SUMMARY

COMPARING TACTICAL AND STRATEGIC MODELING TECHNIQUES
IN THE FIELD OF PUBLIC SCHOOL FINANCE

Tanette N. Nguyen
Graduate School of Public Affairs
Department of Public Administration
State University of New York at Albany
Albany, New York 12222

PURPOSE OF THE STUDY

The purpose of the research is to compare two computer simulation modeling techniques regarding the impact of the implementation of a cost-of-education index in the New York State aid formula for education. Throughout the research, an attempt is made to assess the advantages and disadvantages of the two simulation methods and to examine the utility of combining both approaches in the analysis of school finance issues. Using the two computer techniques, the study evaluates the impact of incorporating a cost-of-education index in the state aid formula in terms of equalizing per pupil expenditures throughout the state. Although the issues being discussed in the study are generic to most states, the research is based on the experience in New York State.

BACKGROUND AND PROBLEM

Essentially a local responsibility during the eighteenth and nineteenth centuries, elementary and secondary education has become increasingly a matter of concern for the state over the last century. Billions of dollars are earmarked every year for education by state governments. In many states, funds are allocated among individual school districts based on equalizing formulas. Over the past decade, court rulings throughout the nation have questioned the ability of current state aid formulas to alleviate the disparity in schooling expenditures among various localities. In late 1971,

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

as strategic models, are not concerned with individual school districts and with detailed financial information. They focus mainly on aggregate key policy variables at the state level, and on long-term effects of these variables on the system. Strategic models are exploratory by nature. They search for unforeseen and sometimes unintended consequences of policy actions. Very little strategic modeling, however, is presently being done by state government agencies because the utility of this kind of simulation is not immediately apparent to the political and bureaucratic decision makers. Moreover, most states do not have the technical expertise to conduct the simulations in-house.

PROPOSITIONS AND HYPOTHESES

Tactical and strategic modeling techniques are very different in terms of their basic assumptions, approaches and outputs. Table I presents some general dimensions which will be used in the study to compare the two types of models and the expected application of those dimensions to the two types of models.

TABLE I

DIMENSION OF COMPARISON KEY	TACTICAL MODEL	STRATEGIC MODEL
Purpose	Evaluate specific state aid proposals for current action.	Explore overall policy issues and their likely impacts.
Boundary	Limited to the Education Law. Use of relatively few variables.	Broadened to include general public finance issues. Use of more heterogeneous data.
Time Horizon	Short term (1 to 5 year non-dynamic projections).	Long term (1 to 20 year dynamic projections).
Output	Precise impact of state aid proposal on each school.	More concerned with long-range behavior of the system.
Level of Aggregation	Disaggregation on a district-by-district level.	Highly aggregated sectors (urban v. suburban v. rural localities).

The purpose of the research is to convey the notion that in fact tactical and strategic simulations are not competing against one another, but rather can be seen as complementary techniques, reinforcing one another. The output of the tactical simulation, for instance, could serve as the input for the strategic model. The result of a concurrent use of tactical and strategic models, it is hoped, will be better analytical capability in the decision making process, without losing the detailed and precise information much needed by the decision maker.

The implementation of a cost-of-education index in the New York State aid formula for education will serve as an illustration of the proposition and hypotheses stated above. Essentially the purpose of the cost-of-education index is to adjust for educational cost differentials among school districts. Theoretically, the index should help the state move toward a more equitable allocation of education by compensating localities which have to pay a higher price for the same standard education resource relative to the state average price of that resource. A tactical model will show how, in the short run, such adjustment affects individual school districts. Gainers as well as losers can be easily identified in the simulation. A strategic model, on the other hand, will provide some insight on the long range impact of implementing the cost-of-education policy. It will help assess patterns of local responses to this equalization proposal.

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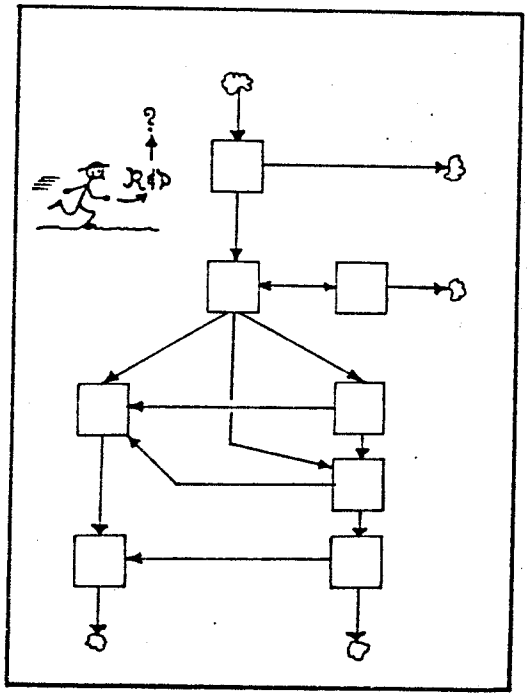

D.R. Davies
R.E.H.M. Smits
R. Tweehuysen
W. Wiis

December 1980

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Department of Public Administration
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State University of New York At Albany
Albany, New York 12222

ABSTRACT

This study proposes to compare two types of computer simulation techniques, namely tactical and strategic simulations. It explores the advantages and disadvantages of the two methods and stresses the importance of the insight to be gained by combining both approaches in the evaluation of public policies. A school finance reform policy is presented as a case study. More specifically, the research evaluates the implementation of a cost-of-education index (a mechanism to adjust for disparities in educational costs among school districts in a state) in the New York State aid formula. The study investigates, using the two computer simulation techniques, the impact of this policy in terms of equalizing per pupil expenditures.

INTRODUCTION

Purpose of the Study

The purpose of the research is to compare two computer simulation modeling techniques regarding the impact of the implementation of a cost-of-education index in the New York State aid formula for education. Throughout the research, an attempt is made to assess the advantages and disadvantages of the two simulation methods and to examine the utility of combining both approaches in the analysis of school finance issues. Using the two computer techniques, the study evaluates the impact of incorporating a

cost-of-education index in the state aid formula in terms of equalizing per pupil expenditures throughout the state. Although the issues being discussed in the study are generic to most states, the research is based on the experience in New York State.

Essentially the study:

1) Surveys the use of tactical and strategic simulation modeling techniques in the field of public school finance
2) Illustrates the application of a tactical model by implementing, as an example, a cost-of-education in the New York State aid formula
3) Illustrates, again using a cost-of-education index, a strategic model
4) Compares the two computer techniques in terms of their usefulness in the decision making process, and within the context of policy analysis.

Definitions

A model is an analytical representation of selected features and relationships of a real-world entity. The entity being represented is also referred to as the "reference system" (Greenberger, Crenson, and Crissey, 1976:49). The development of computer technology has led to the widespread use of formal models as explicit devices to help understand or improve the reference system.

A simulation is the method of developing a model of a real situation and then performing experiments upon the model to test the accuracy of its behavior under varying conditions (Fogarty, 1976:267).

Public Policy Models

Modeling has become a rather commonplace activity in the public sector. A multitude of different types of formal models has been built in a wide variety of policy areas to help the decision maker better understand the intricacies of socio-economic systems (Greenberger, Crenson, and Crissey, 1976:xiv). In addition, computer modeling is a potentially powerful tool to communicate ideas and focus debate around specific policy issues. The proliferation of models in public agencies is not, however, a reliable gauge of the actual impact of modeling in the decision making process. A large fraction of models that have been developed has never been put to use. In many instances, a number of characteristics inherent to the models has hindered their usefulness to the decision maker. Complicated, large-scale models are difficult to understand. They often produce only generalized results that hold only limited interest to public officials confronted with the intricacies of specific problems. Tenuous assumptions, crudely represented relationships, and inadequately calculated variables further undermine the validity of the models' output (Greenberger, Crenson, and Crissey, 1976:23-27). As a general rule, the political setting and the organizational framework within which a given model is developed and applied are crucial determinants of its usability (Greenberger, Crenson, and Crissey, 1976:20).

SIMULATION MODELS IN THE FIELD OF PUBLIC SCHOOL FINANCE

The study focuses on the field of public school finance to illustrate the application of models in the public sector and the difficulties they encounter.

Tactical and Strategic Models: Definitions

Keen and Clark (1978) distinguish between two broad types of computer simulation models, in the field of public school finance. They are tactical and strategic models. According to the Webster New Collegiate Dictionary, the word 'tactical' is a synonym for 'short range' and tactical decisions are decisions made or carried out with only a limited or immediate end in view. They involve actions of less magnitude than those of a strategy. Within the context of this study, tactical simulation models are computer models which involve the creation and short-run evaluation of specific public policy proposals, at a detailed level of disaggregation. As a general rule, they have a limited boundary. More specifically, they involve narrowly focussed analyses, and deal with a selected range of variables. The output from a tactical simulation is generally presented in the form of a series of tables showing the detailed and precise impact of a given proposal on each school district and on the entire state under study. Some more sophisticated models can also provide simple statistics such as mean, median, and ranges, and perform advanced multi-regression analyses. Tactical simulations are most often used as planning devices to assist the decision making process.

Strategic models on the other hand, entail analyses that are long-run, historical, evaluative, and conceptual. More specifically strategic simulations focus on broad policy alternatives and on long-term relationships among variables in the reference system. They examine more qualitative policy issues such as behavioral response of the system to changes in parameter values or in the model's structure. Their concern is not on short-run and detailed information on individual school districts but on aggregate key policy variables. The purpose of strategic research to a great extent is to

explore policy alternatives, analyze and explain their outcomes, and generate insights about important variables and relationships underlying the reference system. Strategic models are not directly linked to the policy making process. They are mainly used in the field of academic research. Consequently they are more independent of the decision maker's immediate concern with detailed policy outcomes.

Background: School Finance Reform in the United States

Essentially a local responsibility during the eighteenth and nineteenth centuries, elementary and secondary education has become increasingly a matter of concern for the state over the last century. Billions of dollars are earmarked every year for education by state governments. In many states, funds are allocated among individual school districts based on equalizing formulas. Over the past decade, court rulings throughout the nation have questioned the ability of current state aid formulas to alleviate the disparity in schooling expenditures among various localities. In late 1971, 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." In San Antonio Independent School District v. Rodriguez, (1973), however, the United States Supreme Court held that the Texas system of financing public education, despite its inequities, does not violate the equal protection clause since education is not guaranteed by the federal constitution and therefore cannot be considered as a fundamental right. The decision of the United States

Supreme Court blocked the federal constitution as a legal route to school finance reform. The arena for school finance litigation was then shifted back to the state courts.

A number of states across the nation has followed the Serrano example in challenging the constitutionality of their education finance system. As a result, the pace of school finance reform has accelerated rapidly over the past few years (Odden and Augenblick, 1980; and Lawyers' Committee for Civil Rights Under Law, 1980). 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.

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 and no longer can be treated in isolation.

Tactical Simulations in Public School Finance

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. Later 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.

A number of tactical simulation models has been developed over the past decade. Early efforts were made to build generalized calculation models that could be adapted to any state. Sklar and Ioup (1971), under sponsorship of

the President's Commission on School Finance, developed a Prototype National Educational Finance Planning Model (NEFP) to simulate the nation's future educational needs and resources. During 1972-74 the model was refined and made operational in several states. The NEFP model is a powerful tool. It has almost unlimited potential because of the infinite variety of data which it can accommodate and the new decision options it can make available to the decision maker (Boardman, et al., 1973; and Boardman, 1974). The model was adopted by several states and is still in use in New Mexico (Keen and Clark, 1979). Another generalized School Finance Equalization Management System (SFEMS) model was developed by staff at the Educational Testing Service and set up in several states around the nation (Keen and Clark, 1979). Generalized models however, are cumbersome and hard to operate. In addition, they cannot be used for a specific state without extensive modifications. As a result, most states have chosen to build their own tactical capabilities in-house. It is often easier to develop a simulation de novo rather than force-fit a specific state's formula into a generalized structure (Keen and Clark, 1979).

Aside from a detailed survey conducted by Keen and Clark (1979), the main source of information on tactical modeling techniques in the field of school finance is provided by the user's manuals for the models used by specific states (LEAP, Washington, 1978; LEGICOM, Michigan, 1977; PASSS, Pennsylvania, 1978; SIMULBUD, New York, 1978; SSF, Oregon, 1975). Other studies available consist of developing or evaluating computer-based school finance simulations for specific states (Bishop, 1975, for Texas; Bookman, 1977, for West Virginia; Huxel, 1973, for New Mexico; Keen, 1978, for California; Mayfield, 1973, for Georgia; Odden and Vincent, 1976, for Missouri; Oregon State

Legislature: Committee on Equal Educational Opportunity, 1974A, 1974B; Pierce et al., 1975, for Oregon; South Dakota State Division of Elementary and Secondary Education, 1977; and Wegryn, 1977, for Michigan).

Strategic Simulations in Public School Finance

There exists currently another class of simulations which examine overall policy-related issues at a more conceptual level. These models, referred to as strategic models, are not concerned with individual school districts and with detailed financial information. They focus mainly on aggregate key policy variables at the state level, and on long-term effects of these variables on the system. Strategic models are exploratory by nature. They search for unforeseen and sometimes unintended consequences of policy actions.

A survey of the literature shows that strategic research performed in the field of public school finance encompasses mostly econometric studies with the exception of a few system dynamics simulations. Econometric models have been essentially cross-sectional multi regression analyses of the impact of various state aid formulas as devices to neutralize the effects of local wealth difference among school districts. In response to various court rulings on the unconstitutionality of present methods of funding public education through local property tax, Stern (1973) built a prototype econometric model of current expenditures by local school districts in Massachusetts. Stern simulated alternative formulas for distributing general purpose state aid and came to the conclusion that a District Power Equalizing (DPE) formula (which assures that districts producing the same tax rate on local property will receive equal revenues through a combination of local and state funds) adjusts

expenditure disparities that are due to property value. The formula does not, however, reduce differences associated with socio-economic status (measured in terms of income).

In a regression analysis of 105 towns in Massachusetts, Feldstein (1975), also shows how the DPE form of aid fails as a device to fully neutralize the effect of local wealth differences among school districts. In addition, Feldstein distinguishes between matching grants and block grants and concludes that a matching grant system, where the state matches the local effort, has superior incentive features. Ladd's (1975) model of seventy-eight communities in the Boston SMSA looks at the implication of the composition of the local property tax base on educational expenditures. She suggests that a school district's educational expenditures are closely related to the size of its total property tax base and that the composition of the base into commercial, residential, and industrial property affects local decisions to provide educational services. Hence the separate components of the tax base deserve greater attention in the determination of local fiscal capacity for education.

Drawing from the results of a study of Vermont, Gatti and Tashman (1976, 1978) suggest a proposed solution to redress the flaws of the DPE formulation. Essentially they advocate the inclusion in the state aid formula of an income component as well as a measure of the district's ability to export school taxes since both are highly significant determinants of school districts' outlays on public education. In an analysis of the Illinois school system, Friedman and Wiseman (1978) have looked at the impact of legislative reform on wealth-related disparity in expenditures among pupils. They stress the importance of distinguishing between immediate effects of the reform on the distribution of expenditures per pupil, intermediate impacts, which occur

after voters have responded to the new formula, and long-run effects brought about by shifts in tax rates. Grubb and Michelson (1974) recognize that both state taxes and other local taxes may be important determinants of school district expenditures. Their study consists of an evaluation of three alternative state aid formulations on a sample of 159 school districts in Massachusetts. In addition, Inman and Wolf (1976) and Inman (1978) have built a general equilibrium model of a typical U.S. metropolitan economy. The model is unique in that it includes a mechanism depicting the communities' behavioral reaction to school fiscal reform. The empirical specification of this model was applied to New York City and fifty-eight Long Island school districts. Finally, Greene (1979) has presented a detailed review and evaluation of past econometric models in the field of school finance.

Aside from Inman's powerful model which explicitly incorporates local behavioral reaction to reform, insufficient attention has been devoted to the dynamics of school finance. As a result very little is known about the ultimate effects of equalization proposals. Knickman and Reschovsky (1980) have called for the explicit inclusion of localities' behavioral assumptions in analyses of school finance policies. Treacy and Frueh (1974) advocate the use of time series data and demographic projections incorporating plausible estimates of migration behavior. These dynamic factors should be incorporated when assessing the effects of policy changes in school financing. Unexpected and undesired changes in school finance systems, they argue, will occur so long as reforms are made under erroneous assumptions concerning the structural relationships existing within the state.

System dynamics models are specifically geared to address those critical dynamic issues which have been overlooked by past studies. System dynamics

was developed in the 1950s by Jay W. Forrester at the MIT Alfred P. Sloan School of Management. In a nutshell, system dynamics is a method for understanding and solving complex problems using the concept of dynamic 'feedback' structure. A feedback system consists of a closed loop structure that brings results from past actions of the system back to control its future actions. In the field of public school finance, for instance, the amount of money spent by a given school district for educational purposes over the long run is not determined by the present true condition of the school district. Instead, it is conditioned by the past circumstances that have been observed, analyzed, and digested by the community.

Very little system dynamics modeling has been performed in the area of education finance. In a study of the funding for special education in Massachusetts, Andersen (1977, 1979, and 1980) has demonstrated that by ignoring behavioral responses of local school districts, traditional tactical models have failed to analyze patterns of expenditure growth. As a consequence, they have produced erroneous cost estimates of reform proposals. Chen (1980) has discovered that policies designed at equalizing school expenditures may work in the short run, but are likely to be reversed in the long term, because of local communities' reaction to incentives built into the reforms themselves (see also, Chen, Andersen and Nguyen, 1980). In further exploratory work, similar patterns of reversal in policy conclusions with respect to strategic simulations of selected issues involved in financing special education in New York State were found (Nguyen, Andersen, and Chen, 1980). In addition, an interactive model has been developed at MIT to analyze Massachusetts' funding system and to explore complex strategic issues in the field of school finance (Stabell, Growchow, and Haan, 1972).

Propositions and Hypotheses

Tactical and strategic modeling techniques are different from each other. They serve different purposes and strive in different environments. Tactical models are usually built in-house to meet the needs of the decision maker. Their usefulness stems directly from the fact that they can respond to the demands and the constraints of the political realities which call for reliable, easy-to-interpret results on a district-by-district basis. The numerical value of the parameters entered in tactical simulations is highly accurate. No controversial assumptions are made concerning the structure of the model since simulations, which involve essentially tinkering with and fine tuning the current state aid formula, are based on the Education law. Furthermore, the output from simulation runs is highly disaggregated so the decision maker can assess at a glance how individual school districts fare under various state aid packages. The time horizon of tactical simulations is limited (one year to five years). Projections, when made, are usually straightforward linear extrapolations from the first year's output. Overall, tactical models are easy to understand and reliable.

Because of their simplicity, however, tactical models are also limited in scope. Decisions on school finance issues do not occur in a vacuum. They are part of the overall public finance system. By dealing exclusively with the state aid formula, tactical models ignore the fact that the choice of any education package will affect the amount of remaining resources that are available for other categories of services. In addition, they contain no mechanism concerning the behavioral responses of the localities to court mandates and to the recommendations proposed by the decision maker (Odden et al., 1977). In other words, they are inadequately equipped to assess the long

range impact of local response to formula changes on the overall goal of equalization. This class of issues is better addressed by strategic simulation models.

Strategic models encompass a broader boundary and a longer time horizon than tactical models. They provide a more comprehensive and realistic picture of the overall field of public finance. They allow, for instance, the public official to gain some useful insight as to how some policy changes in one area, say education, might affect other services (such as social welfare, or transportation). Strategic models use heterogeneous data, ranging from individual school districts' property values, and pupil counts, to state income and sales taxes and levels of expenditures for non-educational services. The range of the variables in the simulation output is also diversified.

Up to the present time, however, strategic simulations have remained with the realm of academic research. Very little strategic modeling is currently being done by state government agencies for school aid purposes. The utility of this kind of simulation is not immediately apparent to the political and bureaucratic decision makers. Indeed, strategic simulations do not seek for the detailed numerical accuracy of their tactical counterparts. First of all, output is not disaggregated on a district-by-district basis. Instead, strategic models group school districts which share some characteristics in common into sectors (e.g. metropolitan, urban, rural sectors). Analyses are made at this sector level. In addition, strategic simulations are not concerned with what will happen next year, but rather with the long range behavioral response of various sectors under different scenarios and policy changes. Given the nature of the political process, long run projections are

not of direct value to the elected official who is more interested in the immediate ramifications of his decisions. Lack of interest in long term prediction stems from the fact that the legislative operates in a muddling-through mode. Policy changes, it is argued, are always possible if and when the situation starts to deteriorate. This mode of operation makes long range projections obsolete. Another major drawback of academic models is the teneousness of many of their underlying assumptions. Many assumptions built within the structure of a strategic model (e.g. the interaction between various variables) are based upon the modeler's own perception of the reality. Such assumptions, however carefully devised, constitute ground for controversial debates and contribute to lower the model's overall validity in the eyes of public officials. Finally, strategic models are difficult to conceptualize. To some extent, the decision maker looks upon the complex structure of a strategic model as a black box which he does not understand nor have any control over, and which he consequently distrusts.

The purpose of the research is to convey the notion that in fact tactical and strategic simulations are not competing techniques exclusive of one another, but rather they can be seen as complementary techniques, reinforcing one another. The output of the tactical simulation, for instance, could serve as the input for the strategic model. Conversely, strategic research generates insights that might be directly applied into a tactical simulation. The result of a concurrent use of tactical and strategic models, might lead to better analytical capability in the decision making process, without losing the detailed and precise information much needed by the decision maker.

Future Developments

Tactical and strategic simulation modeling techniques will be compared regarding the impact of the implementation of a cost-of-education index in the New York State aid formula for education. Essentially, the purpose of the cost-of-education index is 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.

The impact of the cost-of-education index in New York State, will be analyzed using two different computer models. The first is SIMULBUD (Simulation for Budgeting). SIMULBUD is a tactical modeling technique built as a device to simulate alternative school finance formulas and to study the detailed distributive impact of various policy proposals on a district-by-district basis. Modifications and corrections can be effected on an interactive mode. Results appear instantaneously on the terminal under the form of summaries, lists, totals, tables, and correlation coefficients. Appendix A provides an example of an output run from a SIMULBUD simulation. The output from a tactical model shows how, in the short run, such adjustment affects individual school districts. Gainers (i.e., those school districts which register an increase in state aid as a result of the implementation of a cost-of-education index) as well as losers can be easily identified in the simulation. A strategic model, on the other hand, will provide some insight on the long range impact of implementing the cost-of-education policy. It will help assess patterns of local responses to this equalizing proposal. A system dynamics model of the New York State school finance system has been

built, to replicate the general patterns of interrelationships and structural properties in the state. Output of the model is presented in the form of graphs plotting the behavior of parameters against time (see Appendix B or a sample run). Unlike SIMULBUD, which strives for the numerical accuracy of simulation results, system dynamics concentrates on trying to formulate general patterns of behavior of the system under alternative policies.

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APPENDIX A

SAMPLE OUTPUT OF A TACTICAL SIMULATION*

*Source: Description of Educational Improvement Index. New York State Division of the Budget, January 1980.

DISTRICT EDUCATION IMPROVEMENT INDICES PROPOSED FOR USE IN OPERATING AID FORMULA 1980-81 SCHOOL YEAR, BY COUNTY

Dist. Code	District Name	Educational Improvement Index
10100	ALBANY	1.01891
10201	BERNE-KNOX-W.	.957851
10306	BETHLEHEM	.994479
10402	RAVENA COEYMAN	.970313
10500	COHOES	1.01743
10601	SOUTH COLONIE	.997149
10605	NORTH COLONIE	1.01743
10615	MENANDS CSD	1.01308
10622	MAPLEWOOD CSD	1.03402
10701	GREEN ISLAND	1.09840
10802	GUILDERLAND	.995651
11003	VOORHEESVILLE	1.00701
11200	WATERVLIET	.981301
20101	ALFRED-ALMOND	.988548
20501	BELMONT	.978249
20601	ANDOVER	.991734
20701	ANGELICA	.942560
20801	BELFAST	1.05385
21001	BOLIVAR	1.00827
21102	CANASERAGA	.964113
21501	CUBA	.989161
21601	FRIENDSHIP	1.14369
22001	FILLMORE	1.02095
22101	WHITESVILLE	1.15879
22301	RUSHFORD	.966521
22401	SCIO	1.02673
22601	WELLSVILLE	.977191
22901	RICHBURG	.961536
30101	CHENANGO FORKS	.969494
30200	BINGHAMTON	.972307
30501	HARPURSVILLE	1.01597
30601	SUSQUEHANNA VA	.968828
30701	CHENANGO-VALLE	.979196
31101	MAINE-ENDWELL	.995156
31301	DEPOSIT	1.02079
31401	WHITNEY POINT	1.02256
31501	UNION-ENDICOTT	.974006
31502	JOHNSON CITY	1.03932
31601	VESTAL	.995404
31701	WINDSOR	.987458
40101	ALLEGANY	1.01145
40204	WEST VALLEY	.967066
40301	LIMESTONE	1.07204
40901	ELLICOTTVILLE	1.07542
41101	FRANKLINVILLE	1.01154
41401	HINSDALE	.954325
41801	LITTLE VALLEY	.980231
42301	CATTARAUGUS	1.00128
42400	OLEAN	1.03194
42801	GOWANDA	1.00919
42901	PORTVILLE	.971577
43001	RANDOLPH	.988215
43200	SALAMANCA	1.00656
43501	YORKSHIRE-PION	1.00316
50100	AUBURN	.994690
50301	WEEDSPORT	1.00861
50401	CATO-MERIDIAN	.985373
50701	SOUTHERN CAYUG	1.00196
51101	PORT BYRON	1.00785
51301	MORAVIA	1.01601
51901	UNION SPRINGS	.966127
60201	SOUTHWESTERN	1.00438
60301	FREWSBURG	.975601
60401	CASSADAGA VALL	1.02462
60501	MAYVILLE	.972083
60502	CHAUTAUQUA	1.03328
60601	PINE VALLEY	1.02142
60701	CLYMER	1.03959
60800	DUNKIRK	.996280
61001	BEMUS POINT	.999097
61101	FALCONER	1.03874
61501	SILVER CREEK	.987997
61503	FORESTVILLE	.950372
61601	PANAMA	1.00186
61700	JAMESTOWN	1.01212
62201	FREDONIA	1.00815
62301	BROCTON	.976238
62401	RIPLEY	1.00202
62601	SHERMAN	1.03960
62901	WESTFIELD	.971084
70600	ELMIRA	.996886
70901	HORSEHEADS	1.00830
70902	ELMIRA HEIGHTS	.968741

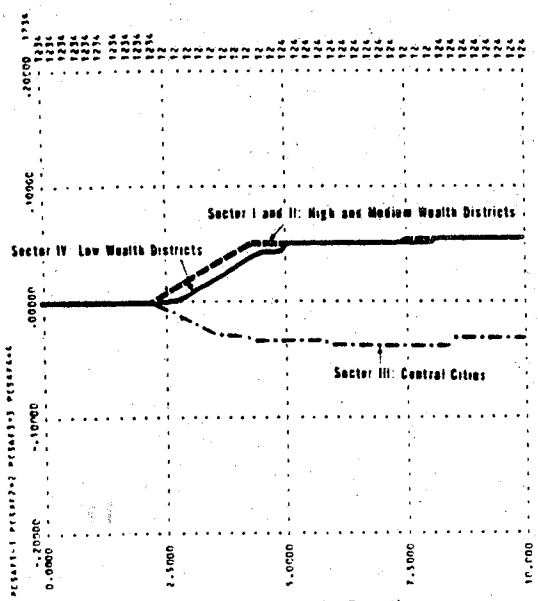
APPENDIX B

SAMPLE OUTPUT OF A STRATEGIC SIMULATION*

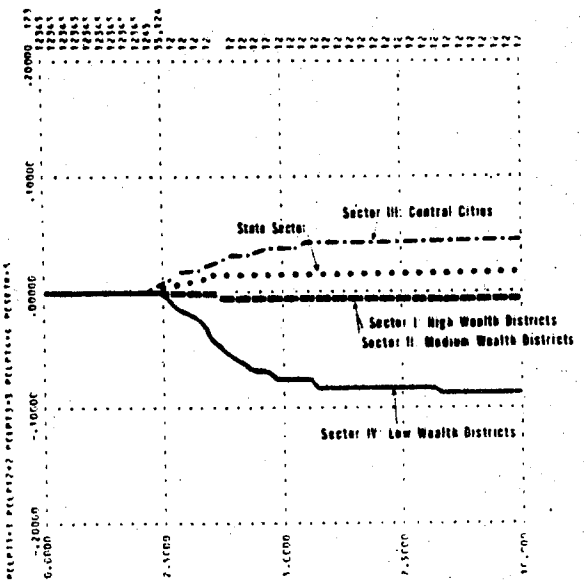
*Source: "The Dynamics of State Aid to Education: Interactions Between Special Education, Regular Education, and Non-Schooling Expenditures." Tanette Nguyen, David Andersen, and Fiona Chen, Graduate School of Public Affairs, State University of New York at Albany, 1980.

DISTRICT EDUCATION IMPROVEMENT INDICES PROPOSED FOR USE IN OPERATING AID FORMULA 1980-81 SCHOOL YEAR, BY COUNTY

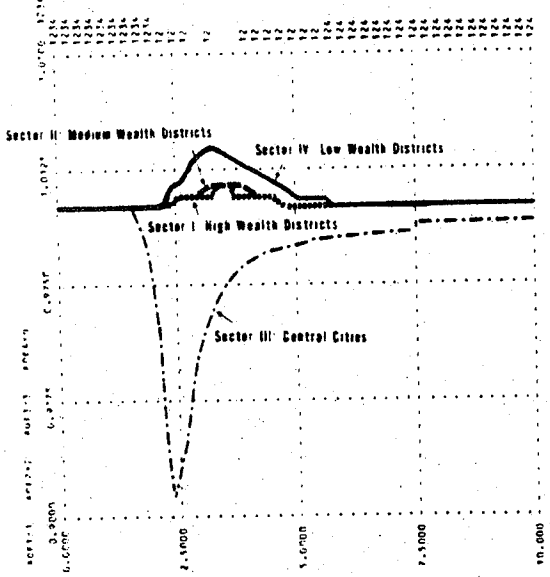
Dist. Code	District Name	Educational Improvement Index
80101	AFTON	.941497
80201	BAINBRIDGE-GU.	1.00891
80601	GREENE	.992419
80701	MOUNT UPTON	.985979
81001	NEW BERLIN	1.06375
81002	S. NEW BERLIN	1.02800
81200	NORWICH	.997704
81401	GEORGETOWN	1.02929
81501	OXFORD	1.05957
82001	SHERBURNE-EARL	1.00864
90201	AUSABLE VALLEY	1.06935
90301	BEEKMANTOWN	1.00669
90501	NORTHEASTERN	1.02620
90601	CHAZY	1.00493
90801	DANNEMORA	1.14755
90901	NORTHERN ADIRO	1.00447
91101	PERU	1.00436
91200	PLATTSBURGH	1.01709
91401	SARANAC	.962574
100501	COPAKE-TACONIC	.979024
100902	GERMANTOWN	1.00927
101001	CHATHAM	1.01954
101300	HUDSON	1.00841
101401	KINDERHOOK	.994165
101601	NEW LEBANON	.979562
110101	CINCINNATUS	1.02788
110200	CORTLAND	.964585
110304	MCGRAW	.957713
110701	HOMER	1.02281
110901	MARATHON	.983295
120102	ANDES	.960787
120301	DOWNSVILLE	1.01501
120401	CHARLOTTE VALL	.943969
120501	DELHI	.951397
120701	FRANKLIN	.974659
120906	HANCOCK	1.01649
121401	MARGARETVILLE	1.02230
121501	GRAND GORGE	.962804
121502	ROXBURY	1.02711
121601	SIDNEY	1.00590
121701	STAMFORD	1.00950
121702	S. KORTRIGHT	1.04260
121901	WALTON	.983268
130200	BEACON	1.00856
130502	DOVER	1.08624
130801	HYDE PARK	.995636
131101	NORTHEAST	1.01086
131201	PAWLING	.993899
131301	PINE PLAINS	1.02562
131500	POUGHKEEPSIE	.976951
131601	ARLINGTON	1.00081
131602	SPACKENKILL	.982627
131701	RED HOOK	.975132
131801	RHINEBECK	1.00094
132101	WAPPINGERS	.999347
132201	MILLBROOK	1.01551
140101	ALDEN	.995118
140203	WILLIAMSVILLE	.993670
140207	SWEET HOME	.978050
140213	EGGERTSVILLE	1.01728
140218	AMHERST-SNYDER	1.00178
140251	AMHERST CHS	.999718
140301	E. AURORA	1.01174
140600	BUFFALO	1.17911
140701	CHEEKTOWAGA	.992474
140702	CHEEK-MARYVALE	.990189
140703	CLEVELAND HILL	.984589
140707	DEPEW	.963434
140709	CHEEK-SLOAN	1.02334
140801	CLARENCE	.995368
141101	SPRINGVILLE	1.03972
141201	EDEN	1.01400
141301	IROQUOIS	1.01141
141401	EVANS-BRANT LS	1.01928
141501	GRAND ISLAND	.969170
141601	HAMBURG	1.02300
141604	FRONTIER	.998782
141701	HOLLAND	1.02302
141800	LACKAWANNA	1.01542
141901	LANCASTER	1.00948
142101	AKRON	.977961
142201	NORTH COLLINS	1.03553
142301	ORCHARD PARK	1.00249
142500	TONAWANDA	.996981
142601	KENMORE-TONAWA	1.01796
142801	WEST SENECA	1.00159



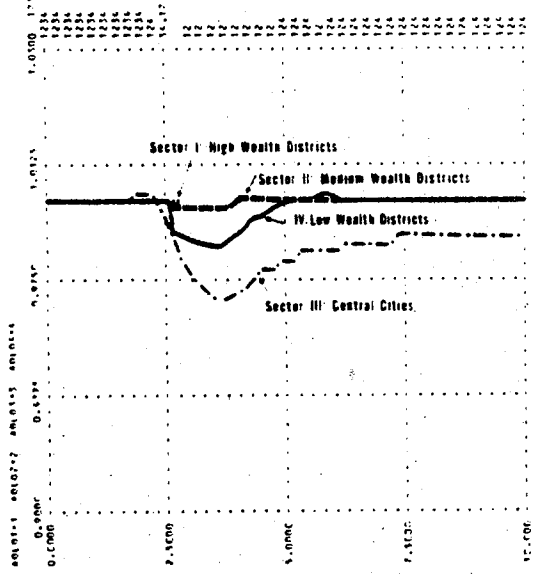
A. Percentage Change of State Aid Fraction versus time (yrs.)



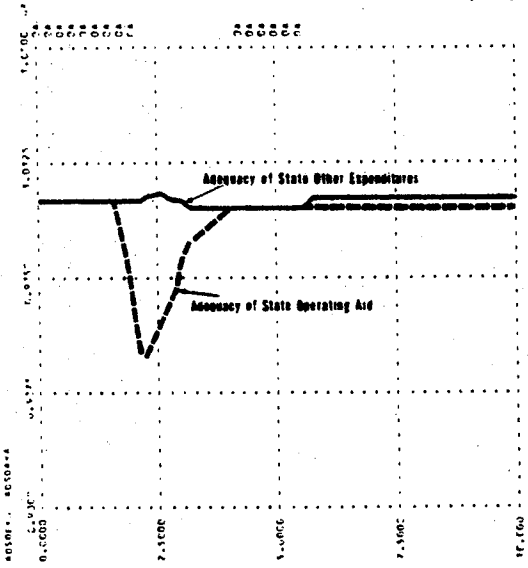
B. Percentage Change of Tax Rates versus time (yrs.)



C. Adequacy of Education versus time (yrs.)



D. Adequacy of Local Other Services versus time (yrs.)



E. Adequacy of State Expenditures versus time (yrs.)

Changes in Both State and Local Sectors Resulting from a 20% step increase in Needed Educational Expenditure per pupil in local factor III (Central Cities).