SUMMARY

THE IMPLEMENTATION OF A COST-OF-EDUCATION INDEX IN STATE AID ALLOCATION FOR EDUCATION -- A System Dynamics Model

Fiona Feng Chen

Department of Public Administration
Graduate School of Public Affairs
State University of New York at Albany
Albany, New York 12222

INTRODUCTION

A system dynamics model of a public school finance system within one state has been established in order to help understand the dynamic implications of the system. Various assumptions on fiscal behavioral responses of the state and different types of localities are simulated to assist the decision-making process in the area of public school finance. Employing this system dynamics model, this study deals with specific problems involving the implementation of a cost-of-education index in a state aid distribution formula for education.

PROBLEM IDENTIFICATION

The issue of educational cost differentials among different types of school districts has been raised lately in the field of education finance. The adoption of a cost-of-education index in a state aid distribution formula for education to reduce the differences has been suggested much by both theoretical and empirical studies. Among them, a series of quantitative studies, mainly multiple regression analyses, have been conducted in order to calculate specific cost indices for individual school districts.

Regardless of the individual approach of the studies mentioned above, they are plagued by two central problems. First, the cost-of-education indices proposed have been discussed from a short-term point of view (one to two years). The long-term impacts of implementing the index have hardly been discussed. Secondly, the inequitable allocation of public school expenditures among school districts within one state has become one of the main issues in education finance in the 1970's and 80's. The impact of cost-of-education index would have on this issues has not been addressed specifically.

THE DYNAMIC IMPLEMENTATION OF A C.O.E. INDEX

The purpose of this paper is to discuss the possible effects of the implementation of a cost-of-education index with regard to the above two problems. That is to say, this paper 1) compares the long-term consequences with the short-term ones, and 2) examines the impact of the policy on equalizing state aid allocation. All the analysis is based upon a series of simulation results from a system dynamics model of the public school finance system within one state.

1) In comparison, the simulation outcome suggests that the possible results of the implementation of a cost-of-education index in the short run (one to two years) is quite different from that in the long run (seven years or more). The expected increase in education expenditures for some school districts may show in the short run but would decrease back to the previous level in the long run. The self-adjusted feedback factor built in the system is usually ignored in current studies for cost-of-education index.

2) Results of system simulations also suggest that under certain circumstances this policy has a negative effect on the state aid allocation for certain types of school districts. In other words, the implementation of

a cost index may move the system away from equalizing goals. However, if the index is used to evaluate (instead of to allocate) state aid distribution, the current inequitable situation will be assessed anew. That is to say, if the index is used as a measurement to reevaluate the present fund allocation, we may find out that much distribution is not as unequitable as what the absolute dollar amounts indicate for some school districts, and that it is not as equitable for some others.

MODEL STRUCTURE

The system dynamics model was established at the Graduate School of Public Affairs of the State University of New york at Albany. For the convenience of data collection, the model used the State of New York. However, the methods and results of the study are generally applicable and should not be restricted to New York State only.

At the present time, the model includes one state taxation sector, four aggregated local taxation sectors (representing about 700 school districts aggregated into four major types of school districts), and four education distribution sectors (containing the aid distribution formula for state operating aid).*

Thus, in the discussion of polity implementation, the dynamics model will show results by aggregated school district types.

* A new edition of the model with more local sectors will be presented in the conference.

in Serrano v. Priest, the California Supreme Court ruled that the state's method of funding education was in violation of the equal protection of the 14th Amendment to the United States Constitution. The Court set up the "fiscal neutrality" standard whereby the quality of a child's education must not be a "function of the wealth of his parents and neighbors."

A number of states across the nation has followed the Serrano example in challenging the constitutionality of their education finance system. As a result of this reform movement, the legislatures in many states have attempted to redesign the school finance system in order to make local tax burden less dependent on local wealth, and guarantee all children a more equitable level of education. Legislators and fiscal agencies have been under much pressure to develop alternative methods of funding education and to support their recommendations with detailed analyses.

As early as the 1950's the New York State Education Department developed some district-by-district analyses. In the 1960's, thanks to improvements in computer technology, several models were built for the analysis of school aid formulas. In 1962, Cornell University produced district-by-district analyses for the New York State Joint Legislative Committee headed by Charles Diefendorf. Such models were not, however, widely used. Overall, traditional processes in the area of public school finance have remained rudimentary in a number of states. They usually involve time-consuming hand calculations, with a large margin of error and little in-depth analysis. The inadequacy of such methods to address the compelling set of issues raised by the court cases, together with the increasing complexity of state aid formulas and the growing volume of data to be processed, has prompted a more widespread development of computer simulations in the area of public school finance. These computer models are essentially tactical by nature. They show the decision maker the

detailed short-run impact of proposed state aid packages on individual school districts as well as at the state level and suggest a course of action.

Reform was not limited to the area of school finance. A series of concurrent public referenda, judicial decisions, and federal mandates in the general realm of public finance has had some drastic impact in the field of education finance. The passage of Proposition 13 in California in June 1978 has limited the ability of localities to raise revenues, and placed a cap on state and local expenditures. Subsequently, similar tax or spending limitation proposals have been initiated in several other states. At the same time, court cases in many states have mandated full value assessment of the property which serves as a basis for the financing of the local share of educational costs (e.g., Hellerstein v. Assessor of Town of Islip in New York State, 1975). Urban school districts have also been restricted in their capacity to borrow funds in order to meet present and long-term expenditure needs (e.g., Hurd v. City of Buffalo in New York State, 1974).

In an era of inflation, economic stagnation, and mounting pressure for more government expenditures at the state level coupled with taxpayer revolt and widespread reform, the field of public school finance is becoming increasingly interconnected and complex. Both traditional methods of analysis and tactical simulation models are static by nature and involve short-run and precise projections on a district-by-district basis. These models are not adequately equipped, however, to examine in depth the intricacies and implications of the current system. In addition, they are unable to foresee the long-range ramifications of policy changes. Finally, they contain no mechanism concerning the behavioral responses of the localities to court mandates and to the recommendations proposed by the decision maker.

There exists currently another class of simulations which examine overall policy-related issues at a more conceptual level. These models, referred to

THE IMPACTS OF IMPLEMENTING A COST-OF-EDUCATION INDEX ON THE EQUALIZATION OF EDUCATION EXPENDITURES PER PUPIL

Fiona Chen David Andersen Tanette Nguyen

Institute for Government and Policy Research
Graduate School of Public Affairs
State University of New York at Albany

ABSTRACT

In this paper, a pilot system dynamics simulation model, EDFIN1, is used to forecast the impacts of a cost-of-education index (COEI) on patterns of per pupil expenditures across various types of local school districts. Originally designed to compensate more fully those districts that incurred greater costs in the purchasing of educational inputs (i.e., higher teacher salaries or greater need for transportation), COEI adjustments are seen also to have direct impacts on the relative equity of per pupil expenditures across the state as a whole.

INTRODUCTION

For most local governments, expenditures for elementary and secondary education are the largest single expense facing the community. For state governments, aid to localities for elementary and secondary education is also one of the largest budget items. Hence changes in how state aid is allocated to localities can have dramatic impacts on tax rates and economic well being at both the state and local level.

This study is an attempt to investigate, using a system dynamics model, the impact of implementing a cost-of-education index (COEI)--a mechanism to adjust for disparities in educational costs among localities in a state--in a state education formula. The paper will evaluate the long range implications that a COEI would have in terms of equalizing per pupil expenditures across the state. The argument in favor of a cost index is that it would be more equitable since it allows localities which have to pay relatively higher costs for the same level of educational services to be compensated under the state aid formula. Model simulations suggest that central cities would benefit from the implementation of a cost index. Wealthy suburban school districts also would receive an increase in state aid with the index. Such aid increases, however, would have to be effected at the expense of less wealthy districts (in rural areas and other less industrialized regions in the state) which in general pay relatively less for educational services. Faced with decreases in state revenues for education, these districts would be confronted with the difficult choice of increasing their already high tax rates in order to make up for aid losses, lowering their overall level of expenditures for education and other services, or a combination of both policies. In other words, lower wealth localities would be penalized by the cost index, and the state would be moving away from its equalization goal.

In the sections that follow, the concept of a COEI is briefly reviewed followed by a brief overview of the model structure used to analyze the long term dynamics of COE adjustments. Finally several simulation runs are presented and discussed.

THE CONCEPT OF A COST OF EDUCATION INDEX

Cost differences exist among localities within a state. As a result, the cost of the same basket of goods and services may vary from one school district to another. This phenomenon creates a particular problem when it comes to the fundamental issue of equalizing state aid for education. There are indeed no adjustments for educational cost differentials in the current aid formula of most states. A possible solution to the problem is to build a cost-of-education index. Essentially, this index would measure the magnitude of spatial cost differentials by calculating the cost of a standard education resource in each school district relative to the state average cost of that resource (Wendling, 1980). The cost index would then be used to adjust for educational cost differences among school districts. Theoretically, the cost-of-education index is used to adjust for educational cost differences among school districts. Theoretically, the index should help the state move toward a more equitable allocation of education by compensating localities which face higher costs for the same amount of education relative to the state average price of that resource.

Adjusting for local cost differences in state aid distribution formulas for education is a fairly recent concept in the field of public school finance. A survey of the literature shows that most articles available on the topic have been written over the past decade. In a study of the Boston Metropolitan area, Toder (1971, 1972) has found much evidence to substantiate the hypothesis that some school districts must pay a higher price for the same standardized unit of teacher input.

Subsequently, some econometric studies have been performed to isolate the components responsible for the differences in educational costs. Antos and Rosen (1975) have set the theoretical framework of the cost-of-education index in the formulation of an exchange mechanism in the labor market between school districts and teachers or administrators. They have distinguished between two types of characteristics which affect the cost of educational services. They are teacher characteristics (e.g., experience, degree earned, race, sex, and age) and school characteristics (e.g., student racial composition, class size, intelligence of students, crime rate). Teacher characteristics are also referred to as controllable factors because, to a great extent, they reflect the choice of school districts for quality education. Hence they should be excluded from the COEI. Among the factors uncontrollable by the localities which should be accounted for in the index, Chambers (1976) isolates supply factors (i.e., factors which reflect the relative attractiveness of employment in the district) and technological factors (better referred to as pupil-need factors). An example of a mathematical model of how to compute a cost index was provided by Chambers, Odden, and Vincent (1976). Some cost-of-education indices have been computed for specific states (Brazer, 1975, and Brazer and Anderson, 1976, for Michigan; Chambers, Odden and Vincent, 1976, 1977; and Chambers, 1978, for Missouri; Chambers, 1980, for California; Kenny, Denslow, and Goffman, 1976, for Florida; and Wendling, 1979, 1980, for New York).

THE SIMULATION EXPERIMENT

Several technical and conceptual problems exist when one actually tries to empirically estimate what an appropriate COEI would be for various local school districts within a state. This study does not address any of these questions. Instead, this study accepts a COEI study completed by Wendling for the State of New York and asks, what would be the long term implications if such an index were to be adopted in a state such as New York. To answer this question, an aggregate system dynamics model of the financing of education in New York State is constructed and analyzed. Initialized in equilibrium, the model is disturbed in year 2 by the implementation of a COEI and the characteristic response of the New York State school finance system is then observed for a period of eight years. Before reviewing simulation results, a very brief overview of the model structure is presented.

SYNOPSIS OF MODEL STRUCTURE

A complete discussion of model structure is beyond the scope of this work (for an equation listing and more details on model structure see Chen, Andersen, and Nguyen (1980) or for an equation by equation description see Chen (1981)). The discussion below merely presents the major sectors of the model and describes the major functions performed in each sector of the model.

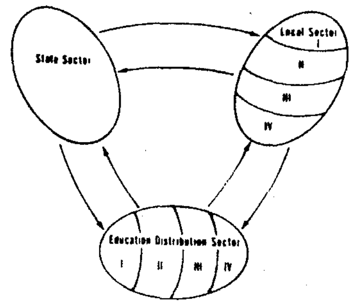


Figure 1: Sectoral Diagram of EDFIN1

As shown in Figure 1, the overall EDFIN1 model is divided into three major sectors --a local finance sector, a state finance sector, and a local distribution sector. The local finance sector simulates the major budgeting and expenditure decisions for each of four types of local communities. The state finance sector simulates the major budgeting and expenditure decisions for the state. In both of these sectors, expenditure and budgeting decisions are roughly divided into decisions concerning expenditures for education and decisions concerning all other expenditures. Finally, a local distribution sector simulates the state aid to localities formula for distributing aid. The COEI is implemented in the local distribution sector. Each of the three major sectors is discussed in slightly more detail below.

The Local Finance Sector. Within EDFIN1, the 703 local school districts in New York State are aggregated into four broad types of districts based upon several relevant characteristics. The four district types represent school districts from the richest to the poorest. The differentiation is based on their full property values, their tax rates, how the state presently computes their state aid, and their education expenditure levels. Generally speaking, the richer school districts have higher full property values, have a greater ability to increase local taxes, and spend more on education per pupil. On the other hand, the poorer districts have less full property value, do not have sufficient ability to increase their tax rate, and spend less on education expenditures per pupil. Based on published data sources, the four district types are set as Sector I (Wealthy Suburban) with high property value, Sector II (Moderate Wealth Suburban) with medium to high full property value, Sector III (Central Cities) with medium to low, and Sector IV (Rural) with low full property value.[1]

Broadly speaking, each of the four local school district types performs three major functions: tax collection, budget setting, and actual expenditure allocation. Expenditures are categorized as those for schooling and all other expenditures.

State Finance Sector. Since the intent of this sector is to observe the overall behavior of the state finance system, state tax bases of personal income, user taxes and fees, and business taxes are integrated into one category forming an aggregate state tax base. Structures performing functions similar to these in the local taxation sector are contained in the state taxation sector.

Education Distribution Sector. The education distribution sector is a connection between the state and local taxation sectors. It is designed to simulate the present distribution formula for operating aid in New York State. The model concentrates on operating aid and at present ignores other types of aid (such as building, transportation, or bilingual education aid.) General state aid contains a ceiling aid limitation and a floor aid protection. That is, the poorest districts (the ones with low property wealth) can not receive more than a certain amount of aid (the ceiling aid) while the richest districts (the ones with high property wealth) can still get a certain amount of aid (the floor aid) whatever their financial needs are. In addition, a save-harmless device protects localities from getting an aid amount less than the aid in the previous year. A final adjustment mechanism will proportionately increase or decrease state aid if the state experiences a shortfall or windfall in the total amount of money budgeted to support state aid to education.

MODEL BEHAVIOR

Three assumptions about the possible stucture of the COEI were simulated. The three assumptions are that: 1) Both Local Sector I (wealthy suburban) and III (central cities) have high costs of education (with an index of 1.2), Local Sector II (moderate wealth suburban) has a moderate cost index (an index of 1.1), and Local Sector IV (rural) has a low cost index (an index of .9).

2) The only type of school districts showing high cost for education are those in central cities (with an index of 1.2) and the poor school districts still have low cost index (.9) while the other suburban districts exhibit moderate costs (1.1 for Sector I and 1 for Sector II).

3) The poor school districts have a cost index of 1.. The other districts are assumed as in case 1. This third case theoretically prevents any district from having an aid entitlement lowered due to a COEI less than one.

The COEI was implemented at year 2 by multiplying the educational expenditure figure used in the calculation of state aid by the index for the relevant district. This has the effect of inflating or deflating a district's reported expenditures (and hence entitled aid) by exactly the amount of the index. Figure 2 shows the simulation results for sectors III and IV (the central cities and rural districts) under the first assumption. Results are shown only for sectors III and IV because these sectors react most dramatically to the proposed policy. Output showing the reactions of all four districts is discussed below.

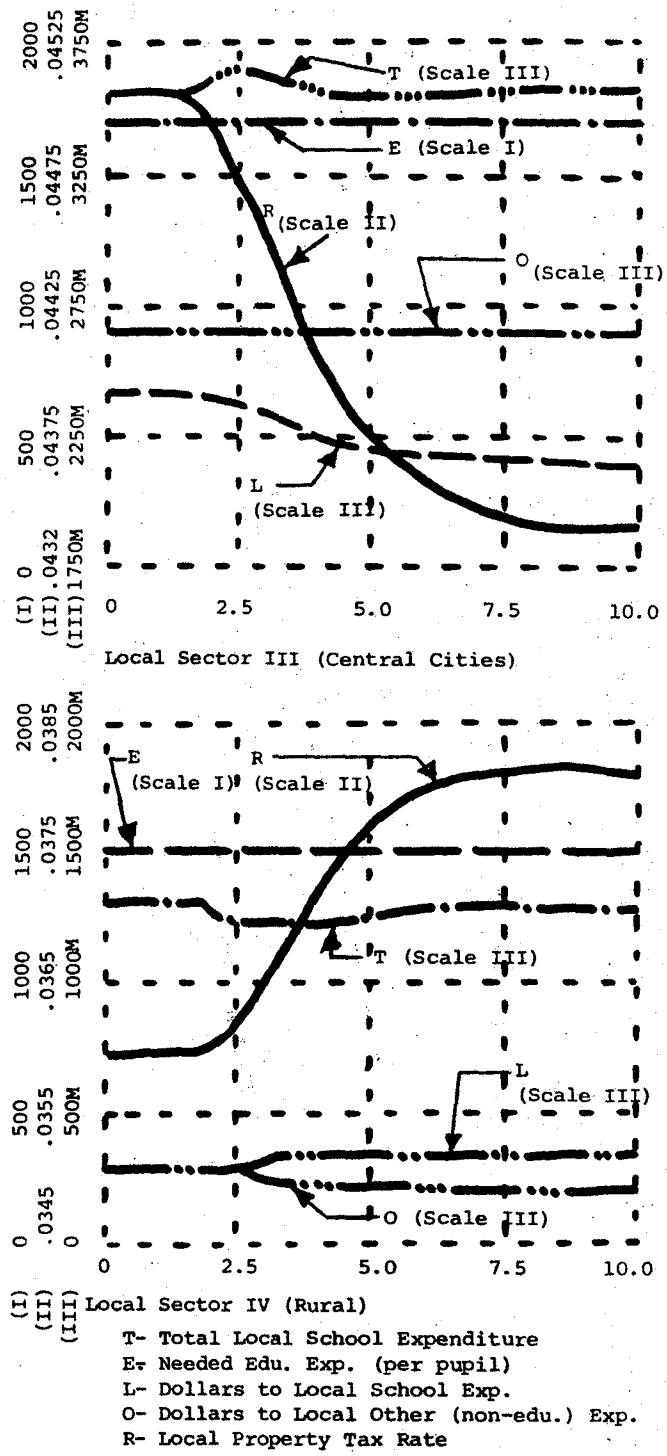


Figure 2: Behavior of Local Sectors III and IV

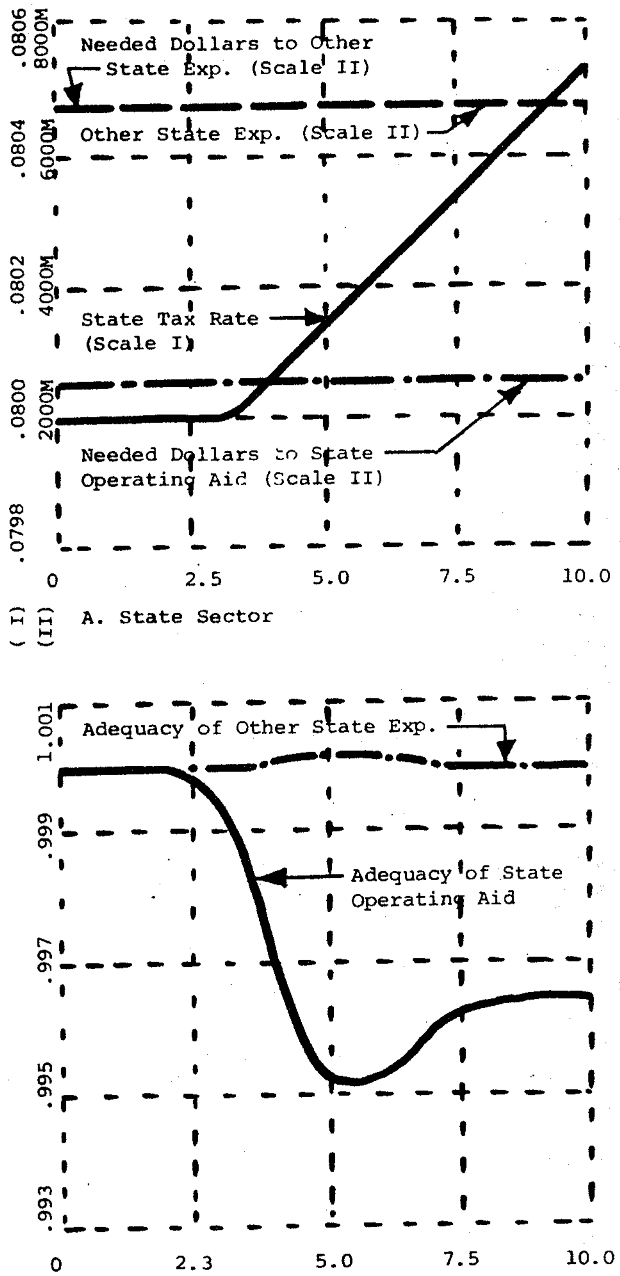
In both sectors III and IV, the target needed educational expenditures (E) stays constant, but the actual amount of those expenditures made up by local taxes shifts dramatically. In Sector III, the local dollars being spent for educational purposes (L) declines whereas in Sector IV this amount increases. This shift occurs because in

Sector III state aid is increased due to the COEI and in Sector IV state aid has decreased. In Sector III, the tax rate drops by several percentage points (from approximately .045 to .043) and in Sector IV, the tax rate increases by several percentage points (from about .036 to about .038). That is, the first order effect of shifting state aid in the two local sectors over time has the second order effect of shifting the local effort and consequently the local tax rate.

In order to compare the behaviors of the four local sectors, several behavioral indices are illustrated in figure 3--percentage change in state aid fractions, percentage change in tax rates, adequacy of education expenditure, change in variance of state-wide education expenditures, and adequacy of local non-educational expenditures. From this figure, we observe the following results: 1) Local Sector III experiences an increase in its state aid for education while the other local sectors experience a decrease in theirs. Local Sector IV has the greatest loss, nearly 10% in the long run. 2) There are slight (less than 1%) tax-rate increases in Local Sector I and II and in state sector. But the tax rate decreases almost 4% in Sector III while it increases more than 6% in Sector IV (as discussed above). 3) The adequacy of education (measured as the ratio of target to actual expenditures) in Sectors I, II and III returns to equilibrium after a two-year adjust period. Local Sector IV, however, has a decrease in its educational service level (7%) in the beginning, and does not recover in the end of the tenth year. 4) As a result of the expenditure changes, the normalized variance of the education expenditures (a measure of equity of state-wide expenditures) increases 40% once the policy is implemented. At the end of ten years, the variance is still 20% more the original value. 5) Since property tax base is also an income resource for local non-educational services, the changes in the educational services have also influenced the service levels of other local services. In the graph of adequacy of other local services, we note a drastic decrease in the service level in Sector IV, and the levels of services remain almost the same in other sectors.

In short, there are no dramatic changes in Local Sectors I and II. However, Local Sector III experiences an increase in state aid fraction and a decrease in tax rate, while Local Sector IV experiences the reverse situation.

The impacts on the state sector are illustrated in Figure 4. There is a slight increase (.5%) in state tax rate, and a slight decrease in the adequacy of state operating aid. That is to say, most of the burden of this policy is absorbed by localities.



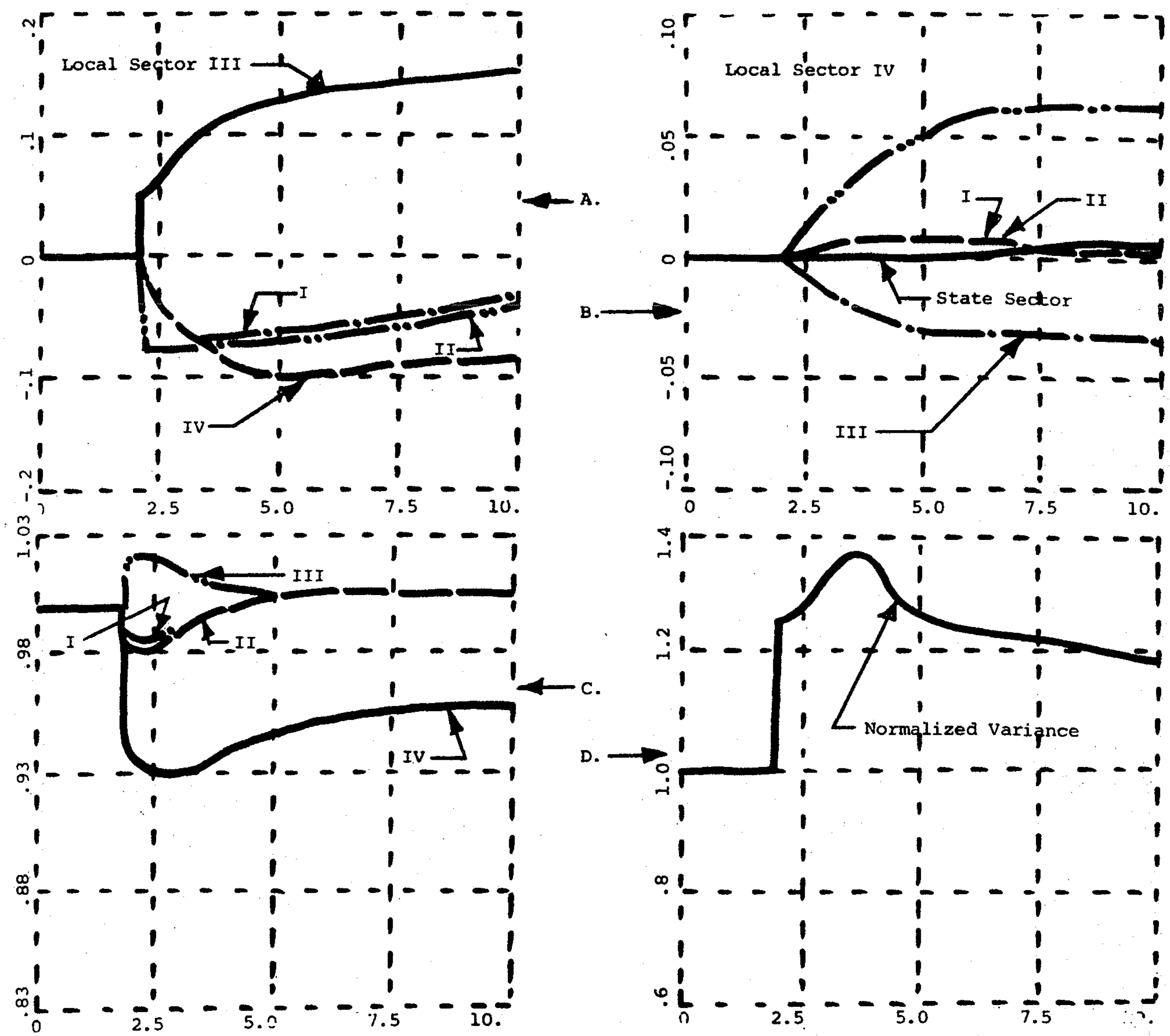
A. State Sector

B. Adequacy of State Service

Figure 4: Behaviors in State Sector Under Assumption I

The results of simulation under assumption II are similar to the ones under assumption I because the change in index number (from 1.2 to 1.1 for Sector I) is not large enough to cause obvious behavioral differences in the system.

The results of simulation under assumption III, no sector having an index number smaller than 1, are similar to the results discussed under the above two assumptions. That is, Local Sector III benefits less and Local Sector IV is better off under this assumption than under the previous two. The major differences between assumption I and those reported earlier are: 1) Local Sector IV still attains a low adequacy of education expenditures but this value is 2% higher than under assumption I; and 2) the variance of education expenditures still increases, but 15 to 30% less than under assumption I. As a result of this



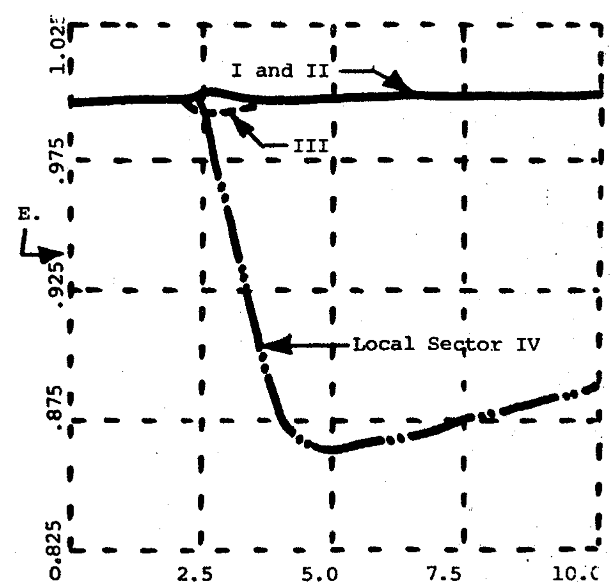


Figure 3: Comparison of Behaviors in Four Local Sectors

CAPTIONS:

A. Percentage Change in State Aid Fractions
B. Percentage Change in Local and State Tax Rates
C. Adequacy of Educational Expenditures
D. Change in Variance of Educational Expenditures
E. Adequacy of Local Non-Education Expenditures

policy, Local Sectors I and II shoulder more of the burden than under the previous two assumptions.

CONCLUSION

The simulation results reveal that adapting a cost-of-education index in the state operating aid formula will result in increases in the variance of education expenditures. Poorer school districts with lower costs for education will be penalized by the cost index. The central city school districts with high costs for education will benefit from the policy. In short, the policy of adapting a cost index in opearting aid formula may reimburse the high cost of education for some school districts. However, it has negative impacts on the equity of per pupil education expenditures. Solving one problem exacerbates another.

NOTE

1. Data sources for estimating model parameters include:

   New York State, Division of the Budget, Technical Services Unit, "New York State Statistical Yearbook," 1977.

   New York State, Division of the Budget, Education Unit, "Current Components of New York State's Educational Finance System: A Review," October, 1977.

   New York State, Division of the Budget, Education Unit, "New York State's System of School Finance --With Example From the 1975-76 School Year," December, 1976.

   New York State, Division of the Budget, Education Unit, "State of New York, Apportionment of Operating Aid for the 1977-78 School Year: A Complex Status Quo," September, 1977.

REFERENCES

Antos, Joseph R., and Rosen, Sherwin. 'Discrimination in the Market for Public School Teachers.' Journal of Econometrics. Vol. 3, No. 2, 1975, pp. 123-150.

Brazer, Harvey E. 'Adjusting for Differences Among School Districts in the Costs of Educational Inputs: A Feasibility Report.' Selected Papers in School Finance, 1974. Washington, D. C.: U.S. Office of Education, 1975, pp. 89-135.

Brazer, Harvey E., and Anderson, Ann P. 'A Cost Adjustment for Michigan School Districts.' Selected Papers in School Finance, 1975. Washington, D. C.: U.S. Office of Education, 1976, pp. 23-81.

Chambers, Jay G. 'Educational Price Differentials: A Clarification of the Issues.' Paper presented at the American Educational Finance Conference in Nashville, Tennessee, March 1976.

Chambers, Jay G.; Odden, Allan; and Vincent, Phillip E. Cost-Of-Education Indices Among School Districts. An Application to the State of Missouri. Report No. F76-3. Denver, Colorado: Education Finance Center, Education Commission of the States, Dec. 1976.

Chambers, Jay G.; Odden, Allan; and Vincent, Phillip E. 'Teacher Cost Differentials and the Allocation of State Aid for Elementary and Secondary Education.' March 1977. (Mimeographed).

Chambers, Jay G. An Analysis of Education Costs Across Local School Districts in the State of Missouri, 1975-76. Papers in Education Finance No. 7. Denver, Colorado: Education Finance Center, Education Commission of the States, Jan. 1978.

Chambers, Jay G. 'The Development of a Cost-of-Education Index: Some Empirical Estimates and Policy Issues.' Journal of Education Finance. Vol. 5, No. 3, Winter 1980, pp. 262-281.

Chen, Fiona, Andersen, D.F., and Nguyen, T., 'A Preliminary System Dynamics Model of the Allocation of State Aid to Education.' Modeling and Simulation. Vol. 11, Proceedings of the 1980 Pittsburgh Simulation Conference, 1980.

Chen, Fiona F. 'A Broad Quantitative View of Public School Financing.' Albany, New York: Graduate School of Public Affairs, State University of New York at Albany, 1981. (Mimeographed).

Kenny, Lawrence W.; Denslow, David Jr.; and Goffman, Irving J. 'Measuring Differences Among the Florida School Districts in the Cost of Education: An Alternative Approach.' Selected Papers in School Finance, 1975. Washington, D.C.: U.S. Office of Education, 1976, pp. 153-221.

Toder, Eric J. 'The Distribution of Public School Teachers by Race and Income Class in an Urban Metropolitan Area.' Ph. D. Dissertation, The University of Rochester, 1971.

Toder, Eric J. 'The Supply of Public School Teachers to an Urban Metropolitan Area: A Possible Source of Discrimination in Education.' The Review of Economics and Statistics. Vol. 54, No. 4, Nov. 1972, pp. 439-443.

Wendling, Wayne. 'Cost-Of-Education Indices for New York State School Districts.' Prepared by the Education Finance Center of the Education Commission of the States for the New York State Task Force on Equity and Excellence in Education. Denver, Colorado, Oct. 25, 1979.

Wendling, Wayne. The Cost-Of-Education Index: Measurement of Price Differences of Education Personnel Among New York State School Districts. Papers in Education Finance No. 26. Denver, Colorado: Education Finance Center, Education Commission of the States, Apr. 1980.