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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Introduction

For the most part, the study of public policy within political science and certain other of the social sciences has proceeded along similar methodological lines. Generally, in these studies, variations in policy outputs (quantified in terms of expenditures) are related to variations in economic or political characteristics using cities, counties, states, or other political jurisdictions as the empirical unit of analysis.[1] These studies are cross-sectional in nature and, to some degree, systems oriented. Only occasionally is a time series perspective attached to these policy inquiries so as to determine change over a time. Yet, while a time dimension may be included in this kind of policy research,

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[1]Stephen Elkin, "Political Science and the Analysis of Public Policy," Public Policy 21 (Summer 1974): 399.

the systems input-output focus remains essentially unexpressed, rendering the research systems oriented in form but not substance.[2] For these reasons existing policy research in political science and other social sciences can be and has been criticized in recent literature for being both time constrained and only tacitly system centered.[3] It is said that the cross sectional nature of most of the policy research studies does not lend itself readily to an assessment of the growth and changing patterns of policy or to an understanding of the dynamics of change in policy over time. Further, cross sectional studies have not revealed the composition of public policy expenditures; what stimulates expenditures in individual areas of policy, for example.[4]

The second area of criticism comes from the use of the systems model. Some critics have called this problem lack of theoretical content.[5] Others have called the problem

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[2]Bryan D. Jones, "Distributional Considerations in Models of Government Service Provision," Paper delivered at the Annual Meeting of the Southwest Political Science Association, Dallas, Texas, April, 1976, p. 1.

[3]See, for example, ibid., p. 3; Paul C. Nystrom, "Input-Output Processes of the Federal Trade Commission," Administrative Science Quarterly 20 (March 1975); and Martin Shefter, "Book Review of Politics and Urban Policies," American Political Science Review 69 (March 1975): 273.

[4]Joseph E. Pluta, "Growth and Patterns in U.S. Government Expenditures, 1956-1972," National Tax Journal 25 (March 1975): 273.

[5]Elkin, "Political Science and the Analysis of Public Policy," p. 401.

lack of model formalization.[6] In either case both criticisms maintain that the systems model used in most studies is little more than a listing of variables. The variables thus employed are left unexamined as to the role they play in the creation of public policy or their linkages to each other.

Furthermore, there has been an additional criticism regarding many of the mainstream policy studies. This criticism is that concentration on outputs as expenditures overlooks the consequences of the expenditures, i.e., impacts.[7] Expenditures, it is argued, do not reveal what is being accomplished, what problems are being solved, or simply what differences are being made in the society by such expenditures. Additionally, the argument continues, expenditure data does not indicate who specifically is benefitting from policy or who is being deprived by it.

This study takes as its subject public policy in a major metropolitan government. The public policy variables to be examined are expenditures (while being fully aware of the criticisms which have arisen over research employing this kind of data in the past). It may be true that expenditures do not in and of themselves reveal what has been accomplished or what benefits or costs have accrued as a result of their having been made. They do, however, give other kinds of

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[6]Jones, "Distributional Considerations in Models of Government Service Provision," p. 3.

[7]Ibid., p. 4.

of useful information. Expenditures can reveal priorities among policies, for example. Expenditures can also help to explain the distribution of costs. A more complete range of information given by expenditures will be explored more fully in the present research. But this does not fully address the problem of what impacts are made as a result of expenditures. The answer is that the question of impacts is one of a series of questions to be answered in policy research. In the past the problem has been that expenditures were examined without fully recognizing the implication of those expenditures. This has been true, at least, until recently. Nevertheless, before examining what impacts have occurred, it is only logical to examine the expenditures themselves before proceeding further. It seems, at least, that examining impacts before expenditures puts the cart before the horse in the research process. Both are essential but can only be useful in the correct position.

The question of impacts, then, is a sequential one not unlike cost-benefit questions where costs are determined first, followed by benefits, to obtain a ratio. Both components are essential but can, and most often do, require different kinds of data so that costs are not confused with benefits.[8] With this argument in mind then, it can be seen

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[8]E. S. Quade, Analysis for Public Decisions (New York: American Elsevier Publishing Company, 1975), p. 103.

that expenditures are costs but impacts can be costs or benefits. Neither should be ignored; they should not be combined either.[9] Analyzing them separately is legitimate, but only with the stipulation that it is clearly known which is being examined. Only then can the audience and researcher be aware of the limitations of the study. Just such a delineation is going to be made in the research undertaken here.

It is true that much of past policy research has not truly employed the systems approach. This situation has occurred perhaps because of a lack of complete understanding of the systems interdependence. When explicitly applied to a natural economic and social entity such as large metropolitan area, the systems model could be brought into sharper focus. Focusing on a single system in this manner can make the input-output functions stand out in bold relief. Research of this kind then becomes more than a traditional case study. This is especially true when combined with a longitudinal perspective.

Since cross sectional studies have employed data from many units at one moment in time, much of the dynamics of input-output processes have been overlooked. Yet this has been the most frequently used research strategy in traditional policy research. For this reason there is a lack of knowledge about internal change within systems (and among

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[9] Ibid., pp. 124-126.

their policies) over time. Longitudinal research or, in econometric terms, times series analysis, can add a depth of knowledge not achieved by usual cross sectional studies.

There is a body of literature based on a research tradition which can be drawn upon in an attempt to address the problems of policy analysis in political science as outlined above. That literature and research tradition is urban modeling. This researcher believes that the methods and concepts of urban modeling can aid in addressing the systems criticism and time perspective criticisms encountered in traditional political science policy research. The modeling tradition is not without its critics as well. Even so, there is much which can be gained from such methodology. In the following section the research literature of urban modeling and its attendant criticisms are reviewed. From this exercise comes the research approach to be taken by the present author.

Review of the Literature

An organization, as in the case of a political entity like a city, can be represented as a system transforming inputs into outputs, with the constraint that the outputs must be acceptable to the environment to assure a continuing supply of required inputs.[10] Transactions of this kind can

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[10] Nystrom, "Input-Output Processes of the Federal Trade Commission," p. 104.

be between a system and its environment or between subsystems of the larger system. These transactions are called flows and as the flows cross system and subsystem boundaries the dynamic nature of the flows makes it impossible to fully separate those which take place between the system and the environment; between subsystems; or between each subsystem and the environment. Investigating the dynamic nature of the transactions or flows, which link systems together in ways only now beginning to be explored, is the way that policy analysis can most profitably make useful contributions to an understanding of public policy as well as improving its operation.[11]

A major step in the direction of understanding the dynamic nature of the transactions of a city was a 1969 study entitled, appropriately enough, Urban Dynamics, authored by Jay W. Forrester.[12] The Forrester book was an attempt to apply techniques gained through the successful modeling of an industrial system to a complex urban system. The model constructed by Forrester is striking for a number of reasons but, most importantly, it is one of the earliest

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[11]James D. Thompson, "Strategies for Studying Organizations," in Fremont E. Kast and James E. Rosenzweig, eds., Contingency Views of Organization and Management (Chicago: Science Research Associates, 1973), p. 29.

[12]Jay M. Forrester, Urban Dynamics (Cambridge, Mass.: MIT Press, 1969).

of a limited number of attempts to examine the urban area as a whole and over time.[13]

> The model developed in Urban Dynamics represents an attempt to model the city as a system in such a way as to overcome some of the deficiencies of existing intuitive and analytic models and to stimulate the effects of policy alternatives in model outputs. (Forrester) has shown that a city and many of the interrelationships within it can be modeled.[14]

The Forrester model is one of a single city from its inception through a period thereafter of two hundred and fifty years. During this period of time, the model simulated the growth and expansion phase of a city to a point of equilibrium and then into a declining phase in which the city becomes unattractive and is increasingly populated by the poor. This is the state in which many large, contemporary metropolises find themselves and in which they are likely to remain unless some policy or policies are undertaken to relieve the situation. Forrester then proceeds to test just such policies using his model.

One policy Forrester tests on the model is the building of public housing in the older central city. On the basis of a simulation of the model with a public housing program, Forrester concludes that such a policy contributes to the further decline of the city in terms of what has been

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[13] Harvey A. Garn and Robert H. Wilson, "A Look at Urban Dynamics: The Forrester Model and Public Policy," in Urban Dynamics: Extensions and Reflections, ed. Kan Chen (San Francisco: San Francisco Press, 1972).

[14] Ibid., p. 82.

called the urban problem: large numbers of poor residents, deteriorating housing, and removal of industry:

> The low-cost housing problem brings additional pressure on the land area. It attracts people in the underemployed category, making the population proportions within the urban area even more unfavorable than in the normal stagnant condition. The higher land occupancy, unfavorable population ratio, and rising tax rate (in part required to service the underemployed) all combine to reduce the kinds of new construction the city needs most (for economic vitality).[15]

Similar outcomes are shown to come about as a result of manpower training and retraining programs when used in Forrester's simulated city. Obviously, these are not pleasant forecasts for major policies now extant in the United States.

Such predictions of policy consequences have led some observers to question the entire computer modeling and simulation approach for policy studies. One of the major objections made concerning models used in simulation is that they are generally too abstract.[16] Models are said to be out of touch with the reality of a city and reflect not so much actual urban variable relationships as the imagination of the urban modeler. A related criticism is that computer models

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[15] Jay Forrester, Urban Dynamics, p. 69.

[16] Howell R. Porter III and Ernest J. Henley, "Application of the Forrester Model to Harris County, Texas," in Urban Dynamics: Extensions and Reflections, ed. Kan Chen (San Francisco: San Francisco Press, 1972), p. 180.

measure and analyze only those aspects of urban problems that are quantifiable.

> They tend to exclude from any description of what megacentropolis is or ought to be whatever cannot be photographed from a plane, rung up on a cash register, measured by automatic counting devices, or included on a survey questionnaire; if it can't be punched onto a data card, it doesn't exist.[17]

Additionally, the criticism has been directed at the underlying assumptions of the Forrester model.[18] One author faults Urban Dynamics genre scientists and technologists, particularly Forrester, for avoiding the value structure of a social entity such as a city when modeling. In modeling an entire city over a 250 year period, the exclusion of important assumptions about a city's social behavior is indeed an audacious undertaking. At least two observers are worried that these models will lead to uncritical acceptance of policy recommendations by decision makers because of the scientific procedures employed despite the fact that the models may be based on plausible but, nevertheless, disputable assumptions.[19]

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[17]Warner Bloomberg, Jr., "VI. The Goals," in "A Symposium: Governing Megacentropolis." ed. Henry Reining, Jr., Public Administration Review 30 (September-October 1970): 514.

[18]See J. E. Gibson, "A Philosophy for Urban Simulations," in Urban Dynamics Extensions and Reflections, ed. Kan Chen (San Francisco: San Francisco Press, 1972); and Garry Brewer and Owen Pl Hall, Jr., "Policy Analysis by Computer Simulation: The Need for Appraisal," Public Policy 21 (Summer 1973).

[19]Brewer and Hall, "Policy Analysis by Computer," p. 365.

Yet, as Marshall Whithed points out, the kinds of policy alternatives suggested by the Forrester model are not the exclusive product of abstract, quantifiable, technological simulation models. Similar conclusions have been arrived at through traditional research in contemporary political science.[20] Despite the wide methodological gulf between Urban Dynamics and The Unheavenly City, laden with extensive use of simulation employing the model described earlier, Forrester arrives at the same point as does Banfield in The Unheavenly City which uses the more intuitive, descriptive analysis of political science: public policies as presently conceived to deal with the problem of deterioration of the inner city only serve to encourage greater numbers of poor persons to immigrate there which further compounds the problem.[21]

The point is this: quantitative simulation models such as Forrester's are no more frought with value problems than are other more traditional kinds of analyses used in policy studies such as the work of Banfield. Certainly, questions about the underlying values of a model should be raised. But having done so, these questions should not overshadow a major attempt to examine a complex social entity

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[20] Marshall H. Whithed, "Urban Dynamics and Public Policy," in Urban Dynamics: Extensions and Reflections, ed. Kan Chen (San Francisco: San Francisco Press, 1972), p. 135.

[21] Edward C. Banfield, The Unheavenly City: The Nature of Our Urban Crisis (Boston: Little, Brown and Co., 1970), p. 43; Forrester, Urban Dynamics, p. 69.

as a dynamic system. There are items omitted in such attempts to be sure. The focus is upon structures that are readily available and quantifiable because these variables are more simple to manipulate. A model, however, is a simplification of reality. As such, it will of necessity leave some areas unexplored. In the beginning, models such as Forrester's are likely to be approximations. Marshall Whithed, a political scientist, recognizes the shortcomings and simplications of the Forrester model, but offers the following statement in support of urban models and simulations involving similar methodologies:

> At present efforts (at models and simulation) are exploratory, and presumably crude. After all, the first Wright Brothers' airplane flew a distance shorter than the length of a Boeing 747 aircraft. Yet without the effort of the Wright Brothers, there would be no modern jetliner. The present efforts at simulating major social systems such as a city are necessarily crude. Great improvement can be expected. . .[22]

As to the question raised by some critics that using models and simulations in policy research unduly influences those charged with the responsibility of making policy because techniques of this kind are not well understood by them, this can be answered by pointing out that additional research has often held sway with such officials even at the very highest echelons of government. The case in point is once again the work of Edward Banfield. Even before publication of The

[22]Whithed, "Urban Dynamics and Public Policy," p. 138.

Unheavenly City, top Nixon administration officials were circulating the page galleys of the book.[23] One's work can go little higher for acceptance.

Of course, the real question is one of responsibility and the potential dangers in regard to research:

> Although this book "Urban Dynamics" is presented as a method of analysis rather than policy recommendations, it is probably unavoidable that many will take these results and act on them without further examination of the underlying assumptions. Doing so is unjustified unless the pertience of the model itself is first evaluated against the requirements of the particular situation. The approach presented in this book is suggested as a method that can be used for evaluating urban policies once the proposed dynamic model or a modification of it has been accepted as adequate.[24]

Other researchers using computer models and simulations, as well as those applying more traditional methodologies, would do well to follow Forrester's caveat.

The purpose of this rather lengthy discussion of the Forrester book was twofold. First, Urban Dynamics was chosen as the beginning point of the literature review because it is a major attempt to model an entire urban system and because of the resultant visibility it achieved. The second component of the overall purpose comes about because of the first. While the Forrester model received so much attention, it naturally drew criticism as well. The major criticisms have

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[23] David R. Morgan, "Cities, Crisis, and Change: Exploring Barriers to Problem Solving," Public Administration Review 34 (September/October 1974): 501.

[24] Forrester, Urban Dynamics, p. 2.

been elaborated above. Since the methodology of urban modeling and simulation is being applied herein, it was felt similar criticism would arise. The criticisms should by now be well understood and have been addressed. Therefore, the theoretical underpinings of the research undertaken to construct a model of Toronto are established. There remains now the task of examing further urban models and simulations.

The Urban Environmental System by Peter House is also a generalized model just as was Forrester's. Therefore, the model is not one of a particular city, but used elements common to most large urban centers for its construction. The purpose for which House utilizes his model are four: education, training, research, and policy-making.[25] The model is also holistic in that it deals with the whole urban system and not a partial model concerned with only a sub-system such as transportation or housing.[26]

The House model is constructed with sectors. "A sector is a theoretical construct which includes a series of relationships and their concomitant data to describe some portion of a total system."[27] The sector approach allows one to separate the activities of a city into components which when fitted together give an overall view of "an urban system

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[25]Peter House, The Urban Environmental System (Beverly Hills: Sage Publications, 1973), p. 19.

[26]Ibid., p. 19.

[27]Ibid., p. 65.

as a representation of the relationship between people and their environment."[28] While such divisions are largely artificial, they provide easily recognizable boundaries to help focus study on the flows within the system. The sectors of the House model were labeled governmental, social, and economic.[29]

The governmental sector controls some financial resources and performs certain regulatory functions. The financial aspect of the governmental sector is in the form of federal-state aid, bonds, tax revenues, and the like which are distributed throughout the model by this sector.[30] The regulatory action of the governmental sector takes place as a result of taxes imposed, legislation enacted, and judicial decisions made.[31] As the financial resources are distributed and regulation carried out, the model registers the quantitative and qualitative effects in the other sectors of the model.

The social sector is "largely quality-oriented (quality of life) and provides a quantifiable response to the subjective reactions of citizens to the inputs from the other sectors."[32] Time and income are the principal resources

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[28] Ibid., p. 66.

[29] Ibid., p. 65.

[30] Ibid., p. 75.

[31] Ibid.

[32] Ibid.

of this sector. Time is allotted for the purposes of work, purchasing, education, recreation, politics, traveling, and leisure.

The third sector, the economic sector, is the area of the model concerned with the business life of the simulated city. This sector is further divided into industrial, commercial, and residential components.[33] Resources such as income and loans can be used for purchases or for savings. Land can be bought, for example. It may then be developed or left undeveloped.[34] If the land is developed, buildings are simulated. Buildings may also be constructed, upgraded, sold, rented, etc.[35] Resources can also be expended for employment, for equipment, and for materials.

The House model, known as GEM CITY, is "Primarily an allocation model that matches supply and demand in the employment, transportation, commercial, time allocation, and government services market."[36] The major assumptions of the GEM CITY model are economic in nature. Growth occurs as markets expand and the population exerts its preferences.[37] The model can thus be viewed as both a Growth Model and a

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[33] Ibid., p. 72.

[34] Ibid., p. 73.

[35] Ibid.

[36] Ibid., p. 90.

[37] Ibid.

Behavioral Model, according to House.[38] Since Growth Models assume statistical stability, rationality, and regularity, such models are used for extrapolation or projections. Behavioral Models are concerned with preferences and the concepts of rational choice, market behavior, and equilibrium.[39] When Behavioral Models are combined with Growth Models, as in the GEM CITY case, the dynamic nature of an urban situation can be examined. One can become better acquainted with the flows of the system and, thus, begin to understand the patterns of growth of a city and the preferences for various policy alternatives of the people who live there. Further, the format of the model allows the researcher to trace changes from one time period to another. House maintains that as a result the feeds and feedbacks inherent in any real world city may be traced more readily. This suggests that a greater degree of accuracy in understanding a system can be achieved with this approach than with other methodologies used in policy research.

Another model which attempts to examine the urban milieu is one constructed by I.S. Lowry, which he calls Metropolis.[40] Like the Forrester model, Metropolis attempts to simulate an entire system. Also, like the GEM CITY model, Metropolis is a combination of model classifications. While

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[38] Ibid., p. 91.

[39] Ibid.

[40] Jack W. Lapatra, Applying the Systems Approach to Urban Development (Stroudsburg, Pa.: Dowden, Hutchinson, and Ross, 1973), p. 63.

Metropolis is similar to Urban Dynamics in its modeling objective, i.e., to capture the workings of an entire city, it is not as complex a model nor is its impact as great as Urban Dynamics in terms of public and scientific controversy.[41] Metropolis, however, does combine allocation and derivation models in its operation. Yet, in terms of sophistication, neither of these model types provides the same level of general applicability as the GEM CITY model. Its shortcomings are due, in large measure, to the fact that the Metropolis model was formulated much earlier than either Urban Dynamics or GEM CITY, when urban modeling techniques were still relatively underdeveloped.[42] It, nevertheless, represents a major contribution to the efforts at urban modeling.

Because Lowry's model is a combination allocation and derivation model, it computes the distribution of residential and residence serving activities.[43] The model derives from residential projections in an urban area the optimal allocation of land use for the projected residential levels and the required related service activities, such as food stores, repair shops, etc. Once these computations are made, the the model adjusts to the new levels created by the service

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[41]William Goldner, "The Lowry Model Heritage," The Journal of the American Institute of Planners 37 (March 1971): 100.

[42]House, The Urban Environmental System, p. 86.

[43]Lapatra, Applying the Systems Approach to Urban Development, p. 63.

activities and goes on to simulate continued land use. The iterative process stops when a stable spatial allocation of population is created which matches the industrial activity for a given simulated area.[44]

The Lowry Model, despite its comparative simplicity with regard to Urban Dynamics and the GEM CITY model, did give rise to several models which use its basic framework, but which make some important additions. One such model is the Pittsburg Comprehensive Renewal Program (CRP).[45] In this adaptation of the Lowry model three new components are added. They are:

1. Conversion to a "marginal allocation model that allows only a portion of the establishments and households to move in a certain period of time," rather than the aggregate, allocative model of Lowry's.

2. Household disaggregation "by income, housing characteristics, social characteristics, or all three."

3. Limitation of the "simulation study to locational characteristics within the city's boundaries."[46]

The Pittsburg CRP model aided prediction of residential locational choice on the basis of job location, and predicts the placement of commercial activity on the basis of the

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[44]Ibid., p. 63.

[45]Goldner, "The Lowry Model Heritage," p. 103.

[46]Ibid.

location of residences.[47] Immediately, one can recognize the Lowry model's contribution to the Pittsburg model. The conceptual formulation and purpose of the Pittsburg model is identical to Lowry's, but the additions allow for greater detail and sensitivity.

Another Metropolitan Growth Model, as Lowry type models have come to be classified, is the Bay Area Simulation Study (BASS).[48] The BASS model made several departures from the original Lowry model, just as the Pittsburg model had. The Bay Area model's major features are as follows:

1. Use of census tracts as opposed to Lowry's grid squares or zones to represent land areas.
2. The BASS model generates population instead of business and commercial entities.
3. The system wide parameters of the Lowry model were disaggregated to the census tracts for BASS such as rates of change.[49]

The purpose of the BASS model was to measure the sensitivity of business and household allocation as a result of the construction of a large industrial park.[50] Later the model was expanded to test the effects of the placement of a number of industrial parks. By using the BASS model, a policy was undertaken for redesigning and redeveloping the industrial parks. As a result of this action, the BASS model itself was

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[47]Lapatra, Applying the Systems Approach, p. 73.

[48]Goldner, "The Lowry Model Heritage," p. 103.

[49]Ibid.

[50]Ibid.

recalculated and revised so that the initial revision of the Lowry framework was eliminated. In its final form (known as PLUM), it resembled more closely a Lowry-type model.[51]

Jack Lapatra lists other of the domestic adaptations of the Lowry model.[52] He reports them as follows:

1. The Garin-Rogers Contributions, 1966;
2. The Cornell Land-Use Game, 1966;
3. A Dynamic Model of Urban Structure, 1968;
4. Projective Land-Use Model, 1968.

The use of the term domestic above indicates that there are some non-U.S. applications to Lowry models. There are, in fact, many Lowry model implementations in Britain. Their use has been in English subregions which correspond to medium-sized metropolitan areas in the United States.[53] The problems addressed by the models have been the impact of new towns, the location of airports, and the planning of urban structure within the framework of a prospective reorganization of local government.

One other useful application of urban models is to conceptualize cities as organic regions, which means a given area is defined by the physical, social, and economic attributes that make it distinct from other regions. The

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[51] Ibid.

[52] Lapatra, Applying the Systems Approach, p. 77.

[53] Ibid.

parameters which form the boundaries for such a region fall into four categories.[54] The first category is the mobile objects in the area: goods, cars, and other transportation devices, as well as people in the area. The second category of parameters is infrastructure: buildings, roads, bus and train depots, airports. The land area is the third parameter category: the space which the region occupies. Finally, the economic and social activities that take place in the region form the fourth category of parameters. Relevant activities to be included as parameters in this group are: shopping, travel, business transactions, bank loans, etc.

Once the parameters of the city/regional model are specified, two important dimensions of the model must be dealt with: the spatial dimension and the sectoral dimension.[55] The spatial dimension refers to units in which people, activities, buildings, etc., are aggregated and the way in which these units are distributed.

> The spatially distributed population could, for example, be aggregated by activity and location, such as residential location, workplace location, shipping, use of public services, and social activities. From this population activity by location, the economic activity could be classified as commerce, construction, manufacturing, retail, public services, social and other services, and public utilities.[56]

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[54] Ibid., p. 103.

[55] Ibid.

[56] Ibid.

The sectoral dimension deals with the degree of detail in the model. For example, the researcher could either aggregate the various factories that use raw materials to produce goods in a single sector called manufacturing, or disaggregate the sector into the separate factory operations to allow for greater detail of the manufacturing taking place in the region. Of course, such detail is contingent upon having the necessary data available.

Among the earliest and best known of regional models to apply computer based technology to regional analysis was a model built for the New York metropolitan region.[57] Known as the Hoover model, it was intended to evaluate and forecast the condition of the New York City region for the use of policy makers in making improvements in regional conditions.[58] Since inequities usually exist in development and income within or among regions, these types of models have attempts to supply guidelines and empirical information for the creation of policies and strategies to alleviate these inequities.[59]

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[57] Edgar M. Hoover and Raymond Vernon, Anatomy of a Metropolis (Cambridge, Mass.: Harvard University Press, 1959).

[58] John F. Kain and John R. Meyer, "Computer Simulations, Physio-Economic Systems, and Intrarational Models," Journal of the American Institute of Planners 58 (May 1968): 175.

[59] G. J. F. Hewings, "The Effects of Aggregation on the Empirical Identification of Key Sectors in a Regional Economy: A Partial Evaluation of Alternative Techniques," Environment and Planning 6 (July-August 1974): 439.

A. G. Wilson divides regional models into two categories.[60] The first he calls "spatially aggregated population systems." Such models are used for the prediction of the age and sex structure of an urban or regional population. The question of migration into and out of an urban area also can be addressed by models of this kind and could enable policy makers to make judgments concerning many problems related to the population of an area, for instance, future sales tax revenues or police facility usage by the area population.

The second category Wilson suggests for regional models is "spatially aggregated economic systems." "As with population models, similar techniques can be applied to aggregate economic structure models at national and urban/regional levels."[61] According to Warner Hirsch, such analysis proceeds from either a theoretical or statistical base.[62] A theoretical base provides a logic for forming coherent and general hypotheses about the interrelationships of variables. The statistical base employs observed empirical relationships that appear to be pragmatically useful.[63]

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[60] A. G. Wilson, ed., Papers in Urban and Regional Analysis (London: Pion, 1972), p. 17.

[61] Ibid.

[62] Werner Z. Hirsch, Urban Economic Analysis (New York: McGraw-Hill, 1973), p. 179.

[63] Ibid.

Hirsch maintains that these model bases always are used in conjunction with a perspective on urban change. Change can be thought of as being produced internally or externally to the urban area or by some internal-external mix.[64] Models then can be grouped by their base and perspective as follows:

Perspective	Theoretical Base	Statistical Base
External	Export	Allocation
Internal	Resource	Extrapolation
Mixed	Input-Output Income-Expenditure	Shift and Shares

> The export-base framework says that local activity is a function of export demand via a multiplier process. The resource-base framework says that local activity is a function of local factor inputs in the area and their comparative advantage to other areas. The input-output framework says that local activity is dependent on various expenditure, demand, supply, and income equations. However, the emphasis is on the producing (or immediate sector) actors.
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> The income-expenditure framework also says that local activity is a function of various expenditure, demand, supply, and income equations relating to both the local and the external areas. Usually the emphasis is on final demand actors in the economy.
>
> The ratio extrapolation or allocation framework says that a local activity is some share of the comparative national activity. The shift and shares framework says that a local activity is a function of three components: the change in the national activity, the change in the comparative advantage which the local area has in that activity, and the particular mix of industries in the area.[65]

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[64] Ibid., p. 180.

[65] Ibid.

Illustrative of the first set of category of models suggested by Wilson is the work of Niles M. Hansen. For some time Hansen has been concerned with settlement patterns and regional development both in the U.S. and abroad.[66] He has been particularly concerned with location preferences of people, migration from slowly developing regions, and policies concerned with bringing migration and location preference in line with development needs.[67] He argues that these are questions which must be addressed in order to simulate policies aimed at the geographic distribution of population and economic activity in the United States; policies in which there has been a great deal of interest lately.[68] This interest is evidenced by the creation of regional development districts and the increased number of federal and state agencies charged with labor mobility projects.[69] Using data gained from survey questionnaires and regional wage scales, Hansen has performed a number of studies indicating workers

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[66]See, for example, Niles M. Hansen, Rural Poverty and the Urban Crisis: A Strategy for Regional Development (Bloomington: Indiana University Press, 1970); and Niles M. Hansen, "The Structure and Determinants of Local Public Investment Expenditures," Review of Economics and Statistics 47 (May 1965): 150-162.

[67]Niles M. Hansen, Location Preferences Migration and Regional Growth (New York: Praeger Publishers, 1973), p. 3.

[68]Ibid., p. 28.

[69]Charles K. Fairchild, Worker Relocation: A Review of U.S. Department of Labor Mobility Demonstration Projects (Washington, D.C.: E. F. Skelley, 1970), p. 58.

will move to an area in response to economic opportunities (even out of developmentally lagging areas such as Appalachia). This remains the case even when family considerations and emotional and psychological ties to the land are entered into the analysis.[70]

A more far-reaching and comprehensive model of the ragional population variety is the New Haven Regional Model developed with aid and funds from the U.S. Department of Commerce, MIT, and Harvard University.[71] Using as its basic parameter the census tract, data on population, age, sex, ethnic origin, housing, jobs, acres of land, etc. are manipulated in such a way as to facilitate analysis of the interrelatedness of the variables and the projection of extrapolation, in the phrase of the modelers, of the variables for the future states of the model. For example, the model can group census tracts into those which show differing rates of growth, i.e., slow or fast. Then, using the demographic data on these tracts, the model can describe the kinds of people most likely to be found living there and the kinds of housing structures in which they live. The analyst may then be able to discover, for example, that the foreign born citizens are moving out of a slow growing area

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[70]Hansen, Location Preferences . . ., p. 99.

[71]David Buich, Reilly Atkinson, Sven Sandstrom, Linda Stack, The New Haven Laboratory: A Test-Bed for Planning (Lexington, Mass.: Lexington Books, 1974).

dominated by multi-unit housing structures and into areas with low-priced, single family dwellings.[72]

This illustration does not fully capture the complexity of the New Haven model, however. The model is literally a simulation of the behavior of the actors in the region.[73] The model can thus project the net result of all the decisions made by all the individuals and all the groups in the social system over simulated time. Yet, events do not occur simply as a function of the passage of time. The computer routines are constructed such that things happen when a decision is made and these decisions, represented by the numerous routines, affect each other.

> For example, when a builder builds a speculative, single-family unit, his action is recorded, and movers looking for new houses of that type will take the new house into account when they move. Similarly, when a plant lays off several thousand employees, as happened in the late 1960s in New Haven, people in the same occupational categories as those of the workers laid off will find it harder to find jobs, and are more likely to become unemployed. That, in turn, will affect the likelihood that they will migrate elsewhere and that others like themselves will migrate into New Haven.[74]

As one can see, the New Haven Model is a very complex example of the spatially aggregated model. The authors report the model is still being refined and evolving. Their purpose in building the model, as it related to public policy, was

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[72]Ibid., p. 15.

[73]Ibid., p. 20.

[74]Ibid., pp. 20-21.

not to test the effect of specific policies, but to understand the phenomena with which those policies are designed to cope. Specifically, the New Haven researchers have attempted to understand the development of zoning ordinances rather than what they consider to be the more abstract question of how zoning affects urban growth.[75] This is the point of view fom from which the Toronto experience will be approached in this research.

In considering the second of Wilson's typologies, the spatially aggregated economic models, the focus will be on input-output type models. This is because such models are the most germane to the one envisioned for Toronto and because input-output models are the most likely to indicate the important actors in the urban setting and reveal the largest number of nontrivial relationships.[76] This is no small accomplishment given the complexity of relationships existent in an urban place.

Urban areas in which input-output models have been applied are large in number.[77] In addition, the purposes to which these models have been put are multidimensional. Not only have input-output models been employed for analytical

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[75]Ibid., p. 434.

[76]Hirsch, Urban Economic Analysis, p. 266.

[77]A bibliography of urban area input-output analyses can be found in Philip J. Bourque and Millicent Cox, An Inventory of Regional Input-Output Studies in the U.S. (Occasional Paper 22, University of Washington, Graduate School of Business, 1970).

purposes, but also they have been used as (1) projection models to indicate probable future states of the areas being modeled based on present trends, and (2) as impact analysis models in which an assessment is made of a particular stimulus or set of stimuli introduced into the model, such as increased disposable income or urban residents.[78]

One such model was constructed for the St. Louis, Missouri Standard Metropolitan Statistical Area by Werner Z. Hirsch in 1955.[79] The model as developed contained thirty-three (33) operating sectors.[80] The classification Hirsch used characterized the St. Louis area as having sixteen manufacturing sectors, eleven non-manufacturing sectors, the household sector, three government sectors, and a sector for capital formation.[81] A matrix of technical coefficients was created using these thirty-three sectors.[82] Each coefficient represents the percentage of direct input from the other local sectors required for the output of any one sector exclusive of the final demand, which is, in large measure, a function

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[78]Hirsch, Economic Analysis, p. 248.

[79]Werner A. Hirsch, The Economics of State and Local Government (New York: McGraw-Hill, 1970), p. 258.

[80]Werner Z. Hirsch, "Interindustry Relations of a Metropolitan Area," Review of Economics and Statistics 41 (November 1959), p. 361.

[81]Ibid.

[82]Ibid., p. 363.

of national demand.[83] Using this methodology, the flows between sectors were revealed, allowing for determination of the impact of demand changes in the areas.

Analysis of the impact of changed demand was done in a later study analyzing the impact of an additional $1 million demand in each sector of the model.[84] Assuming the technical coefficients would remain unchanged over time, a projection was made as to the effect the new demand figure would have on the local school district's fiscal status. While it might be reasonable to hypothesize that increased activity of this magnitude in the area would substantially improve the fiscal health of the school district, the model indicated this hypothesis was not entirely correct.

> The case study confirms the claim that industrialization on the average improves the fiscal health of a school district, but only if state aid is included as a revenue source. Yet it also calls for a rejection of the hypothesis that local industrialization in all cases improves the net fiscal resources status of the district. . . . In general, it appears that the net fiscal resources status improves most if expansion occurs in an industry that has major income and only minor employment effects.[85]

Thus, only if industries which are capital intensive and not labor intensive locate in the area will the schools' financial health improve. This is because resources will not have to

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[83]Ibid.

[84]Werner Hirsch, The Economics of State and Local Governments, pp. 263-264.

[85]Ibid.

be diluted due to additional incoming students. Also, the state government's role stands out in the process. Such has not always been found in other policy studies.

Despite the successful analytical use of the models discussed in the Wilson typology, there are some who remain skeptical of a model's ability to appraise the future. These critics are not opposed to the principle of modeling or the idea of projecting that model's analysis into the future. They are concerned that such projections are based on cross sectional data for the area under study. John F. Kain notes that most studies hypothesize a high degree of stability.[86] (The St. Louis model is a case in point. It assumes the coefficients will remain unchanged through time.) Projections which rely on cross sectional data have underestimated change in the areas modeled, Kain argues.[87] Therefore, greater attention to changes over time should be of concern to modelers. To do this requires a consideration of time series analysis. While time series analysis does not assume a completely accurate forecast of the future, it can provide stronger clues to the future than data taken from a single time period because cross sectional data is not an indication of trend. While a trend through past time can be no guarantee of future time, it seems reasonable to assume that

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[86]John F. Kain and John R. Mayer, "Computer Simulations, Physio-Economic Systems, and Intraregional Models," p. 177.

[87]Ibid.

a trend, once in motion, is likely to remain on track unless acted upon by some rather strong force. Furthermore, such analysis can help reveal not only the magnitude of past change but also the process of change.[88] The predictive power of a model which takes into account the process of change is significantly enhanced when compared to one which does not. A brief look at literature employing time series analysis seems in order, then.

Within the context of input-output models in general, a recent example of the inclusion of time series is a model which analyzed the change in the employment distribution between manufacturing and services industries during the period 1960-1970.[89] The study was undertaken because previous work in the area had not adequately considered the changing pattern of supply and demand over time.[90] Input-output coefficients were derived for the industries under consideration as per standard operating procedure in input-output analysis. A time coefficient was subsequently computed by regressing the final expenditure and intermediate demand for each sector on time.[91] This was done by multiplying actual product by the input-output coefficients each

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[88]Ibid., p. 176.

[89]B. D. Hiag, "An Analysis of Changes in the Distribution of Employment Between the Manufacturing and Service Industries 1960-1970," The Review of Economics and Statistics 57 (February 1975): 35-42.

[90]Ibid., p. 35.

[91]Ibid., p. 39.

year. These two sets of coefficients were then used in a simulation for the period under study. The results obtained from the model showed that there was a relatively faster employment growth in service industries than in manufacturing due mainly to the slower rate of growth in productivity in the service sector.[92] Further, the input-output relations in the model demonstrated that individual sector demand can make significant differences in the rates of growth. The author concludes that this is an important finding since structural change analyses have given input-output models little attention. Here is further evidence of the need to combine the time series approach with other modeling tools.

Another approach to the time series challenge adapted to models employed for regional econometric analysis should be included in this discussion as well. The approach is one which deals with the problem of incomplete data for some variables or, in some cases, the nonexistence of data. Many times longitudinal data are lacking on some variables as consumption of products in an area of nonmanufacturing investment data missing for a region. There also may exist gaps in a data set for certain sectors of the model such as employment or wages. When such a case eventuates, the problem is solved by estimating these gaps for the region in the magnitudes found at the national level. For example,

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[92]Ibid., p. 42.

suppose a regional model includes a wage sector for which data were nonexistent or in which there were substantial gaps. The solution would be to estimate the wage rate in the larger area of which the regional model is a part. After this is done for all sectors which have missing data, a complete model can be assembled for the region. Once assembled, the model can be used to simulate the time period under consideration so as to produce simulated data for each sector which can then be compared with actual data compiled from the region under study for the actual number of years in question

A recent regional model of the state of Mississippi operates in the manner described above.[93] Lacking certain "critical data," a modified model structure was constructed for the Mississippi region.[94] Specifically, the model was without reliable time series data on consumption and non-manufacturing for the Mississippi region as well as complete detail on imports and exports. However, a model was constructed using gross figures on production originating in the region, employment, wages, and salaries as statistical bases.[95] In addition, where feasible because of incomplete data, national demand functions were assumed to exist. For

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[93] F. Gerald Adams, Carl G. Brooking, and Norman J. Glickman, "On the Specification and Simulation of a Regional Econometric Model: A Model of Mississippi," The Review of Economics and Statistics 57 (August 1975): 286-298.

[94] Ibid., p. 286.

[95] Ibid., p. 287.

example, because the manufacturing sectors of Mississippi compete in national markets, those sectors were treated as oriented to external demand.[96] Therefore, the levels of demand existent in the model for sectors without sufficient data were assumed to be the same as national demand levels.

Combining the sectors for which all data necessary existed with those sectors for which relationships were estimated, the model was used to perform a dynamic simulation for the years 1955-1970. The model produced a Gross State Product for each simulated year. This simulated data was compared to actual Gross State Product for the period 1955-1970. A comparison of the two data sets, actual and simulated, revealed an average error of 1.3 percent for the Gross State Product for the simulated fifteen-year period.[97] The builders of the model regard this amount of error as a successful tracking of the major economic aggregates of the Mississippi region for the sample period.[98] Whether one wishes to call it successful or not is open to debate, but at the very least the projections made from the model can be assessed against this standard of error for accuracy (which is the more important point).

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[96]Ibid.

[97]Ibid., p. 291.

[98]Ibid.

Summary

The purpose of this first chapter has been to set out the problem that traditional public policy analyses in political science have had in actual research applications in dealing with the concept of a system. The chapter stresses that under the guise of a systems model most public policy analyses in political science (and some other of the social sciences) have merely presented listings of variables which have been plugged into regression equations. The results coming from such traditional approaches have not been altogether satisfying. Urban public policy analyses have been especially subject to this kind of criticism. Therefore, an approach borrowed from other disciplines, including operations research, econometrics, and regional economics, was offered as an alternative to traditional political science urban policy analysis.

Beginning with the work of Jay Forrester (because his was one of the first attempts to examine an entire urban system) the discussion undertook a consideration of urban models. The roots of urban modeling were traced back to the work of Ira S. Lowry and Lowry type models, then on to the A. G. Wilson typologies of urban models. From this section came the most pertinent model types for the proposed Toronto model: input-output models. Input-output models were emphasized because they set out explicitly the flows between component sectors of the model which is of singular importance in analyzing the process of urban public policy as it pertains to expenditure levels. By tracing the flows between sectors, especially policy sectors, the dynamic nature of urban policy systems can be fully appreciated; something which has been lacking in earlier policy research.

Finally, a consideration of the time element was brought to bear on such models. Drawing on criticisms of earlier models that cross sectional data constrained projections of the model builders, literature was discussed which dealt with the problem of time series analysis within input-output models. Two specific examples were given of models employing time series: the first example stresses the different findings encountered when using time series as opposed to cross-sectional techniques, and the second uses larger national relationships to estimate regional relationships due to incomplete data. Both of these models relate to the Toronto model insofar as the Toronto model will require estimates and modifications as a result of incomplete data. Nevertheless (as the Mississippi Regional Model example shows), a reasonably accurate model can be constructed.

Outline of the Study

With the premise of the study and the review of literature established, attention can now be directed to the work yet to be done. In Chapter 2, the conceptual and methodological groundwork for the Toronto model is laid complete with the model itself. In addition, Chapter 2 contains the justification for the research and the research questions to be addressed. Chapter 3 provides the description of the research setting. The chapter traces the history of the Municipality of Metropolitan Toronto and renders an account of policy trends over that history. A full elaboration of the research design is the subject of Chapter 4. At this point, the analysis takes on the explicit trappings of an experiment with regard to how the model adjusts to changes in its parameters. Chapter 5 then analyzes the data on the basis of the design laid out in Chapter 4. Finally, in the last chapter a summary of findings is put forward along with conclusions regarding the findings as they relate to the research questions posed in Chapter 3. The final chapter also contains recommendations for further research into policy analysis in political science using modeling tools.

CHAPTER 2

THEORY AND DESCRIPTION OF THE MODEL

The Concept of a Model

In the first chapter numberous examples were given of models as they have been applied in the past to analysis of various kinds of policy; urban growth policy, economic policy, urban regeneration policy. The increasing use of these models derives from an awareness of urbanologists of the complex interrelationships extant in urban systems. These models offer the advantage of performing the monotonous, tedious, and complicated calculations attendant to complex systems. In describing models as they have been used in other disciplines, the groundwork was laid for the development of the Toronto model in the political science context. This chapter is concerned with the elaboration of the Toronto model. Before preceding to the details, it is appropriate to discuss the concept of a model. Additionally, since simulation plays an integral part in the model, it should also be elaborated upon.

Over a decade ago Abraham Kaplan provided an excellent description of the concept of the model type envisioned for Toronto:

> . . . a model might be said to be the embodiment of a structural analogy. Such models might be called analogues, as a generic term for both conceptual and physical isomorphs. As with analogue computers, a pattern is instituted on the basis of well-defined correspondences, and the properties of the pattern are then studied in order to learn something about the system to which it corresponds. In behavioral science, analogues are coming to command increasing attention under such designations as "simulation" . . .[1]

This description captures the essence of the Toronto model. An analog of the Municipality of Metropolitan Toronto is to be created to learn something about the city and its policy. Second, it will employ simulation to set the correspondences in motion to reveal the "properties" of the pattern.

It is important from the beginning to distinguish the model as an analog.[2] As an analogue, the model is an abstraction of reality which stresses the interrelatedness of its parts. The model, therefore, has form and substance. It is more than a listing of variables whose only common element is similarity of verbage or disciplinary jargon. This is not to say the model does not contain variables at all; the variables of the model are related through the underlying theory which forms the base of the model.

Theory is the logical framework to which the model is fitted. The theoretical perspective is revealed in the

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[1]Abraham Kaplan, The Conduct of Inquiry (San Francisco: Chandler Publishing Company, 1964), p. 267.

[2]Saul I. Gass and Roger L. Sisson, A Guide to Models in Governmental Planning and Operations (Potomac, Md.: Sauger Books, 1975), p. 7.

set of structural relations which form the model.[3] The structural relations of the model involve the variables the model-builder believes to be most important for the purposes of the model and the way the variables relate to or act on one another. It is left to the modeler's discretion which structures and variables to include or omit. As long as the structures are coherent and consistent, the model-builder may choose those structures and variables which provide the best strategic advantage.[4] Strategically, the best model is the one which is clear, precise, and manageable.

The Concept of Simulation

Once the relevant factors and the relations among them have been formulated into a clear, precise, and manageable analog, the modeler or analyst can translate the analog into instructions in the form of a computer program. Such a program is called a "simulation."[5] The program numerically represents the essential features of the model and, then, performs an analysis of the modeled system's behavior. Thomas H. Naylor defined this simulation process as follows:

> We shall define simulation as a numerical technique for conducting experiments with certain types of

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[3]Ira S. Lowry, "A Short COurse in Model Design," Journal of the American Institute of Planners 31 (May 1965): 160.

[4]Ibid.

[5]E. S. Quade, Analysis for Public Decisions (New York: American Elsevier Publishing Co., 1975), p. 152.

> mathematical models which describe the behavior of a complex system on a digital computer over extended periods of time. The principal difference between a simulation experiment and a "real world" experiment is that, with simulation, the experiment is conducted with a model of the real system instead of with the actual system itself.[6]

By using the simulation approach, inferences are made to the real system from the results obtained by manipulating the model. The utility of a simulation model for the social scientist concerned with policy analysis arises from the experimental facility of simulation.

It is simply not plausible to experiment with a real city such as Toronto. Therefore, simulation provides the setting for what would otherwise be impossible. Furthermore, a simulation model can handle more variables, more complex models, and models which more nearly approximate the actual behavior of real world systems.[7] Simulation also provides the advantage of speed. Twenty years of policy behavior by a city can be compressed into fewer computer seconds for the analyst.

The Input-Output Model Defined

Thus far, the discussion has been concerned with models and simulation in a general way. Since simulation is understood to be an experiment, like other experiments it

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[6] Thomas H. Naylor, Computer Simulation Experiments with Models of Economic Systems (New York: John Wiley and Sons, 1971), p. 2.

[7] Ibid., p. 9.

requires a design. The design of the experiment with the Toronto model is an input-output analysis. Input-output analysis was originated by Wassily Leontief and first applied to the American national economy in 1951.[8] Since that time, the input-output design has been applied in a number of different settings. In Chapter 1 Werner Hirsch's application of input-output analysis to the St. Louis economy was described, for example. Therefore, its appropriateness to an urban situation is by now well established.

Input-output analysis provides a method for examining the inter-industry relationships, or the economic interdependences of industries, in an economic system such as a city. It portrays the structure and functioning of an economy. The reasoning behind input-output analysis rests on the fact that the viability of an economy is largely determined by the extent and character of its productive or income producing activity.[9] With this in mind, one can then conceptualize the input-output technique as explicitly laying out the environment of a city's policy system (government). In many past analyses in political science, the environment was found to be among the most, if not the most, important factors in determining urban public policy. Despite this finding, it was

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[8] Wassily Leontief, The Structure of the American Economy (Oxford: Oxford University Press, 1951).

[9] Kenneth L. Kraemer, Policy Analysis in Local Government (Washington, D.C.: International City Management Association, 1973), p. 110.

never determined just how the environment affected policy decisions; no specific linkages were ever elaborated, nor were any linkages described which tied the elements of the environment together. By using input-output analysis, the environment can be more fully detailed and linkages more firmly established. Including the city government in the analysis can complete the picture of the urban area. In so doing, a more complete portrayal of a city's policy development can be achieved.

In the input-output design the system to be modeled is divided into endogenous and exogenous sectors corresponding to the city's economy and the larger system of which it is a part. The input-output model traces the output of any one sector to the sector or sectors in which that output is consumed. The assumption here is that the various sectors of an area bear measurable relationships to one another. The relationships are expressed in terms of a set of input-output ratios for each sector in relation to each of the other sectors. In effect, these ratios are the flows within the system; such flows tie the system together and make it a system.[10]

The ratios between sectors are termed "flow coefficients." Flow coefficients form linear homogeneous

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[10] Philip J. Bourque, Forecasting with Input-Output, (Seattle: University of Washington, Graduate School of Business Administration, 1971), p. 5.

relationships between the output of a sector and the various supplies and services the sector must intake to produce output. A complete set of flow coefficients for an input-output model of any number, n, sectors forms a matrix. The development of the flow coefficient matrix is central to the input-output design because it is the means for translating the behavioral pattern of a set of final demands into levels of industry activity required to achieve those final demands.[11] Mathematically, these calculations are carried out by the use of matrix algebra.

In algebraic terms the model would be expressed as follows:

> Let X represent a vector of outputs whose values are to be determined for each of n (sectors), Y represent a vector of final demands, and A the matrix of flow coefficients. Then, X = AX + Y, which states that the outputs of different (sectors) depend upon the demands for inputs by (sector) and demands for inputs by final users. Since the A matrix is a given constant and the Y vector is independently determined, the solution of the X vector is obtained as follows:
>
> $$X - AX = Y \tag{1}$$
> $$(I-A)X = Y \tag{2}$$
>
> Where I is an identity matrix which bears the relationship in matrix algebra which the number 1 holds in ordinary numbers. Dividing both sides by (I-A) we obtain:
>
> $$X = \left(\frac{I}{I-A}\right)Y \text{ or } X = (I-A)^{-1}Y \tag{3}$$
>
> The expression $(I-A)^{-1}$ is called the inverse matrix. Such a table constitutes the focus of an input-output

[11]Ibid., p. 9.

> study for impact analysis since it indicates both the direct and indirect effects upon the output of every (sector) per dollar's worth of final demand for the output of any one (sector). It is a table of (sectorial) output multipliers.[12]

In less abstract terms, the basic structure of an input-output table uses the following generalized format shown in Table 1.

Table 1 is aligned with producing sectors down the left side of the table and consuming sectors along the top. It is the producing sectors which supply the goods and services to the local economy. Referring to the earlier algebraic notation, Table 1 corresponds to the AX matrix, with the dollar amounts in the cells of the table corresponding to the flows of the system. By converting these dollar amounts to ratios in the form of the flow coefficients, a table or matrix is produced which corresponds to the A matrix in the formula.

By creating an identity matrix for the A matrix, the expression (I-A) can be produced (an identity matrix is one of similar proportions as the A matrix with 0's in all cells except along the main diagonal which contain 1's). Inverting this (I-A) expression to get $(I-A)^{-1}$ creates the inverse table which is the table of total requirements of inputs (both direct and indirect) for the system.[13]

In graphic terms, Figure 1 is a schematic representation of the just described process. Each sector is represented

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[12] Ibid., p. 10.

[13] Ibid., p. 14.

TABLE 1

THE INPUT-OUTPUT FORMAT

Outputs / Inputs	Consuming sectors (purchases): A Purchases from	B Purchases from	C Purchases from	Final demand sector: D Exported goods and services to rest of the world	Total output
Producing sectors (sells): A Sells to	$XXX	$XXX	$XXX	$XXX	$XXXX Total sales or output of A
B Sells to	$XXX	$XXX	$XXX	$XXX	$XXXX Total sales or output of B
C Sells to	$XXX	$XXX	$XXX	$XXX	$XXXX Total sales or output of C
Non-local inputs Imported goods and services from rest of the world	$XXX	$XXX	$XXX	$XXX	
Total inputs	$XXX Total purchases of A	$XXX Total purchases of B	$XXX Total purchases of C		**Gross volume of activity** *inputs = outputs*

Basic format of an input/output table (using dollar transactions for a single urban area). Source: Arthur D. Little, Inc., ***The Metropolitan Stockton Economy, Analysis and Forecast*** **(San Francisco: Arthur D. Little, Inc., 1964), p. 21.**

by the letter X with a subscript which corresponds to a number delineation; for example X_j. The flow between sectors is the letter "a" with the appropriate subscript, such as "a_{ij}," indicating the flow from sector "j" to sector "i." Taken together, these "a's" form the A matrix referred to in the formula. The letter "y" represents final demand on the three sector systems from the Rest of the World (ROW). The dashed line between ROW and the Environment indicates they are in essence the same. The system thus receives input from and produces output for the environment.

By combining the format in Table 1 with the concepts schematically represented in Figure 1, an idealized input-output system can be illustrated. Table 2 is such a representation. This five-sector example shows the income from the rest of the world proportioned across the five sectors. The numbers in each cell correspond to the "a" coefficients or flow coefficients described earlier. Thus, by examining each column, the distribution of all income in that sector can be discovered. The coefficients are analogous to percentages. Any one sector's income is derived from the rest of the world plus the internal flows into that sector from the other sectors of the system.

> For example, let us consider the income of sector 3 . . . its income consists of the income from the rest of the world, E_3, and various proportions of the income of the other sectors being expended in Sector 3. For instance, if the total income to Sector 4 were 200 units, then 50 percent or 100 units would be received by Sector 3 as income from Sector 4. The

TABLE 2

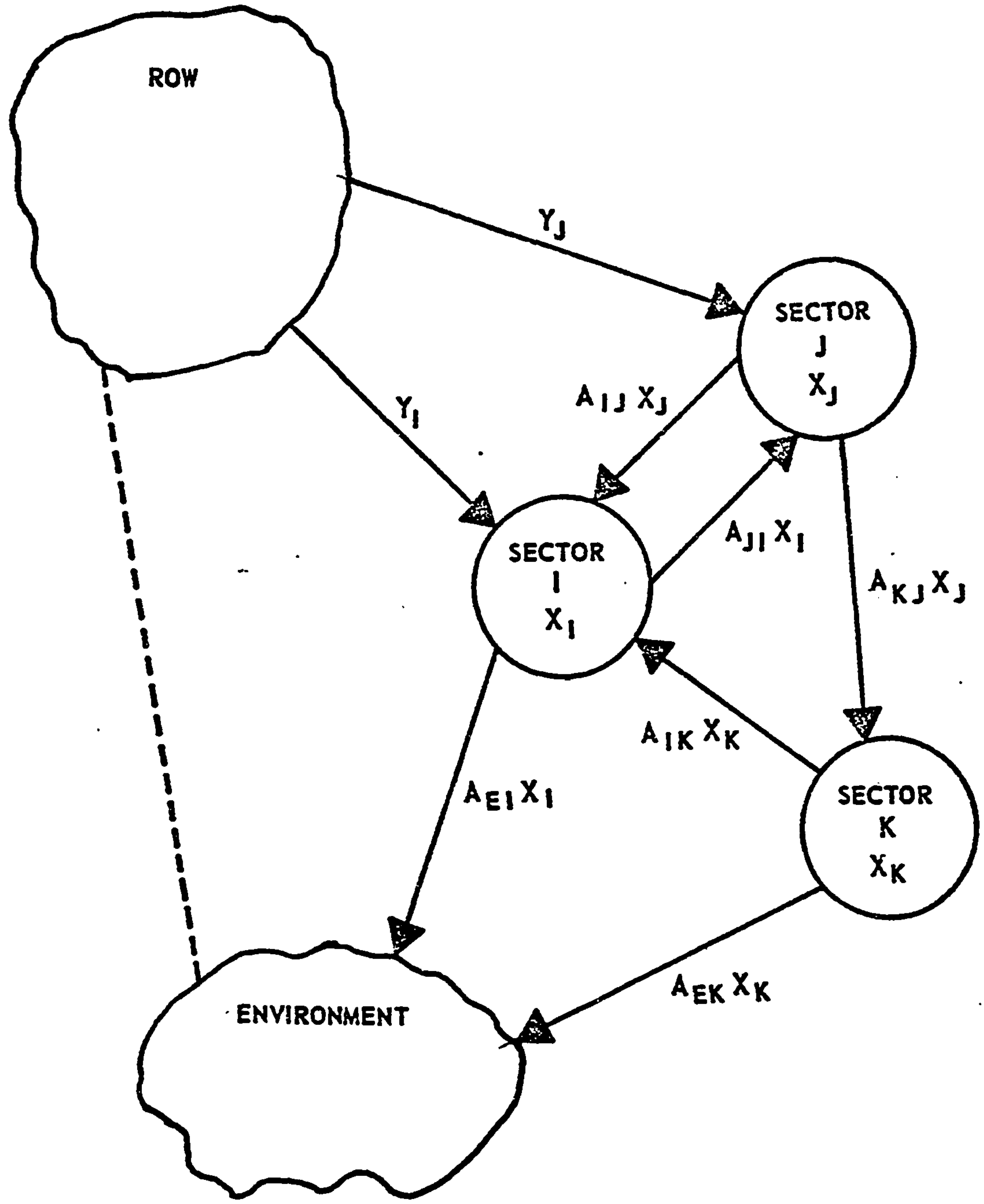
HYPOTHETICAL TABLE OF FLOW COEFFICIENTS

Sectors	1	2	3	4	5	E Income from ROW
1	.21		.09	.03		E_1
2	.01	.08	.07	.29		E_2
3	.03	.20		.50	.07	E_3
4	.31	.02	.38		.03	E_4
5	.10	.25	.26	.01	.04	E_5
ROW	.34	.45	.20	.17	.86	

SOURCE: Hays Gamble and David Raphael, A Micro Regional Analysis of Clinton County, Pennsylvania (University Park: The Pennsylvania State University, Pennsylvania Regional Analysis Group, February, 1965).

FIGURE 1.

THE INPUT-OUTPUT PROCESS



> total income into a sector we also call the sector's total economic activity, since it represents the total money flowing into and out of a given sector. Thus, if we want to describe what is happening economically to a given region with respect to the money-flows, we need to know two things: (1) the income from the rest of the world to each sector, and (2) the coefficients which relate each sector to the others. These two things are sufficient to determine the economic activity of each of the other sectors.[14]

It should be noted that the coefficients relating each sector to the others are based on homogeneous units--in this case dollars. Dollars are the most meaningful measure to determine exchange among sectors. Other units might include persons, raw materials, or other goods.[15] Money flows capture more fully the true nature of transactions among sectors. Unlike some other measures, dollars are not converted to a different type of unit as they flow from sector to sector. As a result of the commonality of units of flow among sectors, proportions can be obtained on this basis. Knowledge of total activity in dollar terms for any one sector derives from these commonly based proportions flowing into a sector and the flow from the rest of the world. In algebraic terms:

> Let Y_i be the input from ROW to Sector i in a given time period. And let a_{ij} be the percentage of inputs to sector i that flow in from Sector j during the same time period. Then X_i, the activity level of

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[14]Hays Gamble and David Raphael, A Micro Regional Analysis of Clinton County, Pennsylvania (University Park: Regional Analysis Group, The Pennsylvania State University, February 1965).

[15]Raymond E. Willis, "An Input-Output Model for Manpower Planning in Large-Scale Systems," Unpublished paper, Navy Personnel Research and Development Center, April 1976.

Sector i for the given time period, can be expressed by:

$$X_i = Y_i + a_{ij}X_2 + . . . +a_{ni}X_n \quad (4)$$

where: n = number of sectors in the system.[16]

Purpose of the Model

Since by this point it is understood that a model is an analog or formal representation of a real system, the need for such a model should be clearly set out; a statement of purpose. While the purpose of the Toronto model was the major theme of the first chapter, a well articulated statement was left until now as an important component of the total model.

The premise of the Toronto model is that models used in the past for policy analysis in political science have not completely fulfilled the definition of a "systems model" they purport to represent. Instead, such models have been listings of variables which might or might not be true system parts (subsystems). Even granting that such variables are in fact part of the system, there are no well established linkages to verify that these variables in fact form a system. This is the point of departure for the Toronto model.

The Toronto model is a fully developed systems model. The first attribute of a systems model is the achievement of

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[16]Edward F. Stafford, "A General Simulation Model for Multifacility Outpatient Clinics" (Ph.D. dissertation, Pennsylvania State University, 1976).

an understanding of the system.[17] This is done with the full elaboration of the interrelated parts or sectors of the system and the flows between them. The second attribute of a systems model is the visibility of the solution attained with the model.[18] That is to say, the model allows for the researcher to determine how and in what magnitude the sectors affect each other. Clearly, such a solution is desirable for the study of urban public policy, and the Toronto model developed here yields such a solution.

The System to Be Modeled

The first problem to be addressed by input-output analysis is to bound the system on which the model is based. There arises from this problem yet another, the question of why the system was chosen for modelling purposes.

The Municipality of Metropolitan Toronto, Canada, is the city upon which the proposed input-output model is based. What has not been fully elaborated upon is why this city was chosen. There are two reasons. First, Toronto is a major metropolitan area in North America. Thus, while it is in a "Foreign" country, it is not so far removed from American experience that its development and the concomitant problems of its urban development cannot be understood by American researchers. The second reason it was chosen stems from its

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[17] Jack Lapatra, Applying the Systems Approach to Urban Development (Stoudsburg, Penn.: Dowden, Hutchinson, and Ross, Inc., 1973), p. 4.

[18] Ibid.

uniqueness. Because it is geographically and politically coterminous with respect to its boundaries, Metropolitan Toronto is especially suited to conceptualization as a single system and, therefore, particularly useful for ease of application of the input-output tool. This feature of the city allows a model-builder to dispense with the problem so often faced by researchers using single cities for models in the U.S. The problems of clear identification and demarcation of a geographic region corresponding to a model are minimized by using the Municipality of Toronto. (Chapter 3 will detail the history, government structure, and geographic boundaries of Toronto more fully.)

Sectors: Derivation from SIC Classifications

The issue of which sectors to include in the model is akin to the problem of aggregation encountered so often in traditional social science research. If the data are aggregated at too broad a level, the researcher loses depth of information. In the opposite direction, if the data are disaggregated to individual functions, the analyst builds a certain inflexibility into the model because such detail does not fully allow for relative changes in output among entities producing similar products in a sector.[19]

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[19] Walter Isard and Thomas Langford, Regional Input-Output Study: Recollections, Reflections, and Diverse Notes on the Philadelphia Experience (Cambridge, Mass.: MIT Press, 1971), p. 45.

The Standard Industrial Classification System (SIC) has come to be the guidepost for the analysts using the input-output technique. The SIC has come to be refined to such an extent that it has helped solve many of the aggregation problems for researchers.[20] The SIC system of aggregation involves several levels. At its broadest level, the SIC is based on major economic divisions: agriculture, mining, manufacturing. At the next lower level of disaggregation, the system groups production entities on a commodity basis, i.e., primary metal, metal fabrication, food products. At the third level of disaggregation, producers are grouped not only by commodity, but also by process (iron and steel mills, structural steel, bakeries). Research indicates that the most accurate flow coefficients are derived from this third level of disaggregation.[21]

Despite the fact that the most desirable data for an input-output model is at the commodity/process level, there is no reason that all sectors must be based on this scheme.[22] Many times the data are simply not available in this form. One may also encounter a broadly aggregated sector that may contain too few producing entities to usefully disaggregate

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[20]Ibid.

[21]Gerald Karaska, "Variation of Input-Output Coefficients for Different Levels of Aggregation," Journal of Regional Science 8 (Winter 1968).

[22]Isard and Langford, Regional Input-Output Study, p. 50.

to the process or commodity level. When either of these situations occur or when there is an absence of data, the researcher may be forced to create a model with differently aggregated sectors. This is not a debilitating problem for the model so long as the specific sector mix is appropriate for the system being modeled.[23]

In the Toronto model there is another constraint on the sectors. Because of the enormous cost attendant to setting up an original input-output model, the Toronto model is estimated from an Ontario Provincial model. The Toronto model is therefore confined to sectors as they exist in the Ontario model. On the positive side, however, is the fact that the Ontario model's sectors conform to the SIC method of aggregation. Also, of positive value to the Toronto model is that the sectors used for Ontario are the same as exist in Toronto with the exception of agriculture and mining.[24] There is no significant agriculture or any resource mining in the Toronto area. Thus, they are not included as sectors in the model.

The Model: Toronto's Sectors

From the outset it should be understood that the model for Toronto is by necessity estimated from an existing regional

[23] Ibid., p. 51.

[24] This can be confirmed by comparing the census of Manufactures for Toronto against the Sectors of the Ontario Model.

table (as pointed out above). The problems of data collection related to input-output studies are usually quite large, especially in terms of cost.[25] Many times, in the absence of data, estimates are interpolated from regional or even national tables.[26] Naturally, this introduces an amount of error into the calculations. Nevertheless, a reasonable approximation of the system can be obtained.[27] Also, the amount of error introduced in such estimations must be weighed against having no model at all. Since there is not now, nor has there ever been at any time in the past, an input-output model of Toronto, the choice favors an estimated model rather than no model at all.[28]

The Logic of Model Estimation

The estimation of the Toronto model poses significantly fewer problems for a potential modeler than is the usual case involving estimates from regional tables in the U.S. In the first instance, all the manufacturing sectors in Ontario are homogeneous with those of Toronto. One would not expect to encounter this situation in metropolitan areas

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[25] Ian Masser, Analytical Models for Urban and Regional Planning (New York: Halsted Press Division, John Wiley and Sons, Inc., 1972), p. 79.

[26] Ibid.

[27] Chiou-Shuang, Introduction to Input-Output Economics (New York: Holt, Rinehart, and Winston, 1969), pp. 103-123.

[28] This was confirmed in a personal interview with spokesmen for the University of Toronto.

of the United States.[29] Second, Toronto is such an enormous portion of the productive capacity of the Province of Ontario that it represents in large measure the flows within the province. In fact, one analyst has argued that with the exclusion of the mining and agricultural sectors, one could use the existing table as a surrogate for a Toronto table.[30] Of course, if one were to carry out such an analysis using the Ontario model, while it might be a reasonable approximation, it would tend to overstate the effect of Toronto. This is because the table does include data from all over the province. Therefore, it is more appropriate to remove the influences of non-Toronto data from the provincial table. This, of course, does not rule out error altogether. Using this second approach will tend to understate the influence of Toronto. In the absence of exact data, the situation calls for a conservative approach. In an initial exploration of otherwise uncharted areas it pays to be somewhat cautious.

There is no question that the "best" model for Toronto would be one based on primary data. Primary data of the kind needed for input-output analysis is obtained from field

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[29] Erik J. Stenehjim, "Forecasting the Local Economic Impacts of Energy Resource Development: A Methodological Approach," Argonne National Laboratory, 1975.

[30] Interview with R. H. Frank of the Econometric Division of the Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs. Mr. Frank was in charge of the input-output analysis of the Ontario model.

research using a census of all economic entities in the area. When a census is not available, survey techniques are applied to gather the data. In either case the costs of doing this kind of field research are enormous, amounting to millions of dollars. Field research also requires thousands of hours from a research staff to compile and analyze the data, thus adding further to the costs. The household sector requires personal interviews necessitating the respondent to go through his personal records to obtain the information on his income and detailed information on its outgo, for example.

Practically speaking, then, estimation is necessitated by economic constraints. Estimation procedures economize on money, time, and personnel. The amount of each which would have to be committed to collect primary data in Toronto is enormous. Even then, however, estimates would still have to be made. It would be extremely difficult to undertake a complete census of all economic units in Toronto with complete detailed records on income and spending. Survey analysis would be required and this is, of course, an estimation procedure itself. Missing data would most likely be a problem which calls for reliance on a regional table anyway.

When viewed as a preliminary effort, an estimated model is most useful. Producing an estimated model can be a reason for funding more in-depth research. It can also insure a new model may be more effectively designed.[31] New and more elaborate sectors could be developed. More attention could possibly be focused on a particular aspect of the model. Such benefits as these transcend the merely practical, and verge on the theoretical.[32] It is at the theoretical and substantive knowledge levels that an estimated model of Toronto is more beneficial.

Certainly, there are problems of accuracy involved in an estimated model. Simply by using the term "estimated model" some inaccuracy is initially introduced. Using an estimated model in the Toronto case is nevertheless justifiable. By employing such a model, the type and number of observations for an area such as Toronto are expanded because none would exist otherwise.[33] The Toronto model estimated herein provides a comprehensive empirical study of a unique, modern urban area. The model is a true systems model complete with its interdependences clearly elaborated. This is an important empirical step within political science's policy research tradition.

Because of the nature of estimation, caution and prudence must be utilized. Wherever it is possible, the

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[31]Herbert H. Hyman, Secondary Analysis of Sample Surveys: Principles, Procedures, and Potentialities (New York: John Wiley and Sons, Inc., 1972), p. 8.

[32]Ibid.

[33]Ibid., p. 11.

most reliable data are used, but in the greatest portion of the model estimates are made. Despite the potential dangers in this remaking of the data, there is ample precedent for such procedures in input-output analysis, as well as in other methodologies.[34] The precedents indicate estimation is a legitimate scientific endeavor. When faced with the lack of general knowledge about certain phenomena and the constraints on data collection, estimation produces results where none are possible. Viewed in the right perspective, such an estimated model can be of value in scientific research.

The Ontario Model

The table for Ontario from which estimates for Toronto are made is presented in Table 3. The year for which the Ontario model was constructed is 1965. This year must of necessity become the base year from which the input-output Toronto matrix is made. At first glance, there may appear to be a considerable time period to have elapsed between 1965 and the present. Without minimizing this elapsed time, it should be pointed out that given the enormity of the task in putting together an original input-output structure it is not unusual for such a long time to pass before getting to the computation of the technical coefficients matrix.

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[34] B. G. Glazer, "Retreading Research Materials: The Use of Secondary Analysis by the Independent Researcher," The American Behavioral Scientist 8 (June 1963): 11-14.

TABLE 3

INTER-INDUSTRY FLOW OF GOODS AND SERVICES, ONTARIO, 1965
(Producers' Prices in Thousands of Dollars)

Industry	Agri., Forestry, & Fish. 1	Mining 2	Food Prod. 3	Dist. & Soft Drinks 4	Tobacco 5	Rubber and Leather 6	Textile Mills 7	Cloth. Indus. 8	Wood & Wood Prod. 9
Agri., Forest., Fishing	101,927	0	837,128	4,025	69,995	0	924	7,267	3,897
Mining	53	44,924	5,692	743	43	1,353	1,228	39	597
Food Products	170,346	4	635,232	37,997	6	27,136	249	265	0
Distilleries & Soft Drinks	0	0	372	9,988	0	0	0	0	0
Tobacco Products	0	0	0	0	24,984	0	0	0	0
Rubber and Leather	7,592	0	0	0	0	91,247	3,197	369	200
Textile Mills	6,340	868	5,859	0	2	48,771	278,133	90,002	24,731
Clothing Indus.	0	0	0	0	0	40	156	10,479	0
Wood & Wood Prod.	3,023	92	1,870	266	775	298	2,949	0	113,255
Pulp and Paper	760	741	83,169	20,005	7,571	6,344	14,012	1,786	7,797
Iron & Steel Mills	0	13,610	844	0	2,487	0	1,376	0	1,573
Metal Industries	28,004	25,064	51,474	6,772	9	7,465	1,119	128	36,897
Transportation Equipment	757	1,104	0	0	0	71	0	0	265
Electrical Indus.	1,238	0	0	0	0	0	40	0	1,506
Non-Metallic Indus.	135	3,116	11,355	11,477	0	1,297	1,179	0	3,572
Petroleum & Coal	35,642	10,187	8,035	1,290	134	1,600	2,429	149	1,523
Plastics & Resins	12	14	13,466	0	1,063	44,026	4,787	96	8,984
Chemical Indus.	57,184	38,430	33,109	2,419	60	27,595	57,241	245	5,725
Other Industries	275	72	2,640	2,886	45	7,368	3,455	7,354	2,029
Construction	32,248	18,011	6,032	1,418	502	1,312	2,468	213	2,047
Transport. & Trade	93,577	34,868	134,068	11,947	6,713	21,792	24,239	12,812	43,272
Other Services	82,728	74,195	57,805	17,009	2,969	20,540	20,721	8,618	19,178
Uncallo. Sectors	69,348	88,833	133,042	46,705	9,415	36,908	33,458	9,669	25,153
Wages and Salaries	358,663	171,437	343,791	66,102	14,557	141,907	144,752	61,958	153,399
Other Value Added	244,544	304,810	218,222	129,037	31,133	78,073	94,811	50,664	63,912
Total Inputs (Rows 1+...+25)	1,294,396	830,380	2,583,205	370,086	172,463	565,143	692,923	262,133	519,512

TABLE 3, continued

Industry	Pulp and Paper 10	Iron & Steel Mills 11	Metal Indus. 12	Trans. Equip. 13	Elect. Indus. 14	Non-Metal. Indus. 15	Petro. & Coal 16	Plastics & Resins 17	Chem. Indus. 18
Agri., Forest., Fishing	102,457	6	3	2	0	80	0	0	3,214
Mining	17,137	132,707	5,830	8,152	1,836	27,842	329,021	37	22,740
Food Products	4,216	34	837	0	0	305	0	2,038	59,188
Distilleries & Soft Drinks	631	0	0	0	0	0	0	77	2,541
Tobacco Products	0	0	0	0	0	0	0	0	0
Rubber and Leather	157	0	634	75,372	2,151	4,637	97	47	5,668
Textile Mills	5,624	30	1,511	62,105	3,207	1,190	0	8	1,733
Clothing Indus.	0	0	0	0	0	0	0	0	69
Wood & Wood Prod.	12,997	2,483	9,614	8,133	1,381	1,644	216	212	1,146
Pulp and Paper	368,894	13,187	12,375	7,924	10,847	13,617	867	676	44,549
Iron & Steel Mills	7,873	501,190	924,561	440,926	392,703	4,421	9,331	0	8,376
Metal Industries	2,921	36,229	217,087	118,126	11,249	5,396	5,935	222	23,770
Transportation Equipment	0	5,236	54,155	1,042,871	1,564	0	0	0	116
Electrical Indus.	0	5,579	15,484	62,721	169,008	1,777	0	477	10,587
Non-Metallic Indus.	6,538	27,491	1,024	42,827	18,180	94,976	96	586	12,244
Petroleum & Coal	7,407	23,165	3,368	4,229	1,405	6,420	44,604	518	52,313
Plastics & Resins	19,317	243	682	1,617	28,008	1,050	0	13,548	19,907
Chemical Indus.	40,923	16,040	18,916	32,061	14,771	5,604	25,237	112,231	247,930
Other Industries	1,731	4	2,815	21,255	7,098	290	249	18,494	12,042
Construction	6,300	12,862	9,587	17,250	3,513	3,445	8,770	678	8,125
Transport. & Trade	71,072	63,643	99,212	174,180	54,865	40,294	51,496	2,377	69,088
Other Services	91,378	66,796	108,428	84,129	62,684	32,341	7,758	2,398	71,256
Unallo. Sectors	99,615	104,839	152,797	165,410	81,770	53,760	6,450	4,167	123,873
Wages and Salaries	449,924	391,870	674,673	599,129	360,070	132,249	23,572	8,581	208,592
Other Value Added	290,864	392,740	433,208	331,909	194,128	99,887	53,759	7,959	230,973
Total Inputs (Rows 1+...+25)	1,607,976	1,796,374	2,746,801	3,300,328	1,420,438	531,135	567,458	175,331	1,240,040

TABLE 3, continued

Industry	Other Indus. 19	Construction 20	Trans. & Trade 21	Other Services 22	Unallo- Sectors 23	Personal Consump. Expend. 24	Invest- ment 25	Changes in Inventories 26	Provin. Govt. Expend. 27
Agri., Forest., & Fishing	941	11,302	75,308	29,182	6,088	192,679	0	4,012	1,432
Mining	1,270	29,439	2,734	4,177	34	0	0	15,229	2,650
Food Products	270	0	5,439	193,023	31,416	1,300,411	0	9,702	3,284
Distilleries & Soft Drinks	0	114	3,037	11,337	22,998	304,121	0	1,904	144
Tobacco Products	0	0	0	0	0	47,562	0	-413	44
Rubber & Leather	14,658	10,127	9,890	1,698	44,324	114,377	402	-279	317
Textile Mills	13,286	20,531	15,040	16,724	7,499	217,857	3,128	8,592	518
Clothing Indus.	305	0	6,114	513	2,128	462,208	0	580	136
Wood & Wood Prod.	13,360	178,419	3,381	7,371	449	145,194	42,799	5,661	885
Pulp and Paper	20,588	27,760	33,952	16,475	343,496	100,379	0	6,440	1,182
Iron & Steel Mills	37,642	147,408	2,896	976	3,722	6,715	0	96,325	308
Metal Industries	28,204	367,388	15,442	8,628	213,267	109,590	497,197	47,547	11,710
Transport. Equip.	464	3,562	23,034	0	53,100	1,134,957	314,176	35,472	592
Electrical Indus.	13,023	114,934	1,556	388	43,805	159,461	155,949	13,619	774
Non-Metallic Indus.	8,077	198,902	1,130	1,956	7,701	33,956	0	3,922	1,679
Petroleum & Coal	1,315	39,233	86,910	20,201	2,100	230,855	0	1,994	2,638
Plastics & Resins	58,076	377	1,144	237	400	1,611	0	1,389	1
Chemical Indus.	7,139	26,754	1,648	30,725	81,708	179,370	0	8,251	2,200
Other Industries	43,167	22,159	5,169	11,480	56,564	137,836	50,288	8,714	736
Construction	2,217	1,808	76,741	423,853	0	0	2,532,496	0	0
Transport. & Trade	23,815	342,664	272,076	97,466	511,495	3,091,327	692,637	67,205	46,369
Other Services	31,081	148,943	354,458	734,195	464,296	4,550,197	89,228	14,769	48,758
Unallo. Sectors	68,440	23,535	312,504	361,708	0	399,336	0	21,255	643
Wages and Salaries	188,502	1,116,382	1,743,107	1,649,936	0	0	0	0	243,000
Other Value Added	74,128	340,155	1,095,607	3,705,758	2,915	0	0	0	0
Total Inputs (Rows 1+...+25)	649,968	3,171,896	4,148,317	7,328,007	1,899,505	12,919,999	4,378,300	371,890	370,000

TABLE 3, continued

Industry	Munic. Govt. Expend.	Federal Govt. Expend.	Exports	Imports	Total Final Demand*	Total Output Demand**
	28	29	30	31		
Agri., Forest., & Fishing	727	924	270,639	- 429,763	40,650	1,294,396
Mining	3,254	3,773	699,733	- 531,887	192,752	830,380
Food Products	544	1,029	971,851	- 871,617	1,415,204	2,583,205
Distilleries and Soft Drinks	82	1	154,203	- 141,464	318,991	370,086
Tobacco Products	35	0	105,336	- 5,085	147,479	172,463
Rubber & Leather	411	99	316,374	- 138,623	293,078	565,143
Textile Mills	206	2,242	273,193	- 416,027	89,709	692,923
Clothing Industries	842	1	199,219	- 420,657	242,329	262,133
Wood & Wood Products	3,139	1,768	146,428	- 189,696	156,178	519,512
Pulp and Paper	2,315	5,348	654,523	- 219,603	550,584	1,607,976
Iron and Steel Mills	6,228	1,236	707,159	- 1,523,512	-705,541	1,796,374
Metal Industries	18,560	5,003	1,482,132	- 635,734	1,536,005	2,746,801
Transportation Equipment	1,253	808	2,010,012	- 1,383,241	2,114,029	3,300,328
Electrical Industries	905	1,495	870,144	- 224,032	978,315	1,420,438
Non-Metallic Industries	8,996	3,335	184,888	- 159,500	77,276	531,135
Petroleum & Coal Prod.	4,325	3,748	195,313	- 225,592	213,281	567,458
Plastics and Resins	10	43	28,603	- 73,380	-41,723	175,331
Chemical Industries	1,727	6,026	583,566	- 424,795	356,345	1,240,040
Other Industries	836	4,021	419,171	- 200,455	421,327	649,968
Construction	0	0	0	0	2,532,496	3,171,896
Transportation & Trade	29,472	38,663	0	- 2,074,387	1,891,286	4,145,317
Other Services	93,131	182,526	499,695	- 714,201	4,764,103	7,328,007
Unallocated Sectors	0	101,732	61,541	- 696,311	-111,804	1,899,505
Wages and Salaries	838,000	718,000	0	0	1,799,999	10,802,153
Other Value Added	0	0	0	0	0	8,469,196
Total Inputs (Rows 1+...+25)	1,014,998	1,082,001	10,833,723	-11,699,562	19,271,349	57,145,164

*(Columns 24+...+31). **(Columns 1+...+31).

This is not a debilitating problem.[35] Furthermore, it takes generally a decade or longer for any changes in technology to fully affect the flows within a system and thus the coefficients.[36] Even so, one of the simplifying assumptions of all input-output analyses is that the coefficients remain stable over time. This assumption allows for projections into the future as well as simulation of past performance. The point is that just because 1965 was taken as the base year the elapsed time between then and now does not invalidate the model, but, in fact, selection of past years as bases is very common in input-output studies.

As mentioned earlier with regard to the sectors, those used in the model are homogeneous with those of Toronto with the exception of Agriculture, Forestry, and Fishing (Sector 1) and Mining (Sector 2). Thus, with the removal of Sectors 1 and 2, the Toronto model is composed of 21 industrial sectors. The Wages and Salaries sector (Sector 24), renamed Households, and Value Added sector (Sector 25) remain intact. This is because these sectors are part of the existing A matrix. When displayed in typical input-output tabular form, these sectors form the matrix discussed earlier when

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[35] See, for example, Anne P. Carter, "Changes in the Structure of the American Economy, 1947 to 1958 and 1962," Review of Economics and Statistics 49 (February 1967): 209-224. Ms. Carter notes that at least eight years have elapsed between the case year data and her analysis.

[36] James Heilbrum, Urban Economics and Public Policy (New York: St. Martin's Press, 1974), pp. 155-156.

their dollar amounts are converted to ratios based on the column totals.

The Final Demand sectors require alteration from their present form also. As the table is constructed, Personal Consumption, Investment, Changes in Inventories, and the Government Expenditures sectors are components of Final Demand. The most important of these must become more closely associated with the inter-industry flows. This is to say that Personal Consumption (renamed Households to match the Households row) and Municipal Expenditures columns must be balanced against rows which match them as inputs. These sectors must be present to calculate the inverse matrix of total demand.[37]

One other change is present in the Toronto model which makes it different from the Ontario model. The sectors outside the model fall into one category which is called simply the "Rest of the World." Money is conceived to flow into Toronto from the rest of the world, and then from Toronto back out to the rest of the world. This is a convention necessitated by the fact that Toronto is a subsystem acted upon in ways somewhat differently than Ontario as a whole. This also simplifies the final demands acting upon the region while maintaining the existing expenditure

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[37] Walter Isard et al., Methods of Regional Analysis: Introduction to Regional Sciences (Cambridge, Mass.: The MIT Press, 1960).

patterns within Ontario interpolated down to the Toronto level. With knowledge of (1) the income from the rest of the world to each sector and (2) the coefficients relating each of the sectors to the others, an economic description of Toronto is obtained.[38] Income from the rest of the world is determined by proportionately scaling down the Total Output column of the Ontario model to the Toronto level. The proportion by which each sector's output or income from the rest of the world is reduced is based on the ratio of employees working in the sectors of Toronto compared to those employed in Ontario in the corresponding sectors. For example, if there are 100 Food Products workers in Ontario and 50 in Toronto, the Ontario output of Food Products found in the Total Output column would be reduced 50 percent to represent Toronto's output for that sector. The proportions of that income spent in the various sectors remains intact from the Ontario model with certain exceptions. The Unallocated Sector is reduced by the proportion used to scale down the Total Output column. This was appropriate because the existing proportions reflect the entire Province and as a result would overrepresent Toronto. Practically, this is necessitated by data constraints as stated earlier: the inability to obtain the Toronto proportions by field research.

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[38] Hays B. Gamble and David L. Raphael, A Microregional Analysis of Clinton County, Pennsylvania (University Park: The Pennsylvania State University, February, 1965).

It is assumed that the proportions remain the same since the technology existent in the Ontario sectors to produce goods and services is the same for corresponding sectors in Toronto. Thus, the new Toronto model as estimated from Ontario data is shown as an A matrix in Table 4.

The model as it appears here is an A matrix of Equation 1. Combining the already established Ontario proportions with the newly computed ones for Toronto should yield an approximation of Toronto's economic relations. The new proportions for Toronto are those in the Households (Wages and Salaries), the Metro Government row, and the Value Added row. The Households data for Toronto come from the Census of Manufactures, published by Statistics Canada, and The Survey of Markets and Business, published by the Financial Post. This data required no reworking for inclusion in the model. The Metro tax data, which are the elements of the Metro Government Sector, required a different approach.

No tax data on a sector by sector basis is available from the Metro or its constituent municipalities. Records are simply not kept in this fashion. In order to obtain the data, a formula was used based on the fact that the tax revenue from business sectors comes to the Metro on the basis of property values. This formula was acquired from the Metropolitan Toronto Industrial Commission, which developed the formula to allow prospective businesses to gauge the amount

TABLE 4

TORONTO A MATRIX

Sectors	Food Prod.	Dist. Soft Dr.	Tobac.	Rubber & Leather	Textile	Cloth. Indus.	Wood & Wood Prod.	Pulp & Paper	Prim. Metal
Food Products	.245908	.102671	.000035	.048016	.000359	.001011	.000000	.002622	.000019
Distilleries & Soft Drink	.000144	.026988	.0	.0	.0	.0	.0	.000392	.0
Tobacco	.0	.0	.144866	.0	.0	.0	.0	.0	.0
Rubber & Leather	.0	.0	.0	.161548	.004614	.001408	.000385	.000098	.0
Textiles	.002268	.0	.000012	.086299	.401392	.343423	.047604	.003498	.000017
Clothing Industry	.0	.0	.0	.000071	.000225	.039976	.0	.0	.0
Wood & Wood Prod.	.000724	.000719	.004494	.000527	.004256	.0	.218003	.008083	.001382
Pulp & Paper	.032196	.054055	.043899	.011225	.020222	.006813	.015008	.229415	.007341
Primary Metal	.000327	.0	.014420	.0	.001986	.0	.003028	.004896	.047004
Metal Industry	.019926	.018298	.000052	.013209	.001615	.000488	.071022	.001817	.020168
Transport	.0	.0	.0	.000126	.0	.0	.000510	.0	.002915
Electrical Indus.	.0	.0	.0	.0	.000058	.0	.002899	.0	.003106
NonMetallic Indus.	.004396	.031012	.0	.002295	.001701	.0	.006876	.004066	.015304
Petroleum	.003110	.003486	.000777	.002831	.003505	.000568	.002932	.004606	.012895
Plastics & Resins	.005213	.0	.006164	.077902	.006908	.000366	.017293	.012013	.000135
Chemical Industry	.012817	.006536	.000348	.048828	.082608	.000935	.011020	.025450	.008929
Other Industry	.001022	.007798	.000261	.013037	.004986	.028054	.003906	.001077	.000002
Construction	.002335	.003832	.002911	.002322	.003562	.000813	.003940	.003918	.007160
Trade	.051900	.032282	.038560	.038560	.034981	.048876	.083294	.044200	.002378
Other Services	.022377	.045960	.017215	.036345	.029904	.032876	.036915	.056828	.002496
Unallocated	.051503	.038138	.054591	.065307	.011440	.036886	.048417	.061951	.003417
Households	.085813	.043274	.084406	.270629	.112864	.239146	.226324	.177280	.156682
Metro Government	.001926	.000935	.010897	.000617	.003219	.007728	.005623	.003400	.003001
Value Added	.171180	.068103	.180519	.045952	.111335	.007181	.062064	.106950	.277524
ROW	.269612	.515913	.397925	.074444	.158260	.203460	.132937	.244818	.427625
TOTAL	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

TABLE 4, Continued

	Metal Indus.	Trans-port.	Elect.	Non Metallic	Petrol.	Plastics & Resins	Chemical Indus.	Other Indus.	Const.
Food Products	.000305	.0	.0	.000574	.0	.011624	.047731	.000415	.0
Distilleries & Soft Drink	.0	.0	.0	.0	.0	.000439	.002049	.0	.000036
Tobacco	.0	.0	.0	.0	.0	.0	.0	.0	.0
Rubber & Leather	.000231	.022838	.001514	.008730	.000171	.000268	.004571	.022552	.003193
Textiles	.000550	.018818	.002258	.002240	.0	.000046	.001398	.020441	.006473
Clothing Industry	.0	.0	.0	.0	.0	.0	.000056	.000469	.0
Wood & Wood Prod.	.003500	.002464	.000972	.003095	.000381	.001209	.000924	.020555	.056250
Pulp & Paper	.004505	.002401	.007636	.025638	.001528	.003856	.035925	.031675	.008752
Primary Metal	.352093	.005954	.095268	.008324	.016444	.0	.006755	.057914	.046473
Metal Industry	.079033	.035792	.007919	.010159	.010459	.001266	.019169	.043393	.115826
Transport	.019716	.004564	.001101	.0	.0	.0	.000094	.000714	.001123
Electrical Indus.	.005637	.019004	.118983	.003346	.0	.002721	.008538	.020036	.036235
NonMetallic Indus.	.000373	.012977	.012799	.178817	.000169	.003342	.009874	.012427	.062708
Petroleum	.001226	.001281	.000989	.012087	.078603	.002954	.042187	.002023	.012369
Plastics & Resins	.000248	.000490	.019718	.001977	.0	.077271	.016054	.089352	.000119
Chemical Industry	.006887	.009714	.010399	.010551	.044474	.023497	.199937	.010984	.008435
Other Industry	.001025	.006440	.004997	.000546	.000439	.105480	.009711	.066414	.006986
Construction	.003490	.005227	.002473	.006486	.015455	.003867	.006552	.003411	.000570
Trade	.036119	.000762	.016971	.075864	.090749	.013557	.024675	.036640	.016247
Other Services	.015219	.025491	.019390	.060890	.013671	.002619	.025449	.047819	.046957
Unallocated	.055627	.050119	.057567	.035561	.011366	.023766	.099894	.064254	.007420
Households	.162063	.128816	.152950	.183307	.003266	.026888	.066904	.171639	.344697
Metro Government	.003202	.002356	.003464	.000352	.002131	.001296	.000376	.001594	.005844
Value Added	.027450	.004784	.170326	.105156	.007449	.052063	.954461	.027159	.099977
ROW	.221501	.639708	.292205	.263132	.703245	.206826	.316716	.248120	.113310
TOTAL	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

TABLE 4, Continued

	Trade	Other Services	Unallo- cated	House- holds	Metro Govt.	Percent Total	Total Output
Food Products	.0	.026340	.016539	.078636	.000535	.006928	958020670
Soft Drinks	.000732	.001547	.012107	.018390	.000080	.000808	111843690
Tobacco	.0	.0	.0	.002876	.000034	.000034	4742733
Rubber & Leather	.002384	.000232	.023335	.006916	.000404	.009032	124890460
Textiles	.003626	.002282	.003948	.013173	.000202	.011874	164179881
Clothing Industry	.001474	.000070	.001120	.027949	.000829	.013283	183670086
Wood & Wood Prod.	.000815	.001006	.000236	.008779	.003092	.011658	161202182
Pulp & Paper	.008185	.002248	.180834	.006069	.002280	.049909	690088093
Primary Metal	.000698	.000133	.001959	.000406	.006135	.008721	120594554
Metal Industry	.003722	.001177	.112275	.006626	.018285	.076593	1059031797
Transport	.005553	.0	.027955	.068631	.003448	.003448	47675559
Electrical Indus.	.000375	.000053	.023061	.009642	.000891	.045139	624129514
Nonmetallic Indus.	.000272	.000267	.004054	.002053	.008863	.013518	186921378
Petroleum	.020951	.002757	.001106	.013959	.004261	.018618	257433556
Plastics & Resins	.000276	.000032	.000211	.000097	.000009	.002428	33582900
Chemical Industry	.000397	.004193	.043015	.010846	.001701	.039720	549198820
Other Industry	.001246	.001567	.029778	.008335	.000823	.028660	396283344
Construction	.018499	.057840	.0	.0	.142538	.034502	477053158
Trade	.065587	.013300	.083499	.057964	.029063	.072173	997919138
Other Services	.085446	.100190	.075794	.189832	.091754	.049214	680478730
Unallocated	.007533	.049360	.0	.024148	.047754	.042599	589006108
Households	.013138	.215077	.0	.010746	.144508	.387161	5353252984
Metro Government	.015057	.023795	.002375	.021512	.399790	.020772	287212507
Value Added	.099977	.404928	.0	.0	.0		
ROW	.666664	.182496	.356799	.283446	.094961		13826711840
TOTAL	1.000000	1.000000	1.000000	1.000000	1.000000		

of taxation required from them by the Metro government.[39] The tax revenue from Households going to Metro was obtained from the Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs, Municipal Finance Division. The household taxes going to Metro are residential property taxes and reflect no sales tax levies which are not used by Metro.

The final row has already been referred to above as the "Rest of the World" (ROW). This row reflects the fact that Metro operates in a larger system and, therefore, receives input from that larger system. The "Rest of the World" row also reflects the fact that the model is constructed to balance. That is to say, each sector spends as much as it takes in. The balance can be seen in that each of the column totals equals one (1).

Justification for Model Simulation

The model as it exists in the A matrix is a static Leontief model. It gives a picture of the Toronto region for 1965. While this is valuable by itself, the model does not have the dynamic qualities called for by Chapter 1. This quality can be obtained by successive use of the model over

[39]The formula is based on an early survey of businesses taken by the Industrial Commission. It is based on the total square footage taken up by the business. This square footage is divided by the number of employees to obtain an employee per square foot figure. This figure in turn is multiplied by the number of employees in a given industry to get a base figure for tax purposes. By multiplying such a figure by tax per square foot which in 1965 was 40 cents, a total tax figure is gained.

several time periods. In order to perform such a dynamic operation the coefficients relating sectors are assumed to remain the same over time. With such a simplifying assumption, the model can be used to reproduce the data with which it was constructed to validate the model. Then, true simulation can proceed to judge impacts caused by various changes in the outside world on Toronto and within/between the sectors, especially the government sector.

Since it is the Metro Sector which is of greatest interest to this research, it is the focus of the simulation. The object is to determine impacts from some levels of expenditures over time and in the future. From these simulated expenditures judgments can be made on the policy impacts within the system that result from Metro activities. Further, indications of the impact of internal sector changes can be gained both on the nongovernment sectors and on the Metro.[40]

Justification for the Research

For the most part, the changes in the Ontario model which yield the estimated Toronto model are technical in nature, requiring fairly straightforward statistical manipulations. The most significant change, however, is the addition of a Metro government sector to the internal structure of the economic system. The addition, while also technical,

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[40]Harold Guetzkow, ed., Simulation in Social Science (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1962), p. 3.

has its greatest significance in the theoretical implications of such an addition. Simply, yet profoundly, the addition of the Metro as a sector internal to the existing economic interdependencies alters the model from its traditional application as a purely economic tool of analysis to one which can be (and is here) applied to public policy analysis.

With a systems model such as this, two kinds of assessments can be made. First, a descriptive analysis is facilitated. Second, the model allows an evaluative assessment of the system. Combining these two important perspectives allows for novel and insightful analysis.[41] The model provides an ability to trace the paths of interaction of the system. This is novel in the political science literature. Furthermore, it isolates interdependencies to facilitate an understanding of the control mechanisms at work. This certainly is insightful.

Insight comes both in the manner just mentioned, which is in effect looking inside the now famous "black box" developed so long ago,[42] and in another equally fundamental

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[41]Bernard L. Brock, James W. Chesebro, John Cragan, James F. Klumpp, Public Policy Decision-Making: Systems Analysis and Comparative Advantages Debate (New York: Harper and Row, 1973), p. 52.

[42]David Easton, The Political System (New York: Alfred A. Knopf, Inc., 1935). While the "black box" is not the exclusive province of political science, it is the work of Easton which brought it to the attention of political science.

way. This second mode of insight comes with regard to exactly what policy analysis really is.

During the decades of the 1950s and the 1960s the term "policy analysis" was used by political scientists to refer to the use of statistical analysis of public policy reflected in public expenditures and then to rank the expenditure on some scale such as liberalism, conservatism, or innovation.[43] During the middle 1960s economists began using the term policy analysis to mean economic analysis of "public choices" (to build or not to build a bridge) usually done through the application of cost-benefit analysis. The Toronto model is an effort to meld these two traditions into one to bring the true meaning of policy analysis into focus. That meaning or definition is built around two questions:

1. What will happen if existing trends (policies/ decisions) continue into the future?
2. What is likely to happen if new policies/ decisions are adopted?

Policy analysis is the use of analytical tools, such as input-output, to obtain answers to these questions. Policy analysis focuses upon future consequences of past value choices and tests likely consequences of alternative value choices.

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[43]A sample of this kind of literature would be: David Lerner and Harold D. Lasswell, eds., The Policy Sciences (Stanford: Stanford University Press, 1960); Austin Ranney, ed., Political Science and Public Policy (Chicago: Markham, 1968); Oliver P. Williams, "A Typology for Comparative Local Government," Midwest Review of Political Science 5 (May 1961): 150-164; and Ira Sharkansky, The Politics of Taxing and Spending (New York: Bobbs-Merrill, 1969).

Since Metro expenditures are the most rapidly available means for determining past value choices, the input-output model is a representation of those choices. It reveals how those choices affected other parts of the system and, thus, it measures the consequences. Simulation provides the means for determining likely consequences should the existing choices in Metro change. The identification of past trends is presented in Chapter 3.

Research Questions

The urban modeling technique has been useful to researchers in other disciplines interested in policy analysis, as was demonstrated in Chapter 1. Such analysis can be adopted by political scientists to more fully implement the systems analysis framework employed to study urban public policy. The research described in this study is directed at just such a goal.

In pursuit of this research goal, the following questions are addressed:

1. Can an estimated input-output model be useful in analysis of urban public policy?
2. How can such a model be used to:
    a. evaluate alternative patterns of expenditures;
    b. test the sensitivity of various effectiveness measures to changes in value of operating parameters of the system?
3. What is the direction for future political science research employing input-output and other urban models?

The answers to all these questions may not be discovered, but an effort is made to illuminate the answers as much as possible.

CHAPTER 3

THE SETTING OF THE RESEARCH

Introduction

"Toronto is an historical accident."[1] Thus, the Executive Assistant to the Metropolitan Chairman described the creation of the municipality of Metropolitan Toronto. Whether or not one believes the creation of Metro Toronto is an accident, in real terms it does not operate on an accidental basis. It works so well in some observers' eyes that they have labeled it a "miracle."[2] Miracle may be too strong a word, but Toronto certainly is a city different from others of its size in its appearance and in its political organization.

For a city of over 2 million people, Toronto is without the problems which are manifest in other North American cities, especially those in the United States. The problem of flight to the suburbs, a common North American urban phenomenon, has not occurred in Metro Toronto because there are

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[1] Interview with J. P. Kruger, Executive Assistant to the Chairman of the Metropolitan Toronto Council, June 26, 1974.

[2] "The Miracle," Newsweek 81, March 19, 1973, p. 50.

no true suburbs. Metropolitan Toronto has subsumed its suburbs under one political structure and in the process has overcome many of the problems found in other large North American urban places: erosion of the tax base, deterioration of services, ghettos of poor people.

While maintaining a city substantially without the "common" problems of urbanization, the Toronto area has continued to grow. Toronto is a self-sustaining economic entity with a diverse economy which allows it to play a large role in the development of Ontario and Canada.[3] Further, Toronto, as a result of its economic "good health," is able to control its own fortune, maintain its own image, and use its political power to maintain its vitality.[4] It is due to this large and forceful role which Metro Toronto plays in Ontario that the use of the Ontario model for Toronto analysis is more reasonable than would be the case for such a procedure in other North American cities. To understand how Toronto came to occupy such a position in the Province of Ontario, it is necessary to trace Toronto's history. A description of that history follows.

Toronto's History: Political Development

Toronto was established by the British as a seat of government for a colony in a vast wilderness area in

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[3]James and Robert Simmons, Urban Canada (Toronto: The Copp Clark Publishing Company, 1969), p. 60.

[4]Ibid.

1793.[5] Situated on the shores of Toronto Bay of Lake Ontario, it was favorably suited as a marshalling point for settlement of what was to become the Province of Ontario. Gradually, as the area began to grow, roads were built which allowed commerce to flow both into and out of the port built along the bay.[6]

By 1834 the town had 9,000 residents and became incorporated as the City of Toronto.[7] While most people chose to live within the city boundaries, a series of villages and smaller towns began to develop adjacent to the incorporated city. Until about 1920 the City of Toronto expanded by annexation of these smaller entities.[8] Despite the creation of several new municipalities after 1920, the City of Toronto ceased to use annexation as a tool for expansion.[9] Suburban growth was so fast paced annexation could no longer effectively cope with it. By the beginning of World War II, the boundaries of the City of Toronto were adjoined by twelve municipalities.

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[5] Metropolitan Toronto Planning Board, Metropolitan Toronto 1973 (Toronto: The Carswell Printing CO., 1973), p. 4.

[6] Ibid.

[7] Albert Rose, Governing Metropolitan Toronto: A Social and Political Analysis 1953-1971 (Berkeley: University of California Press, 1972), p. 2.

[8] Ibid.

[9] Ibid.

It was especially during the post-World War I years that the Toronto area began its first phase of rapid economic development as well. Toronto had gained in population (as evidenced by the number of municipalities in the area). The population came in response to favorable economic conditions. Toronto was fast becoming a financial and commercial center in Canada. It was during this period that the roads originally used for settlement began to become arterial roads for commerce and population movement. Land values increased as a result of development and a great deal of building took place.

This pattern of urban development was displaced during the Depression years. The rigors were especially difficult for the suburban municipalities in the area to withstand. Following the Depression period, these smaller units continued to suffer. Even in the post-World War II years, these suburban areas found it difficult to borrow in order to service a population which was still on the increase.[10]

This typical North American suburban growth phenomenon was accentuated by a growing immigrant population as well. The population of Toronto in 1951 was 1,117,470.[11] This figure represented a smaller proportion of those claiming

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[10]Metropolitan Toronto Planning Board, Metropolitan Toronto, p. 6.

[11]Statistics Canada, Census 1951: Population by Census Tracts, Toronto, Bulletin CT-6 (Ottawa: Statistics Canada, 1951), Table 1, p. 4.

British origins and a significantly larger proportion of Italians and Germans than had been counted in the pre-war census. These trends continued for another decade. Later analysis revealed that in the years between 1946 and 1961, a time span called the "period of immigration," the population of the City of Toronto alone increased by 196,000.[12] The surrounding municipalities also received marked increases, although not as dramatic as the central city. Such a situation is reflective of typical urban growth: newcomers moving to the central core while older residents move to outlying areas. The point is that the urban development of Toronto was progressing in similar fashion to other metropolitan areas in the United States and Canada. Toronto's response to the pressures created by this development was unique, however.

Efforts to establish Toronto and the area municipalities as a single entity can be traced as far back as 1925.[13] A bill was introduced in that year in the Ontario legislature to create a metropolitan area of Toronto. For lack of support, the bill was never adopted. Later, in 1935, a study was prepared at the request of the Minister of Municipal Affairs which urged the unification of cities in the Toronto

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[12] Albert Rose, Governing Metropolitan Toronto, p. 5.

[13] Thomas J. Plunkett, Urban Canada and Its Government: A Study of Municipal Organization (Toronto: Macmillan of Canada, 1968), p. 84.

region.[14] Plans and proposals for such consolidation were interrupted by the war. After the war, with the pressures of growth even greater than before, the issue of one urban unit resurfaced.

The first initiatives toward this goal were begun by the Town of Mimico in 1947. Seeking to create a method of joint administration for a number of services with other municipalities in the area, Mimico went before the Ontario Municipal Board with such a proposal.[15] In early 1950, yet another area city proposed a more far-reaching recommendation: amalgamation with four adjoining communities.[16] Shortly thereafter, the City of Toronto applied to the Board to amalgamate all twelve area municipalities. The Ontario Municipal Board gave priority to Toronto's proposal and began public hearings on the matter in the summer of 1950; the hearings ended one year later. It was not until 1953 that the Board issued its report entitled Decisions and Recommendations of the Board.[17]

The report rejected Toronto's application for amalgamation. In the report, the Board went further by suggesting a solution of its own. L. R. Cumming, the Chairman of the

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[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] Albert Rose, Governing Metropolitan Toronto, p. 21.

Ontario Municipal Board, indicated the Board supported the creation of a two-tier metropolitan federation for the Toronto area. Mr. Cumming was widely respected in the fields of municipal affairs and city planning,[18] and his judgments were therefore considered well researched and reasonable.

The Ontario Provincial legislature acted on the proposal one month after the Cumming report was issued. A bill was introduced by the Prime Minister of Ontario, Bill 80, which substantially followed the Cumming report recommendations. The bill was entitled "An Act to Provide for the Federation of the Municipalities in the Metropolitan Area."[19] The act formed a new political entity, the Municipality of Metropolitan Toronto. The new Municipality was a rejection of the amalgamated, unitary government approach put forward by the City of Toronto. Metro, as it soon became known, was to maintain the existing municipalities in the area, while at the same time provide for area-wide needs. Structurally, the new government consisted of a twenty-five person Metropolitan Council, with a chairperson as the presiding officer elected from within the Council. Membership on the Council was to be determined by election from the municipalities making up the new Metropolitan government. These municipalities and their governments were to remain intact. In fact, members of the Metro Council first have to be elected to serve in

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[18] Ibid.

[19] Ibid.

area municipal legislative bodies before being elected to Metro office. The idea behind such an approach was to preserve established traditions, identities, and administration of purely local services while uniting multiple jurisdictions to provide for common problem solutions.[20]

The Province of Ontario appointed the first chairperson of the Metropolitan Council. He was Frederick G. Gardiner. Mr. Gardiner had served on the city council of the Village of Forest Hills prior to his becoming Metro Council Chairperson. His term was on an interim basis to establish Metro's operation. He served as unelected chairperson from January 1, 1954, until January 1, 1955, at which time the chairperson became a fully elective office. Mr. Gardiner was re-elected for a second term and in subsequent elections until 1961.

Gardiner was to set the tone for Metro Council chairpersons to follow. He interpreted his position as a combination of mayor and city manager.[21] It was at Gardiner's urging that an executive committee was established which began to function as a cabinet.[22] No provision for such a structure had been made in the original mandate for Metropolitan Toronto. It was such bold and decisive action on the part of the chairperson, combined with his long-term electoral success, which

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[20]Ibid., p. 22.

[21]Ibid., p. 20.

[22]Ibid., p. 28.

did a great deal to enhance public acceptance and stability for the new government in Toronto.[23]

As originally mandated, the new Metropolitan government was to have jurisdiction over eleven generic city functions:

1. Water Supply
2. Sewage Disposal
3. Roads
4. Transportation
5. Education
6. Health and Welfare
7. Justice
8. Housing
9. Planning
10. Parks
11. Finance and Taxation[24]

Under provisions of the act creating Metro, the Province of Ontario was to review the activities of Metro in fulfilling these eleven functions. A Commission of Inquiry was formed in 1958 and issued a report which stated the commission was greatly impressed by the continued and widespread support for the principle of federation of autonomous local governments.[25] Further, the commissioners believed the initiatives taken in forming Metro were sound. They believed no substantial changes should be made at the time.

Despite these laudatory findings, there were still those who were not satisfied with Metro. The major thrust of

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[23]Ibid.

[24]Ibid., pp. 25-26.

[25]Ibid., p. 41.

the dissidents was that the Metro concept did not go far enough to solve area-wide problems. These interests wanted an amalgamated, unitary government for Toronto.[26] Early in 1963 the City of Toronto re-issued its 1950 proposal to the Ontario Provincial legislature for an amalgamation of all thirteen area municipalities into one.[27] The government of Ontario took a different course on the matter than it had in 1950. Instead of referring the proposal to the Ontario Municipal Board, this time the Prime Minister established a Royal Commission consisting of one man, H. Carl Goldenberg, to explore the question of Metro Toronto's advantages and disadvantages.

Goldenberg submitted his report in June of 1965. The report called for a complete reorganization of Metro. Specifically, the recommendations were as follows:

1. consolidation of the thirteen area municipalities into four cities;
2. transfer of assets from the existing thirteen cities to the new four;
3. the cities of North York, Scarborough, and Etobicoke should continue to exist for purpose of provincial road grants;
4. elimination of assessment exemptions in Toronto and New Toronto;
5. retaining area municipal employees who hold permanent status one year prior to reorganization.[28]

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[26]Ibid., p. 102.

[27]Ibid.

[28]Ibid.

Goldenberg also called for a change in representation on the Metro Council, with half of the Council to be elected from Toronto and the other half proportional among the newly formed cities.[29] Further, he called for an extension of Metro's boundaries to the north and west, with compensation to be paid to the jurisdictions from which Metro would take dominion.[30]

It was not until January of 1966 that Ontario began to take action on the Royal Commission's report.[31] Few of the details of the Commission's report were accepted. Nevertheless, the Ontario government did embrace the main principles of the Goldenberg Commission: (1) the continuation of the two-level federated system of metropolitan government; (2) the consolidation of constituent municipalities rather than total amalgamation; (3) an increase in the authority and responsibilities of the government of Metropolitan Toronto.[32]

In April of 1966 Bill 81 was introduced in the Ontario parliament. The act passed in May of the same year. Bill 81, entitled "An Act to Amend the Municipality of Metropolitan Toronto Act," contained the major provisions

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[29]H. Carl Goldenberg, Report of the Royal Commission on Metropolitan Toronto, June 1965, pp. 21-28.

[30]Ibid.

[31]Albert Rose, Governing Metropolitan Toronto, p. 113.

[32]Ibid.

of the Royal Commission as outlined above.[33] The new bill simply placed into law the government's proposals for Toronto. The transition to the new form went relatively smoothly with the vast majority of interests in the area willing to abide by the decision of the Province of Ontario.[34]

Figures, 2, 3, and 4 display the original 1953 Metro features. Figure 2 gives a picture of the physical appearance of the cities combined to form the geographical space occupied by Metro in 1953 contrasted with an exhibit of the same area in 1967 reflecting the reformulated geographic structure consolidating some area municipalities. Figures 3 and 4 are charts featuring the pre- and post-Bill 81 political and service structures of Metro Toronto.

While the political structure of Toronto was being developed, the area was also developing economically, perhaps by accident (as the Executive Director believes), but also by design. The Province of Ontario played a large role in the structuring and development of Toronto. While being similar to states in the United States system, the Canadian provinces have used their political power to a much greater extent than most any state.[35] The role played by Ontario in

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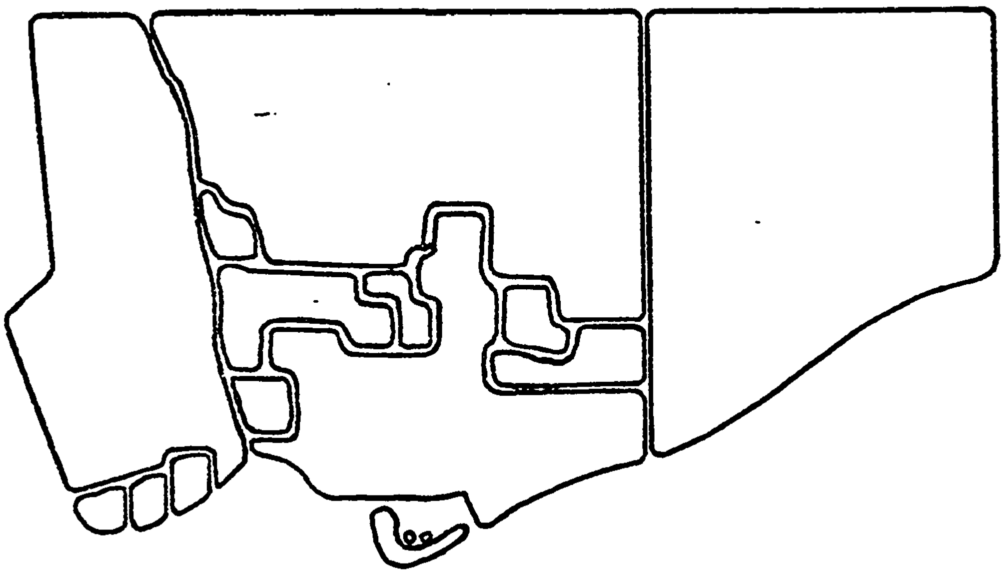
[33]Ibid., p. 122.

[34]Jeffrey C. Rinehart and Michael L. Hall, "Reform from the Top: Ontario's Role in the Development and Growth of Metro Toronto," paper delivered at the 1976 National Conference on Public Administration, Washington, D.C., April 19-22, 1976, p. 11.

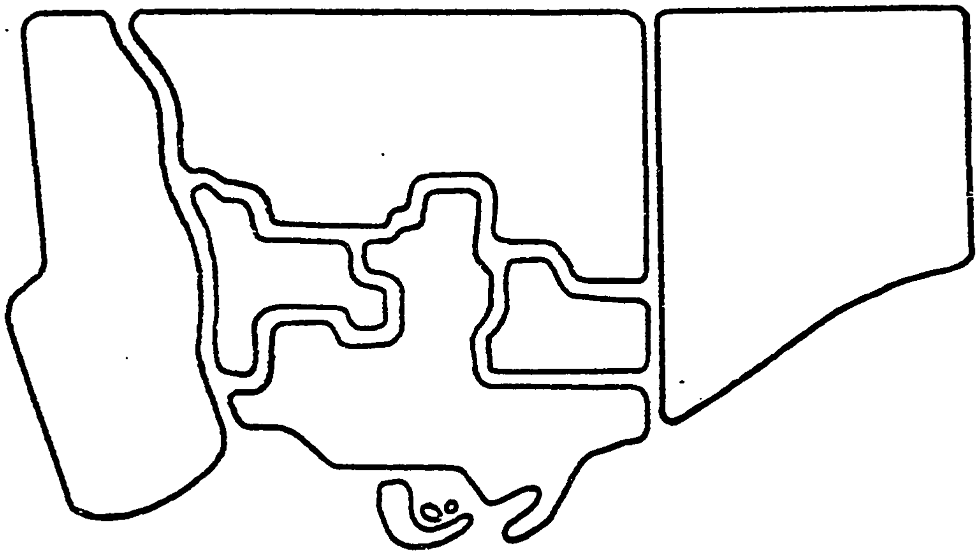
[35]Ibid., p. 1.

FIGURE 2

METRO TORONTO'S ORIGINAL 1953 AND
REFORMULATED 1967 BOUNDARIES



1953



1967

FIGURE 3

DISTRIBUTION OF RESPONSIBILITIES

	Metro 1966	Metro 1967[a]
METRO LEVEL	Actual Roads; Assessment; Borrowing; Business Licensing; Courts; Health and Welfare Assistance; Homes for Aged; Police; Public Transportation; Regional Parks and Conservation; Sewage Disposal; Water Supply.	CNE; Emergency Ambulance Service; Public Welfare; Educational Programs; Waste Disposal.
SHARED RESPONSIBILITIES	Educational Financing; Hospital Grants; Parking (Metro level inactive); Planning; Public Housing; Redevelopment; Traffic Regulation; Waste Disposal.	Libraries.
LOCAL LEVEL	Building Regulation; CNE; Local Electricity Distribution; Emergency Ambulance Service; Fire; Libraries; Parks and Recreation; Local Community Services; Public Health; Sewers (local); Welfare Assistance (optional); Zoning.	

[a]Only includes services that changed level of responsibility.

Source: Bureau of Municipal Affairs, "News Brief #103," August, 1966.

FIGURE 4

METRO TORONTO'S ORIGINAL 1953 RESPONSIBILITIES
AND REFORMULATED 1967 RESPONSIBILITIES

		METRO 1966	CHANGES AS ENACTED BY BILL 81 FOR IMPLEMENTATION IN 1967[a]
COMPOSITION OF GOVERNMENT	METRO LEVEL	Council (indirect election); City 12 (Mayor, 2 Controllers, 9 Aldermen) Suburbs 12 (1 Council head from each of 12) Chairman 1 (elected by Council) Executive Committee (optional): City-2;* suburbs-2;* Chairman-1. School Board (indirect election): City 10 Suburbs 10 Separate School Board 2 Principal Appointed Bodies:T.T.C,Metro Planning Board,Police Commission,Licensing Commission, Metro.Toronto & Region Conservation Auth.	Council (indirect election): City 12 Suburbs 20 (see numbers in parentheses below for breakdown) Executive Committee (mandatory): City-5; Suburbs-5; Chairman-1. School Board (indirect election): City 6 Suburbs 9 Separate School Board 3 Additional Appointed Bodies: Library Board.
	LOCAL LEVEL	13 Municipalities: City of Toronto; Townships of North York, Scarborough, Etobicoke, York, East York; Towns of Leaside, Mimico, New Toronto,Weston; Villages of Forest Hill, Long Branch,Swansea. 10 School Boards(boundaries coterminous with municipalities; one combined Board serving 3 Lakeshore municipalities).	6 Municipalities: City of Toronto (Toronto, Swansea, Forest Hill). Borough of North York (North York) (6) Borough of Scarborough(Scarborough) (5) Borough of Etobicoke (Etobicoke, New Toronto, Long Branch, Mimico) (4) Borough of York (York, Weston) (3) Borough of East York (East York, Leaside) (2) 6 School Boards (boundaries coterminous).
		All electoral terms: 2 years.	All electoral terms: 3 years.

[a]Details not included in these columns indicate that no change related thereto was recommended or enacted: for example, the Council Chairman is to be elected from within or outside the Council as at present.

*Or 3

Source: Bureau of Municipal Research, "News Brief #103", August 1966.

the creation of Metro has been seen earlier. No local electons on the Metro matter were ever held. The Province created Metro in 1953 and reorganized it in 1966. The Province also wished to use the Toronto-centered region for economic development. In fact, economic development was one of its stated aims in furthering regional governments of the Metro variety throughout Ontario.[36] The economic development of Toronto is, therefore, intimately involved in the Metropolitan experience. In the following section Toronto's economic development is discussed.

Toronto's History: Economic Development

The site of Toronto was determined by the presence of the harbor (which is a bay). Originally small, the bay provided the best harbor on Lake Ontario and the easiest to defend from attack in the early years of settlement.[37] While this has already been mentioned, it is important enough to reiterate because the growth of Toronto was a result of its being a transportation center; first as a shipping point for seagoing trade, then as a vital link in rail transport, to the present-day status as a highway and air traffic intersection for Canada's flow of goods, services, and people.

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[36] Richard H. Foster, "Canadian Intergovernmental Relations and the Reform of Local Government: Regional Local Government in Ontario" (Ph.D. dissertation, University of Oklahoma, 1974), p. 76-79.

[37] Donald F. Putnam, ed., Canadian Regions: A Geography of Canada (New York: Thomas Y. Crowell Co., 1950), p. 266.

In the beginning, the city was built around the port area.[38] This small area of about 100 acres became the site of the parliament buildings, churches, and military barracks. Slowly, as greater immigration occurred, these structures were rebuilt a greater distance from the original site.[39] The growth of the city remained relatively stable in the area until 1850 when the railroad from Montreal was extended southward to Toronto.[40] The railroad brought with it greater growth as people moved in to work in the jobs it created. With the railroad also came wholesale and warehouse establishments.[41] These businesses located near the port and rail facilities already established. From this area the main arterial roads, Bay and Yonge streets, were extended, and along which commercial outlets aligned. This formed present Toronto. The growth of Toronto until World War II remained a result of its being first a center of transportation, rather than industry. With the coming of a war, Toronto took on a new significance--that of an industrial center.

Because of its rail system, Toronto attracted many industrial plants in the first years of World War II.[42] Since the center of the city was already occupied with other

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[38]Ibid., p. 267.

[39]Ibid., p. 268.

[40]Ibid.

[41]Ibid.

[42]Ibid., p. 270.

commercial properties, plants producing goods for wartime began to locate in the suburbs around Toronto. It was a relatively simple matter to extend rails to these areas to provide links to the existing lines used for shipment. The wartime production brought greater population to the suburbs. Ajax, Scarborough, Leaside, and Long Branch were suburbs which grew as a result of wartime industry.[43] This was a period in which a diversity of production came to the area as well. The port facility was enlarged to accommodate the greater traffic.[44] Toronto grew rapidly at this time because of the industrial activity and emerged from World War II the prototype of the thriving metropolis of the post-war years.

By 1950, Toronto was a dynamic metropolis. It had become not only a commercial and industrial center, but a financial one as well. The city had attracted the headquarters of five of the ten chartered banks of Canada.[45] Further, several trust companies, insurance companies, and investment enterprises had located there. The Toronto Stock Exchange became large enough to make Bay Street, on which it was located, known as Canada's Wall Street.[46] It was second only to Montreal as a manufacturing center, having made a

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[43]Ibid.

[44]Ibid.

[45]Ibid., p. 271.

[46]Ibid.

successful shift from war products to peacetime industry ranging from food products to metal products to oil refining and many others. The keynote of manufacturing in the Toronto area was diversification, as one contemporary publication put it.[47]

From the period of the creation of the Municipality of Metropolitan Toronto, the area has played an increasingly important role as the leader in national economic development.[48] The Metro's chief rival for leadership in the national economy has been Montreal. Since 1953, the year of the formal creation of Metro, Toronto has become dominant (over Montreal) in almost every index of metropolitan stature.[49] The most important contributing factor to Toronto's increasing economic importance has been the choice of Metro Toronto as the headquarters for many of Canada's financial, corporate, and industrial enterprises.[50] Therefore, not only are the forces of production actually located in Toronto, but also the planning and management structures are located there as well. This situation is not entirely by "accident" either. Economic decision making has become increasingly concentrated in Toronto as a result of the Canadian national policy for

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[47]Ibid.

[48]George A. Nader, Cities of Canada (Toronto: Macmillan of Canada, 1975), p. 219.

[49]Ibid., p. 220.

[50]Ibid.

regulation of the economy.[51] This policy attempts to use central Canada's industrial base to compliment the economic structure of other Canadian regions to produce an integrated economic system.

Reflective of Toronto's position as a center for business decision making is the fact that commercial and institutional land use predominate the downtown area.[52] Further, there has been declining employment in goods handling activities such as manufacturing, wholesaling, and transportation while there has been sustained growth in office and service functions (e.g., financial and governmental services) and stable employment in retail businesses.[53] More specifically, within the downtown core, employment growth has been almost entirely concentrated within the office district (the area bounded by Yonge, Queen, Simcoe, and Front Streets).[54] Here once again is evidence of Toronto's predominance as the financial and corporate center of Canada.

Since its creation in 1953, Metropolitan Toronto has grown with regard to manufacturing also. With the central

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[51]Ibid., p. 225.

[52]Ibid., p. 111.

[53]Ibid., pp. 111-114.

[54]Ibid., p. 115.

city core occupied primarily by office employment, industry has moved to the suburban areas (these are Scarborough, North York, Etiobicoke, East York, and York). Yet the City of Toronto still accounts for one-third of the Metro's manufacturing employment.[55] As can be seen in the input-output model developed in Chapter 2, the combined industrial base of Metro's central core and suburban areas is a varied one. Even more important than the variety of industry in Metro is the fact that in large measure the output of the manufactured goods produced in Metro are marketed there as well.[56]

Summary

Metropolitan Toronto, favored by a good natural site for its location, has grown into a primate city of the first order in the Province of Ontario. Its economic position in the Province enhances its national stature; it has also become a focal point for Canadian national economic policy. The preceding paragraphs have detailed Toronto's growth from a small trading post guarded by a small garrison of British troops in the colonial period to the center of Canadian economic decision making. Perhaps, in the beginning because

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[55] Statistics Canada, Manufacturing Industries of Canada: Sub-Provincial Areas, Catalogue 31-209 (Ottawa: Statistics Canada, 1972), Table 2, p. 82.

[56] Ministry of Treasury, Economics, and Intergovernmental Affairs, Interprovincial Trade Flows, Employment, and the Tariff (Toronto: Ministry of Treasury, Economics, and Intergovernmental Affairs, 1977), p. 3.

the choice of a demographic location for Toronto came as the result of early exploration for trade routes, its development might be labelled accidental since development was contingent on trade and transportation for that trade. Certainly, modern Toronto's economic structure is no accident because, in large measure, this is a result of being a federal and provincial focal point for economic planning.

Politically, the Metro format might have come about as a result of being the right concept at the right time and, thus, might also be called an accident. Nevertheless, the Province did not act in a haphazard or accidental manner in creating Metro. While the Province operated with no public mandate for such a proposal, Ontario went about the task of determining the optimum balance of interests through hearings before the Municipal Board--a deliberate, not accidental, operation. Further, William Gardiner, the first Metro chairperson, acted in a direct, trend-setting manner in his management of Metro operations. His activities set the tone for chairpersons to follow. A trend once in motion is more than accidental. Finally, Metro's twenty-three year history of performance has hardly been accidental. The economic strength of the area has allowed the Metropolitan Corporation to achieve a creditworthy stature to the extent that it has held a double A (AA) bond rating on the New York Stock Exchange for several years.[57]

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[57]Standard and Poor, Bond Guide, April 1977 (New York: Standard and Poor, 1977), p. 175. A double A (AA)

The discussion to this point has provided a descriptive and historical study of Metro Toronto. The political and economic developments of Toronto are only two of the components of trends intended for elaboration in this chapter. More precise trend analysis is to follow. That analysis comes from another research tradition: econometrics, or more specifically, time series analysis. Time series analysis, while not necessarily yielding accurate forecasts, is useful for an understanding of what has gone before. In this sense, then, trend analysis does belong in an historical picture of Metro, which is the theme of this chapter. If the past is described and analyzed, the future may become more comprehensible. Attention is directed at Toronto's political expenditures and economic trends in the next section.

Time Series Analysis

In Chapter 1 of this study, the absence of a time perspective in much urban public policy analysis was pointed out. Yet, policy is a process; it occurs over time within a governmental system.[58] The fact that policy occurs over time is even more important if the process of analysis is to

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bond rating indicates a high degree of safety for investment.

[58]Virginia Grey, "The Use of Time Series Analysis in the Study of Public Policy, in Methodologies for Analyzing Public Policies, ed. Frank P. Scioli and Thomas J. Cook (Lexington, Mass.: Lexington Books, 1975), p. 52.

compare the policy of two or more units or two time series from the same unit.[59] Virginia Grey has noted that when comparisons of policy over time are made among different subnational units, there are a number of reversals of previous findings employing cross-sectional methodology.[60] Therefore, consideration of time series analysis is most appropriate as a tool to examine the past policy performance of Metro Toronto and to address the criticisms of past policy analysis.

There is a problem which is generic to comparative time series analysis though. This is the problem of autocorrelation or serial correlation. Autocorrelation is not encountered in cross-sectional correlation and, if not properly dealt with in time series analysis, it can lead to significant problems.

Autocorrelation is a situation which arises when the error terms in regression equations are correlated. In the normal regression equation, the error terms, e_i, are assumed to have equal variance, that is, the sigma square is constant. This is called homoscedasticity.[61] When the variance

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[59] Marsha Chandler, William Chandler, and David Vogler, "Policy Analysis and the Search for Theory," American Politics Quarterly 2 (January 1974): 107-118.

[60] Virginia Grey, "The Use of Time Series," p. 53.

[61] Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics (New York: John Wiley & Sons, Inc., 1970), p. 132.

of the error term is not constant, heteroscedasticity obtains. The following equations are illustrative of the point.

$$Y_t = a + bX_t + e_t \tag{5}$$

$$Y_{t-1} = a + bX_{t-1} + e_{t-1} \tag{6}$$

These equations are the familiar regression equations. They appear here in somewhat more complex form due to the t subscripts indicating time, instead of the more widely recognized i subscript used to indicate a state, city, or other unit. Autocorrelation exists if e_t is correlated, positively or negatively, with e_{t-1}.[62] These errors may be correlated because whatever factors produce the disturbance, e, in the first time are likely to carry over into the following time period. Jan Kmenta illustrates this phenomenon with a musical analogy: autocorrelation or serial correlation is like striking a musical string; the sound is loudest when the string is first struck, but it lingers awhile.[63] The shorter the elapsed time between taps on the string, the greater the likelihood of blending of tone. The same is true of data points. The shorter the time period between them the greater the chance of autocorrelation.

The assumption of ordinary least squares regression that the error terms are not correlated cannot hold in the

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[62] Virginia Grey, "The Use of Time Series," p. 54.

[63] Jan Kmenta, Elements of Econometrics (New York: Macmillan Company, 1971), p. 270.

face of autocorrelation and, therefore, the r and R^2 coefficients, as well as the t and F statistics used to determine the acceptability of r and R^2, are rendered meaningless. Since the error terms can no longer be kept separate, the sampling interval around each estimate of alpha and beta is large. With such large error, the meaning of a line of best fit is lost because distortion is added to the ordering of the data.

A simple test to determine if there is autocorrelation in time series data is to graph the data points. Figure 5 is such a graph of the total expenditures for each of the twenty-one years of Metro's operation for which data is available. What is evident from the data in this display is a distinct trend increasing from $58,570,177 to $926,534,644. The presence of this trend indicates that autocorrelation exists in the data. Actually, this is not at all unusual in data of this kind. Government expenditures in any given year are often a function of expenditures of previous years.[64] Nevertheless, if analysis is to proceed, one must take care to avoid complications created by the presence of any trend. Therefore, by excluding the trend in time series data, one can use regression procedures for analysis. Furthermore, with a trend clearly delineated, the trend itself can be observed and studied. Since regression

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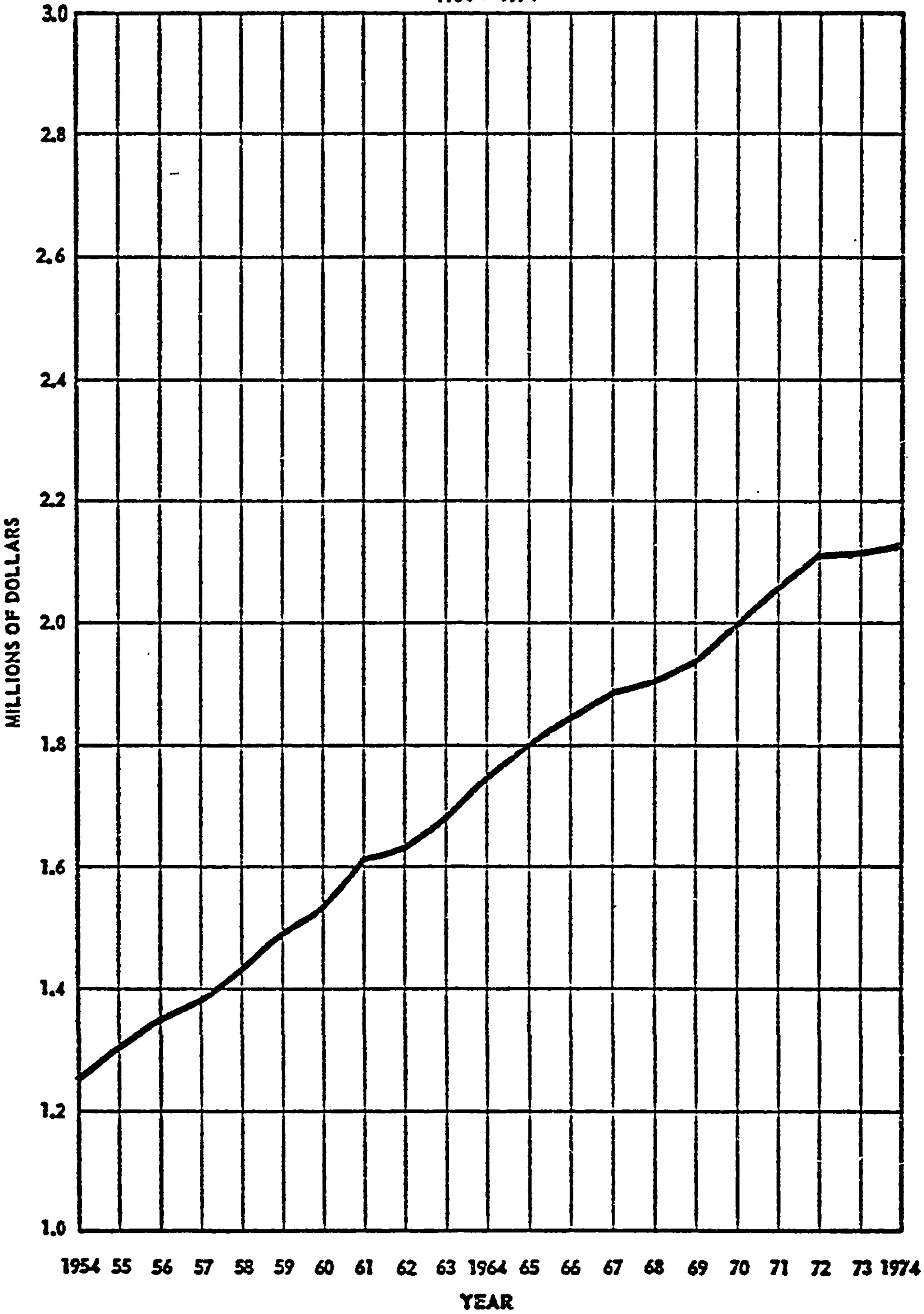
[64] John Wanat, "Bureaucratic Politics in the Budget Formulation Arena," Administration and Society 7 (August 1975): 214.

FIGURE 5

TOTAL EXPENDITURES

METRO TORONTO, CANADA

1954 – 1974



cannot be performed without first removing trend from time series data, it would be well to set out the trends in some of Metro's policy data for examination before proceding further.

There are a number of methods for analyzing trends in time series data. Figure 5 is illustrative of one of those methods: graphing. While this method is not as exacting as other methods, it is useful if for no other reason than observation. Another method is one called semi-average trend analysis. This technique involves dividing the data in chronological halves (such as dividing a twenty-year time period into two ten-year segments), then calculating a mean value for each half.[65] A third method is called simple moving averages. A moving average estimate of trend is produced by summing the first n observations, then dividing by n. A trend value is determined from this mean or average.[66] The first observation is then eliminated from the series and the n + 1 observation is included. A new average is calculated, which becomes the trend value for the next time period. Figure 6 is a graph of the total expenditures of Metro over the twenty-one-year period shown in Figure 5 combined with the trend values computed on a three-year moving basis. In this case, then, n equals 3.

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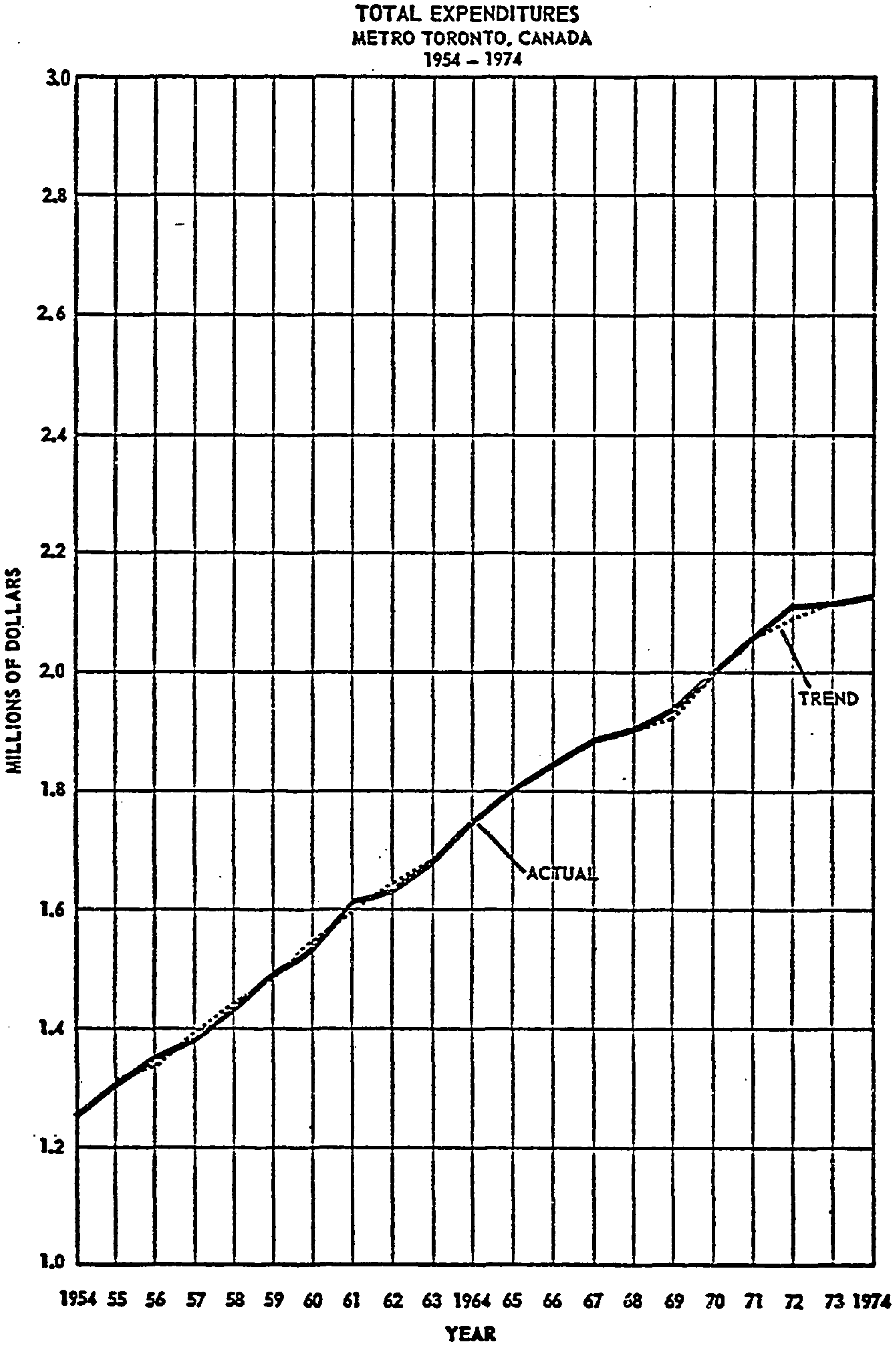
[65] K. A. Yeomans, Statistics for the Social Scientist: 1 Introducing Statistics (Baltimore: Penguin Books, 1974), p. 214.

[66] Ibid.

FIGURE 6


TOTAL EXPENDITURES
METRO TORONTO, CANADA
1954 – 1974
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
MILLIONS OF DOLLARS
TREND
ACTUAL
1954 55 56 57 58 59 60 61 62 63 1964 65 66 67 68 69 70 71 72 73 1974
YEAR

The three-year moving average was chosen because of the ease with which the results may be centered. This is because there is an odd number of data points. An odd number of years in the series allows a true middle or half-way point to be selected. Since twenty-one years are in the time period being studied, a middle year automatically divided the series into two equal halves, each containing ten years. If the series contained one more or one less year, making an even number of data points, a more elaborate scheme would be required to center the data.[67]

With the data detrended, an analysis of the history of Metro's total expenditures is provided without the oscillations or fluctuations caused by influences other than the social, political, and economic factors at work in Metro. The trend in Metro over the years of its history then can be seen as a regularized pattern of an ascending trend of expenditures. At the top of the trend line one can see that the leveling off of expenditures in Metro is not fully accounted for. This situation arises as a result of the moving average technique. The technique does not fully allow for the introduction of the last full year into the calculations. Further, the moving average technique has no mathematical regularity of form. More simply put, the moving average trend line has no equation which can be used to

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[67]Ibid.

describe it or allow for future projections. Nevertheless, it is included in this chapter because the technique has found wide use in analysis of the past and, since this is an historical chapter, it is apropos at this point.

Yet, there is another way to analyze trend in time series data which does possess regularity of form. This method is least squares regression. Least squares regression has been discussed earlier as inappropriate when dealing with comparisons of two or more units over time or when comparing two different time series.[68] This, it will be recalled, was due to the random error terms being correlated. Nevertheless, least squares regression can be employed to describe the linear trend in a single time series. The components to examine in this situation are the rate of change coefficient, b, and the intercept coefficient, a. With these two components, a regression equation can be developed which describes the trend line in the data. The equation provides the mathematical regularity of form called for in more precise trend analysis alluded to earlier.

In fitting a regression equation to a trend line, certain modifications of the normal procedures must be made. Time takes the place of the X variable, while the series in which the researcher is interested becomes the Y variable.

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[68]Samuel A. Kirkpatrick, Quantitative Analysis of Political Data (Columbus, Ohio: Charles E. Merrill Publishing Company, 1974), pp. 402-403.

The Y variable in this case is the total expenditures of Metro. The time variable requires modification from year to time units around an arbitrary origin point. The most convenient point is 1964 because it falls directly in the middle of the series with equal numbers of years on either side of that point. The time units can then be taken as the number of years from 1964 which the data point represents. For example, 1954 would be ten years prior to 1964. Therefore, the time units involved would be represented as -10. Conversely, 1974 is ten years beyond 1964. The number of units involved for this year equals +10. These two variable vectors, X and Y, can then be placed in the regression calculation to determine an equation for describing the trend line. Below is displayed the equation for the Metro Total Expenditures data.

$$Y_t = 368{,}650{,}000 + .9600X_t \tag{7}$$

<u>Metro Policy Trends</u>

Combining these three methods of trend analysis (plotting the data, moving averages, and fitting a regression equation to the trend), a quantitative description of selected time series relating to the Metro government can be undertaken. Figures 7 through 10 furnish such a description.

What is evident from the data presented here is the steady, long-term growth of expenditures. There are no true displacements of trends in the public expenditure data.

FIGURE 7

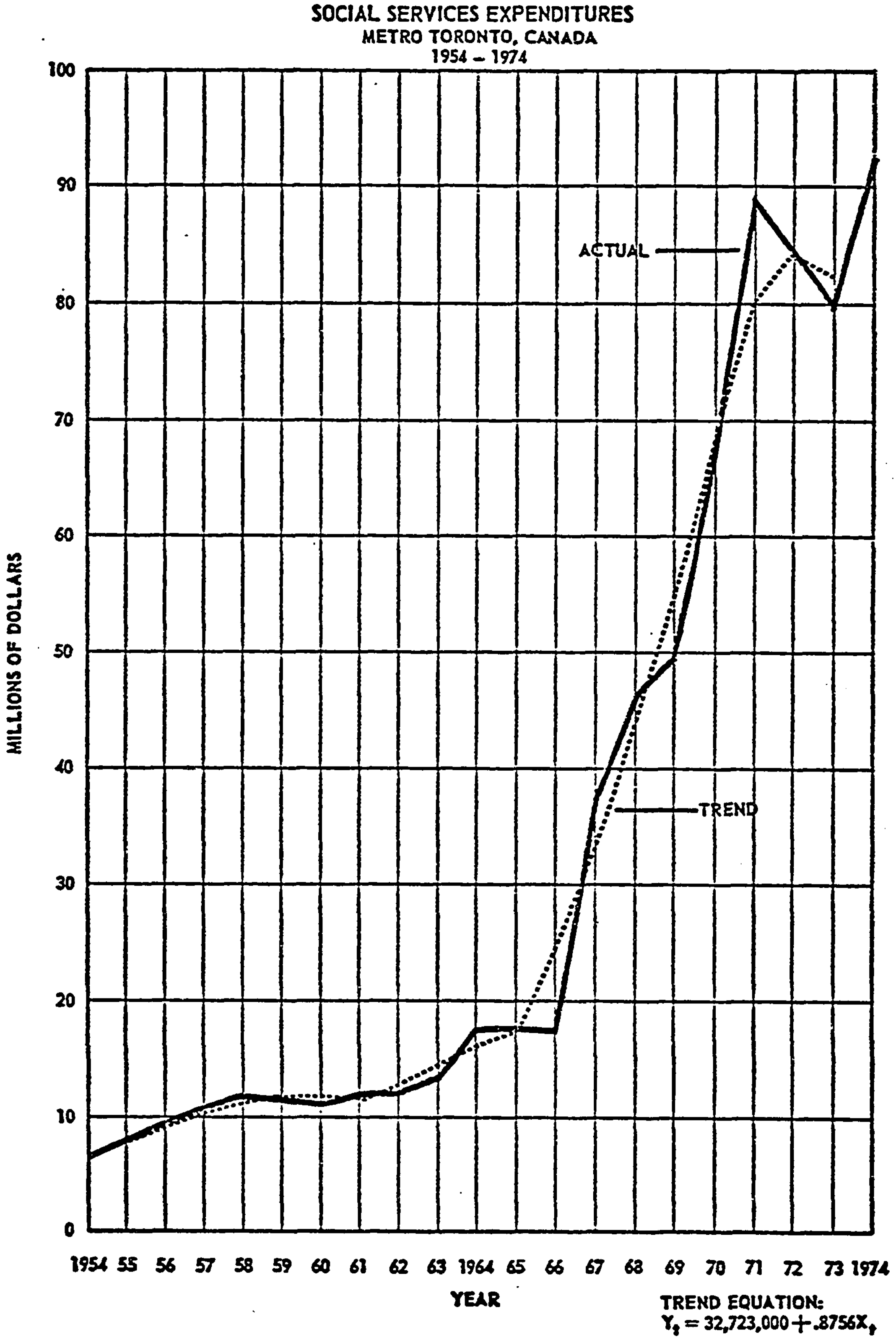
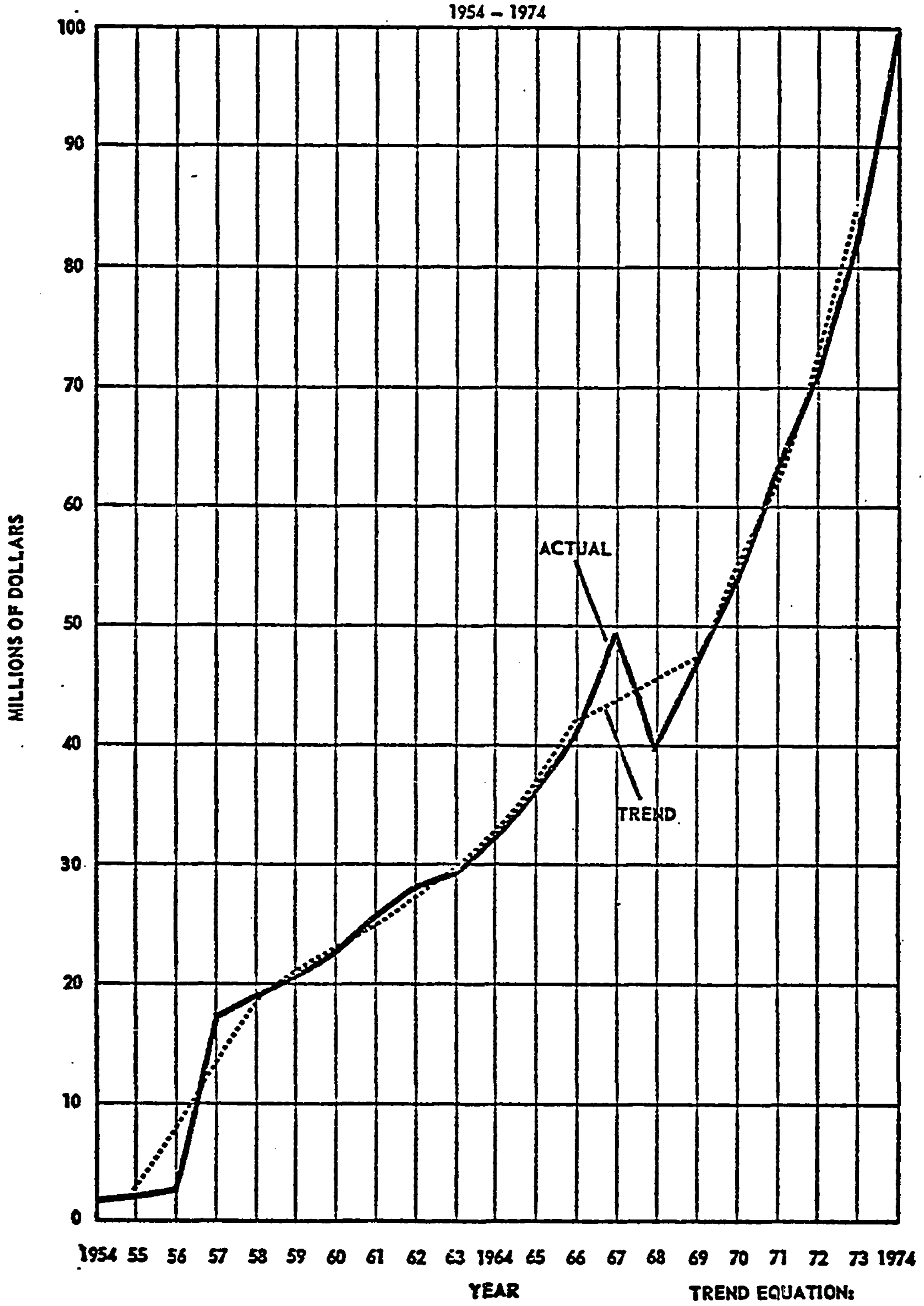

SOCIAL SERVICES EXPENDITURES
METRO TORONTO, CANADA
1954 – 1974
MILLIONS OF DOLLARS
100
90
80
70
60
50
40
30
20
10
0
ACTUAL
TREND
1954 55 56 57 58 59 60 61 62 63 1964 65 66 67 68 69 70 71 72 73 1974
YEAR
TREND EQUATION:
Yt = 32,723,000 + .8756Xt

FIGURE 8

EXPENDITURES FOR POLICE SERVICES
METRO TORONTO, CANADA
1954 – 1974



TREND EQUATION:
Y = 35,987,000 + .9702X_t

FIGURE 9

PER CAPITA TAXES
METRO TORONTO, CANADA
1954 – 1974

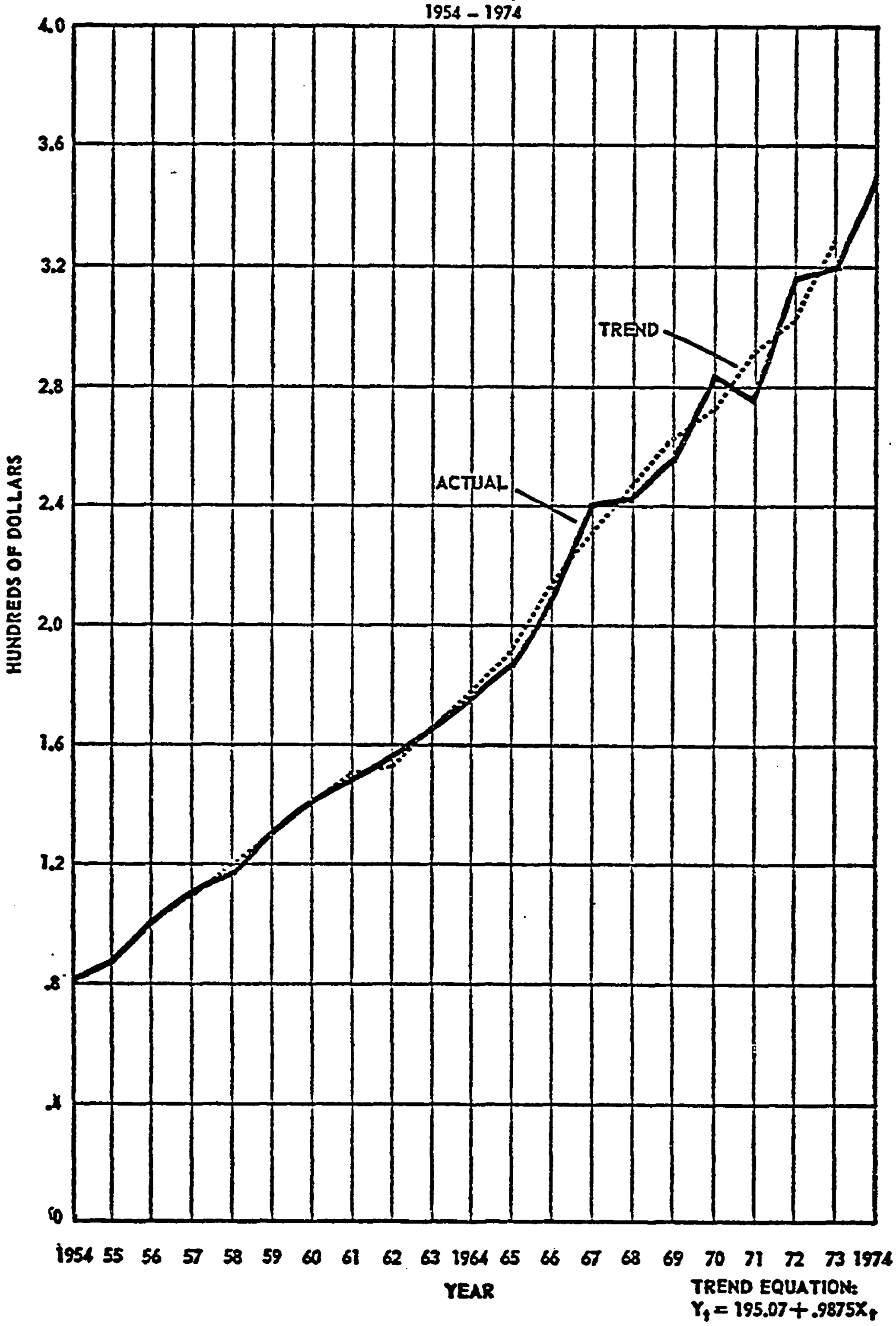
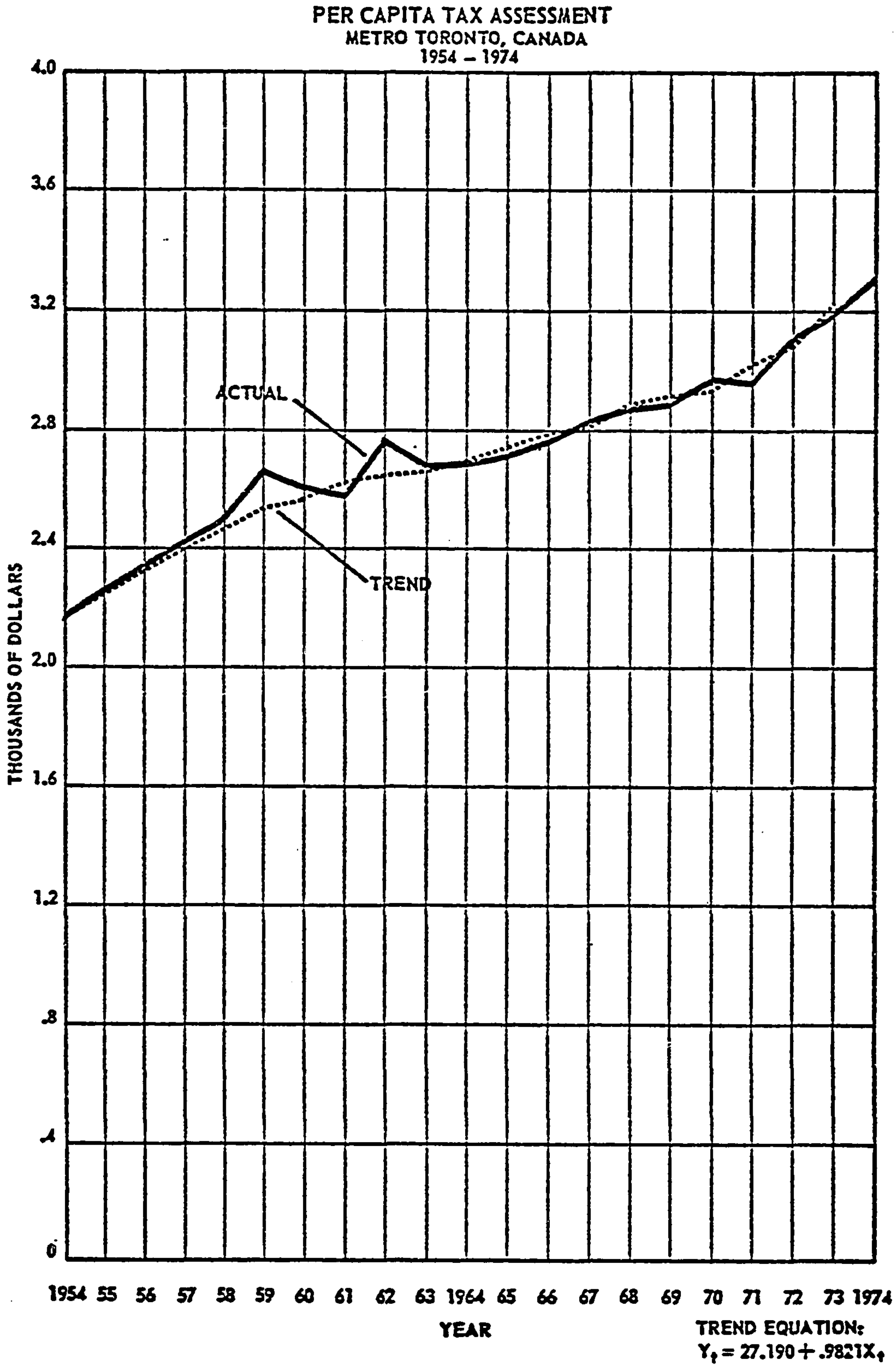


FIGURE 10


PER CAPITA TAX ASSESSMENT
METRO TORONTO, CANADA
1954 – 1974
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
.8
.4
0
THOUSANDS OF DOLLARS
ACTUAL
TREND
1954 55 56 57 58 59 60 61 62 63 1964 65 66 67 68 69 70 71 72 73 1974
YEAR
TREND EQUATION:
Yt = 27.190 + .9821Xt

These trends are, therefore, in line with other time series studies on Canadian governmental expenditures.[69] Toronto trends follow similar growth patterns to those discovered in Government and Gross National Product time series data for Canada as a whole. These studies have demonstrated the same stability in the post-war years. The association between economic factors in these growth trends was not explored in previous research. This analysis function will be briefly taken up in later paragraphs.

The object of this description of Metro expenditures and tax related data is not to formulate a general "law" of public policy of Metro-type governments. Such undertakings are appropriate for more broadly based studies.[70] In focusing on the trends in Metro, an effort has been made to examine change over time to determine and observe patterns. By examining these patterns, an index of spending and taxing is developed as an indication of Metro's effort in certain public policy areas.

Metro's Economic Trends

While Metro was developing its public policy patterns in terms of expenditures and taxes, the Metropolitan Toronto

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[69] Barry D. Rosenfield, "The Displacement-Effect in the Growth of Canadian Government Expenditures," Public Finance 28 (1973): 311.

[70] See, for example, Joseph E. Pluta, "Growth and Patterns in U.S. Government Expenditures, 1956-1972," National Tax Journal 25 (March 1974): 71-92; or Ved P. Gandhi,

economy was developing as well. Time series techniques can be applied to selected indicators of economic development to obtain a picture of Metro's economic growth during the same twenty-one year period. Figures 11 through 13 are graphic representations of three of the important variables in that economic development: disposable income, housing completions, and the Toronto Stock Exchange year ending index.

In both sets of time series data, Metro expenditures and economic development, the trends are clear. The growth patterns of Toronto's economic indicators and public policy indicators have been upward. While there has been on occasion a slight dip in the actual data, the trend has remained relatively steady in an ascending path. These observations confirm what the narrative section described earlier.

Having used the time series approach as a descriptive device, it is now appropriate to use the time series technique for more analytic purposes. As pointed out earlier, when using time series analysis in the comparative context, certain problems arise if regression procedures are applied for this purpose. Ordinary least squares cannot accurately represent the association between two series because of the autocorrelation problem. Therefore, an alternative procedure must be used. In this instance two-stage least squares is

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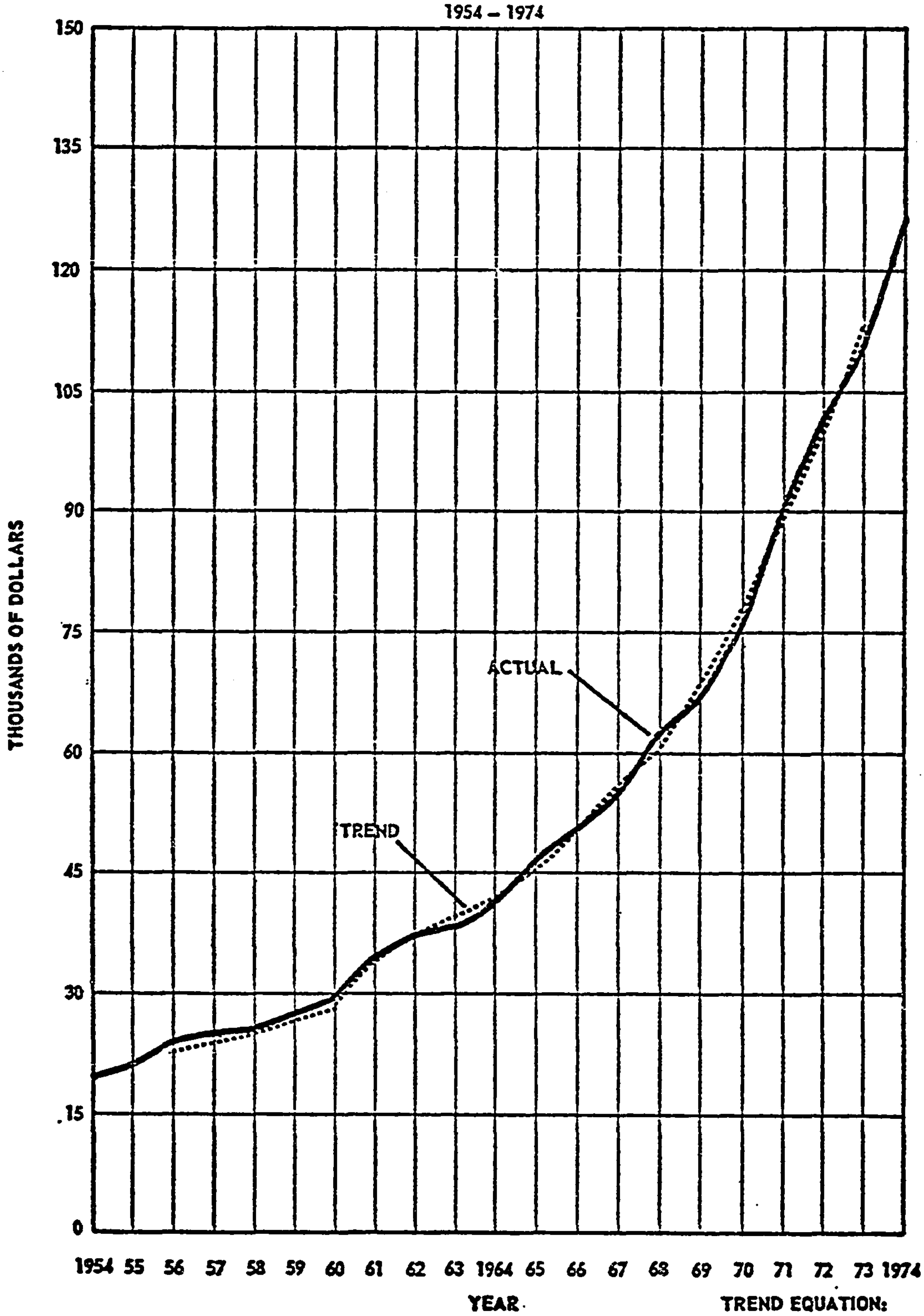
"Wagner's Law of Public Expenditure: Do Recent Cross-Section Studies Confirm It?," Public Finance 26 (1971): 44-56.

FIGURE 11

TOTAL PERSONAL DISPOSABLE INCOME
METRO TORONTO, CANADA
1954 – 1974



TREND EQUATION:
$Y = 5123.9 + .9420X_t$

FIGURE 12
HOUSING COMPLETIONS
METRO TORONTO, CANADA
1954 – 1973

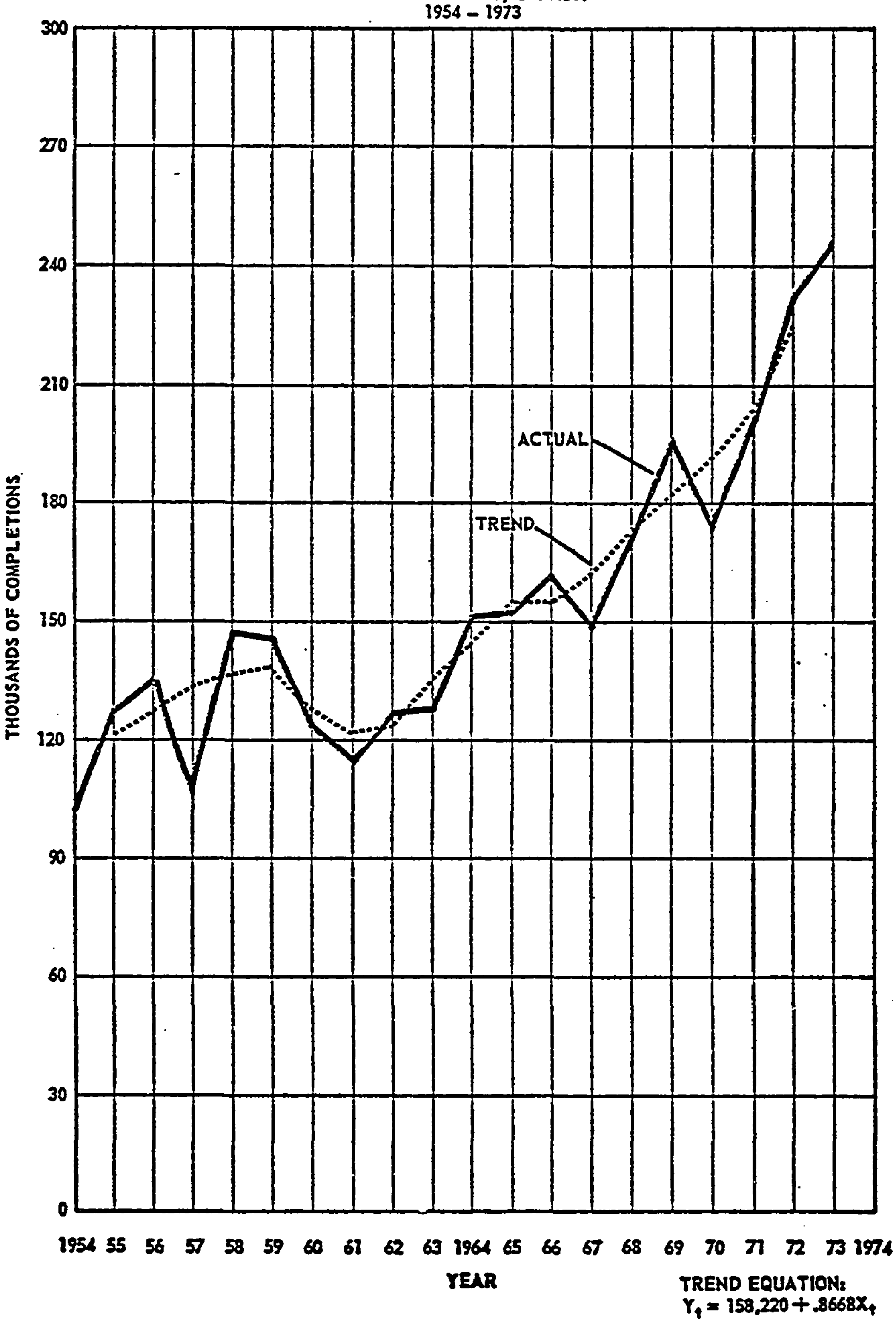
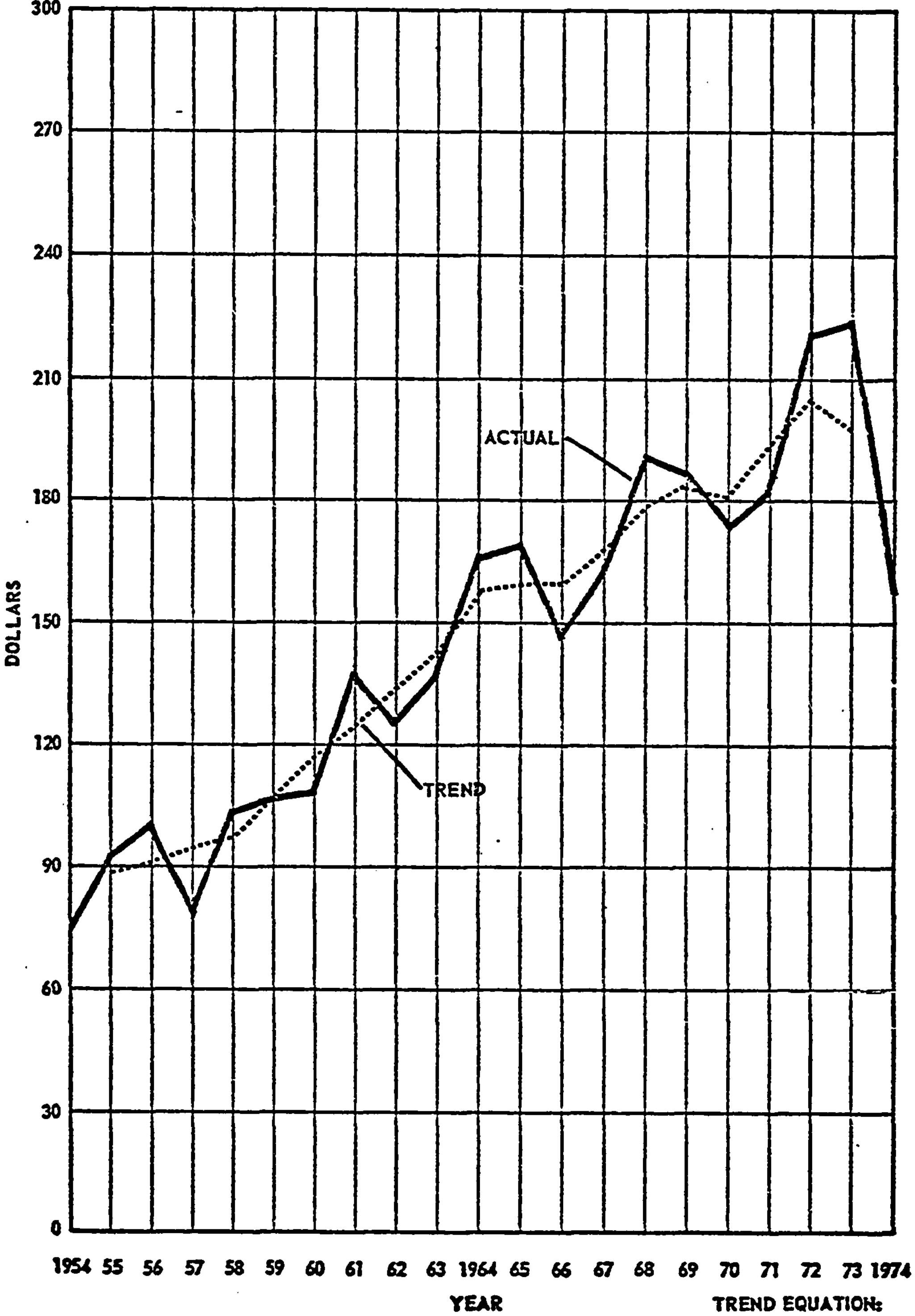


FIGURE 13

STOCK EXCHANGE INDEX
METRO TORONTO, CANADA
1954 – 1974



TREND EQUATION:
$Y_t = 147.47 + .9637X_t$

designated for the analysis.[71] Two-stage least squares manages the problem of error term correlation between two time series by first removing the influence of error terms from the variables being correlated, then by regressing the "clean" variables together without the compounding influences. With the correlated error terms removed in this mannaer, the second stage is actually the ordinary least squares function and is understood in the same way.

By applying the two-stage squares technique to the time series data exhibited above, some comparisons by way of correlation can be made. For example, one would expect that per capita tax assessment and housing completions are related. Therefore, these two variables should be entered into the two-stage regression procedure. Likewise, one would also expect that as disposable income rose in the area, police expenditures would be associated with the rise in wealth, since greater wealth in the area might require greater protection. The table below gives the correlation coefficients for these variables.

TABLE 5

POLICY AND ECONOMIC VARIABLE CORRELATIONS

	Housing Completions	Personal Disposable Income
Per Capita Tax Assessment	r = .871	
Police Expenditures		r = .965

Table 5 shows that the hypothesized relationships do exist. Per capita tax assessments and housing completions vary together through time to a significant degree. The amount of explained variance (R^2) with a Pearson's r of .871 is 75 percent. The explained variance for an r of .965 is even higher: R^2 = 93 percent. Again, these variables have been purged of compounding influences extant in time series data. Removal of such influence still leaves a significant amount of association between these variables as the correlation coefficients show.

Clearly, these relationships indicate strong association between variables. The relationships are strong enough to overcome the competing hypothesis that chance produced such correlations. Metro government spending and economic growth in Metro are substantially linked. In addition, because of the time series nature of the data, the linkage is a systematic one.

Conclusion

The goal of this chapter has been to provide an historical and descriptive survey of the research site--Toronto, Canada. This survey has pursued three lines of examination. First, a political historical approach was taken to furnish the reader with an understanding of the structure of the political subsystem which is the focus of the policy analysis herin undertaken. The premise underlying this section is that the political organization of the structure of an urban system has a fundamental effect on the functioning of that system. Second, an economic sketch of Toronto was given. Changes in the economic structure of Toronto were such a large factor in generating pressure for reform of the political structure that the two should not be separated. Finally, an econometric account of Metro's public policy and economic evolution was rendered to provide a time perspective and, thus, a picture of the processes at work in Metro Toronto's urban system.

In portraying the research setting in the foregoing manner, several objectives were also sought in the chapter. The first objective was to demonstrate that Metro's political structure and economic systems are not solely the product of accidental forces at work. To be sure, Toronto's location placed it in a favorable position for economic growth, and certain values in the Canadian political culture allowed for a kind of political organizational reform not as readily acceptable in the American context.[72] Nonetheless, the creation of Metro, its operation, and its sound financial footing result from conscious effort. Further, Metro's economic growth has also been the result of overt policy action on the part of the Canadian federal government, the Province of Ontario, Canadian business, and the Municipality of Metropolitan Toronto.

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[72]Seymour M. Lipset, Revolution and Counterrevolution: Change and Perspective in Social Structures (Garden City: Doubleday, 1970), Chapter 2.

The second objective of this kind of description of Toronto was to add reinforcement to the case for using the Ontario regional model for analysis within Metro Toronto. By bringing to bear evidence from sources ranging from Standards and Poor stock ratings to Ontario's Ministry of Treasury, Economics, and Intergovernmental Affairs, the strength, size, and diversity of Metro Toronto's government and economy were firmly established. Most importantly, for purposes of the model, were the fact that (1) Metro's economy represents such a preeminent position in the productive capacity of the Province as a whole that it is not totally unrealistic to use the Ontario model and (2) much of the production of Ontario and Toronto remains in the system by virtue of consumption on the part of the system. This second phenomenon lends credence to the model in that the flow coefficients take on greater significance as representations of the linkages between subsystems in the form of sectors in the input-output format.

Yet a third objective was sought for this chapter as well. It will be recalled from the first chapter that one of the major criticisms of urban public policy analysis as performed by traditional scholars was that such studies were time constrained. In performing time series analysis on selected policy indicators, this criticism has been met in part (it will be addressed again in the next chapter). Further, the time element is not simply another variable to be entered into a regression equation. Time as a variable presents certain confounding influences in analysis which, if not properly dealt with, can lead to significant inaccuracies. Therefore, a technique was brought to bear on the autocorrelation problem, as the confounding influences of time have been termed. Removal of autocorrelation from the Toronto time series data revealed once again the important link between Metro public policy and the Metro's economic system. The linkage is a strong and sustained one as the time series analysis demonstrated.

CHAPTER 4

THE RESEARCH DESIGN

Introduction

The task of the present chapter is to elaborate upon in some detail the direction and the method in which the research employing the input-output model for Toronto proceeds. Since the Toronto model is based on the premise that the system it represents is too complex to be handled in the traditional way, but it is not so complex as to defy analysis, the model is focused on middle-level problems. As such, the model assumes that whereas the original system is complex, it can be structured in meaningful categories constructed so as to analyze each category separately, as well as in relation to one another.[1] Simulation provides the wherewithal by which this endeavor is accomplished.

The computer model advanced in these pages differs not in principle to other formalized models, but, rather, in format. The model derives from the econometric regional

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[1] Urban Norlen, Simulation Model Building: A Statistical Approach to Modeling in the Social Sciences with the Simulation Method (New York: Halsted Press, 1975), p. 9.

analysis tradition. In the realm of model building, econometrics has played a pioneering role and provides a proven frame of reference. Yet, it is not solely an econometric model for two reasons: (1) it contains a newly created Metro Government sector and (2) it is being applied for policy analysis purposes. Such interdisciplinary cross fertilization is an important part of the definition of policy analysis.

To date, two of the three elements of the research process have been fitted to Toronto. First, the analysis portion of the project was entered, which involved breaking the system into its component parts (here called sectors). Second came the construction function, which consisted of placing the component parts in relation to one another and the creation of the new Metro sector complete with its relationships to the other components. The final stage is synthesis, which proceeds by way of simulation and is the substance of the present chapter.

The Nature of the Simulation Experiment

From an experimental point of view, the model system is in many ways easy to manage.[2] The experimental system can be regarded as closed and, thus, permits complete control while making possible reproduction of the results by

[2] Ibid., p. 65.

replication of the experiment. From the experiments with the system, it is possible to estimate the effects or responses of many factors or stimuli. The factors are chosen in accordance with the target set for the experiment. In this instance, the factors are the elements of the final demand vector, and the target of the experiment is to observe the changes in the activity of the sectors, particularly the Metro government sector. It is also valuable to observe changes in other sectors' activity as Metro output levels change. The experimental, time series, and projection simulations which will be performed have the flexibility to provide this information as well.

In essence, given the nature of the input-output flow coefficients, the focus of the experiment through simulation is on the stochastic properties of the model. The stochastic nature of the model makes it necessary to determine probable outcomes and to be able to assess the value of an individual observation on the model's behavior.[3] There arises, consequently, the need for analyses that report and give an account of the distribution of the disturbances or changes in the model's behavior for the estimated parameters and values for predetermined variables.[4] (The parameters and predetermined variables in the case of the Toronto input-output model are the flow coefficients and values inserted

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[3]Ibid., p. 66.

[4]Ibid.

in the final demand vector, respectively!) It is also important to examine the distribution of changes in localized areas of the estimated parameters. Before going further, it might be well to take one further look at the nature of the parameters of the Toronto model in order that a complete understanding of the preceding discussion and of the later proposed experiment is gained.

The Input-Output Model Parameters

The most accurate method of calculating flow coefficients was referred to in Chapter 2 as necessitating the collection of primary data from the research site.[5] What this means in specific terms is that historical data are collected on a time series basis. Parameters are then derived by using least squares regression to arrive at coefficients on consumption expenditures for the sectors in the model. These coefficients are then taken as the approximate flow coefficients out of the sectors.

Since the data required for such an exercise in accuracy in the Toronto context are not available, an alternative solution was required. That solution is similar to the one conceived for one of the pioneering efforts in

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[5]There are other methods of calculating flow coefficients though. A discussion of this topic can be found in Edward F. Stafford, Jr., "An Iterative Procedure for Estimating and Validating Technical Coefficients," paper delivered at the annual meeting of the American Institute of Decision Sciences, San Francisco, California, November, 1976.

regional input-output work. The research project alluded to here is the New York Metropolitan Region Model.[6] Given the data limitations of that study, the builders of the New York model once they chose to use a regional input-output framework had no other choice but to use national coefficients.[7] Other modelers have also encountered similar problems of data collection and have been forced to rely on coefficients already determined in national tables.[8] Therefore, employing Ontario provincial coefficients in the Toronto research is in line with earlier established studies. In addition to assuming the provincial or national coefficients held for the region under examination, another assumption about coefficients was made: that they remain stable over time. For example, the New York model was used to make projections from its base year of 1960 to 1985.[9]

Multipliers

By now the concept of flow and flow coefficients should be well understood. Discrete units (in the present context dollars) enter one or more of the sectors of the

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[6] Raymond Vernon, Metropolis 1985: An Interpretation of the Findings of the New York Region Study (Cambridge, Mass.: Harvard University Press, 1960).

[7] J. W. Milliman, "Large- Scale Models for Forecasting Regional Economic Activity: A Survey," in Essays in Regional Economics, eds. John F. Kain and John R. Meyer (Cambridge, Mass.: Harvard University Press, 1971), pp. 318-319.

[8] Ibid.

[9] Ibid.

model from the rest of the world (ROW), may be exchanged among individual sectors, and then leave the system to return to ROW. The units flowing between sectors are converted to proportions of the total number of units coming into a sector and these are termed flow coefficients. These proportions are the a_{ij}'s of the A matrix in the matrix algebra formula $X = (I - A)^{-1}Y$. Knowledge of A and knowledge of Y, the final demand vector, allows solution of X, which is the resource or unit requirement (sector activity) to meet the final demand expressed in Y.

Because solution of the above formula requires inversion of the A matrix (expressed by the exponent -1), a new set of coefficients is produced. When the A matrix containing the a_{ij}'s is inverted, the flow coefficients become interdependency coefficients, also known as multipliers, which supply information about how much activity is generated in each sector of the model for each dollar of external income into that sector.[10] More simply, the multipliers give the dollar amounts of activity in a sector as a result of changes in final demand. Table 6 will aid in understanding this concept.

This table of interdependency coefficients or multipliers is derived from the flow coefficients of the five

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[10] Hays Gamble and David L. Raphael, A Microregional Analysis of Clinton County, Pennsylvania (University Park: The Pennsylvania Regional Analysis Group, The Pennsylvania State University, February 1965), p. 16.

TABLE 6

HYPOTHETICAL TABLE OF MULTIPLIERS

	Sectors				
Sectors	1	2	3	4	5
1	1.33	.05	.18	.15	.02
2	.23	1.17	.30	.50	.04
3	.40	.36	1.41	.82	.13
4	.58	.19	.61	1.38	.09
5	.31	.41	.48	.38	1.09
Sector Multiplier	2.85	2.18	2.98	3.23	1.37

sector model presented in Table 2 of Chapter 2. The table illustrates the concept of generated activity in each sector for each dollar of income. For example, one dollar of external income to Sector 1 generates $1.33 worth of activity in Sector 1.[11] In Sector 4 there is $.58 worth of activity generated as a result of one dollar coming into Sector 1.[12] Each coefficient in the column for Sector 1 gives the economic activity generated by each dollar of external income into Sector 1. If the total Sector 1 external income is $200,000, then the activity in a particular sector created by the $200,000 can be found by multiplying the individual sector interdependency coefficients times the $200,000

[11]Ibid.

[12]Ibid.

coming into Sector 1.[13] The following example serves to illustrate the point. The discussion is taken from the study of Clinton County, Pennsylvania, conducted by Hays Gamble and David Raphael.

Total activity generated by $200,000 coming into Sector 1 is:

(1.33)($200,000) = $266,000

in Sector 4 is:

(.58)($200,000) - $116,000

By summing all the coefficients in the sectors' columns, a multiplier for the sector is obtained. This multiplier, when applied to the external income of that sector, yields the total economic activity generated by its external income. In the earlier table, the sum of all coefficients in the column for Sector 1 is 2.85, which becomes the multiplier for Sector 1. Again, using the same $200,000 of external income, the total activity generated by this amount coming into Sector 1 is:

(2.85)($200,000) = $570,000

There is another way to look at interdependency coefficients as well. Earlier it was demonstrated that $200,000 of external income to Sector 1 generated $116,000 of activity in Sector 4. This $116,000 can be viewed as the amount of activity required of Sector 4 in order that Sector 1 be able

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[13] Ibid.

to meet its external demand of \$200,000. The \$116,000 also represents the direct and indirect activity in support of the Sector 1 external demand of \$200,000. If the external demand incomes to the other four sectors were \$100,000 in each case, the total economic activity of Sector 1 would be \$306,000. This is calculated as follows:

(1.33)(\$200,000)	=	\$266,000
(.05)(\$100,000)	=	\$ 5,000
(.18)(\$100.000)	=	\$ 18,000
(.15)(\$100.000)	=	\$ 15,000
(.02)(\$100,000)	=	\$ 2,000
Total Sector 1 Activity		\$306,000

To understand fully the concept of direct and indirect activity which these coefficients represent, the original flow coefficients must be used again. It will be recalled from Table 2 in Chapter 2 that the flow coefficient between Sector 1 and Sector 4 was .31. This means that Sector 1 spends 31 percent of its total income directly in Sector 4 in order to satisfy its external or final demand of \$200,000. Thus, the amount of income and, therefore, activity of Sector 4 <u>directly</u> in support of Sector 1 is

(.31)(306,000) = \$94,860

The economic activity <u>indirectly</u> involved is then

\$116,000 - \$94,000 = \$21,140

To add substance to these illustrative figures, assume Sector 4 is the households sector for the modelled system. The households of the system require services, retail stores, and other facilities. So, too, do all the other households in the system not receiving income directly from Sector 1. The "Sector 1 households" must pay for these goods and services, as do the others. A portion of the $94,000 paid directly to households from Sector 1 goes to make these payments. These expenditures, taken as income by the sectors receiving them, are in turn distributed, some of it in the system, some external to it. Part of that spent within the system is for labor, or becomes income to other households. This process can be repeated until all of the original internal expenditures by "Sector 1 households" has flowed through the system. That portion of the flow which becomes payments to other households in the system is the amount by which the system's households are supporting those households receiving income directly from Sector 1. This is the $21,140 indirect household income generated by the $200,000 of activity by Sector 1.

A model understood in this way can yield detailed information on the interrelated, multisector economic activities of a system. Simulating various economic and technological changes with a model of this kind provides a multidimensional evaluation of the impact of these changes on the system. The calculations attendant to such a task are enormously tedious and time consuming. With the aid of a computer, the task is less onerous. The following paragraphs describe the computer program which is to be used to manipulate the Toronto model for the purpose elaborated above.

The Input-Output Program

The program which is used to operate the input-output model was written by M. C. Hallberg and W. M. Swope of the Department of Agricultural Economics of The Pennsylvania State University. The program solves the static Leontief input-output problem for a model which can contain as many as 160 sectors. The Leontief input-output model is expressed in matrix algebra form as

$$X = (I - A)^{-1}Y \qquad (1)$$

Given a working set of A_{ij}'s forming the Matrix A and an estimate of Y_i's (final demand amounts for each sector), the program calculates the expected amounts of resources required (sector activity) from each sector to meet the estimated final demand. The data required for the program are:

1. the total output or receipts vector from the base year of the model;
2. the input matrix of flow coefficients;
3. a vector or vectors of final demand.[14]

Output from the program consists of:

1. a matrix of flow coefficients;
2. a matrix of interdependency coefficients $(I - A)^{-1}$;

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[14] M. C. Hallberg and W. M. Swope, Input-Output Program for Model 360/67 (University Park: Agricultural Economics, The Pennsylvania State University, March, 1970), p. 1.

3. a vector of sector multipliers;

4. a vector of outputs required to satisfy each Y.[15]

The program is a flexible one in that it allows multiple problems to be run at the same time. In other words, the program would allow sequential changes in the Y vector through several iterations or simulated years. Each year would be represented by a vector of different Y_{ij} values.[16]

The mathematics of the program function in the following manner. Each row of the table of input coefficients is read as part of an equation for the total output of the sector represented by the row. Using a simplified 3 sector example where

Xm = total manufacturing output
Xs = total service output
Xh = total household output

and a set of hypothetical coefficients,

three equations can be formed:

Xm = .1xS + .4Xh + exports
Xs = .3Xm + .6Xh + exports
Xh = .3Xm + .7Xs + exports.[17]

The first equation states in specific mathematical language what the previous section on multipliers described narratively. Total manufacturing in this case must supply two other sectors with output from its own operations as well as

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[16]Ibid., p. 4.

[17]James Hielbrun, Urban Economics and Public Policy (New York: St. Martin's Press, 1974), p. 159.

exports from outside the system.[18] These exports are the elements of the equation which are supplied by the researcher to the program. By supplying these elements to the program, the simulated response is calculated. Mathematically, the program looks at the problem using the simple 3 sector example as follows:

> Suppose it is projected that the manufacturing sector must respond to $50 million of final demand, the service sector $10 million, and the household sector none. The program sets up the equations to read
>
> $$Xm = .1Xs + .4Xh + 50$$
> $$Xs = .3Xm + .6Xh + 10$$
> $$Xh = .3Xm + .7Xs + 0$$ [19]

The program solves for the X's in the multiple simultaneous equations of an actual model. The number of X's equals the number of sectors of the model. In the Toronto model there are 28. Therefore, 28 separate X's or dollar requirements are determined by the program to meet the estimates of final demand. Instead of looking at the problem of solving 28 individual equations, the program performs the calculations in matrix fashion. The matrices involved in the program would appear as shown in Table 7. The upper case A denotes that the matrix has been inverted. The program thus has the capability of examining the implications of the complex interrelationships of the system.

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[18] Ibid.

[19] Ibid.

TABLE 7

TWENTY-EIGHT SECTOR MATRIX MULTIPLICATION

X_1		A_{11}	A_{12}	A_{13}	A_{14}	.	.	.	A_{127}	A_{128}	Y_1
X_2		A_{21}	A_{22}	A_{23}	A_{24}	.	.	.	A_{227}	A_{228}	Y_2
X_3		A_{31}	A_{32}	A_{33}	A_{34}	.	.	.	A_{327}	A_{328}	Y_3
.		.	.	.	.	.	.	.	.	.	.
.	=	.	.	.	.	.	.	.	.	.	.
.		.	.	.	.	.	.	.	.	.	.
X_{27}		A_{271}	A_{272}	A_{273}	A_{274}	.	.	.	A_{2727}	A_{2728}	Y_{27}
X_{28}		A_{281}	A_{282}	A_{283}	A_{284}	.	.	.	A_{2827}	A_{2828}	Y_{28}

Final Demand Projections and Most Important Sectors Survey

The table of flow coefficients of the input-output model has been shown to provide a descriptive picture of the flows of a system. The multipliers derived from these coefficients become the means for manipulation of the model. The computer program performs the manipulation. It remains, then, to determine the stimuli by which the model will be calibrated. But before proceeding directly to the stimuli to be used in the Toronto model, it may be well to examine briefly the purposes to which the stimuli or final demand levels have been put in other models. From such a review may come suggested dollar amounts to be used as final demand to examine impacts for the model of Toronto, as well as the sectors most likely to be affected by the manipulation of these amounts.

In Werner Hirsch's St. Louis model, an effort was made to contact industrialists and economic experts in estimating the final demand vector. In so doing, two points were considered of primary importance in the creation of final demand for a local industrial sector: (1) national and international demands and (2) the local industry's location to actual and potential markets.[20] Total final demand was estimated on a ten-year projection to rise 38 percent

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[20]Werner Hirsch, "Interindustry Relations of a Metropolitan Area," Review of Economics and Statistics 41 (November 1959): 363.

from the base year levels.[21] The experts' estimates for final demand of leather and leather products, for example, were compiled and determined to decline at a rate of 19 percent over the ten year projection. The transportation equipment sector was likewise projected to increase by 119 percent.[22] Projections were made for the other sectors of the model as well and the final demand figures were computed by increasing the base year amounts by the estimated percentages. These amounts then became the elements of the final demand vector for manipulation of the St. Louis model. The sector found to have the greatest overall impact on the St. Louis economy was the printing and publishing sector.[23] The sector having the least overall impact on the St. Louis economy was the products of petroleum and coal.[24]

The New York model proceeded along similar methodological lines in determining projections for final demand. Straight-line growth projections were assumed to be the normal rates of growth. The New York model was also manipulated in the same way as the Hirsch St. Louis model. The purposes to which the model was put differed though. The designers of the New York model were more interested in the employment impact of the sectors being used. They, therefore,

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[21] Ibid.

[22] Ibid.

[23] Ibid., p. 366.

[24] Ibid.

did not try to discover the most important sector solely on the basis of the multipliers for each sector, as Hirsch had done for St. Louis. They instead converted the analysis to one which focused on employment potential for the various industries in the New York region. No individual sector was singled out as the most important for reporting, as in the St. Louis study. This information could be obtained, nevertheless, by examining the multipliers for each of the sectors in the model.[25]

Arthur D. Little, Inc. did pioneering work in the field of input-output analysis. The Little organization created a model for Stockton, California, in 1964. The study created one of the most elaborate local government sectors ever included in input-output analysis.[26] Further, it was directly used to measure effects on sales of sectors in the Central Business District (CBD) and on wages of seasonally employed workers.[27] The main interest of the modellers and their clients was the effects of the size of the municipal budgets in the city's CBD and on wages. The projections fitted into the Y vector were those for differing sizes of

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[25]J.W. Milliman, "Large-Scale Models for Forecasting," p. 319.

[26]Kenneth Kraemer, Policy Analysis in Local Government (Washington, D.C.: International City Management Association, 1973), p. 114.

[27]Ibid.

the capital and operating budgets.[28] Holding other sectors stable, the major manipulation was on the government sector of the model.

Walter Isard and his associates undertook to develop and apply an input-output model for Philadelphia, Pennsylvania. The researchers were primarily interested in the new integrated iron and steel sector for the region. The data for final demand were generated in a slightly different way in this study. On the basis of data on value of output for workers in each sector and in the iron and steel sector as well, it was possible to convert the estimates of employment increases into increases in final demand for products of the sectors in dollar terms.[29] A five-billion dollar projection of final demand was determined on this basis for iron and steel. In this model transportation, trade, communications, printing, and publishing were among the sectors most significantly affected by the increase of $5 billion in final demand for iron and steel products in the Philadelphia region.[30]

In an elaborate and well-financed study of the West Virginia economy, a four-step process was used to project final demand for use in the input-output model constructed

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[28] Ibid.

[29] Walter Isard et al., Ecological-Economic Analysis for Regional Development (New York: The Free Press, 1972), p. 28.

[30] Ibid., pp. 26-27.

for the state.[31] First, an approximation of final demand for each sector in the target year of the projection was estimated by time series analysis and comparisons with national trends were then made. Second, the resources that would be required to sustain the projected levels of demand were estimated. Next, initial demand forecasts were adjusted to eliminate inconsistencies between resource requirements and resource availability. Lastly, the final forecasts were compared with national trends and adjusted for significant departures from these trends. This study found that the construction sector was the most important sector to the West Virginia economy.[32]

Levels of Demand for the Toronto Model

Drawing on the studies cited above, the Toronto model will employ three separate approaches to the issue of the levels of final demand to be used in the Y vector of the model. The first approach will be a true experimental design and comes from the approach taken in the Arthur D. Little model of Stockton, California. Under conditions of *ceterius paribus*, or holding all else equal, the Metro sector will be the only sector varied. This will be accomplished by drawing on some of the data presented in Chapter 3. Since complete

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[31] William H. Miernyk, Kenneth L. Shellhammer, Douglas M. Brown, Ronald L. Coccari, Charles J. Gallagher, and Wesley H. Wineman, *Simulating Economic Development* (Lexington, Mass.: Heath Lexington Books, 1970), p. 34.

[32] Ibid., p. 264.

expenditure data for Metro are available from the base year of the model to the year 1974, it can be plugged into the Y vector of the input-output program to examine the effects such manipulation has on the system. This is similar to varying the size of budgets in the Stockton model.

The second approach to the levels of demand comes from the well-established tradition in the other models cited in the survey above. This, of course, is the use of time series to establish growth patterns in the past on the output of the sectors. Yet, there is a departure from the practice as used before. Since rates of growth for the years 1969 and 1974 are available from the Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs, vectors for each one of those years can be created. In addition, since there are Metro expenditure data available for those years as well, it, too, can be included in the vector to add an element of realism.

Finally, drawing upon the same data for the years 1969 and 1974, a projection can be made into the future. Since the period of past years is six, a projection of six years hence from 1974 would seem to be reasonable. That would make the target year 1980. Again, this approach comes directly from the research tradition of input-output modelling outlined above. Below, in Tables 8, 9, and 10, are listed the three sets of Y vectors to be used in the input-output program.

The set of vectors in Table 8 form the Y's to be used as stimuli in the experimental section of the research design. Note the only changes that occur are in the Metro sector where the total amount of money expended in the years 1969 through 1974 has been utilized in the vectors. Also note that the Value Added sector does not appear in this vector. This situation seems to be a matter of convention. There appears in the literature no particular reason for the sector to drop out of the matrix, but it is not included when inverting the matrix nor is it included in subsequent manipulation.[33]

The vectors as shown in Table 9 represent the years 1969 through 1974. These vectors contain the estimated actual demand for the sectors in each of these years, as well as the actual Metro government expenditures in 1969 through 1974.

The elements of each vector are estimated by percentage growth rates. The increase from 1965 to 1969 was approximately 10 percent in all sectors, except for Construction and Households, which increased by more than 20 percent. The manufacturing sectors were estimated to rise uniformly by the following rates:

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[33]See, for example, Werner Z. Hirsch, "Interindustry Relations of a Metropolitan Region," Review of Economics and Statistics 41 (November 1959): 363; Walter Isard et al., Ecological-Economic Analysis for Regional Development (New York: The Free Press, 1970).

TABLE 8

EXPERIMENTAL SIMULATION VECTORS

	1965	1969	1970	1971	1972	1973	1974
Food Products	958,020,670						
Distilleries & Soft Drinks	111,843,690						
Tobacco	4,742,733						
Rubber and Leather	124,890,460						
Textiles	124,179,881						
Clothing	183,670,086						
Wood and Wood Prod.	161,202,182						
Pulp and Paper	690,088,093						
Primary Metal	120,594,554						
Metal Indus.	1,059,031,797						
Transportation Equipment	47,675,559						
Electrical Industries	624,129,514						
Nonmetallic Industries	186,921,378						
Petroleum & Coal	257,433,556						
Plastics	33,582,900						
Chemicals	549,198,820						
Other Indus.	396,283,344						
Construction	477,053,158						
Trade	997,919,138						
Other Services	680,478,730						
Unallocated	589,006,108						
Households	5,353,252,984						
Metro Govt.	287,212,507	601,668,169	681,746,206	746,417,526	769,146,149	837,014,582	926,534,644

TABLE 9

TIME SERIES SIMULATION VECTORS

	Vector					
	1969	1970	1971	1972	1973	1974
Food Products	1,053,822,737	1,064,360,964	1,213,371,498	1,274,040,072	1,280,410,272	1,357,234,888
Distilleries & Soft Drinks	123,028,059	1,242,583,390	1,404,119,230	1,474,325,191	1,548,041,450	1,621,757,709
Tobacco	5,217,006	5,269,176	5,954,168	6,251,876	6,564,469	6,958,337
Rubber and Leather	137,379,506	138,753,301	156,791,230	164,630,791	172,862,330	183,234,069
Textiles	168,821,679	167,479,895	189,252,281	198,714,895	208,650,639	218,586,383
Clothing	367,340,172	371,013,573	419,245,337	440,207,603	442,408,641	468,953,159
Wood and Wood Prod.	177,322,400	179,095,624	202,378,055	212,496,957	223,121,804	236,509,112
Pulp and Paper	759,096,902	766,687,871	866,357,294	909,675,158	955,158,915	1,012,468,449
Primary Metal	132,654,009	133,980,549	151,398,020	158,967,921	166,916,317	176,931,296
Metal Indus.	1,164,934,976	1,176,584,325	1,329,540,287	1,396,017,301	1,465,818,166	1,553,767,255
Transportation Equipment	52,443,114	52,967,545	59,853,325	62,845,991	65,988,290	69,947,587
Electrical Industries	686,542,465	693,407,889	783,550,914	822,728,459	863,864,881	915,696,773
NonMetallic	205,613,515	207,669,650	234,666,704	246,400,039	247,630,040	262,487,842
Petroleum and Coal	283,176,911	286,008,680	323,189,808	339,349,298	356,316,762	377,695,767
Plastics	36,941,190	37,310,601	42,160,979	44,269,027	46,482,478	49,271,426
Chemical Indus.	604,118,702	610,159,889	689,480,674	723,954,707	760,152,442	805,761,588
Other Indus.	435,911,678	440,270,974	483,005,997	517,656,296	543,539,110	576,151,456
Construction	524,758,473	540,501,227	664,816,509	718,001,829	1,112,902,834	1,157,418,947
Trade	1,995,838,276	2,035,755,041	2,056,112,591	2,138,357,094	2,309,425,661	2,424,896,944
Other Services	877,817,561	912,930,263	958,576,776	1,016,091,382	1,087,217,778	1,174,195,200
Unallocated	647,906,718	654,385,785	739,455,937	776,428,733	815,250,169	864,165,179
Households	7,708,684,296	8,710,813,254	10,278,759,630	11,409,423,190	12,778,553,970	14,695,337,060
Metro Govt.	601,668,169	681,746,206	746,417,526	769,146,149	837,014,582	926,534,644

1% 1969 to 1970
13% 1970 to 1971
5% 1971 to 1972
5% 1972 to 1973
6% 1973 to 1974

The Construction, Trade, Service, and Household sectors each required their own percentage estimates. Construction, Trade, and Service output increases were not directly reported by the Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs. The percentage increases in these sectors' demand were pegged to the increases in the employment indices reported by the Ministry for these sectors. No full report of wages and salaries which comprise the Household sector's increases exist so these items were taken to closely resemble the rises in personal disposable income. The following table gives specific percentage increases for those sectors.

The final phase of the simulation involves the projection into the future. The projection is made on the basis of the performance of the system over the period for which data is available in the past. According to the data source from which the earlier vectors were formed, the manufacturing growth over the period from 1969 to 1974 was 6 percent. The elements of the final demand vector for the six years beyond 1974 for the manufacturing sectors reflects a 6 percent rise in the final demand for these products. This is the rate by which the previous six years' growth increased in manufacturing. Trade over those same six years increased by 18 percent.

TABLE 10

FOUR YEAR ESTIMATED GROWTH RATES

	Construction	Trade	Service	Households
1969 to 1970	3%	2%	4%	13%
1970 to 1971	22%	1%	5%	18%
1971 to 1972	7%	4%	6%	11%
1972 to 1973	54%	8%	7%	12%
1973 to 1974	3%	5%	8%	15%

The projection for that sector represents the same growth pattern. Construction growth was calculated at 6 percent and will be projected at that rate. The Service sector grew in the past and, thus, is projected to grow at 25 percent over the new six-year period. Finally, the Household sector's growth amounted to 61 percent and its projected final demand for six years is 61 percent larger than 1974. Table 11 represents the final demand vector for the target year of 1980 for the projection simulation.

The Metro sector can be expected to grow as well. If the six years from 1974 to 1980 exhibit growth comparable to the six-year period from 1969 to 1974 in Metro's expenditures, the amount will be substantial. The growth rate in the projection to match the historical period is 53 percent.

TABLE 11

1980 PROJECTION SIMULATION VECTOR

Food Products	1,438,668,981
Distilleries and Soft Drinks	1,719,063,171
Tobacco	7,375,837
Rubber and Leather	194,228,113
Textiles	231,701,565
Clothing	497,090,348
Wood and Wood Products	250,699,658
Pulp and Paper	1,073,216,555
Primary Metal	187,547,173
Metal Industries	1,646,993,290
Transportation Equipment	74,144,442
Electrical Industries	970,638,579
NonMetallic Industries	278,237,112
Petroleum and Coal	400,357,513
Plastics	52,227,711
Chemical Industries	854,107,283
Other Industries	610,720,543
Construction	1,226,864,083
Trade	2,861,378,393
Other Services	1,467,744,000
Unallocated	916,015,089
Households	23,659,492,660
Metro Government	1,417,598,005

Use of Multipliers from the Toronto Model

The multipliers from the model used for analysis should also be examined. It is through the study of multipliers that the most important sectors of the model can be determined. Therefore, by examining the sectors and their multipliers, the sectors which affect Toronto the most in terms of its economic activity will be picked out.

Also, the use of multipliers in the Toronto model will help to determine the direct and indirect resource requirements of the final demand estimates shown in the vectors in the preceding section. The direct and indirect requirements can be determined as shown in the section explaining the multiplier as a concept.

Once these tasks are complete, a third phase of the analysis of multipliers can be undertaken. That is the task of comparison. The multipliers from some of the studies mentioned in the brief survey earlier in this chapter can be used for comparison against those for Toronto to demonstrate any similarities.

Of particular interest in the study of Toronto multipliers will be the Metro Sector's multiplier. Examination of this sector's multiplier is the real substance of the policy analysis of this research. A comparison of this sector's multiplier with other local government sectors' multipliers will be done so that a relative size judgment can be made. Further, it is this multiplier which can reveal most about the effect on the system of the Metro's expenditures as policy. The whole column of interdependency coefficients will be studied to determine the estimated effects on the other sectors of the model.

Summary

This chapter has laid out the research design for the model created and described in Chapter 2. It began with a discussion of the parameters of the model to reiterate the need to rely on coefficients already determined and used in another model. The situation is not an unusual one because of the kind of data required for an input-output model. A major study of the New York area was cited in support of the method used in construction of the Toronto model.

The next issue discussed in the chapter was that of the multipliers. Consideration of multiplier derivation was the first topic discussed. Next, the discussion turned to examples of their use in determining direct and indirect resource requirements (sector activity) to meet the demand placed on each particular sector.

Discussion of the computer program which creates the multipliers from the flow coefficients, or more accurately the (I - A) inverse, followed. The mathematics of the program was elaborated to demonstrate the matrix approach to the solution of the model. With the final demand vectors included in the program, a simulation of effects of the change in stimuli on the model can be calculated. Thus, there were created in the chapter several final demand vectors to be used in the program.

The vectors fell into three categories. The first was called an experimental vector of final demand because the only change introduced into it was that of the Metro government's expenditures over the period from 1969 to 1974. The next set of vectors was used on a time series basis. For the years 1969 to 1974, for which data were available on the growth of the sectors in the Toronto model, vectors were created which demonstrated the growth of the Metro economy along with the changes in Metro government expenditures. Here is the true systems nature of the model at work. Finally, a vector based on a projection of six years into the future was made. This was the period of years for which estimates of actual growth existed and which are reflected in the times series vectors.

In the last section of the chapter attention returned to the multipliers of the model. The multipliers are the keys to understanding the important sectors of the model. In addition, the multipliers from other models might well reveal some similarities when compared to those of Toronto. The policy analysis which is the focus of this whole research project will also be an integral part of the examination of the multipliers. The discussion of the multipliers begins in the following chapter with a presentation of the inverse of the Toronto A matrix (presented in Chapter 2) from which the multipliers come.

CHAPTER 5

Introduction

In this chapter an application is made of the Toronto coefficients and their derived inverse. The application pertains to the levels of final demand set up in Chatper 4. This process is in line with the usual input-output operations.[1] That is, changes in final demand are made and, with the use of the inverse, the implications of those changes are examined. The A matrix from which the inverse is derived has been presented and discussed in detail in Chapter 2. It is fitting at this point, then, to present and discuss the inverse table before proceeding to its application. The inverse table is presented below.

Toronto's Inverse Table

The inverse of the (I - A) matrix is a 23 x 23 matrix which contains 529 coefficients. The inverse used here is

[1]Walter Isard and Thomas W. Langford, Regional Input-Output Study: Recollections, Reflections, and Diverse Notes on the Philadelphia Experience (Cambridge, Mass.: The MIT Press, 1971), p. 151.

one based on full technical coefficients or flow coefficients. Full, as used in this sense, means that regardless of whether an input of some commodity was furnished 100 percent by local producers or only in part, the coefficient represents flow unreduced by the amount of imports of the commodity into the sectors. When a commodity is wholly imported, so that the local production of the sector producing that commodity as primary output is zero, then a table of full technical or flow coefficients does not contain any coefficients corresponding to the use of a commodity that is wholly imported. This practice can give rise to errors in many situations and represents one of the shortcomings of traditional input-output research when the imports are not fully incorporated into the model.[2] Acceptance of the unreduced or full coefficients and, thus, the inverse, is necessitated by the inescapable problem of data availability. Yet, the full coefficients can still be useful. The inverse of full coefficients can yield indications of local Toronto impacts within a range of error. The error is created by the national and provincial components of the coefficients being applied to Toronto. But because Toronto is a center of national and provincial forces, both governmental and nongovernmental, and thus reflects the effects of those forces, it seems appropriate in this first research effort to

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[2]Ibid., p. 142.

err with the full coefficients until such time as research support becomes available to collect the more precise data. The precedent for this approach was set in the Philadelphia Regional Model of 1966-1968.[3]

The inverse matrix appears in Table 12 below. This inverse takes on the same substantive meaning as the hypothetical inverse presented in Table 6 of Chapter 4. That is, each dollar of income into any given sector of the Toronto model generates an amount of activity equal to the interdependency coefficient for that sector. Further, Table 12 for Toronto illustrates the interrelationships of the system's generated activity.

The lynchpins of these interrelationships are the individual multipliers of the cells of the table, for it is the multipliers which yield the economic response, both direct and indirect, to the external demand placed on any one sector of the Toronto system. For example, the interdependency coefficient for the response of the Food Products Sector to the demand placed on the Metro Sector is A_{128} = .020390 (The A coefficient indicates an element of the inverse table; the subscript refers to the location of the coefficient in the table; see Table 7 of Chapter 4). The

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[3]For a complete and detailed rationale for using the unreduced or full coefficients in the Philadelphia Study, see Walter Isard and Thomas Langford, Regional Input-Output Study, pp. 142-144.

TABLE 12

THE TORONTO INVERSE MATRIX

Food Products	1.356822	0.163497	0.025610	0.153387	0.055259	0.065367	0.063630	0.056120
Distilleries & Soft Drinks	0.005519	1.031716	0.004624	0.012151	0.007504	0.010210	0.010608	0.009038
Tobacco	0.000660	0.000478	1.169983	0.001674	0.001029	0.001489	0.001512	0.001143
Rubber & Leather	0.006026	0.005018	0.005078	1.206056	0.016848	0.014942	0.011267	0.008720
Textiles	0.017847	0.010845	0.011537	0.201817	1.691344	0.624366	0.127863	0.028487
Clothing	0.006032	0.004373	0.005250	0.015073	0.009615	1.055069	0.013596	0.010267
Wood & Wood Products	0.006683	0.006171	0.011683	0.013101	0.016918	0.013268	1.289730	0.021042
Pulp & Paper	0.087698	0.103573	0.094090	0.083412	0.080859	0.065440	0.072741	1.340594
Primary Metal	0.022609	0.019090	0.028146	0.030532	0.020728	0.020434	0.059505	0.023711
Metal Industry	0.049568	0.040552	0.019233	0.057536	0.028635	0.030836	0.130836	0.031840
Transportation Equipment	0.018064	0.013264	0.015346	0.040849	0.024585	0.034885	0.038951	0.028357
Electrical Industries	0.006964	0.005626	0.005920	0.014942	0.009836	0.011653	0.016748	0.010103
NonMetallic Industries	0.012035	0.043864	0.004697	0.014655	0.011858	0.009632	0.020031	0.013546
Petroleum & Coal Products	0.013942	0.011864	0.009260	0.026006	0.025183	0.019580	0.022017	0.019999
Plastics	0.011496	0.005044	0.011169	0.113091	0.021562	0.014305	0.031082	0.022033
Chemical Industry	0.041794	0.026655	0.018761	0.160028	0.199126	0.090634	0.064326	0.070243
Other Industry	0.009345	0.014321	0.007220	0.043670	0.020332	0.046214	0.020204	0.013486
Construction	0.015970	0.016249	0.014234	0.026985	0.024803	0.025655	0.029690	0.024921
Trade	0.111060	0.076698	0.080919	0.134973	0.113572	0.136792	0.183738	0.114110
Other Services	0.108339	0.116154	0.088416	0.212720	0.160181	0.195047	0.201612	0.192065
Unallocated	0.098493	0.074433	0.088440	0.149813	0.073530	0.096434	0.117758	0.121886
Households	0.196123	0.142051	0.171029	0.497318	0.305598	0.442300	0.449262	0.339708
Metro Government	0.020390	0.015507	0.034705	0.035419	0.031452	0.046100	0.044568	0.032341

TABLE 12, Continued

Food Products	0.028151	0.044643	0.033528	0.039337	0.049849	0.011993	0.065694	0.112977
Distilleries & Soft Drinks	0.004638	0.007692	0.005440	0.006713	0.007939	0.001577	0.005673	0.008829
Tobacco	0.00738	0.001096	0.000739	0.000907	0.001133	0.000161	0.000510	0.000662
Rubber & Leather	0.003787	0.008114	0.033302	0.009064	0.019871	0.002557	0.011233	0.015316
Textiles	0.011616	0.020320	0.048753	0.020543	0.026169	0.004638	0.016918	0.018923
Clothing	0.006488	0.009774	0.006597	0.009188	0.010175	0.001630	0.004744	0.006179
Wood & Wood Products	0.006460	0.012451	0.008668	0.007734	0.012746	0.003639	0.010105	0.008379
Pulp & Paper	0.022797	0.043209	0.032508	0.045806	0.072500	0.015706	0.061092	0.111433
Primary Metal	1.064968	0.418476	0.033062	0.130582	0.029713	0.030091	0.028754	0.038887
Metal Industry	0.033712	1.118482	0.058758	0.034370	0.037033	0.023231	0.036860	0.059948
Transportation Equipment	0.019862	0.049149	0.023616	0.024317	0.027341	0.005396	0.014643	0.020283
Electrical Industries	0.008541	0.017325	0.028593	1.143521	0.013346	0.003473	0.016214	0.021700
NonMetallic Industries	0.023263	0.014089	0.021188	0.025106	1.224516	0.004350	0.015936	0.022354
Petroleum & Coal Products	0.021178	0.017543	0.009436	0.012433	0.028836	1.093031	0.028511	0.067162
Plastics	0.002236	0.004291	0.007231	0.028862	0.008028	0.002235	1.106866	0.029183
Chemical Industry	0.022438	0.033332	0.034130	0.043079	0.039614	0.066473	0.410544	1.287070
Other Industry	0.004179	0.009673	0.014440	0.016669	0.009735	0.003482	0.135072	0.025464
Construction	0.015584	0.020906	0.016200	0.016383	0.026465	0.024440	0.017128	0.022671
Trade	0.030775	0.088012	0.038992	0.063009	0.147859	0.118621	0.067228	0.099567
Other Services	0.064328	0.119723	0.100395	0.111275	0.191729	0.047739	0.081523	0.121780
Unallocated	0.024308	0.094872	0.080666	0.097141	0.083132	0.028610	0.098758	0.165624
Households	0.219390	0.325748	0.219716	0.272481	0.336613	0.047917	0.151568	0.196812
Metro Government	0.017634	0.028466	0.018873	0.024736	0.026404	0.011406	0.015349	0.018232

TABLE 12, continued

Food Products	0.057194	0.0701183	0.015054	0.084852	0.060023	0.140799	0.074385
Distilleries & Soft Drinks	0.008791	0.011696	0.002896	0.009807	0.017414	0.023704	0.012254
Tobacco	0.001172	0.001821	0.000270	0.001178	0.000619	0.003936	0.001773
Rubber & Leather	0.038404	0.014065	0.005321	0.007762	0.034977	0.015785	0.013202
Textiles	0.064592	0.046170	0.013753	0.024419	0.027769	0.056064	0.035033
Clothing	0.011044	0.016068	0.004079	0.010540	0.006885	0.034404	0.016650
Wood & Wood Products	0.037417	0.093323	0.005418	0.013068	0.009571	0.018008	0.034705
Pulp & Paper	0.092885	0.050053	0.021598	0.037295	0.267001	0.043164	0.059437
Primary Metal	0.105585	0.118839	0.010122	0.020088	0.066259	0.020177	0.067320
Metal Industry	0.085114	0.159605	0.015732	0.033222	0.146035	0.034503	0.100410
Transportation Equipment	0.031115	0.044808	0.012799	0.028052	0.046647	0.084372	0.048144
Electrical Industries	0.036077	0.053947	0.004098	0.011229	0.034868	0.019111	0.025073
NonMetallic Industries	0.026518	0.087166	0.004767	0.011448	0.014481	0.011295	0.045790
Petroleum & Coal Products	0.018774	0.031352	0.027991	0.014399	0.015560	0.025412	0.027841
Plastics	0.114479	0.008425	0.002071	0.003971	0.013759	0.006544	0.006366
Chemical Industry	0.086014	0.042947	0.009771	0.026323	0.085235	0.038653	0.038057
Other Industry	1.094873	0.019053	0.044326	0.010652	0.040782	0.017639	0.016309
Construction	0.023999	1.025277	0.034030	0.082671	0.020516	0.029760	0.268483
Trade	0.107615	0.099186	1.088730	0.065427	0.143707	0.109689	0.132673
Other Services	0.178314	0.213412	0.132860	1.220840	0.178559	0.289705	0.338860
Unallocated	0.125713	0.071286	0.025426	0.089798	1.064211	0.074444	0.141733
Households	0.348188	0.541197	0.080046	0.349567	0.183903	1.169642	0.507113
Metro Government	0.029205	0.044614	0.036575	0.065211	0.025542	0.059383	1.706976

final demand being met directly by Metro in the base year of the model (see Table 8, column 1, of Chapter 4) is Y = \$287,212,507. The response by or activity generated in the Food Products Sector to this level of demand is $A_{128}Y_{28}$ = (.020290)(287,212,507) = 5, 856,263.01 units. Since in this model the units of flow are dollars, this figure translates to \$5,856,263.01 of direct <u>and</u> indirect economic activity.

When knowledge of the direct and indirect response by the whole region to a given sector's external demand is desired, it is only necessary to find the product of that sector's multiplier and its final demand. From Table 6 of Chapter 4 it has already been demonstrated that the sector multiplier is found by summing all of the interdependency coefficients which form the elements of the sector columns. Entering this column sum for any one sector along with the final demand for that sector into the above calculation produces the total system's direct and indirect response to the sector's workings as it functions to meet its final demand. More simply, multiplying the sector's final demand by its sector multiplier calculates the amount of economic activity generated throughout the economic system by the sector's production or, in the case of a government sector such as Metro, its policy.

Attention now focuses on these economic response issues with respect to Metro Toronto's operation. In doing so, a true systems model policy analysis is shaped. The following applications of the Toronto inverse deal specifically with the system's response to Metro policy and the individual sectors most affected by Metro policy activity. The subject of sector multipliers will be addressed in greater detail in a later section.

Application of the Inverse: Experimental

The Toronto inverse may be applied to a specified level of demand. To examine the generated activity within the system, the first application is that of the experimental set of vectors created in Chapter 4.

The main concern here is with the levels of spending in the Metro sector and the relationship of that spending to the other sectors of the model. For the year 1965, which is the base year of the model, the final demand figure for the Metro sector was $287,212,507. According to the estimates of output for the base year of 1965, this amount spent by Metro generated $4,204,084,470 worth of activity in the Toronto system. The sectoral contribution of generated activity to the system is given in Table 13. Table 14 is the activity in dollar terms created in each sector by Metro spending.

As Table 14 shows, in 1965 expenditures of $287,212,507 by the Metro government generated in the other sectors the activity in varying quantities. The most affected sector was the Households sector, where $145,649,400

TABLE 13

CONTRIBUTION BY SECTOR TO TOTAL SYSTEM ECONOMIC ACTIVITY

Sectors	Dollars
Food Products	9,707,723,595
Distilleries and Soft Drinks	1,527,740,147
Tobacco	234,814,794
Rubber and Leather	1,178,411,378
Textiles	3,763,001,917
Clothing	2,201,910,509
Wood and Wood Products	1,430,439,509
Pulp and Paper	4,229,365,549
Primary Metal	5,999,824,738
Metal Industry	14,142,105,168
Transportation Equipment	5,287,819,210
Electrical Industries	2,040,240,724
NonMetallic Industries	1,136,641,708
Petroleum and Coal Products	2,000,898,690
Plastics	585,069,352
Chemical Industry	3,505,305,113
Other Industries	1,602,411,956
Construction	2,580,272,154
Trade	8,582,646,095
Other Services	18,679,167,369
Unallocated	6,264,137,566
Households	68,119,764,351
Metro Government	4,204,084,470

TABLE 14

SECTOR ACTIVITY CREATED BY METRO POLICY

Sectors	Dollars
Food Products	21,364,400
Distilleries and Soft Drinks	3,519,800
Tobacco	509,300
Rubber and Leather	3,791,800
Textiles	10,062,200
Clothing	4,782,300
Wood and Wood Products	9,967,900
Pulp and Paper	17,071,300
Primary Metal	19,335,300
Metal Industry	28,839,200
Transportation Equipment	13,827,700
Electrical Industries	7,201,400
NonMetallic Industries	13,151,600
Petroleum and Coal Products	7,996,300
Plastics	1,828,400
Chemical Industry	10,930,600
Other Industries	4,684,300
Construction	77,111,800
Trade	38,105,400
Other Services	97,325,000
Unallocated	40,707,700
Households	145,649,400
Metro Government	490,264,900

worth of activity was generated. The next most affected sector was the Services sector, which experienced activity in the magnitude of $97,325,000.

Taking another view of these figures, they are the amounts required of these sectors in order that the Metro sector meet its output requirements of $287,212,507. In addition, these amounts consist of both direct and indirect activity in support of the Metro sector. Referring back to the flow coefficients in the Toronto A matrix, it is estimated that the Households sector spends 14.45 percent of its income in the Metro sector in order for the Metro government to meet its output requirements. The amount of income and, therefore, activity of the Households sector directly in support of Metro is found by taking 14.45 percent of the total activity generated by the Metro sector. In this case the calculations are as follows:

(14.45)4,204,084,470) = $607,523,838

There is also an indirect amount of support of Metro from the Households sector. That amount is found by taking the difference between the amount directly supporting Metro and the amount generated in the Households sector by Metro. Thus,

607,523,838 - 145,649,400 = $461,874,438

The amount of direct and indirect support from the Services Sector is as follows:

Direct Support of Metro from the
Services Sector

(.047)4,204,084,470) = $382,571,986

Indirect Support of Metro from the
Services Sector

382,571,986 - 40,707,700 = $341,863,986

The indirect amounts are sums paid to other sectors which in turn pass them through the system back to the Metro sector. In this context, one can see in detail how the system is linked together and the effects which are generated by the operation of the system's component parts. With this in mind, an examination can be undertaken to see how the system responds when varying levels of output for the Metro sector are introduced into the system while all else remains stable.

Table 15 is a summary of the experimental results for the two most affected sectors, using 1969 through 1974 Metro expenditure levels and holding output from the other sectors at existing 1965 levels. What the table shows is growth in total system activity as a result of steadily increasing Metro expenditures as well as greater activity in the two sectors being studied: Households and Services. What the results show in the direct and indirect support categories is even more interesting.

According to the experimental simulation results, as Metro expenditures grow, direct support from the Households sector grows, indicating a heavier burden on Households in

TABLE 15

SUMMARY OF EXPERIMENTAL RESULTS FOR THE HOUSEHOLDS AND SERVICES SECTORS

Year	Level of Metro Output	Total Activity Generated by Metro Sector	Activity Generated in House.	Activity Generated in Services	Direct Support House.	Indirect Support House.	Direct Support Services	Indirect Support Services
1969	601,668,169	4,740,852,821	305,114,100	203,881,500	685,053,232	379,939,132	431,417,606	227,536,106
1970	681,746,206	4,877,544,129	345,722,800	231,016,800	704,805,126	359,082,326	443,856,515	212,839,715
1971	746,417,526	4,987,936,537	378,518,500	252,931,400	720,756,829	342,238,329	453,902,222	200,970,822
1972	769,146,149	5,026,733,757	390,044,500	260,633,200	726,363,027	336,318,527	457,432,771	196,799,571
1973	837,014,582	5,142,583,562	424,461,500	283,631,100	743,103,324	318,641,824	467,975,104	184,344,009
1974	926,534,644	5,295,392,183	469,858,300	313,965,900	765,184,170	295,325,870	481,880,688	167,914,788

the system. Without the operation of the other sectors of the system along with that of the Households sector, Metro grows more dependent on this single sector. This situation could not continue for any length of time because it is economically unhealthy for the Metro to depend so heavily on this one sector. Also, it would be politically unwise to do so. The same is true of the Services sector since the same situation accrues with regard to its support of Metro. Without the operation of the other sectors of the system, greater direct support is required of Services in order for Metro to meet its output of expenditures.

Other information produced by the simulation shows that the Metro sector ranks eighth out of the twenty-three sectors of the model in terms of total system activity generated by all the sectors' operation. Figure 14 lists the top ten sectors in order of the activity they generate from the sector producing the most activity to the sector producing the least.

FIGURE 14

TOP TEN ACTIVITY GENERATING SECTORS

1. Households
2. Services
3. Metal Industry
4. Food Products
5. Trade
6. Unallocated
7. Primary Metal
8. Metro Government
9. Textiles
10. Chemical Industry

Being eighth among the top ten in the system indicates the importance of the Metro for the rest of the system. Removal of Metro output, it can be reasoned, would radically alter the structure and strength of the system. Less severe than removal of Metro activity, but of equal consequence to the system, would be a reduction in Metro activity. More about this subject will be gleaned in the following section. The main point here is the important linkage which exists between Metro and the rest of the system.

The simulation experiment further demonstrates the linkages in the system and the implications the linkages have for Metro policy. For example, allowing only Metro output to increase, while holding all else equal to base year levels, still produces growth activity in the sectors. Table 16 is illustrative of the point. The growth in Metro expenditures over the six years of the simulation was 53.99 percent. Such a percentage rise in Metro output produced growth in activity generated in the top ten producing sectors by the percentages shown in the table.

Summary

The simulation experiment is the first of three phases of this research which demonstrate the functioning of the interrelationships of the system and the implications these interrelationships have for Metro policy. By performing a true experiment with the simulation of input-output

TABLE 16

GROWTH RATES IN ECONOMIC ACTIVITY IN TOP TEN PRODUCING SECTORS VARYING ONLY METRO OUTPUT

Sector	Growth Rate (percent)
Households	4.75
Services	1.59
Metal Industry	.45
Food Products	.48
Trade	.98
Unallocated	1.44
Primary Metal	.71
Metro	11.69
Textiles	.59
Chemical Industry	.69

mechanisms, observations have been made about how the system's parts operate together. In this phase of the data analysis, several items of interest have emerged. First, a base year of activity was provided displaying the estimated activity levels created in the system by the sectors. From this effort came the second important piece of research information: the sectors which produced the greatest levels of activity as a result of Metro activity. Using this information, the third item of interest came to light. The two sectors which receive the greatest amount of activity as a result of Metro output must in turn increase their direct support of Metro to sustain its output or policy which produces that activity. Fourth, the simulation revealed that Metro plays a relatively large role in the total production of the system. Thus, increasing its level of output (expenditures) while keeping the rest of the system as a base year level of production can still produce measurable effects in the system.

These research findings can now be used as the basis for comparison with system behavior based on estimates of actual performance. The research at this point turns to that task.

Application of the Inverse: Time Series

The first area of concern is the generated activity levels among the sectors. Table 17 lists the sectors and

TABLE 17

SIMULATED ACTIVITY GENERATED IN TORONTO 1969-1974

	1969	1970	1971	1972	1973	1974
Food Products	3,063,069,210	3,415,411,260	3,927,113,230	4,211,141,500	4,489,945,230	4,915,530,790
Distilleries & Soft Drinks	396,039,740	1,577,045,290	1,791,319,340	1,895,593,280	2,013,642,340	2,142,296,660
Tobacco	46,540,300	51,365,530	59,662,960	65,089,800	72,155,520	81,048,350
Rubber & Leather	415,882,110	441,640,730	504,397,780	539,405,900	584,058,520	637,368,450
Textiles	1,240,267,730	1,315,532,910	1,507,382,810	1,617,689,320	1,748,652,880	1,914,035,620
Clothing	743,401,290	789,283,440	905,592,640	972,185,050	1,033,647,220	1,135,556,570
Wood & Wood Products	540,508,770	573,320,450	656,992,410	702,117,770	782,366,410	849,526,060
Pulp & Paper	2,044,879,450	2,227,181,280	2,259,311,450	2,682,441,850	2,865,769,920	3,086,697,890
Primary Metal	1,214,663,650	1,273,726,570	1,448,735,350	1,534,988,500	1,671,523,660	3,112,783,370
Metal Industry	2,117,022,100	2,225,674,330	2,530,135,770	2,679,634,790	2,899,245,720	3,112,783,370
Transportation Equipment	1,018,808,440	1,126,833,700	1,306,214,800	1,423,756,930	1,579,193,000	1,771,869,880
Electrical Industry	1,099,097,680	1,136,830,720	1,293,348,100	1,370,535,350	1,474,143,270	1,584,372,000
NonMetallic Industry	545,318,260	614,942,570	701,427,330	744,547,200	809,513,710	870,202,460
Petroleum & Coal Prod.	755,527,560	803,111,210	911,785,610	972,828,970	1,054,422,230	1,146,684,180
Plastics	270,899,090	285,943,890	325,081,030	345,422,030	370,335,360	400,031,160
Chemical Industry	1,572,627,960	1,657,474,560	1,886,939,460	2,005,477,820	2,149,691,130	2,322,988,330
Other Industries	776,726,590	818,539,530	926,608,990	983,973,110	1,053,514,210	1,137,032.820
Construction	1,219,051,690	1,310,370,480	1,528,876,080	1,639,772,600	2,123,636,480	2,273,648,070
Trade 3,954,99	3,954,992,450	4,215,759,280	4,543,717,790	4,816,836,140	5,245,248,480	5,663,636,610
Other Services	4,876,953,500	5,385,264,630	6,093,675,710	6,585,311,030	7,253,665,950	8,051,472,590
Unallocated	2,179,245,390	2,367,037,690	2,695,346,890	2,875,717,910	3,103,697,490	3,379,268,430
Households	12,003,489,410	13,416,457,240	15,642,562,560	17,181,138,220	19,140,546,740	21,644,279,060
Metro Government	1,824,594,350	2,044,356,520	2,283,894,520	2,410,567,100	2,646,040,270	2,939,382,970

the activity levels generated throughout the system for each sector in each simulated year. The total activity generated in the system by Metro output in 1969 declined from its 1965 level reported earlier as $4,204,084,470 to $1,824,594,350. The model simulated activity levels from 1969 to 1974 never reach the 1965 level for the Metro sector. Substantively, this is due in part to reduced capital spending on the part of Metro. The year 1965 was the end of a construction period for the Toronto subway system.[4] Removal of such large sums from the economic system would certainly affect economic activity generated for the whole system. Even so, the Metro sector's decline in generated activity is matched by the rest of the system as well. Again, in part, this is explained by a drop in the total number of producing establishments and the total number of workers employed by producers.[5] The model, then, appears to be tracking, in gross terms at least, the actual operations of the system over time.

Nevertheless, in terms of rankings for amounts generated in the system, Metro still stands among the top ten producers during 1969-1974. Table 18 provides the rankings of the sectors based on activity produced by estimates of

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[4] The Municipality of Metropolitan Toronto, Annual Report (Toronto: Municipality of Metropolitan Toronto, 1965), p. 27.

[5] Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs, Ontario Statistical Review, 1973 (Toronto: Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs, 1974), p. 61.

TABLE 18

SECTOR RANKINGS OF GENERATED ACTIVITY 1969-1974

Sector	Rank
Households	1
Services	2
Trade	3
Food Products	4
Unallocated	5
Metal Industry	6
Pulp and Paper	7
Metro Government	8
Chemical Industry	9
Textile	10

actual output. These rankings reflect the actual development of the Toronto economic system. The highly developed service sectors of Metro rank high while the manufacturing sectors rank relatively low.[6] The importance of the Households sector is of particular note here as well and reflects the important position of wages and salaries (which as pointed out in Chapter 2, compose the Households sector) to the economic life of Toronto.[7] The high ranking of these sectors in terms of activity produced by their output is further evidence of the close association among these sectors and evidence, too, of the acceptability of the model.

More to the point of the policy analysis of this research is the strong position of the Metro sector in the system. Earlier it was seen in the experimental simulation that the Metro sector was among the top ten sectors in terms of growth of activity produced. The estimates of actual output show again that the Metro sector holds this place in real terms as well; a most important fact to keep in mind in terms of policy output.

As in the experimental simulation, the two sectors most affected by Metro policy, or the sectors in which the

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[6] Statistics Canada, Retail Trade, Catalog No. 63-005 (Ottawa: Statistics Canada, March 1976), pp. 98-102.

[7] Statistics Canada, Employment Earnings and Hours, Catalog No. 72-002 (Ottawa: Statistics Canada, February 1976), pp. 60-62.

the largest amounts of activity are generated, are the Households sector and the Service sector. Also, as occurred in the experiment (but not previously reported), the Construction sector surfaced as the third most affected sector. The sectors are listed below in order of activity generated in them by Metro from greatest to least amounts. As Table 19 shows, the Households and Services sectors once again rank highest.

Among these sectors there were many which experienced substantial growth in terms of the economic activity produced as a result of Metro policy or expenditures during the years simulated. Those with the higher rates of growth produced by Metro activity are:

FIGURE 15

RATES OF GROWTH CREATED BY METRO POLICY

Food Products	75%
Construction	56
Services	55
Households	51
Trade	50
Pulp and Paper	50
Primary Metal	50
Metal Industry	50

As was done in the experimental section of this chapter, attention is given to the support from the two sectors most affected by Metro policy output: Households and Service. In both sectors, the direct support categories show growth. However, the levels of direct support from both sectors are not of the same magnitudes here as in the earlier simulation. This is because in the second simulation the

TABLE 19

RANKINGS OF SECTORS RECEIVING GREATEST AMOUNTS OF GENERATED ACTIVITY BY METRO POLICY

Sector	Rank
Households	1
Services	2
Construction	3
Unallocated	4
Trade	5
Metal Industry	6
Food Products	7
Pulp and Paper	
Primary Metal	
Transportation Equipment	8
NonMetallic Industries	
Textiles	9
Wood and Wood Products	
Chemical Industry	
Distilleries and Soft Drinks	10
Rubber and Leather	
Clothing	
Other Industries	

entire system is allowed to operate to provide support in addition to that provided by Households and Services. The indirect support does not exhibit the same pattern as in the experimental simulation. Where earlier there was an upward trend in Services and a downward trend in Households, there is both up and down movement in the indirect support categories from both sectors. Table 20 displays these data in detail.

Summary

With the simulation of actual system performance, a true systems analysis has taken place. The model has performed in such a way as to render a realistic view of the Toronto system's operation. The picture which emerges is one of a vigorous economy where Metro plays an important role. By the measures of activity produced, Metro ranks among the strongest contributors in the system. Further, it is closely attached to all the major sectors in the economy.

What the simulation of actual performance of the Toronto system has shown in specific terms are the following. First, removal of large sums from the economic system by Metro substantially reduces the levels of activity created in the system by Metro. Second, the two sectors most closely associated with Metro as measured by activity produced in them by Metro are the Households and Service sectors. Third, Metro created over the simulated period large rates of growth in other sectors in terms of economic activity.

TABLE 20

DIRECT AND INDIRECT SUPPORT PROVIDED BY
HOUSEHOLDS AND SERVICES TO METRO

	Direct Support From Households	Indirect Support From Households	Direct Support From Services	Indirect Support From Services
1969	263,653,883	46,346,105	166,038,085	33,961,915
1970	295,409,517	54,590,483	186,036,443	43,963,557
1971	330,022,758	49,977,242	207,834,401	42,165,599
1972	348,326,945	41,673,055	219,361,606	40,638,394
1973	382,352,819	37,647,181	240,789,664	39,210,336
1974	424,740,839	45,259,161	267,483,850	42,516,150

In the simulation, the Food Products sector exhibited the largest growth rate in activity as a result of Metro output. Finally, the direct support levels of the two most closely aligned sectors with Metro showed steady increases over the six simulated years, confirming what the experimental simulation had produced. The indirect support levels revealed no real pattern.

With the results from the simulation using estimates of actual system behavior firmly in hand, the question of future activity can now be raised. It will be recalled from Chapter 2 that one of the important questions of policy analysis is that which concerns trends for the future. The following section addresses the future of the Toronto system with a simulation using the projection vector from Chapter 4.

Application of the Inverse: Projection

The first item to be concerned with is the amount of systems activity likely to be created by Metro in the Toronto system of 1980. That activity amounts to $4,364,243,680. This figure is considerably larger than that produced in the time series portion of the analysis, but it is only slightly larger than the activity produced in the base year of 1965 (which was $4,204,084,470). The other system activity created by individual sectors for 1980 can be seen in Table 21. In general, the table reveals activity below the

TABLE 21

1980 PROJECTION OF ECONOMIC ACTIVITY GENERATED BY TORONTO SECTORS

	Amount Generated
Food Products	6,404,167,310
Distilleries and Soft Drinks	2,470,790,650
Tobacco	118,838,600
Rubber and Leather	812,225,530
Textiles	2,506,722,340
Clothing	1,492,551,080
Wood and Wood Products	1,065,658,090
Pulp and Paper	3,661,260,410
Primary Metal	2,102,321,610
Metal Industries	3,634,139,040
Transportation Equipment	1,848,516,410
Electrical Industries	1,848,516,410
NonMetallic Industries	1,037,594,990
Petroleum and Coal	1,444,361,900
Plastics	481,191,660
Chemical Industry	2,800,072,800
Other Industries	1,358,559,550
Construction	2,795,867,640
Trade	7,279,196,270
Services	11,334,679,810
Unallocated	4,272,874,870
Households	32,718,606,270
Metro Government	4,364,243,680

base year levels of 1965. The Households, Services, and Trade sectors lead in activity produced. The Food Products sector follows those in economic activity that create strength in the system. Table 22 shows the 1980 projection of rankings of the sectors with regard to their activity generating capacities.

Changes take place in the projection simulation when compared to the experimental simulation and the time series simulation. Households and Services continue to hold their one and two positions in the system, respectively. Trade moves into the number three rank. In the base year, the Trade sector ranked fifth and in the Time Series simulation it ranked third. Food Products ranks fourth in the projection. It holds this position from the base year and the Time Series simulation. The Metro sector moves into the fifth-ranking position in production of activity, whereas in the previous simulations Metro had been eighth in activity-generating ability. The Unallocated sector remains sixth. The Metal Industry drops to eighth--the position formerly held by Metro. It had ranked third in the base year. The Chemical Industry remains in ninth position (its Times Series rank; Chemicals had placed tenth in the base year). Textiles drops out of the top ten activity-producing sectors altogether. In the base year it had placed ninth. The Time Series simulation had ranked it in tenth position. The tenth-ranking sector in terms of economic activity created is shown by the

TABLE 22

1980 PROJECTION OF TOP TEN ACTIVITY GENERATING SECTORS

Sector	Rank
Households	1
Services	2
Trade	3
Food Products	4
Metro Government	5
Unallocated	6
Pulp and Paper	7
Metal Industry	8
Chemicals	9
Construction	10

the projection to be the Construction sector. Overall, then, Metro Toronto is projected to continue its trend toward a service-based economy with the Metro Government sector projected to be among the highest-ranking activity-generating sectors in the Toronto economy.

The next issue of concern is the amount of activity created in the sectors, or subsystems, of the larger system by Metro policy. Table 23 gives a sectoral breakdown of the activity produced by Metro output. Households still remains the sector in which the greatest economic activity is produced by Metro. Services is also once again the second most affected sector. Construction receives a projected activity level which ranks it third in terms of activity produced by Metro. The Unallocated sector is the fourth-ranking sector in this category. The Trade sector ranks fifth here, followed by the Food Products sector, Primary Metal, Pulp and Paper, and Transportation Equipment.

For comparison with the two earlier simulations, the direct support from the two most affected sectors in the projection are computed and displayed below:

<u>Direct Support:</u>

Households

(.1445)(4,364,243,680) = \$630,633,211

Services

(.047)(4,364,243,680) = \$205,119,452)

TABLE 23

PROJECTED SECTORAL ECONOMIC ACTIVITY PRODUCED BY METRO POLICY

Sector	Amount
Food Products	110,000,000
Distilleries and Soft Drinks	2,000,000
Tobacco	Trace
Rubber and Leather	2,000,000
Textiles	5,000,000
Clothing	2,000,000
Wood and Wood Products	5,000,000
Pulp and Paper	8,000,000
Primary Metal	110,000,000
Metal Industries	140,000,000
Transportation Equipment	7,000,000
Electrical Industries	4,000,000
NonMetallic Industries	6,000,000
Petroleum and Coal	1,000,000
Plastics	1,000,000
Chemical Industry	5,000,000
Other Industries	2,000,000
Construction	380,000,000
Trade	190,000,000
Services	480,000,000
Unallocated	200,000,000
Households	720,000,000
Metro Government	2,000,000,000

In the case of the Households sector, the direct support is projected to rise by $23,109,373, or 3.8 percent, over the fifteen years since the base year. Direct support from the Services sector is projected to decline by $256,754,986, or 55.5 percent, from its 1965 level. Here is the application of policy analysis for the future. The consequences of continued value choices projected into the future reveal that although the absolute value of Households' direct support increases, it is only a 3 percent rise from the base year. Additionally, the Services sector's support actually declines. This occurs as a result of the operation of the entire system together and reveals the importance of dealing with the system as one entity composed of separate parts functioning with others at the same time. Further, it is important to note the time element here. Looking back to the base year puts the direct support of Households and Service in perspective in order that the hundred million dollar sums are not seen in isolation and thus give the impression of undue stress on any one sector.

Summary

With the three simulations performed and reported, a section of summary seems appropriate. What this chapter has done is to approach the two important policy analysis questions posed in Chapter 2. First, in the form of the experiment, a base from which to make judgments about the consequences of Metro policy was established. Then, in that same section, an examination of the likely consequences of changes in the values of the policy for the system was made. By holding all else steady and allowing Metro to increase its output, the results showed a heavy burden of direct support being placed on those sectors (Households and Services) most closelv affected by Metro policy in the form of generated economic activity.

Using this base of comparison, a second simulation was done to examine the consequences of actual Metro policy. What was discovered in this phase of the research proved to be an interesting contrast with the first simulation. Metro's policy output still depended heavily on Households and Services,but not nearly to the extent that the experimental results had shown.

The third and final simulation added yet another perspective to the policy analysis. The projection indicates a lessened dependence on Households as the years pass. Further, there is a decline in the support from the Services sector of the system.

Another important finding emerged from all three simulations. In each simulation, the Metro Government sector was found to be among the most important economic activity-producing sectors of the system. The Metro sector's policy output plays a substantial role in the overall functioning of the system. The projection simulation indicates this will be even more true in the future. With this important fact in mind, the Sector Multiplier for Metro and the other sectors should be examined to understand why the above results occurred.

The Sector Multipliers

The sums of each column of the interdependency or inverse matrix displayed in Table 12 supply the sector multipliers. These multipliers have signifiance in describing the interdependence of any one sector with the other sectors of the system and the relative contributions to the economy from the external income of each sector. Table 24 lists the sectors, the multipliers, and a ranking of the multipliers in order of magnitude. The table shows, rather startingly, that the Metro Government sector ranks in first position in activity-generating ability. This means that relative to the other sectors of the system, Metro's impact is greatest on the internal operation of the system.

These multipliers, and especially the one for the Metro sector, give an indication of the power of a dollar spent internally by a sector to generate additional economic activity within the system. Nevertheless, these particular multipliers are not the "best" measure of this kind of power. Such measurement is better made by the indirect internal multiplier.[8] In order to derive this coefficient, one needs

[8]For a complete explanation of the derivation of this multiplier, see Hays Gamble and David Raphael, A Microregional Analysis of Clinton County, Pennsylvania, Vol. II

TABLE 24

SECTOR MULTIPLIERS FOR THE
TORONTO SYSTEM

Sector	Multiplier	Rank
Food Products	2.223	15
Distilleries and Soft Drinks	1.947	18
Tobacco	1.926	19
Rubber and Leather	3.245	2
Textiles	2.950	5
Clothing	3.070	3
Wood and Wood Products	3.021	4
Pulp and Paper	2.533	8
Primary Metal	1.657	21
Metal Industries	2.507	9
Transportation Equipment	1.875	20
Electrical Industries	2.182	17
NonMetallic Industries	2.431	12
Petroleum and Coal	1.552	23
Plastics	2.400	13
Chemical Industry	2.470	11
Other Industries	2.723	7
Construction	2.855	6
Trade	1.557	22
Services	2.221	16
Unallocated	2.504	10
Households	2.326	14
Metro Government	3.718	1

more extensive data on imports and exports than were available for this research. Since, as explained earlier, this analysis makes use of full technical or flow coefficients, an indirect internal multiplier cannot be derived. Yet, because the amounts of generated activity shown in the experimental, time series, and projected analyses have already been reported along with the relative sizes of the multipliers which produced the activity, it is well known by now that the Metro Government's policy output creates very strong effects. From this fact it can reasonably be surmised, even without the use of the indirect internal multiplier, that Metro's policy impact generates a large amount of activity. In lieu of the additional detail, the internal multiplier could provide, it seems more useful to examine the sector multipliers of the Toronto system with the sector multipliers from other studies. Particular attention is directed at the local government sectors of the other models for comparison.

Table 25 is a comparison of the Toronto sector's multipliers with comparable ones from other studies. Three of the studies have been either cited or reviewed previously: the Hirsch St. Louis study, the Miernyk et al. West Virginia model, and the Gamble and Raphael model of Clinton County, Pennsylvania. The fourth study was chosen for

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(University Park: The Pennsylvania Regional Analysis Group, The Pennsylvania State University, June 1966), pp. 67-72.

TABLE 25

COMPARISON OF SECTOR MULTIPLIERS

Sector	Toronto	St. Louis	West Virginia	Clinton County	Petersborough
Food Products	2.223	2.57	1.501	2.172	1.147
Distilleries & Soft Drinks	1.947	2.34	1.152		
Textiles	2.950	2.00		1.713	
Clothing	3.070		1.079	1.619	1.021
Wood and Wood Products	3.021	2.20	1.319		1.149
Primary Metal	1.657	2.08	1.116		
Metal Industries	2.507	2.37	1.188		1.212
Construction	2.855		1.837	2.378	
Trade	1.557	1.90	1.165	1.523	1.228
Service	2.221	2.03		2.287	1.160
Households	2.326			2.396	1.758
Local Government	3.718	2.269		2.708	2.036

inclusion here as a non-U.S. basis of comparison, since the Toronto model is a non-U.S.-based study as well. The Peterborough model is one for an urban area in the United Kingdom done in 1968.[9] It should be pointed out also that it appears at first glance that apples are being compared to oranges. This, however, is not the case. The basis of comparison is that these entities are systems treated as regions. (It will be recalled from Chapter 1 that this classification of systems allows the use of modelling tools for urban areas.) Seen as regions then, the studies may be examined together and compared.

Relevant as well to the table is the fact that not all the models contained exactly the same sectors. This accounts for the "gaps" in the table. From the discussion of the aggregation of sectors in Chapter 2, the reader is now aware that modellers aggregate and disaggregate sectors on the basis of the needs of the study. Therefore, since the Toronto study is of primary importance, its sectors are displayed first, then the other studies are examined to select those which corresponded to the Toronto sectors.

One of the main reasons for applying this comparison is to point out once more the feasibility of the Toronto model. As the table shows, these multipliers, derived from

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[9]Peter Smith and W. I. Morrison, <u>Simulating the Urban Economy: Experiments with Input-Output Techniques</u> (London: Pion Limited, 1974), p. 14.

essentially provincial level coefficients, are not unrealistic for an urban region. The multipliers are not out of line compared to those derived from other studies--that is, with one important exception: The Local Government sector. This brings forth the most important reason for doing this comparison--to contrast the Toronto Metro sector multiplier with other local government sector multipliers. Toronto's Metro Government sector multiplier is the largest of those for local governments in the table. The Clinton County multiplier is the one closest in size, but it is still .47 units smaller than Toronto's. This means that Toronto's Metro sector produces a substantially larger activity level in its system than does the Clinton County, Pennsylvania, government. In the case of St. Louis and Peterborough, the differences are even larger: 1.44 and 1.68 units smaller respectively.

Conclusion

This chapter has, through a true systems analysis, approached urban public policy analysis from a novel perspective. In general, the study presented here is an attempt to develop more adequate methods for a better understanding of the functioning of public policy in an urban system. The input-output model for Toronto is an endeavor to shape a tool for assessing and anticipating income and output consequences of Metro Government public policy. Despite some handicaps and shortcomings of the model, several important facts have been learned.

First, adapting a strictly economic model to public policy analysis is useful. It proves to be a method which strikes at the heart of the criticism of the lack of systems related policy analyses as traditionally performed. Through the input-output mechanism, the important interrelationships of the whole system are disclosed.

Second, having accomplished this, the impact of Metro policy on the system as a whole and its component parts as well has been examined. The subsystems most affected by Metro output or policy have been discerned and the extent to which they are affected has been gauged. Further, implications for the future have been examined and assessed assuming Metro is to continue on its present course.

A third and perhaps the most important finding has also emerged from the input-output approach to policy analysis. That finding is that the Metro sector is one of the most important sectors of the Metropolitan Toronto system. It stands well within the most important economic activity-producing sectors of the system. Removal or reduction of its contribution to the system produces important consequences. This was borne out by the reduction in system activity between 1965 and 1969 when Metro completed a building period on its mass transit system. This is an extremely important finding since in much traditional policy analysis literature the operation of public policy did not always produce such substantial results.

The analysis is carried out in this research has been for the most part broad gauged. As pointed out before, this is caused by the lack of data and the fact that this is a first attempt to apply the model. Much work remains to be done, both to improve the input-output estimates and to refine the framework or model within which they are utilized. In the meantime, an important first step has been taken. A useful technique has been brought to an area in need of better analytical techniques to overcome the criticisms of traditional policy studies. For this reason alone this research effort has been worthwhile.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Summary

In the beginning of this research, two major problems were gleaned from the literature of urban public policy analysis in social science, and these problems, it was learned, stood as significant limitations to the study of urban policy as traditionally done. These obstacles were of such magnitude as to render traditional policy analysis impotent. This may seem an overstatement, but when the criticisms are considered in relation to the approach purported to have been used in these traditional studies, the statement is justified.

To reiterate the indictments of traditional urban public policy analysis, it will be recalled that while the first criticism is the various analyses were employing the systems approach and using a systems model, the variables used to describe the system were little more than lists of characteristics of an entity under study that might or might not be in fact functioning subsystems of the system under study. Additionally, there have been no true interrelationships established between the variables used, thus avoiding entirely one of the central components of the definition of a system. Therefore, without a fully developed system it is impossible to carry out a systems analysis.

Equally as important a mistake in traditional analysis is the disregard for the time element in the policy process. The lack of a time perspective is the second major criticism of urban policy analysis. Most of the traditional research is of a cross-sectional nature. Observations are taken at one moment in time across a number of units (jurisdictions or cities) for the purposes of making generalized statements about the policy activity of all units of similar type. (Here again, in addition to ignoring time as an important variable, the lack of a true systems perspective is evident. Simply calling a set of cities in a sample a system does not make those cities into a system.) Yet, policy is a process occurring over time and, as Virginia Grey discovered, when time is included in the analysis of policy, different findings often emerge.[1]

Finally, a third shortcoming often cited is that of the nature of data used to perform the analysis: expenditures from the city units under examination. Expenditures are of limited value in assessing the impact which urban policy makes. Expenditures, it is argued, do not explain what is

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[1] Grey, Virginia, "The Use of Time Series Analysis in the Study of Public Policy," in Methodologies for Analyzing Public Policy, eds. Frank P. Scioli and Thomas J. Cook (Lexington, Mass.: Lexington Books, 1975), p. 52.

occurring in the system and especially to residents of the system.

These three objections to traditional policy analysis were felt to be (1) interlocking (that is, so closely related that they in fact formed the heart of a single problem) and (2) serious flaws in such an important area that an effort should be undertaken to address them. With this in mind, an investigation of a research tradition beyond that used for policy analysis (until now) was thought appropriate to the task: urban modelling.

Urban modelling offers a vigorous approach to the two primary criticisms of urban policy analysis as traditionally done. Several alternative forms of urban models were discussed to provide an understanding of the kind of approach to be taken in the subsequent research on Toronto. Beginning with what many consider to be the most visible and most discussed of the urban models, Forrester's Urban Dynamics, a brief and concise rejoinder was provided to the criticisms of models in order that a clear understanding of the uses and limitations of models be gained. This was done lest these same criticisms befall the Toronto model and, thus, obscure the value models offer to policy analysis.

The arguments for and against models will not be reiterated here except to say that models are still relatively new in planning, economics, marketing, etc., and even newer to political science. New efforts in research should receive criticism, to be sure, for only through attention to shortcomings can improvements and refining of detail be accomplished. Yet, criticisms of new techniques should not completely hinder efforts to move forward in a research area simply because the technique is new. It was in this spirit that the urban modelling approach was deemed useful.

It was in this spirit as well that a model using expenditure data as measures of policy was proposed. Recognizing that the third criticism of policy analysis has been the use of expenditures, these measures were employed nevertheless. Agreeing in part that expenditures as traditionally used have often been less than satisfying in terms of yielding certain results concerning effectiveness of policy, expenditures were relied on anyway. It was argued that: (1) seeking to determine effects before fully understanding and describing what was done with expenditures was a reversal of the research process; (2) expenditures can reveal a great deal more than previously found in other policy research if alternative research techniques are used; and (3) models are by definition simplifications of reality and tend to rely on expenditures and other quantitative data since these measures are the ones most readily available and most widely understood. An addendum was proffered to the third argument lest it be interpreted as a rationalization. The addendum was taken from the earlier stated premise of the spirit of a new approach wherein certain shortcomings are tolerated in order to obtain a larger goal.

More specific objectives were intended to be gained from introducing modelling literature in this research. These objectives included presentation of concepts which are, for the most part, not as recognizable in political science as in the other fields from which urban modelling comes. Such concepts were simulation, sectoring, and time series. Taken together, these ideas form the elements of the method used to address the criticisms of policy analysis.

The method used was introduced in the final section of the urban modelling literature review: input-output analysis. The input-output model was chosen because it specifically examines the linkages in the system, thus forming a true systems model. This is true for several reasons. First, its sectors form the subsystems of the larger system. Second, the flows between the subsystems form the linkages between system parts and are explicitly set out in the form of flow or technical coefficients.

Equally as important a concept introduced at this juncture was that of time series analysis in the context of modelling. There has been criticism of the way time has been utilized in modeling as well as in social science policy analysis. Yet, there have been major efforts at improvement of this aspect of modelling research, as the manufacturing and service industry model which was reviewed in the first chapter shows. While the Toronto model was not constructed in this way because of data constraints, the example was used to provide both an indication of the productive use of time as a variable and to form a backdrop against which the Toronto model might be seen (and hopefully to become one way the model will be refined for better use later). Having gained a full perspective on what time can do when included in a model when complete data are available, a second example of the use of the time variable was included in which complete data were not available. This requires the use of estimation procedures but, nevertheless, includes time because of its importance in the systems analysis process. From this example comes the justification for estimation with regard to the time component of the Toronto model. The foundation for the model now adequately established, the model itself was addressed.

It is not necessary to detail the model here again. The important point is the divergence of this model from other purported systems policy analysis models. The variables of the Toronto model were fully laid out and not simply listed. The parameters were exhibited and the linkages aligned for a complete examination of the system. Certainly the model has shortcomings, but these shortcomings were clearly stated and not avoided. Major efforts need to be undertaken to solve some of the problems of the model. Nevertheless, the problems of the model notwithstanding, it still accomplishes the two purposes for which it was created: (1) to move in the direction of more rigorous policy analysis and (2) to add a time dimension. The model proceeds in the same manner as many major studies using input-output methodology; models such as the New York Regional Model, the Mississippi Regional Model, and others. Given that it is a first time effort certain problematical efforts are bound to occur, but these effects should not deter a useful effort. In the case of the Toronto model at this point in time, it is the systems methodology which is most important and the findings, therefore, should be interpreted cautiously. This was the guiding principle behind the conduct of the research.

In broad terms, the model system matched the real world system. As Chapter 3 elucidated, Toronto is a well-developed primate city which is financially sound, economically healthy, and politically robust. These factors were graphically demonstrated in the model. Because of its importance to the productive capacity of the province of which it is a part, the metropolitan Toronto system has taken on a major role in the development of both Ontario and Canada. As a result, the government of the metropolitan region of Toronto has been able to provide increasing expenditures in important policy areas. A demonstration of this phenomenon was also given in Chapter 3 through the time series analysis of policy variables.

Attention was next directed at the true policy analysis nature in the larger systems context. The purpose was to fully confront the definition of policy analysis. Two important questions which policy analysis must answer had been posed in Chapter 2 and an experiment was drawn up to determine answers for those questions with regard to Toronto in Chapter 4. Chapter 5 reported the findings of the experiment.

Conducted in three phases, the experiment revealed some important policy facts about Toronto's Metro Government sector. Measured in terms of economic activity generated by expenditures in pursuit of policy goals and objectives, the Metro sector was found to be a strong member of the Metropolitan Toronto economic community. The details of the findings need not be repeated here since they have already been extensively reviewed in Chapter 5. The important point to be emphasized is the strong, prominent role the Metro Government plays in the Toronto system.

Certainly, economic activity generated by policy expenditures is no complete measure of policy effectiveness either in terms of meeting stated goals or satisfying citizen needs. Yet, it is not a bad measure of accomplishment for policy. It is reasonable to assume that with the quantity and magnitude of expenditures placed in the system by the Metro Government, a great deal is being accomplished to further the good economic health and other social conditions of the Municipality of Metropolitan Toronto. Given such a state of well being for the economic system, benefits are likely to accrue for the subsystems that comprise it.

Two such subsystems, Households and Services, were singled out as being the two which receive the largest share of Metro generated activity and, thus, are the two which most directly benefit in economic terms from Metro expenditures. Having received the benefit of economic activity created by Metro, an indication of policy impact on Households, Services, and other sectors was gained. The fact that this activity generated is only an indication is due not to any flaw in the technique of modelling nor to some underlying debilitating error in the particular model for Toronto. Rather, it is due primarily to the calibration of the model which results from data availability problems. But the model is capable of being refined and more precisely graduated to reflect a more complete version of the policy impact from the Metro Government's operation. The important fact to bear in mind at this point is that a large measure of policy impact can be gained from the use of expenditure data as a result of this kind of policy analysis.

Conclusion

In Chapter 2 several research questions were posed which need to be addressed at this point. In answer to the first question, can an estimated input-output model be useful in analysis of urban public policy, it can be stated that such models are indeed useful to the policy analysis task. It has been shown in some detail that the input-output model can be adapted quite well to procedures aimed at understanding public policy. Even more important, the input-output model allows the researcher to take note of the effects of Metro activity throughout the system and on subsystems. The estimated nature of the model does not create insurmountable problems for accepting the effects shown to develop by the model. However, the effects should not be wholeheartedly endorsed either. The model is only a tool, but can be a good tool insofar as it is calibrated to realistically represent the modelled system. In the Toronto case, the estimates are realistic enough so that the effects generated by the model are as acceptable as the effects generated by models similarly conceived and constructed. Yet, this does not mean the effects are without error. The range of error is in question, but the range must be determined at a later date with further research.

As to the question of how such models may be used to determine alternative patterns of expenditures, the model when used in the experimental setting successfully demonstrated the testing procedures with regard to alternatives in policy spending. The examples were especially useful in the experimental application of the Toronto Inverse Table and also in the projection application. With greater refinement of the model, more can be learned from similar exercises. For example, by dividing the Metro sector into its component policy areas such as Police Services, Social Services, Roads., etc., even more information can be added about the magnitude of the effects of Metro Government policy and the particular sectors most affected by it.

The attendant question of effectiveness measures is difficult to deal with at this time. To truly test the sensitivity of various measures of effectiveness to changes in the parameters of the model, one needs reliable historical data or resources to begin collecting the data for use in the future. Neither of these situations has occurred to date. Historical data at the sub-state/provincial level is currently not being gathered. Such information would, for example, include the value of the gross product of metropolitan areas. Work is underway in some quarters to develop these data, but it is an extensive task requiring large amounts of time and money to compile the information.[2] When the data do become available, a significant step can be made in improving the model itself, its reliability, and the effectiveness measures for the paramters.

Finally, the answer to the question of the future of input-output modelling in political science is in a word:

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[2]Personal interview with John B. Blanchard of the Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs, February, 1977.

worthwhile. To use the input-output technique in policy analysis would be particularly worthwhile. This is the case in both instances because the input-output modelling approach meets the four criteria outlined in a recent article in the Public Administration Review written by Norman Beckman.[3]

First, the input-output model when applied to political science policy analysis is integrative and interdisciplinary.[4] The approach comes from a number of disciplines (listed in Chapter 1). It is as sophisticated a tool as the complex problems of policy analysis require for resolution. Further, it helps to synthesize information in a systematic fashion to allow for a true systems analysis.

Second, the technique can be anticipatory. When used in the projection context, the model provides a way for researchers and decision-makers alike to look forward toward decisions which must be made. The technique can aid in structuring uncertainties surrounding an issue such as how much support will be required from a particular sector in order to sustain a prescribed level of policy or how a particular sector will be affected by a reduction in capital expenditures. As the model is operationalized to answer such questions, it may identify new aspects of a policy

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[3]Norman Beckman, "Policy Analysis in Government: Alternatives to 'Muddling Through,'" Public Administration Review 37 (May/June 1977): 222.

[4]Ibid.

under consideration, causing, perhaps, a new policy to emerge. In doing this, input-output modelling may redirect attention toward the long-term questions of resource availability and options for using those resources.

The third criterion that the technique meets with regard to the definition of policy analysis is that the results are, or can be, decision oriented. The technique helps meet problems which are real and not abstract: for example, whether or not to continue subway construction. As the model is refined, the range and detail of the questions which can be addressed will markedly increase. This requires no small expense. Once the model is operational though, with an occasional check to maintain the accuracy of the flow coefficients, the model will be serviceable for a long period of time.

Finally, the input-output model is value conscious and can be client oriented, as the Beckman definition suggests. This has been the theme throughout the history of input-output modelling in general and urban modelling in particular. The literature review earlier pointed out this fact. Creating sectors of the model allows for identification of the stakeholders in the system. Using the sectors in this way provides knowledge of costs and benefits to system participants (in systems terms, subsystems). Knowledge of this kind provides a graphic illustration of the plural interests which comprise the system.

Modelling tools are developing rapidly. Policy analysis as a field is also experiencing fast-paced development. Political science can and should take advantage of these developments to make a significant contribution to knowledge.

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