ECONOMIC MODELLING: ITS ROLE IN STATE POLICY-MAKING

Countless programs and periodicals have documented the enormous increase in state government revenues over the past decade. With this growth have come increased problems of state fiscal management. For instance, it is considerably more difficult today to efficiently allocate current revenues as well as accurately predict what variables will influence state operations in the near future. A working knowledge of both areas is essential for a state which not only wishes to be financially efficient but also a front-runner in state management. One tool which can be of vital significance in both of these areas is a form of economic modelling called Input-Output Analysis. "I-O" is essentially a blueprint of the structure of the different parts of an economy.

The essentials of modern input-output analysis were devised by Wassily Leontief of Harvard University in the 1930's. Since that time input-output analysis has undergone considerable conceptual refinement and elaboration, but the basic elements are still as Leontief conceived them. Presently, input-output analysis has become one of the most widely applied tools of economic analysis. Because of its great usefulness as a practical analytical tool, input-output economics has been characterized as "one of the most fundamental and fruitful innovations in economic analysis in recent decades."[1]

Although I-O has been used by foreign governments such as France, Norway and England, as well as the United States,[2] its use on the state level until recently has been severely limited.[3] Within the past several years, however, more than one hundred I-O studies have been developed for sub-national economies in the United States.[4] These studies evidence the growing interest in I-O, which is founded upon its great flexibility as a planning device. Before further exploring the advantages of I-O, a more explicit explanation is in order.

Like all economic models, the I-O attempts to reflect the major factors in an economy. It strives to roughly simulate the workings of an economy so that the impact of future events can be predicted based on past responses. Initially, the economy must be disassembled so that each important variable can be considered independently. Each variable is called a sector. Once the sectors are established data for each is collected. This is done primarily through industry survey, but it can also be collected from previously existing state and federal sources. After considering this data, economists construct equations to represent the impact each industry has upon the economy in general as well

1. Robert Dorfman, *Wassily Leontief's Contribution to Economics*, 75, No. 2 Swedish Journal of Economics 440 (1973).
2. Chiou-shuang Yan, Introduction to Input-Output Economics 736 (1969).
3. D. Allensworth, Public Administration 41-2 (1973).
4. M. Jarvin Emerson & F. Charles Lamphear, Urban and Regional Economics 11 (1975).

as the impact it has on all other industries.[5] These operations and data are then fed into a computer which evaluates the relationships between each sector of the economy.

I-O MATRIX

The function of the computer can be visually represented by an I-O matrix (see figure 1). When completed this matrix simulates the economy of a region.[6] The cells in each horizontal row show the distribution of the outputs (the sales of one industry) to the other industries, including intra-industry sales (sales to itself for further refined output).[7] Conversely, the cells in each vertical column show the distribution of the inputs (the purchases of that industry) from each of the other industries.[8]

In figure 1, only the cells relating to the "fuel" industry were completed for simplification. Reading across figure 1 we see that the fuel industry sold $200 million of its products to the textile industry. This also means that the textile industry purchased $200 million of fuel to create its final product. The lower left-hand corner of each cell contains the "input-output coefficient." For the fuel-textile cell, the coefficient indicates that for each $1,000 of output (sales) by the textile industry a direct input (purchase) of $30 worth of fuel supplies is required from the fuel industry.[9] Similarly, for each sale of $1,000 by the auto industry and the mining industry, purchases from the fuel industry would amount to $40 and $10, respectively. For instance, if we expect the auto industry to experience a $100 million increase in sales, the input-output table indicates that an additional $4 million worth of fuel will be required.

The small number in the lower right-hand corner of each cell is known as the "inverse coefficient". It expresses, for the industry in whose row the cell appears, the portion of that industry's total output required directly and indirectly to meet one unit of final demand for the product of the industry in whose vertical column the cell appears. For example, a multiplication of the final demand for textiles ($200 million) by the inverse coefficient (.06) yields $1.2 million. Thus, $1.2 million represents the direct and indirect demand for fuel generated by the sale of $200 million worth of textiles.

5. Implicit in these equation/relationship processes are a number of assumptions. For instance:
   1) When state data is not available for a particular variable one assumes that the state responds to stimuli in the same fashion as does the nation as a whole. In this way the state can assume that the state's proportion of the nation's total responds as if it were in fact produced in the state. The Washington State Input-Output Model: Its Usefulness for State and Substate Impact Analysis, (unpublished memorandum enclosed with letter from Karen R. Fraser, Washington Office of Community Development to the author) (May 31, 1977) on file with the *Journal of Legislation* [hereinafter cited as Washington State Input/Output Model].
   2) Each sector employs only one technology and generates only one type of output. Giles T. Rafsnider & Leonard Kunin, A 1967 Input-Output Model of the Idaho Economy 2 (1971).
   3) Each product is supplied by only one producer. *Id.* at 5-6.
   4) The price of a product is established solely by costs. Retail mark-up is excluded from consideration. Emerson & Lamphear, *supra* note 4, at 15.
   5) There is a fixed linear relationship between volume of output and size of inputs. There are no diminishing returns. William H. Miernyk, The Elements of Input-Output Analysis 30-1 (1965). Thus, coefficients describing the relationships between input and output are fixed proportions, as are producers' returns. Emerson & Lamphear, *supra* note 4, at 15.
   Although these assumptions may not be valid in a particular situation, the chance of measurable error through them is insignificant. Thus, the validity of I-O in general is not jeopardized and its accuracy in a particular case is only minimally affected.
6. Miernyk, *supra* note 5, at 8.
7. "The Illinois Policy Model-Description and Work Plan," unpublished memo enclosed with letter from Roger Christ (Planning Department Illinois Bureau of the Budget) to the author (January 12, 1977) on file with the *Journal of Legislation* [hereinafter cited as Roger Christ].
8. *Id.*
9. Miernyk, *supra* note 5, at 21.

FIGURE 1

INDUSTRY PURCHASING

OUTPUTS / INPUTS	PROCESSING SECTOR: Textiles	Auto	Coal Mining	Agriculture	Steel	Services	Fuel	FINAL DEMAND: Gross Inventory Accumulation	Exports to foreign countries	Government Purchases	Gross Private Capital Formation	Households	Total Gross Output
Textiles							100 10 .01						
Auto							20 30 .03						
Coal Mining							10 20 .05						
Agriculture							400 40 .04						
Steel							200 50 .06						
Services							30 60 1.01						
Fuel	200 30 .06	400 40 .02	150 10 .01	20 20 .05	25 40 .02	15 10 .01	40 20 .04	0	0	15	0	85	950
Gross Inventory Depletion							0						
Imports							25						
Tax							25						
Value Added							15						
Labor							60						
Total Gross Outlays							950 1.24						

Rows Textiles to Fuel: PROCESSING SECTOR; rows Gross Inventory Depletion to Labor: PAYMENT SECTOR

INDUSTRY PRODUCING

Summing these inverse coefficients in a column provides an output multiplier which shows the total expenditure generated in an economy by the sale of an additional one dollar of goods or services by the industry designated at the top of the column.[10] For example, since the sum of inverse coefficients for fuel is 1.24, an additional one dollar sale by the fuel sector eventually produces a $1.24 worth of transactions in the entire economy.

APPLICATION OF I-O

To illustrate how the model may be used statewide as one tool in policy decisions, consider the following example. State "A" is underdeveloped. It specializes in manufacturing heavy machinery and agriculture. Further assume that a large proportion of its people work at low-pay, low-skill jobs. The legislature of state "A", wishing to increase the well-being of the public and to stimulate total production, decides to stimulate the economy. But which specific measure should it use? Should it decrease corporate or individual taxes? Should it supplement personal wages or install a jobs program? Prior to the introduction of I-O, selection of the proper tool would have been arduous. Legislators were primarily dependent upon their knowledge of economic theory and their recollection of historical reactions in that region to previous economic policy devices. Many legislators, with a minimum of economic training, would have customarily leaned toward the use of an income redistribution plan. This entails monetary aid to less economically fortunate families at the expense (higher taxes) of the more affluent.

The income redistribution plan usually draws support because it is extremely popular with the voting public. It is believed that since all of the above mentioned alternatives would produce the same effect, the one which is most visible to the voter should be used. However, all the alternatives do not produce the same result. In fact, given an economy of this type, some of the alternatives, including the income redistribution plan, would be counterproductive.[11]

The crux of an income-transfer plan revolves around the hypothesis that above a certain level of income the added benefit to the consumer provided by additional income is minimal. Thus, people with extra money save it, keeping the total level of spending low. By taxing the higher income levels and transferring the surplus funds to lower-income individuals who need money, the total level of spending is increased. This, in turn, would lead to more demand for goods and increased employment.

The conditions in state "A", however, are such that an income transfer plan would reinforce rather than offset the original problem. Given the needs of the low-wage classes, their added income would inevitably be spent on products such as clothing, televisions, or furniture (which, in this instance, are produced by other areas). They would not demand appreciably more of locally produced goods such as corn, butter or earth moving machines. Since the money would go to goods produced in other areas, firms of state "A" would not experience a permanent increase in demand. Likewise, the loss of income

10. Dean Schreiner, Arthur Ekholm & James Chang, A Guide to Input-Output Analysis for the Oklahoma Economy 4-5 (1977).
11. F. Galladay and R. Haveman, *Regional and Distributional Effects of a Negative Income Tax*, 66 The American Economic Review 640 (1976).

by the high-wage classes in state "A" via higher taxes would cause these classes to reduce their purchases of those goods typically produced by state "A", increasing income and employment in other states while leaving the underlying economic conditions in state "A" unchanged. Though undetected by typical analysis, the lure created by the high-wage job regions could also influence the migration of the labor supply from state "A" to other states, further contributing to the economic dilemma of state "A". The I-O would point out that an income-transfer program, as mentioned above, in a low-skill low-wage region would not have the impact anticipated.[12]

Under the conditions mentioned, the I-O would show that a skills development program (job training) would produce the optimum benefit for state "A".[13] The economic policy of training people to perform highly skilled labor would reduce training costs to prospective corporations, inducing them to locate in state "A". This would also eventually create a ready labor pool. The well-trained labor pool also would induce a greater variety of producers to locate in state "A". As they do so, the employment-based income would rise. Just as important, among the new firms would be companies which produce consumer goods (*i.e.*, clothing, televisions and furniture). Thus, rather than having income siphened off to other economies to meet consumer needs, the income would remain in the indigenous economy where it would have the greatest multiplier effect. Eventually, the income from the jobs created would be plowed back into the economy of state "A" since consumer demand could be satiated by consumer-oriented firms that had located in state "A".

GROWTH AND USE OF I-O

Some form of I-O has been used in at least twenty-five states.[14] I-O is not necessarily being used for economy-wide projects, but it is at least being used by assorted agencies within those states.

At least four additional states are still in the planning or construction stages with I-O,[15] which points to the ever-increasing interest in the area. Even more states wish to expand the existing uses of I-O analysis when fiscally feasible.[16]

Possibly the best way to illustrate the recent growth and interest of I-O would be to analyze the state-by-state uses of I-O. The following table, figure 2, is a compilation of the current and proposed uses of I-O by various state governments.[17] Uses which are feasible but unsupported by at least one state

12. *Id.* at 634.
13. *Id.*
14. The states with *at least some use* of I-O are: Alaska, Arizona, California, Connecticut, Florida, Georgia, Idaho, Illinois, Kansas, Kentucky, Maryland, Michigan, Minnesota, Montana, Nevada, New Jersey, New York, North Carolina, Oregon, Rhode Island, Texas, Utah, Washington, W. Virginia and Wyoming.
15. Alabama, Delaware, Oklahoma and South Carolina.
16. The states wishing to expand I-O use are Alabama, Florida, Kansas, Oklahoma and Pennsylvania.
17. The information for Figure 2 comes from the following sources:
    Alabama Wayne C. Curtis, "A Research Proposal for an Input-Output Study of the Economy of Alabama with Implications of Alternative Energy Policies," (Alabama: Center for Business and Economic Services, 1977) p.3.
    Alaska Letter from David L. Gale (State of Alaska, Department of Labor, Chief of Research and Analysis) to the author (May 19, 1977) on file with the *Journal of Legislation.*

- David M. Reavme, Studying the Impact of Potential Development - The Alaska Policy Planning Model, a paper presented at the meetings of the Western Economics Association, June 23, 1977.

Arizona Letter from Eric J. Anderson (Economist, Office of Economic Planning and Development, State of Arizona) to the author (June 14, 1977) on file with the *Journal of Legislation.*

Arkansas Letter from Robert K. Middleton III (Director, Economic Development Planning Program, Arkansas Industrial Development Commission) to the author (June 2, 1977) on file with the *Journal of Legislation.*

- Letter from Frank H. Troutman (Head, Industrial Research and Extension Center, Univ. of Arkansas) to the author (June 9, 1977) on file with the *Journal of Legislation.*

Connecticut Letter from Raymond S. Peterson (Director of Economic Planning, Office of the Governor, State of New Jersey) to the author (June 13, 1977) on file with the *Journal of Legislation.*

California Letter from Patricia Landingham (Assistant Economist, Department of Finance, State of California) to the author (July 19, 1977) on file with the *Journal of Legislation.*

Delaware Letter from Helen Gelof (Principal Planner, Economic and Statistical Unit, Office of Management - Budget and Planning, State of Delaware) to the author (May 12, 1977) on file with the *Journal of Legislation.*

Florida Letter from Richard J. Welsh (Planning Officer, Office of Management and Budget, State of Florida Department of Commerce) to the author (June 3, 1977) on file with the *Journal of Legislation.*

Georgia Letter from Clark T. Stevens (Office of Planning and Budget, State of Georgia) to the author (May 18, 1977) on file with the *Journal of Legislation.*

Hawaii M. Norman and R. Russell, *The Personal Income Model for Hawaii,* 23 National Tax Journal 429 (1970).

Idaho Letter from John T. Sahlberg (Economist, Division of Budget: Policy Planning and Coordination, State of Idaho) to the author (May 24, 1977) on file with the *Journal of Legislation.*

- Rafsnider and Kunin, *supra* note 5.

Illinois Roger Christ, *supra* note 7.

- The designations represent the options available under the IPM. It is not limited to the state's current uses of I-O.

Kansas Letter from A. Edwin Riemann (Economic Development Representative, Kansas Department of Economic Development) to the author (May 12, 1977) on file with the *Journal of Legislation.*

Kentucky Letter from William L. Short (Office of the Secretary, Development Cabinet, State of Kentucky) to the author (May 27, 1977) on file with the *Journal of Legislation.*

Maryland John H. Cumberland, Design for a Maryland State Planning Model with Economic-Environmental Linkages 3 (1971).

- Curtis C. Harris, 1970 Interindustry Model of the Maryland Economy 1 (1971).

Michigan Letter from Jorge M. Ipina (Department of Management and Budget, State of Michigan) to the author (June 29, 1977) on file with the *Journal of Legislation.*

Minnesota Letter from James E. Moore (Director of Research, Department of Economic Development, State of Minnesota to the author (May 10, 1977) on file with the *Journal of Legislation.*

Montana Letter from Bruce Finnie (Montana Department of Community Affairs) to the author (May 26, 1977) on file with the *Journal of Legislation.*

Nevada Letter from Victor R. Hill (Special Projects Engineer, State of Nevada, Department of Conservation and Natural Resources) to the author (July 15, 1977), on file with the *Journal of Legislation.*

New Jersey Letter from Raymond S. Peterson, *supra* note 17 – Connecticut.

New Mexico Letter from Eleanor V. Reed (Librarian, State Planning Office, State of New Mexico) to the author (June 1, 1977), on file with the *Journal of Legislation.*

New York Letter from Raymond S. Peterson, *supra* note 17 – Connecticut.

N. Carolina Letter from Ken Flynt (Chief Economic Advisor to the Governor, North Carolina Department of Administration) to the author (May 25, 1977) on file with the *Journal of Legislation.*

Oklahoma Letter from Harley Lingerfelt (Economic Planner, Department of Economic and Community Affairs, State of Oklahoma) to the author (May 11, 1977) on file with the *Journal of Legislation.*

- Schreiner, Ekholm, and Chang, *supra* note 10.

Oregon Letter from Donald A. Watson (Professor of Finance, University of Oregon) to the author (July 19, 1977) on file with the *Journal of Legislation.*

Pennsylvania Telephone interview with Robert Lembke (Office of State Planning and Development, Office of the Governor, State of Pennsylvania) (May 19, 1977).

Rhode Island Letter from Beatrice C. Frazer (Assistant Budget Analyst, Division of the Budget, State of Rhode Island) to the author (May 13, 1977) on file with the *Journal of Legislation.*

S. Carolina Letter from Harry W. Miley, Jr. (Senior Economist, Division of Research and Statistical Services, State of S. Carolina) to the author (June 8, 1977) on file with the *Journal of Legislation.*

are omitted from the table. The word or words heading each column describe that function in the same terms which that state chose to describe that use. Thus, since each state chose to classify a use in a certain fashion, several headings, although similar in result, have different titles. Likewise, a cell received a check only if that state specifically enumerated that function as a task of I-O for the state. Although certain functions may be prerequisites for completing a later function, an earlier function is not enumerated unless it is a goal of I-O.

Texas	Letter from Taylor S. Boone, (Chief Budget Examiner, Economic Development and Transportation Sector, Budget and Planning Office, State of Texas) to the author (May 20, 1977) on file with the *Journal of Legislation.*
Tennessee	An Economic Report to the Governor of the State of Tennessee, Center for Business and Economic Research College of Business Administration, University of Tennessee, An Economic Report to the Governor of the State of Tennessee (1977).
Utah	I. E. Bradley and B. L. Fieldsted, *The Utah Input-Output Project*, 35 Utah Economic and Business Review 1 (October, 1975).
Virginia	Letter from Robert G. Marty, Jr. (State Tax Research Assistant, Department of Taxation, State of Virginia) to the author (June 2, 1977) on file with the *Journal of Legislation.*
-	Letter from Robert J. Griffis (Chief, Economic Research Section, Department of Planning and Budget Commonwealth of Virginia) to the author (May 12, 1977) on file with the *Journal of Legislation.*
Washington	Washington State Input-Output Model, *supra* note 5.
-	Letter from Chuck Sawyer (Economic Analyst, Department of Commerce and Economic Development, State of Washington) to the author (June 6, 1977) on file with the *Journal of Legislation.*
-	Lincoln Wolverton, Progress Report on the Washington State Econometric Model, a paper presented to the Tenth Annual Pacific Northwest Regional Economic Conference, Victoria British Columbia, May 6-8, 1976.
W. Virginia	Telephone interview with Robin Geiger (Research Analyst, State Tax Department of West Virginia) (July 27, 1977).
-	Letter from Robin Geiger (Research Analyst, State Tax Department of West Virginia) to the author (July 26, 1977) on file with the *Journal of Legislation.*
Wisconsin	Letter from Dr. Stephen M. Smith (Economic Policy Analyst, Office of State Planning and Energy, Department of Administration, State of Wisconsin) to the author (June 2, 1977) on file with the *Journal of Legislation.*
Wyoming	Letter from Gary Yaquinto (Economist, Executive Department, State of Wyoming) to the author (May 12, 1977) on file with the *Journal of Legislation.*

FIGURE 2

NATIONWIDE USES OF I-O BY STATE GOVERNMENTS OR AGENCIES

	Has I-O	I-O Plus	Sectoral Flow	Linkage	Co-efficients	Multipliers	Impact	Increase Activity	Projection	Forecasting	Simulation	Strategy	Planning	Priorities	Alternatives	Conservation	Resource Allocation	Current Services	Marketing	Tax	Housing Needs	Income Transfer	Transportation	Manpower	Consumer Spending	Employment	Income	Demand	Population
Alabama	●		●	●	●	●	●																						
Alaska	●																												
Arizona	●	●		●			●		●		●																		
Arkansas																													
California	●																●												
Colorado																													
Connecticut	●						●											●	●	●					●	●	●		
Delaware	●																												
Florida	●	●				●	●					●																	
Georgia	●																												
Hawaii																													
Idaho	●	●		●			●		●	●					●	●	●												
Illinois	●	●			●	●	●		●			●			●	●		●	●	●	●	●	●	●		●	●		
Indiana																													
Iowa																													
Kansas	●	●					●	●	●	●	●			●		●				●	●						●	●	
Kentucky	●								●				●																
Louisiana																													
Maine																													
Maryland	●	●	●	●	●	●			●	●			●		●					●			●	●		●	●		
Massachusetts																													
Michigan	●									●																			
Minnesota	●																●												
Missouri																													
Montana	●	●		●			●		●		●				●			●								●			●
Nebraska																													
Nevada	●						●										●												
N. Hampshire																													
N. Jersey	●						●											●	●	●					●	●	●		
N. Mexico																													
N. York	●						●											●	●	●					●	●	●		
N. Carolina	●																												
N. Dakota																													
Ohio																													
Oklahoma	●				●	●																							
Oregon	●						●										●												
Pennsylvania																													
R. Island	●																									●			
S. Carolina	●	●	●				●			●																			
S. Dakota																													
Tennessee																													
Texas	●												●																
Utah	●						●			●			●			●				●									
Vermont																													
Virginia																													
Washington	●		●				●		●	●	●		●																●
W. Virginia	●		●	●	●	●																							
Wisconsin																													
Wyoming	●	●															●												

The following is a brief explanation of the various vertical column headings (uses to which state governments have put I-O analysis):[18]

1. **Has I-O** – These states use or have used I-O in at least some capacity.
2. **I-O Plus** – These states not only have I-O but combine it with other models and matrices to increase the scope of the system's usefulness.
3. **Sectoral Flows** – Delineates the flows of goods and services among the various sectors of the economy. A sectoral flow analysis shows the absolute quantity of goods being demanded by each industry from all other industries.
4. **Linkages** – Determines the structural relationship among various sectors of the economy. Linkage analysis generates the inverse coefficients which represent the demand of each industry for the commodity produced by other industries.
5. **Coefficients** – Determines the direct, indirect and induced effects of the linkages on such factors as output, income and employment as changes occur in various economic activities.
6. **Multipliers** – Develops and interprets multipliers for the sectors. The following states use multipliers for the specifically stated areas:
   —*Alabama:* The relationship regarding output, income and employment.
   —*Florida:* The effect on employment, income and demand.
7. **Impact** – Determines the impact of a change in any variable on a specific sector or the economy in general. The following states have made specific efforts to discern the impacts by or on the stated areas:
   —*Alabama:* Energy demand or changes in the price level impact on the economy.
   —*Arizona:* Federal and state policy impact on state revenues.
   —*Florida:* Public policy decisions on manpower resources.
   —*Kansas:* Federal spending on output, personal income and employment.
   —*New Jersey:* Federal and state tax rates on state revenue.
   —*Oregon:* Foreign trade and tourism on the state economy.
   —*Washington:* Impact of resource shortages.
8. **Increase Activity** – I-O is used to test the total change in state economic activity based on alterations in variables. It could test, for instance, whether a tax cut would increase state GNP more than a public works project.
9. **Projections** – Estimates of the future status of a variable based on past trends. The following states use projections to determine trends for the stated variables:
   —*Alabama:* State revenue.
   —*Arizona:* Population and employment.
   —*Maryland:* Personal income and state revenue.
   —*Montana:* Employment and population.

18. The explanation of the vertical column headings in Figure 2 is based on the sources listed in *supra* note 17.

10. **Forecasting** - Predicts sector levels and conditions based on past relationships. The following states make forecasts for the stated variables:
    —*Idaho:* Population and employment.
    —*Kansas:* State revenue.
    —*Maryland:* State revenue and pollution.
    —*Michigan:* Employment and labor.
    —*Washington:* Employment, wages, and personal income.
11. **Simulations** - Involves establishing long-run growth paths under alternative sets of assumptions and varying potential developments. The following states use simulation to specifically project the growth paths of the stated variables:
    —*Arizona:* Population, labor supply, employment and income.
    —*Montana:* Income, employment and population.
    —*Washington:* Federal and state fiscal policies on the state's economy. (For example, state officials could simulate the effect of a ten-year revenue sharing program on the economy of the state.)
12. **Strategy** - Develops strategies for state economic development with special emphasis on selected target industries.
13. **Planning** - Uses I-O as one tool to help determine the appropriate course of future action for an area. Texas, for example, uses I-O to help plan water conservation.
14. **Priorities** - Establish a priority system for economic development. Certain industries are crucial to expanding income and employment opportunities in a state. A few of these industries will continue to grow without extraordinary development efforts because of the locational advantages available in the state. By channeling funds into other select industries, greater returns will be realized, and through an adequate study of the determinants of "family" industry development, these select industries can be identified. Certain industries are structurally related in their inputs and in their product markets; thus, the existing structure of an economy encourages the growth of certain industries while virtually blocking entrance for others. A rigorous identification of these structural relations in a state's economy would direct development efforts into proper channels.
15. **Alternatives** - Evaluates different governmental programs for achieving maximum desired results with the least adverse effect. It also may be used to establish an acceptable range of impact. The following states test alternatives for the stated areas:
    —*Idaho:* Demand, income, employment, and output.
    —*Illinois:* Public policy decisions.
16. **Conservation** - Assesses the economic cost of various parameters such as rationing or substitution. It also allows for the construction of alternative strategies. The following states develop conservation strategies for the states' resources using I-O:
    —*Idaho:* Forestry.
    —*Kansas:* Energy and water.
    —*Utah:* Energy and water.
17. **Resource Allocation** - Determines a strategy or set of strategies for the most efficient resource use given state needs and conditions. The following states have constructed resource allocation policies regarding state resources using I-O:

—*California:* Water.
—*Minnesota:* Energy.
—*Oregon:* Energy.

18. **Current Services** - Establishes current and future trends in the amount of state revenue spent on keeping governmental machinery operating. I-O also determines the effect of changing the level of revenue spent on current services.
19. **Marketing** - Puts the state's industrial attraction efforts in the most favorable light possible, via a detailed marketing package. All of the major factors regarding location and an analysis of market availabilities are presented in this type of I-O analysis.
20. **Taxes** - Projects current and future tax levels, as well as tax trends, and the impact of alternative tax proposals.
21. **Housing** - Establishes statewide housing needs by geographic area.
22. **Income Transfer** - Establishes the long-run costs and caseload volume of state income transfer programs.
23. **Transportation** - Determines flows of goods into, through and out of the state, thereby illustrating where transportation departments should concentrate their funds.
24. **Manpower** - Translates employment impacts of a change in one of the model's input variables into occupational demand impacts, indicating the type, number and location of various manpower needs.
25. **Consumer Spending** - Compares how households of different income categories allocate their consumer spending among the various kinds of goods and services.
26. **Employment** - Estimates current and future employment levels, as well as employment trends.
27. **Income** - Determines current and future income levels as well as income trends.
28. **Demand** - Estimates demand stemming from the magnitude and mix of state industries and population characteristics.
29. **Population** - Estimates current and future population levels as well as population trends.

ONE STATE'S PROPOSAL FOR I-O

Although Illinois is a relative newcomer to I-O use, it has extensively researched the use of such analysis. The result of this research was the Illinois Policy Model (IPM), a "work program" listing possible elements of an integrated I-O system for the state. Portions of the IPM have not been implemented due to limitations on manpower and financial resources. Nonetheless, the sophistication and relevancy of the model warrant its further consideration. The Illinois Policy Model (IPM), as proposed, could be used to measure the direct, indirect, and induced changes in the final demand for goods and services. IPM is a generalized policy-simulation model that is given a specific structure whenever it is used to analyze a particular issue. As the result of being interfaced, IPM could coordinate the modelling efforts of state agencies and makes them consistent with not only IPM, but also with each other. In this way, interagency planning and impact analysis possibilities are expanded. For example, IPM could be used to tie environmental, labor and energy variables together so that analysis is consistent on fundamental interdependent issues. IPM could also structure the agencies' collection and exchange of information to minimize duplication and increase the usefulness of data.

The Illinois Policy Model could be used independently or as a component of a larger system. This flexibility of use with large data bases is a major attribute of IPM. It is demonstrated by the following current or proposed uses of the IPM:

1. **Multiplier Analysis**[19]

Increased production by any industry in the state will create new demand for goods and services in the state. This increased production stimulates demand for goods causing a multiplier effect throughout the state's economy. The multiplier itself is the factor by which the dollar increase in production is multiplied to obtain the sum of the additional demand caused by the increased production. The industries represented in the Illinois I-O model would be rank ordered according to their income and employment multipliers so that a better understanding of the relative contribution of different industries to income and employment could be obtained. These orderings can then be used as a guide in identifying industries which can maximize either employment or income impacts of industrial development efforts.

2. **Analysis of the Impacts of Industrial Location**[20]

The employment, income and income distribution impacts of the addition or loss of a manufacturing plant on the economy of the state could be examined to identify any market adjustments which should be facilitated by public institutions. For example, the impacts of locating solar energy testing plants in Illinois can be analyzed.

3. **Marketing Package**[21]

Efforts to attract new industrial activity into the state usually begin with the provision of general information on the living and operating conditions in the state to potential investors. This type of information unfortunately is of little value to a firm interested in selecting a new plant site. The initial location screening process requires knowledge of the supply availabilities and market potentials of the region. To provide the state's industrial-attraction efforts with a competitive advantage over the information dissemination activities of economic development agencies of other states, a detailed marketing package which specifies the profile and amounts of inputs available and an analysis of market availabilities by industry could be designed. The major component of this information package is the Illinois Interindustry Model. By making relevent information readily available, the state would have a valuable tool for promoting economic development through encouraging new firms to locate in Illinois.

4. **Analysis of Pollution Control Regulations**[22]

The Illinois Institute for Environmental Quality is mandated by law to assess the economic impacts of state pollution control regulations. The I-O Model is currently being used to assess the output and employment impacts

19. Roger Christ, *supra* note 7, at 4.
20. *Id.*
21. *Id.* at 5.
22. *Id.*

of these regulations. It can further be used to assess the income distribution and occupational impacts. If IPM is interfaced with an effluent matrix, *i.e.*, a matrix of the pollutants by type and industry, this larger model would assess the pollution impacts of alternative regulations and levels of industrial production.

5. **Sales Tax and Household Income Tax Analysis**[23]

An associated matrix (TRIM) yields estimates of state and federal income tax payments by Illinois income classes. Price - sensitive sales tax analysis could also be done if the requisite Consumer Expenditure System becomes available. When interfaced with the Consumer Expenditure System, TRIM could yield estimates of sales tax payments by income class and commodity. By incorporating the analyses in IPM, employment, output, and income distribution impacts can also be estimated.

6. **Costs and Caseloads of Income Transfer Programs**[24]

IPM could estimate the eligibility costs and caseloads of various income transfer programs. Specifically, an anlysis has been undertaken of the historical caseloads to estimate participation rates and reveal discrepancies between actual and estimated eligible caseloads. This analysis could form the foundation of caseload and cost projections for the next five years.

7. **Housing Needs**[25]

The Department of Local Government Affairs' Housing Needs Model is based, in part, upon Illinois population estimates and their household characteristics. Needs estimates are calculated on a state-wide basis by matching changed household characteristics against changes in the housing stock.

8. **Energy Conservation**[26]

The Illinois I-O matrix could be benchmarked to duplicate the state-wide energy survey of 1971. Upon interfacing, IPM would serve as an integrating model to assess the economic impacts of capital expenditures by the energy industry, the effects of energy costs and substitution of energy forms by various industries, and industry rationing.

9. **State Budget Line Item Impacts**[27]

Alternative state budgets could be examined for their employment, income and income distribution impacts. The various budgets could then be analyzed for their occupational impacts to determine which occupations are most affected. IPM may be used to outline how each alternative might compete with private industry for labor. For example, state projects which impact high unemployment occupations could be given high priority or projects which affect recession sensitive occupations can be initiated toward the end of a cyclical expansion.

10. **Population and Employment Projections**[28]

The population projections now prepared by the state could be used to update the micro-date base of TRIM. Eventually, employment projections would be formally tied to the I-O matrix which indicates the interrelatedness of the Illinois economy.

23. *Id.*
24. *Id.* at 6.
25. *Id.*
26. *Id.*
27. *Id.*
28. *Id.*

11. **Manpower Planning**[29]

IPM would include the Bureau of the Budget's Occupational Model, and, therefore, all employment needs of industry could be translated into occupational demand impacts. Given information about labor supply, the Labor Market Model would indicate occupations for which training would not be redundant.[30]

29. *Id.* at 7.
30. There are still other states, represented in column 2 of Figure 2 which use I-O in conjunction with other models or matrices. These states either use their systems in conjunction with the I-O or as an alternative for comparison to it. The following briefly explains several of these expanded systems;

Arizona has developed an I-O table for the state, using secondary data, and employed it as part of economic submodel of the Arizona Trade-Off Model 3 (ATOM 3). *See* Anderson, *supra* note 17-Arizona, at 1. The I-O methodology was combined with other projection techniques to project population and employment by county for the state.

The next step in this process was the design of the Arizona Economic-Demographic Projection Model (EDPM). *See Id.* Projections of population and employment generated by EDPM are used in many aspects of state planning as well as input for various federally-sponsored programs. EDPM is also used to determine the impact of specific governmental projects.

In addition, Arizona has designed and now operates the Arizona Econometric Model (AEM), formerly the Arizona Revenue Forecasting Model. *See Id.* This is a regression model composed of approximately 80 equations and relationships. It is used to provide state-level projections of Gross State Product, employment, personal income and various state tax revenues. AEM is also used to analyze the impact of various events on tax revenue.

Florida has combined I-O with a very small occupational matrix to demonstrate the use of I-O in forecasting employment. *See* Welsh, *supra* note 17-Florida, at 2. This process involves standard mathematical manipulation of the two matrices which may be set up in a variety of ways. Florida likewise has developed all of the various employment, output, final damand and income multipliers which are normally part and parcel of I-O modelling. *See Id.* They have demonstrated:

Self-sufficiency analysis
Import substitution strategies
Agglomeration strategies
Application to industrial incentive programs
Application to new industry analysis
Tourism income/employment applications
Estimation of final demand (Gross State Product) from sales estimates.

The major application of input-output analysis in Idaho is resource allocation to maximize economic well-being and to plan for needs deemed most socially significant. This necessitates combining the model with a maximizing function constrained by internal needs. *See* Rafsnider and Kunin, *supra* note 5, at 8. For state planning purposes, this application in large measure necessitates disaggregation of the model into another model composed of economic regions in the state with their corresponding linkages. Once disaggregated, it is possible to plan development in each region to meet explicit policy goals. With similar intent, the Idaho legislature has sponsored development of an Idaho specific energy demand model (*See* Sahlberg, *supra* note 17-Idaho, at 1) and an Idaho specific model to project state revenue. *See Id.*, at 2.

The Idaho Department of Water Resources has recently completed, in cooperation with Boise State University, an Interactive Population Employment (IPEF) econometric model for each of Idaho's 44 counties. *See Id.* These models predict employment and population by county at five-year intervals.

Maryland has proposed an economic-environmental planning model to provide a consistent framework within which to evaluate the possible benefits and costs resulting from alternative development proposals. *See* Cumberland, *supra* note 17-Maryland. The research programs designed in this plan are oriented towards identifying opportunities to achieve desired rates of economic development with minimal environmental damage and finding opportunities to improve the overall quality of economic development.

South Carolina is planning to incorporate an input-output model with its econometric model. *See* Miley, *supra* note 17-South Carolina, at 1. The plan's goal is to link the input-output model designed at Clemson University with the present model to reduce the overall maintenance expenses considerably. This approach will enable South Carolina to obtain the aggregate forecasts from the econometric model and at the same time analyze the interindustry impacts available from the input-output model.

PROBLEMS REGARDING I-O USE

Despite the advantages, I-O has several obvious limitations. The major drawbacks of I-O are as follows:

1) Since I-O looks at an economy as of a particular point in time, it generates constant coefficients. This reduces the possibilities for the substitution of input variables. The model fails to accurately reflect the dynamic nature of a state's economy.[31]
2) As an economy changes, matrices must be recalculated, which is a very time consuming job.[32]
3) The cost to construct and maintain an I-O can be economically prohibitive in these days of state fiscal austerity.[33]
4) Since I-O is relatively new on the state level there has been very little substantive data collected.[34] With an insufficient data base accurate calculations are attenuated at best.[35]
5) Since there is a lack of first hand data, planners must occasionally rely on the federal coefficients for the industry in question. They assume that the state economy mirrors the national economy.[36]
6) Even if primary data is used, it is necessary to use only certain data. Planners include only those industries which they feel will have a measurable effect on the model. Although deletion and aggregation is necessary to make a model more manageable, a certain amount of accuracy is sacrificed.[37]
7) The model represents an average pattern for each sector. Certain industries may deviate substantially from the average pattern.[38]
8) I-O is based on the assumption that relationships are linear. Thus, variations in one variable are matched by proportional variations in another variable. Since this is not always the case in the real world the linear functions do not accurately reflect the changing economic pressures.[39]
9) Since the model is static it fails to account for temporary imbalances (short run) created by the relocation of inputs.[40] For instance, though an increase in an interest rate may eventually lead to a reduction in inflation, in the short run it may decrease demand in the construction industry.
10) It is also important to note that the model, although appearing objective, is actually subject to the beliefs of the planners. In actuality, the factors which go into the model are subjective determinations.

Despite these drawbacks, I-O is gaining more acceptance each year as a viable state planning tool. This is evidenced by the widespread use of I-O by many states for different programs as discussed above. One of the major

31. Miernyk, *supra* note 5, at 105-6.
32. Miernyk, *supra* note 5, at 33.
33. Curtis, *supra* note 17-Alabama, at 11. To construct even an elementary I-O system as of 1974, initial fiscal outlays can easily run close to $90,000. This figure includes personnel costs ($6,000), operating expenses - *i.e.*, computer time ($4,550) and indirect costs - miscellaneous ($15,750).
34. Gale, *supra* note 7-Alaska.
35. Emerson and Lamphear, *supra* note 4, at 350.
36. Miernyk, *supra* note 5, at 66-8.
37. Walter D. Fisher, *Criteria for Aggregation in Input-Output Analysis*, XL, Review of Economics and Statistics 250 (1958).
38. Washington State Input-Output Model, *supra* note 5, at 2.
39. *Id.*
40. Galladay and Haveman, *supra* note 11, at 638.

reasons for this is that I-O provides a formal analytical framework for economic analysis.[41] In addition, it explicitly shows inter-industry relationships and portrays relationships in a consistent manner.[42] I-O also provides a disaggregated view of the economy; giving the flexibility needed for evaluating different alternatives in state government decision-making.[43] Finally, due to improved technology, model construction costs appear to be less of a problem than once expected.[44]

CONCLUSION

Over the past decade, state governments have become increasingly more aware that a major determinant of state fiscal security is organized economic growth which can only be accomplished through a mature planning mechanism. For orderly economic development to occur at any level, some means of quantitatively assessing the impact of alternative developmental approaches must be employed. One technique which has been successfully used to estimate the total effects of given changes in economic activity is the input-output model, a form of interindustry analysis.

I-O is essentially a blueprint of the relationships among different parts of an economy. It simulates an economy so that the impact of certain events can be roughly predicted. I-O has been used by numerous states for a wide range of problems. It has been most frequently used to forecast, simulate and plan. These uses, however, barely scratch the surface of I-O potential. Given the proper funding and organization an I-O can quickly and efficiently solve dozens of tasks for a state.

A strong appeal of input-output models for planning purposes is the interdependency captured by the model. A change in one area will eventually lead to changes in other areas. Likewise, changes in other areas eventually affect local industries. Input-output models facilitate impact evaluation and projections that consider these interactions. Long-run economic trends become clearer so that the need for capital investment (such as changes in technology or equipment) and diversification can be seen far enough in advance to prevent major problems. In essence, this means that states can attain greater control over cyclical fluctuations in their economies. Despite its inability to adapt to changes in the economy, I-O has proven to be an effective tool of analysis for evaluating different state economic planning devices. Thus, the versatility and usefulness of I-O make it a boon to the statesman as well as the economist.

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41. Washington State Input-Output Model, *supra* note 5, at 2.
42. *Id.*
43. *Id.*
44. This can be partially attributed to the cost-cutting measures such as state-university joint ventures. The states constructing models in conjunction with state universities are: Alabama, Arizona, Arkansas, Delaware, Florida, Idaho, Montana, Nevada, New Mexico, Oklahoma, South Carolina, Washington, Wisconsin, and Wyoming. Grant monies, federal and private, also reduce cost. The states which have received grants from the EDA or HUD are: Arkansas, Florida, Kansas, Maryland, Oklahoma, Delaware, West Virginia, and Washington. The Andrew W. Mellon Foundation has contributed to the development of a regional I-O for the New York Urban Region. The Kerr Foundation has contributed to the efforts in Oklahoma. Costs can also be minimized by a "modular" construction. Emerson, *supra* note 17-Kansas. The advantage of such a system is the construction of the model in stages after the initial I-O matrix is completed. A state may add other matrices such as employment, population and revenues as desired.