducted policy simulation experiments with the model for a seven-year period (1966-1972). For a given plan, one solves for S^i each period in terms of (a) the value of S^i generated by the model in the preceding period, (b) the value of the neighborhood variable, (c) the value of G^i_{t-1} as given by the particular plan, and (d) the stochastic error term. We assumed that the error terms were normally distributed with expected value equal to zero and standard deviation equal to the standard error of the estimate. For each plan we ran the simulation seven years and calculated Z. Population projections were generated by

$$P_t^i = (1+p_i)\, P_{t-1}^i$$

where p_i is the average growth rate of P^i for 1961 through 1965.

There are two reasons for making the simulations stochastic. First, by including the stochastic variable E_t^i, we take into consideration the random effects which have not been explained by the model. Second, we can now say something about the degree of confidence that we have in any inferences which we might make about the differences in the effects of the six policies on the state-federal educational expenditure ratio.

The simulation experiment was replicated thirty times per plan. The sample means, $\overline{Z}_j$, appear in Table 2.

Table 2. Sample Means, $\overline{Z}_j$

Plan j	$\overline{Z}_j$
1	7.1281
2	6.1762
3	7.4247
4	7.4272
5	6.2519
6	6.4423

Data Analysis

To begin analysis of the output data generated by the simulations it was asked whether the expected values of Z_j for the six allocation plans are equal; and if they are not, between what plans will one find differences? An F-test was conducted to test the null hypothesis that the state-federal educational expenditure ratios for the plans are identical. As the computed F of 1350 dwarfed the tabulated F with 5 and 174 degrees of freedom at the .005 level (3.35), the null hypothesis was discarded. In order to identify where the suggested differences might be, Tukey's method (10, 11) for constructing simultaneous confidence intervals was used; as the confidence allowance at this level is $\pm$ .0064, all the differences between the sample means $\overline{Z}_j - \overline{Z}_k$ (see Table 3) are significant except for those of plans 3 and 4.

Table 3. Differences of Sample Means, $\overline{Z}_j-\overline{Z}_k$

j \ k	2	3	4	5	6
1	0.9519	-0.2966	-0.2991	0.8762	0.6858
2	---	-1.2485	-1.2510	-0.0757	-0.2661
3	---	---	-0.0025	1.1728	0.9824
4	---	---	---	1.1753	0.9849
5	---	---	---	---	-0.1904

The sample means indicate that the federal government's contribution to total state spending over the simulation period was between 13.5% (plan 4) and 16.2% (plan 2) after beginning in 1965 at 9.6%. The simulations also suggest that the most effective way examined to induce additional federal grants, for the system as a whole, is the direct rewarding of that activity and the penalizing of the opposite activity (plans 3 or 4).

Perhaps the most interesting point to notice is that a general increase in federal support over the control plan may <u>reduce</u> total state expenditures; this is what one observes in moving from plan 1 to plan 2, where the numerator of Z shrinks and its denominator enlarges. What was intended to stimulate may in fact retard. If this proposition is valid, then its explanation may be sought in the expectations held by state administrators concerning future flows from external sources, a factor to which we only alluded earlier and upon which we would encourage research.

As a closing comment, we would add that, although the preliminary quality of the simulations has already been mentioned, the results associated with plans 1 and 2 are not as tightly tethered by this qualification as are the other plans.

Footnotes

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[1]All data are taken from (2), and are defined in some detail there. Minor amendments were made in series whose composition had changed definitionally over time.

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