FISCAL IMPACT MODELS FOR LOCAL ECONOMIES

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INTRODUCTION

Fiscal impact analysis refers to the rather broad range of economics studies which consider the public sector effects of various economically related aberrations. Such analyses are typically conducted within broader impact analyses including economic, demographic, environmental, and sociological components ponents. This reflects not only the fact that sound decision-making requires information on all of these dimensions, but also the fact that these dimensions are frequently interrelated and must be projected simultaneously.

Impact analyses are usually conducted with the aid of a model or framework. National and state governments usually have access to sophisticated econometric models designed especially for their jurisdictions, frequently for specific purposes. Local governments, except for the very largest of cities, and senior levels of government concerned with local issues cannot afford the luxury of highly specific models. Instead, they must make do with more generic versions, or with nothing at all. How does the typical local government administrator choose from among the numerous models available?

This paper develops a conceptual framework within which local fiscal impact models may be compared and contrasted. The purpose is to shed light on the strengths and weaknesses of the models and their appropriate range of applications. This information should be useful to all those who have a stake in and who influence the viability of their local economy.

COMPUTERS AND FISCAL IMPACT ANALYSIS

Computers seem ideally suited for fiscal impact analyses. They are capable of providing a rapid and relatively inexpensive means of answering (or providing additional information about) the "what if" questions faced by local governments. They often provide local governments with rationales for proceeding with or delaying development projects related to economic development, public service provision and infrastructure investments (Muller, 1975). In addition, they frequently provide local governments

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and industry with projections required by state and federal governments as part of grants and cost sharing, or for regulatory purposes (Burchell and Listokin, 1978).

But with any rapid growth in use and popularity comes a need for greater understanding and information. The growing number of microcomputers now in use by local governments, and the anxiousness of local government staffs to acquire their own fiscal impact models, underscores the urgent need for standardization, and understanding of fiscal impact models and analysis. Such an understanding requires a sound conceptual framework within which strengths, weaknesses, successes and failures become transparent.

This paper begins with the development of a conceptual framework within which fiscal impact models may be viewed. This framework leads to an image of the "ideal" fiscal impact model. This ideal, while clearly nonattainable, provides a benchmark against which existing models are then compared. Finally, the economics of developing and using fiscal impact models is explored. As is so often the case, we are faced with the need to make tradeoffs among desirable characteristics.

DIMENSIONS OF FISCAL IMPACT MODELS

Murdock and Leistritz (1981), in outlining the rationale for selection of socioeconomic assessment models, have identified three criteria upon which fiscal impact models should be evaluated:

(1) information needs of the user;
(2) methodological characteristics of the model; and
(3) user characteristics of the model.

These criteria take into consideration the dimensions, project phases, geographical units, time increments, total areal units, methodological forms, dynamic capabilities, forms of validation, data input requirements, and user and computerization characteristics of the model. In this study, these three categories have been reorganized to include six dimensions: temporal, spatial, public service, sectoral, demographic, and modeling. Each of these dimensions are discussed in turn.

Temporal Dimension

The temporal dimension addresses the length of projection and simulation periods, and the model's capacity to separate long-run and short-run impacts and to provide baseline projections. Sound projections of temporal impacts are essential in identifying and anticipating problems which local governments may encounter in growth situations, such as the need for early investment in infrastructure and public services. In addition, potential cash-flow problems--the so-called "front-end financing" problem (Murray and Weber, 1982; Leistritz and Murdock, 1981)--can be predicted. Temporal dimensions also influence the model's ability to provide information for calculation of net present values for benefit-cost analyses.

Spatial Dimension

The spatial dimension addresses the degree of disaggregation in the model, and the level of jurisdiction handled. Typically, a model will identify impacts at the county, city, town, or state-wide level. Some models also handle multiple service or planning jurisdictions. The model's spatial dimensions are crucial in determining the transferability of the model to other states or regions, since they determine multipliers, jurisdictions, and labor market and commuting pattern coincidence (Murdock et al 1980; Winter et al 1981).

Public Service Dimension

Fiscal impact models vary widely with respect to public services identified. Some deal only with specific areas such as housing or education, while others address a wide range of public services. Models can also be differentiated by whether or not specific revenue sources are identified. Those that do identify specific revenue sources can be further categorized by their bases for revenue projection. These typically involve trend extrapolation, ratios, or econometric equations.

The public service dimension has important implications for the usefulness of the model as a planning tool. The more disaggregated the public service component of the model--that is, the greater the number of specific services identified and addressed by the model--the more useful the model will be to local planning interests (Halstead et al 1980). Increased disaggregation allows for more accurate determination of investment needs (in this respect, this dimension is closely related to the temporal dimension). The benefits of this greater planning ability must be weighed against the added development costs and other potential costs. For example, greater disaggregation of the fiscal dimension may adversely effect the transferability of the model, if in the process of disaggregation it takes on more of the unique characteristics of its development area.[1] On the other hand, more aggregated structures do not are necessarily imply fewer assumptions; the assumptions needed just more explicit. Also, a model requires essentially the same data whether or not public services are disaggregated.

Sectoral Dimension

A model's sectoral dimension determines the extent to which the model can identify differential impacts on different sectors and whether or not the model incorporates a multiplier effect. The most common multipliers are final demand, income, employment, and value-added. These multipliers are based on either economic base or input/output (survey or non-survey) techniques. There appears to be an inverse relationship between usefulness of multipliers (in terms of precision and accuracy) and expense of development. Economic base multipliers are easier to develop, relatively less expensive, and easier to transfer than input-output (I/O) multipliers (Pfister, 1976). However, they lack the specificity (and consequently, also the accuracy) that I/O multipliers possess (Leistritz and Murdock, 1981). Survey based I/O models are commonly considered more dependable than non-survey based models. Again, then, there seems to be a tradeoff between transferability and complexity/expense of model type.

Demographic Dimension

The number and characteristics of people moving in or out of a community is an essential input into determination of local fiscal and public service impacts. Demographic projection techniques which incorporate age/sex cohorts are widely accepted as most accurate (Shryock and Siegel, 1973; Leistritz and Murdock, 1981). In addition, many models project occupational demands and supplies and migration and commuting levels.

A sophisticated demographic sector is critical for good prediction, especially if the model's public service dimension is disaggregated. For example, gross population change estimates which lack breakdowns of age characteristics will be of limited use in estimating impacts on education or other age-related services. Thus, the need for detail in the demographic sector is closely related to the degree of disaggregation in the public service sector.

Modeling Dimension

The final dimension considered is the modeling dimension--the actual mechanics of model implementation. This includes type of computer (mainframe or micro), programming language, and software requirements. Sources and costs of data required, time and financial resources needed to run the model, and output format are also important. Finally, documentation available for the model plays a key role in the models transferability and usefulness. Documentation can be broken down into three levels:

(1) Descriptive documentation. This is merely a general overview of the model, describing the nature of multipliers used, capabilities, services identified, etc. This level of documentation should allow the potential user to determine if the model has the ability to answer the user's questions. Furthermore, it should give some indication of the model's reliability and specificity.
(2) Mechanical documentation. This level of detail permits the potential user to run and interpret a setup-calibrated model. It must be very specific about routine data needs, how to develop scenarios, how to run the model, and how to interpret the output.
(3) Full documentation. In this case, the potential user is provided with enough information to transfer the model to his/her own area, incorporating region-specific algorithms and characteristics.

What these dimensions translate into is the user-friendliness of the model, its potential transferability to other states and regions, flexibility with respect to different scenarios, and usefulness for decision-making purposes. Also of note is the model's potential for abuse--the greater the model's transferability and ease of use, the more likely the model will be misused by parties not familiar with its assumptions and limitations. Training programs for potential users and careful documentation can help alleviate these problems.

THE "IDEAL" MODEL

Based on the preceding discussion, one can describe the characteristics of an ideal model. Ignoring for a moment the development costs, this model would involve minimum application expense while providing maximum projection accuracy. It would be flexible and allow for easy transfer to other states/regions.

Toward these ends, several features would be incorporated. In the temporal dimension, the model would include variable length of simulation periods, provide baseline projections, and be capable of separating short-run (construction) impacts from long-run impacts. The spatial dimension would handle multiple jurisdictions, and identify specific public revenue expenditures. The model might also identify a maximum number of public services like education, fire protection, and social welfare. The economic sector would use a survey-based I/O module, even though the data and development requirements of this module would have an adverse effect on model expense. The demographic dimension would use an age/sex cohort method; the model would also project commuting levels (using a gravity basis) and migration levels.

On the implementation side, the necessary data would be clean, accurate, and easily and cheaply accessible. Although a model of this size and complexity would likely be developed on a mainframe, adaptations could be made for microcomputer (for example, the Nevada microcomputer fiscal impact model is a scaled-down version of the larger Texas Assessment Modeling System). Finally, to maximize the model's usefulness, an extension program could be developed for it.

Thus we have the IDEAL model--Ideal Demographic-Economic Assessment model for Local governments. As this discussion indicates, a model often enhances its capability in one area (e.g. transferability) at the expense of another (e.g. complexity). Accuracy and flexibility come with a price tag during development. These tradeoffs, along with other institutional factors, may be why there is no one "best" model currently in existence, accounting for the wide diversity of fiscal impact models. The next section departs from the ideal and addresses some of the realities of modeling.

STUDY RESULTS

A mail survey was developed to identify the models and programs described in the introduction. Potential respondents were obtained from publications on modeling, various listings, and through recommendations of professionals known to have been active in fiscal impact analysis. Forty-five individuals were contacted. Of these, twenty-five responded. The survey identified twenty-three models used in seventeen states and the Province of Alberta, Canada[2]; some states had more than one fiscal impact model (e.g. Iowa, Texas), while some models were used in more than one state (NEDAM, IIM).

Historical Bases

While the use of economic-demographic models can be traced to the 1960's (Murdock and Leistritz, 1980), all of the models identified were developed in the 1970s or later. The ancestry of these models was principally found in three places: the economic growth impact model (often called the Florida model) (Clayton and Whittington, 1977), the REAP Economic-Demographic Model (RED) (Hertsgaard et al 1978), and the Shaffer-Tweeten impact estimation procedures (Shaffer and Tweeten, 1972; Shaffer and Tweeten, 1974).

The Florida model uses a system of economic base multipliers, while the RED models rely on an I/O module to develop multipliers. The Shaffer-Tweeten procedure is not a fiscal impact model per se; rather, it is a non-computerized framework developed for measuring the impacts of new developments on rural communities. These procedures have since been quantified to provide the basis for models in Ohio (Morse and Gerard, 1980), Iowa (Otto, 1984), and Indiana (Darling, 1979).

Comparisons

Responses to the survey related to twenty-one models, summarized in table 1. Of these, eleven were designed for use on mainframe computers, eight were for use on microcomputers, and two could be used on either mainframe or micro. Estimated costs of model development varied considerably, but were generally higher for mainframe models. As expected, costs of running the models are insignificant for micro-based models, while mainframe models cost up to $100 per run. A further categorization could be made based on type of multipliers used in the models--survey I/O, non-survey I/O, or economic base. As noted, there is usually an inverse relationship between multiplier complexity and cost of model development, with survey I/O being the most complex. Although the information collected by the survey on data and setup cost is difficult to interpret due to wide variability of possible applications, it appears that models using I/O multiplier modules are more expensive to develop than those using economic base.

Only eight of the models incorporated age/sex cohorts: TAMS, NEDAM, COALTOWN, PAS, SEAM, IMPACT, SEARS and CIM. TAMS, SEARS, and NEDAM are all direct descendants of the RED I and II models, while CIM's development was influenced by the RED family. Employing age/sex cohorts requires considerable data input on fertility rates, mortality rates, and migration rates, both for present and future generations, making it the most detailed and demanding of the five projection techniques identified by Irwin (1977).[3] The information requirements of this technique may

Table 1. Selected Fiscal Impact Models and Characteristics

Model	Computer Type	Multiplier Base	Multiplier Type	DataCost	RunCost	Specific Public Service Expenditures Identified (No. of Public Services)	Projects Migration Levels	Projects Commuting Levels	Uses Age/Sex Cohorts	Extension Program Available
TAMS[a]	Mainframe	Survey I/O	Final Demand	$3,000	$100	Yes (13)	Yes	Yes	Yes	Yes
NEDAM[a]	Mainframe	Survey I/O	Final Demand	$40,000[1]	$100	Yes (6)	Yes	Yes	Yes	No
CIM[a]	Mainframe	Non-Survey I/O	Final Demand, Income Empl.	Variable	$5.00	Yes (10)	Yes	No	Yes	Yes
Microcomputer Fiscal Impact Model[a]	Micro	Non-Survey I/O	Final Demand	$500	0	Yes (4)	No	No	No	Yes
SCIM[b]	Mainframe	Survey I/O	Final Demand, Income Empl.	$200	0	Yes (8)	Yes	Yes	No	No
CDIM[b]	Mainframe	I/O	Income Empl., Value Added	0	0	Yes (4)	No	No	No	Yes[2]
OJIM[c]	Mainframe/ Micro	Economic Base	Final Demand	$200 - 1,000	$2.50	Yes (4)	No	No	No	No
IIM[c]	Mainframe/ Micro		Income	$200	$5.00	Yes (0)	No	No	No	Yes
KIM[c]	Micro	Economic Base	Income	$100	0	Yes (10)	Yes	Yes	No	Yes
IEFIM[c]	Micro	Economic Base	Income Empl.	Variable	Variable	Yes (6)	No	No	No	Yes
Local Gov't. Capital Improvement Programming Model	Micro	N/A	N/A	Variable	0	Yes (6)	No	No	No	Yes

[1] $40,000 to set up state data base; $500 for specific project data and set up for analysis.

[2] Current inactive.

[a] Descended from RED models.

[b] Descended from Florida model.

[c] Descended from Shaffer-Tweeten model.

Table 1. Selected Fiscal Impact Models and Characteristics (continued)

Model	Computer Type	Multiplier Base	Multiplier Type	DataCost	RunCost	Specific Public Service Expenditures Identified (No. of Public Services)	Projects Migration Levels	Projects Commuting Levels	Uses Age/Sex Cohorts	Extension Program Available
Energy Tax	Mainframe	Economic Base	Employment	Variable	$5.00	Yes (1)	No	No	No	No
FTMS	Micro	N/A	N/A	0	0	Yes (4)	N/A	N/A	N/A	Yes
Fort Drum Fiscal Impact Analysis Model	Micro	Non-Survey I/O	Final Demand Income	Variable	0	Yes (12)	Yes	No	No	No
VIP	Micro	Economic Base, I/O	Employment	$500	0	Yes (11)	Yes	Yes	No	No
Coaltown	Mainframe			$100	$50.00	Yes (1)	Yes	No	Yes	Yes
PAS	Mainframe	I/O	Value Added	"High"	$10.00	Yes (12)	Yes	Yes	Yes	No
SEAM	Mainframe	Economic Base	Employment	N/A	$5.00	Yes (12)	Yes	Yes	Yes	No
Impact	Micro	Economic Base	Employment	N/A	Minimal	Yes (13)	No	No	Yes	No
Boom	Mainframe	Survey	Employment Value Added	5 man days	$5-10	No	Yes	No	No	No
Sears [a]	Mainframe	I/O Survey	Final Demand	30000	$100	Yes (9)	Yes	Yes	Yes	Yes

[1] $40,000 to set up state data base; $500 for specific project data and set up for analysis.

[2] Current inactive.

[a] Descended from RED models.

[b] Descended from Florida model.

[c] Descended from Shaffer-Tweeten model.

contribute to the fact that the data costs of NEDAM and TAMS are substantially higher than for the other models reporting specific data costs.

Disaggregation by public services varied widely, ranging from no specific public services identified by the IIM (Industrial Impact Model) to 13 public services itemized by the TAMS (Texas Assessment Modeling System). It is difficult to use the number of specific public services identified as an evaluation criterion, however, since some of these models were designed with the intent of looking at development impacts on only one or two areas (for example, the ENERGYTAX model only identified impacts on education). All of the models identified specific public service expenditures.

Eleven of the models had complementary extension programs (several of the models were not expected to have extension programs, since they were developed by consulting firms). Excluding the Fort Drum Model, six of nine models compatible with microcomputers had extension programs, while five of the mainframe-only models had programs. In addition, two of the other micro models--the OJIM and VIP--have been used in conjunction with extension activities, although they currently have no formal programs. This may indicate that micro models are more adaptable to extension uses than mainframe models.

SUMMARY AND CONCLUSIONS

The fiscal impact modeling survey identified twenty-three models varying in size, cost, complexity, and transferability. There appears to be a trend in recent years to adapt fiscal impact models to the microcomputer, both through development of new models and modification of existing mainframe models. For example, as recently as 1980, a discussion of twelve fiscal impact models by Murdock and Leistritz did not examine one model with microcomputer applications, while ten of twenty-one models in this survey were compatible with microcomputers.[4] Undoubtedly, this is due not only to a wider understanding of the principles and applications of fiscal impact modeling, but also to the increased sophistication and capacity (as well as decreasing costs) of the modern microcomputer.

The Economics of Fiscal Impact Models

Evaluation of fiscal impact models can be focused on a number of issues and characteristics. These include:

(1) costs of developing the model;
(2) costs of running the model;
(3) adaptability (transferability) of the model to other areas/regions;
(4) data requirements of the model; and
(5) accuracy of the model's projections.

The survey did not test criterion number five, which relates to model validation. This information can probably be obtained from the appropriate model documentation in the reference section.

As noted, costs of running the twenty-one models varied from negligible to $100. However, the only models which required $100 per run were NEDAM and TAMS, which are (not coincidentally) the most data-intensive of the group, utilizing both survey I/O components and age/sex cohort modules. The other models' runcosts ranged from $0-5, so this criterion is seldom of much importance in model evaluation.

Conversely, costs of developing a model can be substantial, even when the model's basic concepts have been previously developed. For example, the NEDAM model's data base can cost up to $40,000 to develop for a state. In fact, it is difficult to discuss criterion one without considering three, four, and five, since a model`s sophistication reflects its accuracy and data requirements, which in turn affect its cost. A model which uses a survey I/O module and an age/sex demographic component, and which has a highly disaggregated public service dimension, will likely provide more useful projections than a less complex model. These economic and demographic components will also have greater information requirements. In addition, a highly disaggregated public service dimension may incorporate a greater number of state-specific features, making the model less amenable to transfer. Thus, there is a direct relationship between sophistication/complexity and accuracy, and an indirect relationship between sophistication and transferability and expense.

When choosing a fiscal impact model for adaptation or development in a particular state or region, one should consider the marginal costs of increased complexity. Not every institution needs a model of the size and sophistication of TAMS or NEDAM; the relative ease of transfer of a model with economic base multipliers, no age/sex cohort component, and a highly aggregated public service dimension may outweigh the advantages of the larger mainframe models. As the survey results indicate, there are ample applications and uses for a wide range of models, tailored to suit users needs.

ENDNOTES

1. The transferability of these models is currently quite subjective. It is, however, the subject of current research.

2. Models identified were the BOOM Series (Southwestern United States and Alberta, Canada); Bureau of Reclamation Economic Assessment Model (BREAM) (Colorado); COALTOWN (Montana, North Dakota); Community Development Impact Model (CDIM) (Kentucky); Community Simulation Model (CIM) (Oklahoma); ENERGYTAX (Minnesota); Fiscal Trend Monitoring System (FTMS) (Iowa); Fort Drum Fiscal Impact Analysis Model (New York); Impact Model for Planning Alberta Communities over Time (IMPACT); Industrial Impact Model (IIM) (Texas, Oklahoma); Iowa Economic and Fiscal Impact Model (IEFIM); Kansas Impact Model (KIM); Local Government Capital Improvement Programming Model (New York); Microcomputer Fiscal impact Model (Nevada); North Dakota Economic-Demographic Assessment Model (NEDAM); Ohio Job Impact Model (OJIM); PAS (Planning and Assessment Model) (Southwestern

United States); Socioeconomic Assessment of Repository Siting (SEARS); Social and Economic Assessment Model (SEAM); South Carolina Impact Model (SCIM); Texas Assessment Modeling System (TAMS); and the Virginia Impact Projection Model (VIP). Full reference and documentation information for these models is available from the authors on request.

3. The five projection techniques Irwin identified were: (1) extrapolative, curve-fitting, and regression-base techniques; (2) ratio-based techniques; (3) land use techniques; (4) economic-based techniques; and (5) cohort component techniques.

4. Of these 21 models, the Community Economic Growth Impact (Florida) Model, BREAM, CDIM, and ENERGYTAX are no longer in use or have been transformed into other models.

REFERENCES

Burchell, R.W. and D. Listokin. 1978. The Fiscal Impact Handbook. Brunswick, N.J.: Rutgers Center for Urban Policy Research.

Clayton, Kenneth C. and David Whittington. 1977. The Economics of Community Growth: An Impact Model. Gainesville: University of Florida. Food and Resource Economics Department Staff paper 40rr.

Darling, David L. 1979. An Industrial Impact Model for Indiana Communities. Agricultural Experiment Station, Purdue University. Bulletin 229.

Halstead, J.M., R.A. Chase, S.H. Murdock, and F.L. Leistritz. Socioeconomic Impact Management: Design and Implimentation. Boulder, Co.: Westview Press.

Hertsgaard, Thor A., Steve H. Murdock, Norman Toman, Mark Henry, and R. Ludtke. 1978. REAP Economic-Demographic Model: Technical Description. Bismarck: North Dakota Regional Environmental Assessment Program.

Iowa State University. 1984. Financial Trend Monitoring Data Manual. Ames, Iowa: Cooperative Extension Service. CRD 193.

Irwin, Richard. 1977. Guide For Local Area Population Projections. U.S. Bureau of the Census. Washington, D.C.: U.S. Government Printing Office.

Leistritz, F. Larry and Steve H. Murdock. 1981. The Socioeconomic Impact of Resource Development: Methods for Assessment. Boulder, Co.: Westview Press.

Morse, George W. and John D. Gerard. 1980. Users' Manual for the Rural Ohio Economic Growth Impact Model. Department of Agricultural Economics and Rural Sociology, Ohio State U. ESO No. 739.

Muller, T. 1975. Fiscal Impacts of Land Development: A Critique of Methods and Review of Issues. URI 98000. Washington D.C.: The Urban Institute.

Murdock, Steve H. and F. Larry Leistritz. 1980. "Selecting Socioeconomic Assessment Models: A Discussion of Criteria and Selected Models." Journal of Environmental Management. 10: 241-252.

Murray, J.A. and B.A. Weber. 1982. "The Impacts of Rapid Growth on the Provision and Financing of Local Public Services." In Coping with Rapid Growth in Rural Communities. R. Howell and B. Weber, eds. Boulder, Co.: Westview Press.

Otto, Daniel. 1984. Iowa Economic Growth Model: Assessing Economic Change in Rural Iowa. Ames: Iowa State University. Cooperative Extension Service.

Pfister, R. 1976. "On Improving Export Base Studies." Regional Science Perspectives. 6: 104-116.

Shaffer, Ron and Luther Tweeten. 1972. "Measuring the Impact of New Industry on Rural Communities in Oklahoma." In Research Application in Rural Economic Development and Planning. Agr. Exp. Sta. Res. Rpt. P-665, Oklahoma State University.

Shaffer, Ron and Luther Tweeten. "Measuring Net Economic Changes from Rural Industrial Development: Oklahoma." Land Economics. August (1974): 261-270.

Shryock, H. and J. Siegel. 1973. The Methods and Materials of Demography. Washington, D.C.: U.S. Government Printing Office.

Winter, R.C., D.J. Santini, D.W. South, C.M. Hotchkiss, and M.J. Bragen. 1981. Selection of Economic Impact Assessment Models for Use by Communities in the Tennessee-Tombigbee Corridor: Phase I. Argonne, Ill.: Argonne National Laboratories. ANL/EES-TM-160.

Woods, Mike and Gerald A. Doeksen. 1983. A Simulation Model for Rural Communities in Oklahoma. Stillwater: Oklahoma State Uni. Agricultural Experiment Station. Bulletin B-770.

Woods, Mike D. and Lonnie L. Jones. "Measuring the Fiscal Impacts of New Industry in Small Towns." Municipal Management: A Journal. 5(1982-1983): 48-56.