Statewide Transportation Analysis & Research

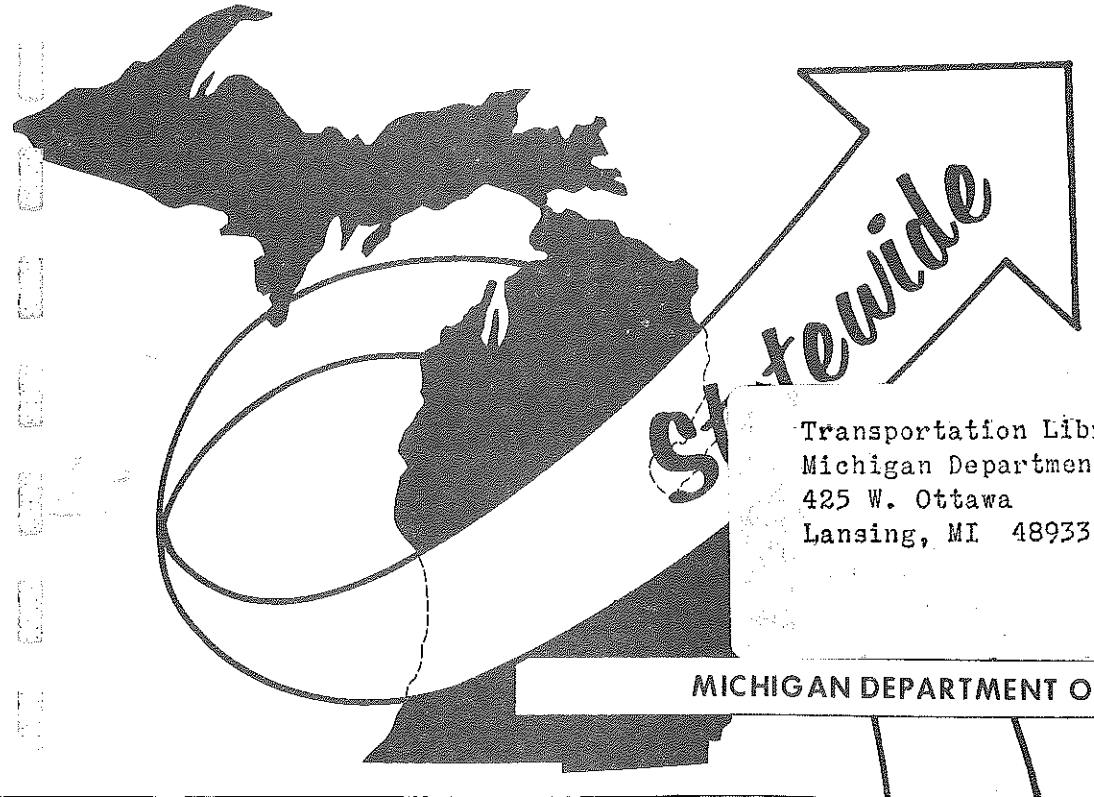
Michigan's Statewide
Transportation Modeling System

Volume I-Q

APPLICATION OF AN INPUT-OUTPUT MODEL TO RAIL FREIGHT TRAFFIC FORECASTING

Transportation Planning Procedures Section

November 1982



MICHIGAN DEPARTMENT OF TRANSPORTATION

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BUREAU OF TRANSPORTATION PLANNING

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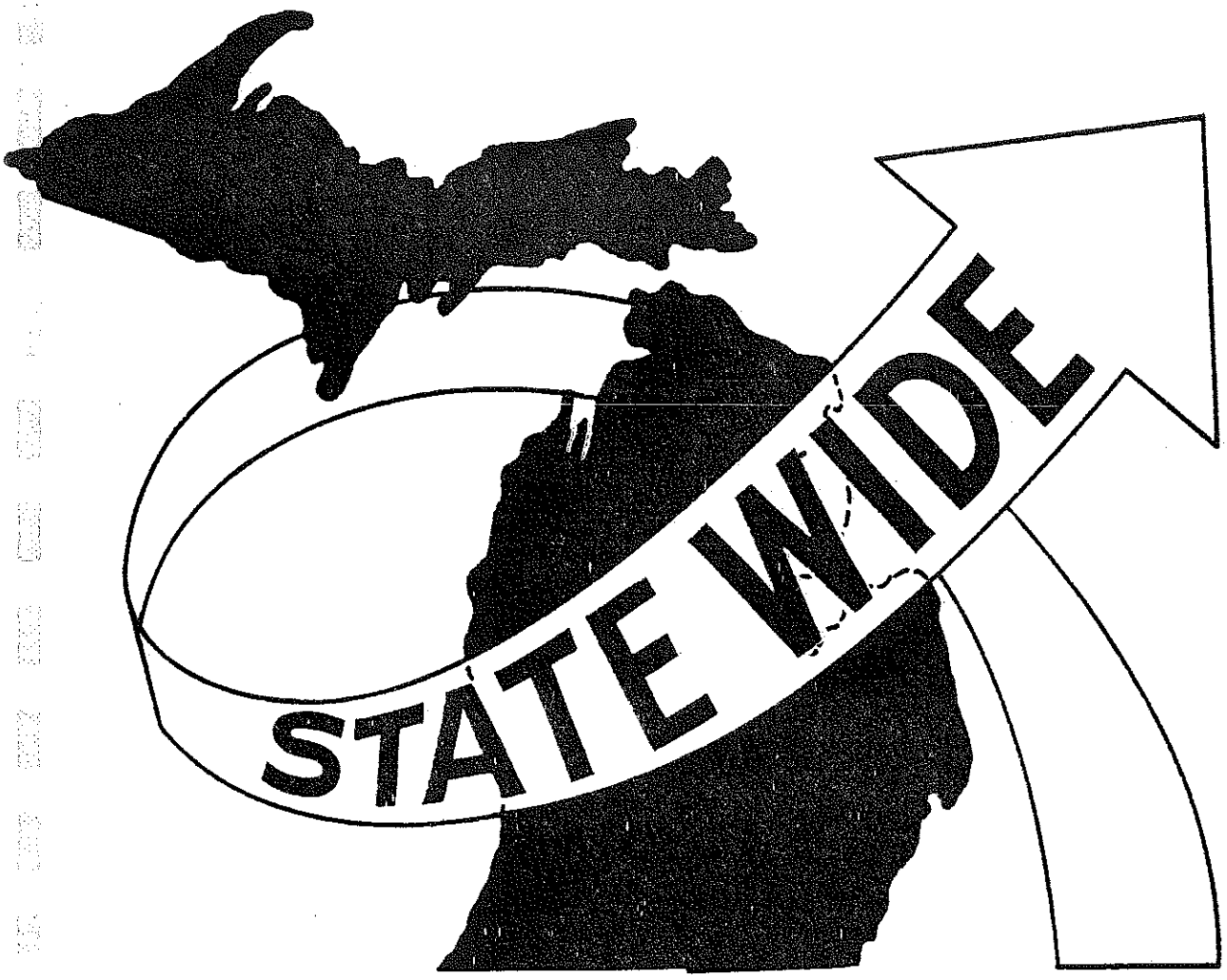
JON M. WESA

INTRODUCTION



INTRODUCTION

The changing character of government involvement in freight transportation issues and the importance of an effective transportation system to the vitality of the Michigan economy have focused interest in the development of a multi-modal multi-commodity freight planning capability. A principal element in multi-modal multi-commodity freight analysis is the relationship between freight transportation demand and the level and location of economic activity. The input-output model and rail traffic projection techniques described in this report suggest a useful framework for the development of a commodity specific freight system analysis.

The integration of commodity specific freight demand forecasting into the Statewide Transportation Modeling System has long been an objective of the Transportation Planning Procedures Section. Several alternative approaches to commodity-specific forecasting have been evaluated with respect to their practicality and adaptability to the Statewide Modeling System. Through discussions with other state government agencies, particularly the Departments of Commerce and Labor, it became apparent that input-output analysis would be suitable for addressing issues concerning the relationships of Michigan industries to one another and to freight transportation requirements.

The input-output model described in this analysis was developed for the Michigan Energy Administration by a consultant. Jeffrey L. Jordan, then associated with the Department of Agricultural Economics at Michigan State University, proposed using the model in a study to evaluate the applicability of input-output forecasting techniques for making rail freight traffic projections. The purpose of this report is to summarize a test of the input-output approach.

A test of the forecasting method applied the 20-sector input-output model projections to a 1% sample of rail traffic over a four-year period. The application of this approach to forecasting rail traffic is an initial step in developing a comprehensive freight flow forecasting capability.

For railroad movements, the Michigan Statewide Transportation Modeling System already contains (1) a rail network, as described in Statewide reports, Michigan Goes Multi-Modal (Volume XIII) and 1972 Statewide Rail Network: Summary Tabulations, and (2) commodity flow data from 1% waybill samples for all railroads shipping to and from Michigan, as described in the Statewide report, Commodity Flow Matrix (Volume XIVC). The 1% waybill samples are currently available to 1980.

Other reports in the Statewide Transportation Modeling Series are:

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VOLUME I	- OBJECTIVES AND WORK PROGRAM
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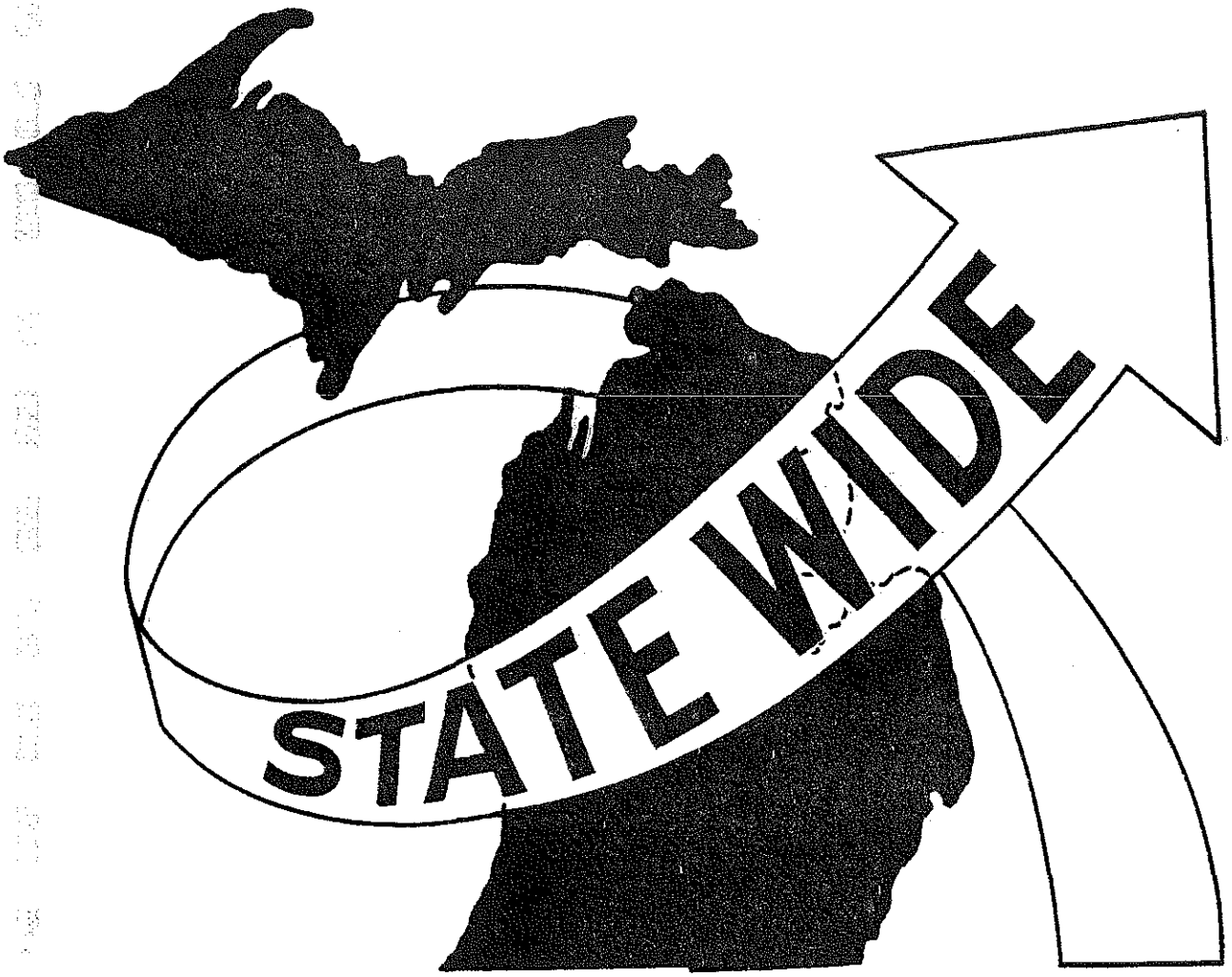
THE MICHIGAN INPUT-OUTPUT MODEL



THE MICHIGAN INPUT-OUTPUT MODEL

The 20 commodity sector input-output (I/O) model described in this report was adapted from a 44-sector model developed for the Michigan Energy Administration. The structure of the Michigan model parallels the structure of a model of the State of Minnesota, developed by the Minnesota Energy Agency and used for energy analysis in that state since 1975. The model utilizes the United States Bureau of Economic Analysis/(BEA) relationships for the U.S. economy as a basis for Michigan relationships.

Generally, the U.S. input-output table was split into two regions, Michigan and Rest-of-Nation, according to a process developed by Hwang and Maki[1]. The process assumes that the national input-output structure for an industry sector will prevail at the state level and that any surplus (deficit) in the state is exported to (imported from) the remainder of the nation. The primary benefit of the approach is the utilization of existing information at the national level, eliminating the prohibitive cost and time requirements of collecting information at the state level. The major drawback is assuming that the national structure for each industry sector will prevail at the state level.

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[1] "Users Guide to the Minnesota Two-Region Input/Output Model", an unpublished paper by Henry H. Hwang and Wilbur R. Maki, Regional Economic Impact Forecasting and Simulation (REIFS), Report No. 9, Department of Agricultural and Applied Economics, University of Minnesota, September 1979.

To construct the 1976 I/O table for Michigan, the 1967 national table was reduced from the original 367 sectors to 47 by aggregation, and then updated to 1972. The 1972 table was then segmented into two regions, Michigan and Rest-of-Nation, with the computer routines developed by Hwang and Maki. The 1972 I/O table for Michigan was then reduced to 44-sectors and updated to 1976 by replacing the 1972 output totals (by sector) and the final demand components with 1976 values and rebalancing the entire table using a least-squares algorithm.

The 44-sector model was obtained from the Michigan Energy Administration and aggregated to 20 sectors by Jeffrey L. Jordan. The model was aggregated to 20 sectors to improve the match between the mix of commodity groups moving over Michigan's rail system and the input-output sectors. Similar commodity groups with low tonnage were aggregated, producing the 20 sector model. The sector identifications for the 44 and 20-sector models are presented in Tables 1 and 2 respectively.

Table 1

Sectors Defined by SIC, 1976 I/O Table for Michigan

Sector	Industry	Industry Number 1967 I/O	1972 SIC Code
1	Livestock and Products	1	02
2	Other Agriculture, Forestry Services	2, 3, 4	01, 07, 08
3	Metals and Minerals	5, 6, 9, 10	10, 11, 12, 14
4	Crude Petroleum, Natural Gas	8	1311, 1321
5	Construction	11, 12	part 138, 15, 16, 17
6	Meat Products	14.01	201
7	Dairy Products	14.02 - 14.06	202
8	Preserved Food	14.07 - 14.13	203
9	Grains, Bakery, Sugar, Fats	14.14-14.20, 14.24-14.32	204-207, 209
10	Beverages	14.21-14.23	208
11	Textile, Apparel	16-19	22, 23
12	Lumber, Wood	20, 21	24
13	Furniture	22, 23	25
14	Paper and Allied Products	24, 25	26
15	Printing and Publishing	26	27
16	Chemicals and Allied	27, 29.02, 29.03, 30.00	28 excluding 282, 283
17	Plastics and Synthetic	28	282
18	Drugs	29.01	283
19	Petroleum Refinery	31	29
20	Rubber and Leather Products	32-34	30, 31
21	Stone, Clay, Glass	35, 36	32
22	Foundries and Metal Products	37.02-37.04, 38	332-336, 339
23	Blast Furnace, Basic Steel	37.01	331
24	Metal Containers, Heating, Plumbing, Fabricated Metals	39.01, 40	3411, 343, 344
25	Screw Machine Products	41.01	345
26	Metal Stampings	41.02	346
27	Other Fabricated Metal	39.02, 42	342, 347-349
28	Engines and Turbines	43	3511, 3519
29	Farm and Construction Machinery	44-46	3523-353
30	Metal Working Machinery	47	354
31	Industrial and Service Machinery	48-50, 52	355, 356, 358, 359
32	Office and Computing Machines	51	357
33	Electrical Equipment	53-58	36
34	Truck, Trailers, Motor Vehicles	59	371

Table 1 (con't)

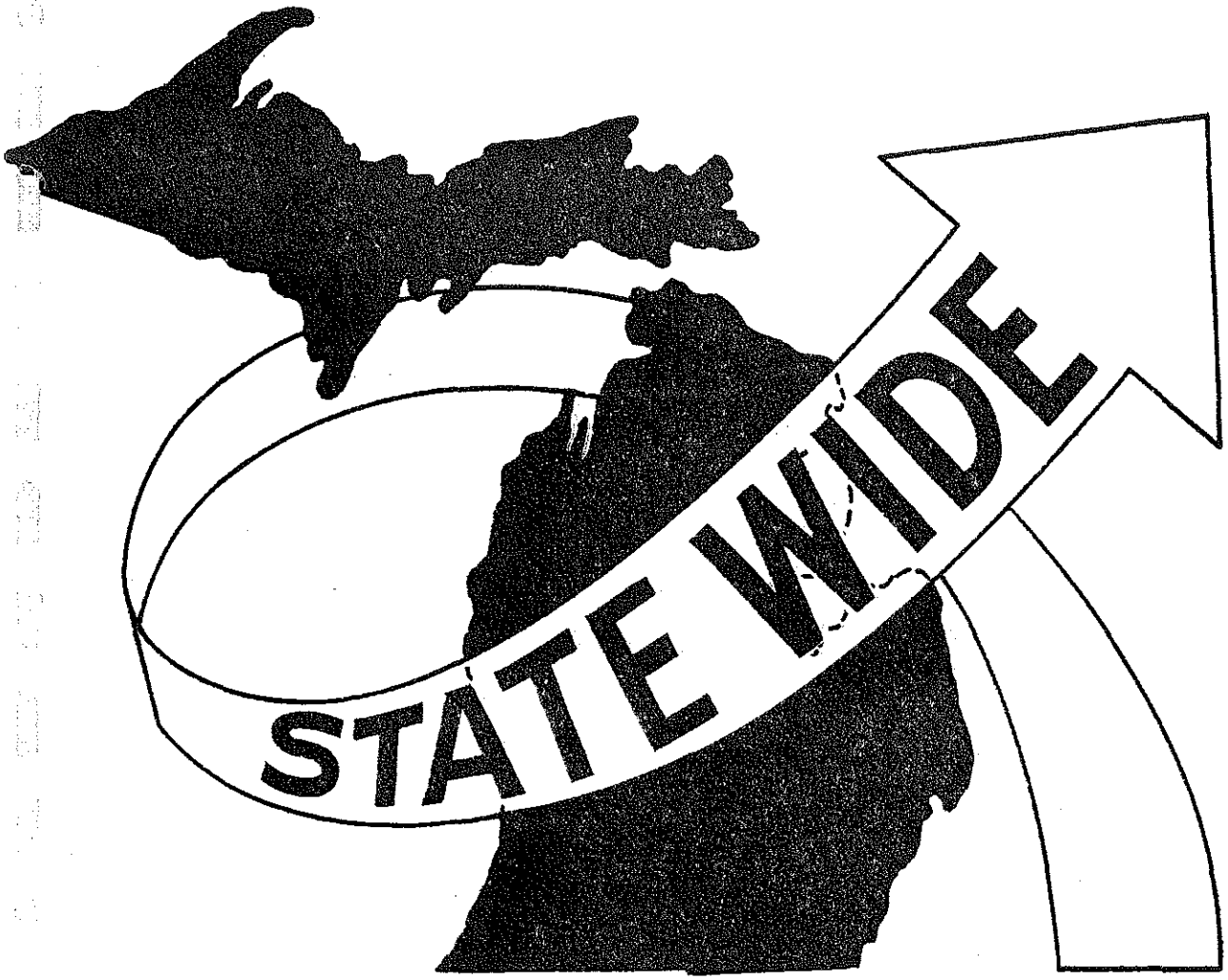
Sector	Industry	Industry Number 1967 I/O	1972 SIC Code
35	Aircraft and Parts, Other Transportation	60, 61	372-379
36	Miscellaneous Manufacturing	62-64	38, 39
37	Transportation, Communication	65-67	40-48
38	Electric Utilities	68.01	491, part 493
39	Gas Utilities	68.02	492, part 493
40	Water and Sanitary Services	68.03	494-497, part 493
41	Wholesale and Retail Trade	69	50, 52-59
42	Finance, Insurance, Real Estate	70-71	60-67
43	Services	72-77	70-89
44	Government Enterprises	78-79	

Table 2

1976, 20-Sector Input-Output Classification

Sector	Industry	Sector Number from 44-Sector I/O
1	Livestock and Products	1
2	Other Agricultural Products	2
3	Mining	3, 4
4	Construction	5
5	Food and Kindred Products	6-10
6	Lumber, Furniture, Paper, Printing	12-15
7	Chemicals, Drugs, Plastics	16-18
8	Petroleum Refinery	19
9	Rubber, Leather, Stone, Glass, Clay	20, 21
10	Primary and Fabricated Metals	22-27
11	Machinery, Except Electrical	28-32
12	Electrical Equipment	33
13	Motor Vehicles and Parts	34
14	Aircraft and Other Transportation Equipment	35
15	Transportation and Communication	37
16	Utilities	38-40
17	Wholesale, Retail, Miscellaneous Manufacturing, Including Textiles	11, 36, 41
18	Financial, Insurance, Real Estate	42
19	Selected Services	43
20	Government Enterprises	44

INPUT-OUTPUT ANALYSIS



INPUT-OUTPUT ANALYSIS

The input-output technique is a tool of economic analysis used to represent interdependence among production sectors in the economy. The organization of transactions data according to major product or industry groups in a transactions table permits the quanitification of economic interdependencies. The transactions table or matrix is a system of accounts that represents input requirements and the distribution of products for all sectors of the economy.

By using this accounting method, it is possible to show how outputs in dollars from each producing sector are distributed to other producing sectors and final consumption (final demand). The 20-sector transactions table for the Michigan economy is presented in Appendix B.

In the transactions table, the sectors of the economy are arrayed horizontally and vertically, in identical order. The purchasing sector is listed horizontally and the selling sector vertically. Thus, the distribution of a sector's sales is read across its "row" in the matrix and the distribution of a sector's input purchases is read down its "column". The transactions matrix quantifies the intersectoral flows in thousands of dollars.

A hypothetical transactions matrix is shown as an example in Figure 1. In reading the sales of the manufacturing sector across Row 2, $5,000

F I G U R E 1

HYPOTHETICAL INPUT-OUTPUT MODEL TRANSACTIONS MATRIX
(Thousands of Dollars)

	Agriculture	Manufacturing	Trade	Service	Consumption	Exports	Investment	Total Sales
Agriculture	2	2	4	2	10	5	1	26
Manufacturing	5	5	4	4	20	5	3	46
Trade	3	2	3	1	10	1	3	23
Service	2	2	5	5	15	1	0	30
Households	8	29	4	15				
Imports	4	2	1	1				
Depreciation	2	4	2	2				
Total Purchases	26	46	23	30				

Processing Sectors

Final Demand Sectors

Processing Sectors

Payments Sectors

worth of manufacturing output is sold to the agricultural sector, $5,000 is consumed in manufacturing, and $4000 each is sold to the trade sector and the producers of services. A total of $28,000 worth of manufacturing output is sold to the final demand sectors, $20,000 of which is absorbed in consumption. Total output in manufacturing equals $46,000. The $5,000 sale of manufacturing output to the agricultural sector can be seen to be a purchase by agriculture when reading down Column 1. In addition to the purchases from the four processing sectors, the input required to produce $26,000 worth of agricultural output in the example requires the purchase of $14,000 worth of inputs from the payment sectors. Included are $8,000 worth of labor services purchased from households, $4,000 of imported inputs, and $2,000 of depreciation expense. (see figure 1 a)

The transactions matrix is used to derive the technical coefficients of production. The technical, or direct requirements, coefficients represent the amount of industry i's output necessary to produce one unit of output in industry j. This is done by dividing each column entry for the processing sectors by the corresponding column total. Direct requirements coefficients are computed only for the processing sectors, since no relationships are assumed between the payments and final demand sectors.

For example, total sales (which are equal to total purchases) for agriculture are $26,000 in Figure 1. Purchases of $5,000 are made from

manufacturing and purchases of $4,000 are made from imports. The direct requirements coefficient for agriculture from manufacturing is .192 ($5,000/$26,000) and from imports is .154 ($4,000/$26,000). Each element in a direct requirements matrix indicates the dollars of input required from each selling sector (horizontal) in order to produce one additional dollar of output in a purchasing sector (vertical). One dollar of additional output in the agriculture sector requires .192 dollars of output from manufacturing and .154 dollars of imports. The example direct requirements coefficient matrix is presented as Figure 2.

Note that the sale of one dollar of output to final demand by any one processing sector necessitates that the other processing sectors which supply it with inputs must increase their outputs by more than the direct amounts as well. For example, a $1.00 increase in final demand for manufacturing output requires that each of the other processing sectors increase output by an amount sufficient to meet direct requirements. For agriculture to increase output to supply manufacturing, however, all other sectors must increase output by an additional amount sufficient to meet the direct requirements for agriculture. A similar impact will result when all other processing sectors increase output to meet the direct requirements for manufacturing. This feature of the economy is represented by the interdependency coefficient matrix, which is derived from the direct requirements matrix.[1] Each entry in this

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1/ See Appendix A.

F I G U R E 2

HYPOTHETICAL INPUT-OUTPUT MODEL DIRECT REQUIREMENTS MATRIX

	Agriculture	Manufacturing	Trade	Service
Agriculture	.077	.0435	.174	.0667
Manufacturing	.192	.109	.174	.1333
Trade	.115	.0435	.1305	.0333
Service	.077	.0435	.217	.1667
Households	.308	.630	.174	.5
Imports	.154	.0435	.0435	.0333
Depreciation	.077	.087	.087	.0667
Total	1.0	1.0	1.0	1.0

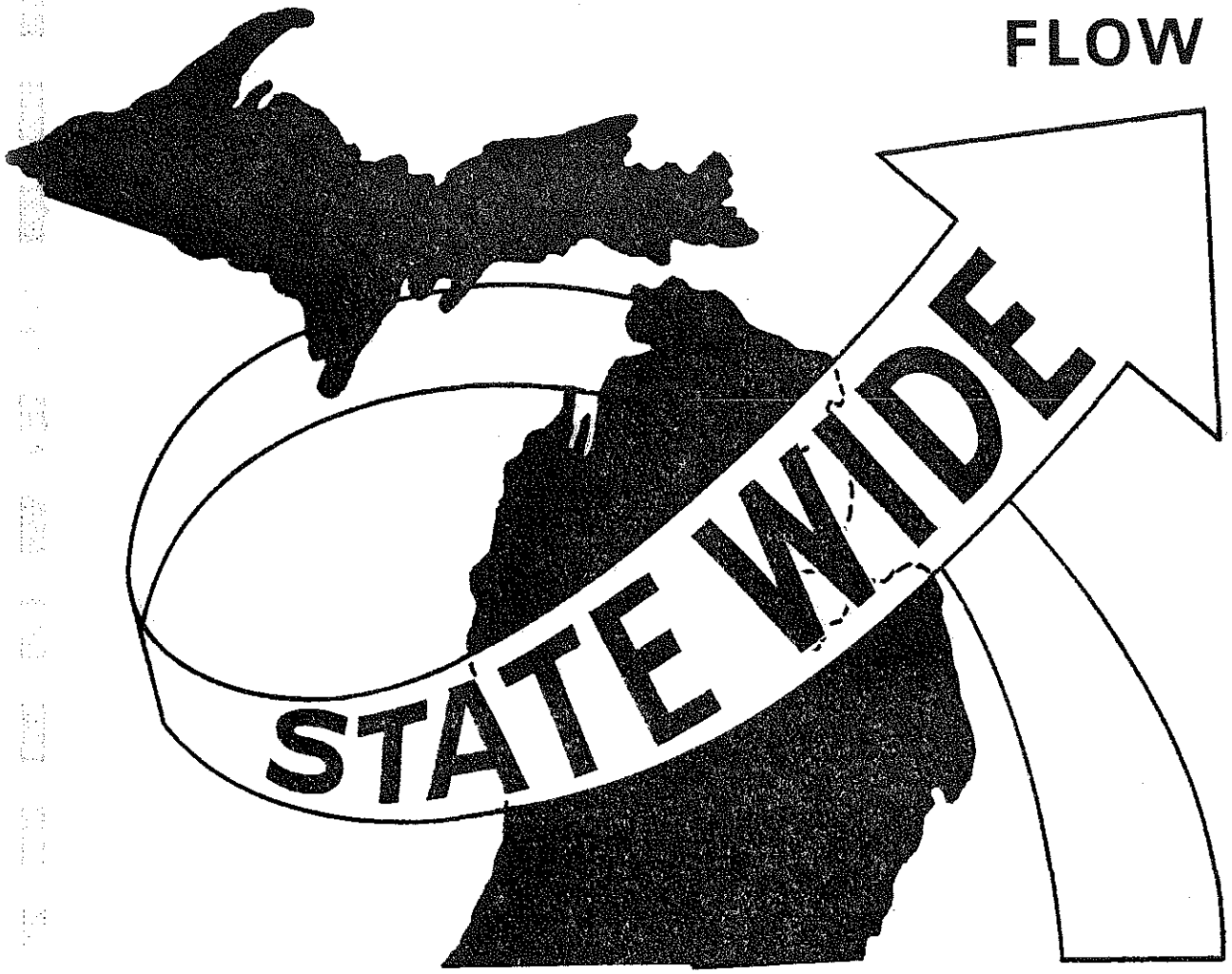
matrix is called an interdependency coefficient, which represents the direct and indirect requirements of sector i per unit of final demand for the output of sector j.

The interdependency coefficient matrix can be multiplied by any size and composition of final demand in order to obtain output for each industry. This provides a powerful tool of analysis since it allows the measurement of the total impact on the economy on a sector-by-sector basis resulting from any change in the level or composition of demand.

The input-output specification requires the assumption of constant production coefficients for each economic sector. Where a relatively stable economy exists, the constant technology assumption may be a reasonable approximation of reality.

Also, each sector is assumed to produce only one product, with one process. It is obvious that firms within sectors have diverse input and output structures. Yet, it is not feasible to attempt to model all of these differences. This assumption is essentially an aggregation problem which must be confronted in virtually all economic analysis. There are no set rules for aggregating firms into individual sectors. The aggregation of any input-output model depends mostly on the region to be studied and the objectives of the analysis.

LINKING THE INPUT-OUTPUT SECTORS TO COMMODITY FLOW DATA



LINKING THE INPUT-OUTPUT SECTORS TO COMMODITY FLOW DATA

To forecast rail traffic, it is necessary to forecast changes in the economy, given changes in the final demand sector. The disaggregated structure of input-output analysis is particularly well suited to transportation planning because the demand for service on specific rail lines or segments is often commodity dependent. The I/O method disaggregates the effects of economic changes (final demands) on a commodity-by-commodity basis in order to estimate the future demand for rail services.

Transportation data has been compiled from a sample of audited revenue waybills submitted to the Federal Railroad Administration (FRA) by railroads under terms specified by the Interstate Commerce Commission. Waybills are a shipping document prepared by the originating railroad from the shipper's instruction as to the disposition of freight. They are used by the railroads as the authority to move the shipment and as the basis for determining and settling the freight charges among the carriers involved.

The sample includes only rail carriers having $3 million or more average operating revenues over a three-year period. Some types of movements excluded from the waybill data are:

- Canadian and Mexican originations.
- Mail and express traffic.

- Less than carload traffic.
- Shipments weighing less than 10,000 pounds and moving on "any-quantity" rates.
- Non-revenue movements.
- "Dead-head" traffic (company material whose movement is entirely on one road).
- Empty cars returned for reloading.
- Movements in substitute services, e.g., truck in lieu of rail.

The waybill data is classified by commodity using the seven-digit Standard Transportation Commodity Code (STCC). The first step is to link the input-output sectors based on SIC codes to the STCC codes on waybill records. Table 3 shows the STCC categories in each of the 20 input-output sectors. The 1% waybills are expanded to obtain an estimate of total originating and terminating rail traffic in Michigan. Table 4 shows the expanded waybill sample for Michigan for the years 1976 and 1980.

Table 3

STCC Codes in Each Input-Output Sector

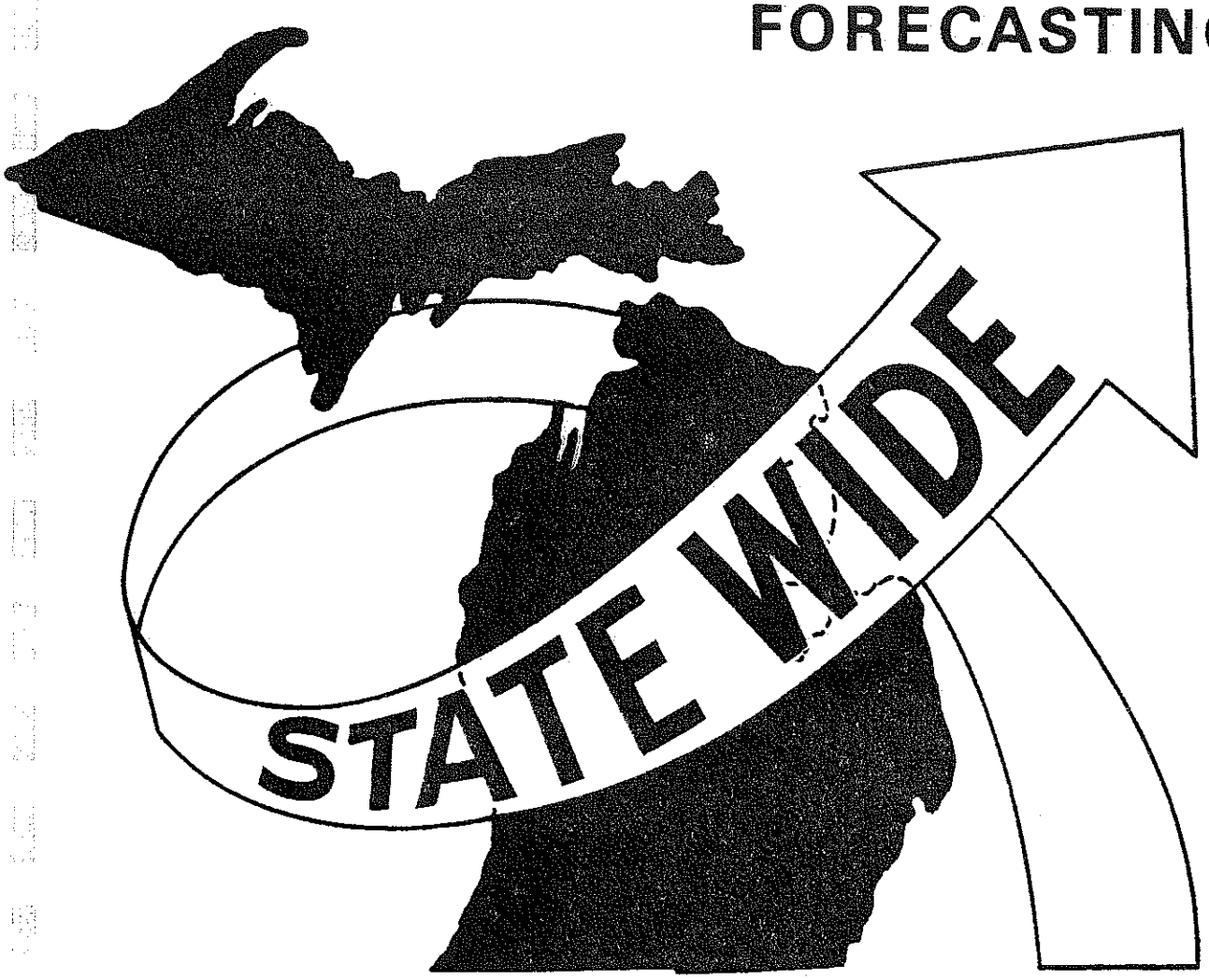
Sector	Industry	STCC Code Contained in I/O Sector
1	Livestock and Products	014, 015
2	Other Agricultural Products	011, 012, 013, 019, 084, 086, 091
3	Mining	10, 14, 111, 112, 122
4	Construction	
5	Food and Kindred Products	201, 202, 2032-2035, 2037-2039, 204-209
6	Lumber, Furniture, Paper, Printing	24-27
7	Chemicals, Drugs, Plastics	281, 284-286, 289, 282, 283, 287
8	Petroleum Refinery	29
9	Rubber, Leather, Stone, Glass, Clay	30-32
10	Primary and Fabricated Metals	332, 333, 335, 336, 339, 331, 3431, 3432, 34331, 34333-34336, 34339, 344-346, 341, 342, 348, 349, 191, 192, 196
11	Machinery, Except Electrical	351-359, 34332
12	Electrical Equipment	36
13	Motor Vehicles and Parts	371
14	Aircraft and Other Transportation Equipment	372-376, 379, 193
15	Transportation and Communication	
16	Utilities	
17	Wholesale, Retail, Miscellaneous Manufacturing, Including Textiles	22, 23, 38, 39, 211, 212, 401, 402, 441, 412, 421, 422, 431, 441, 451, 461, 462, 471
18	Financial, Insurance, Real Estate	
19	Selected Services	
20	Government Enterprises	

Table 4

Expanded 1 Percent Waybills, Michigan,
1976, 1980, by Input-Output Sector

Sector	Industry	1976 Tons	1980 Tons
1	Livestock and Products	0	0
2	Other Agricultural Products	1,211,200	1,545,000
3	Mining	31,641,100	35,463,300
4	Construction	0	0
5	Food and Kindred Products	3,476,700	2,667,800
6	Lumber, Furniture, Paper, Printing	4,607,900	4,021,100
7	Chemicals, Drugs, Plastics	4,180,300	2,713,700
8	Petroleum Refinery	2,520,400	1,679,000
9	Rubber, Leather, Stone, Glass, Clay	2,592,600	1,798,500
10	Primary and Fabricated Metals	6,025,000	3,684,100
11	Machinery, Except Electrical	242,300	111,400
12	Electrical Equipment	5,502,600	4,224,800
13	Motor Vehicles and Parts	134,000	97,000
14	Aircraft and Other Transportation Equipment	13,204,600	8,170,800
15	Transportation and Communication	165,100	129,800
16	Utilities	0	0
17	Wholesale, Retail, Miscellaneous Manufacturing, Including Textiles	0	0
18	Financial, Insurance, Real Estate	0	0
19	Selected Services	0	0
20	Government Enterprises	0	0
	Total	75,503,800	66,306,300

TESTING THE USE OF INPUT-OUTPUT METHODS FOR RAIL TRAFFIC FORECASTING



TESTING THE USE OF INPUT-OUTPUT METHODS FOR RAIL TRAFFIC FORECASTING

The procedure used to test the rail traffic forecasting ability of the input-output model is summarized in Figure 3. Beginning with the 1976 20-sector input-output model of Michigan for the base year of 1976, final demands for the test year of 1980 are estimated. The 1976 final demands are those estimated when the two-region input-output model was constructed. The 1980 final demands were estimated by Jeffrey L. Jordan, using as much Michigan specific data as possible. Most state input-output models rely on sharing techniques that apportion national changes in the final demand sectors to the state level.

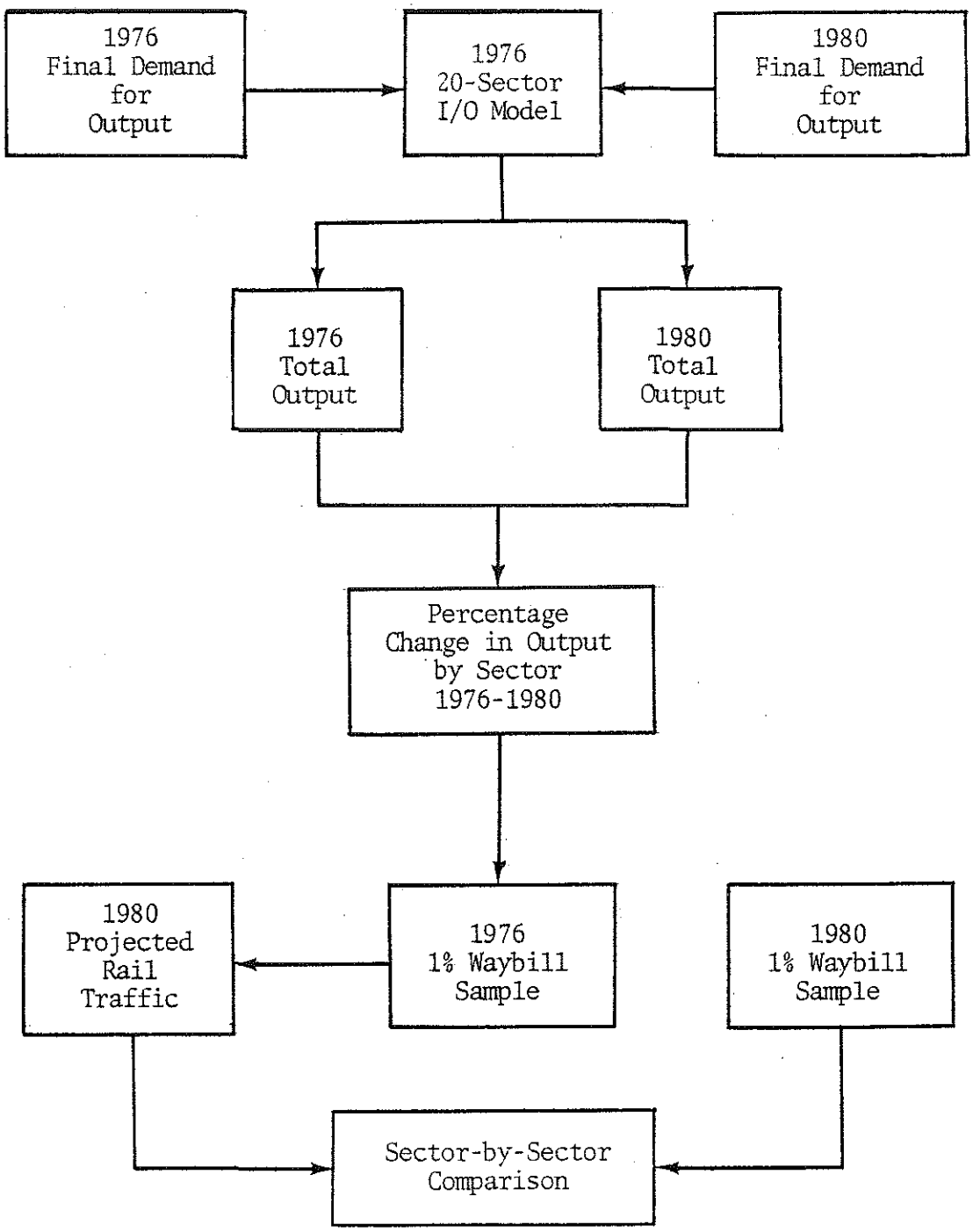
Once the 1980 final demands are estimated, the following steps represent the testing procedure:

1) 1980 final demands are multiplied by the interdependency coefficient matrix of the 20-sector input-output model to obtain 1980 estimates of total outputs. These total outputs are also calculated in terms of percentage changes from 1976.

2) The 1980 total output estimates are then used to obtain projections, by sector, of 1980 rail traffic in Michigan. The 1976 one-percent expanded waybills are factored by the projected percentage changes in total output by sector. The results are 1980 rail traffic projections.

F I G U R E 3

FLOW DIAGRAM OF RAIL
TRAFFIC FORECASTING TEST



3) The 1980 rail traffic projections are then compared to the actual one-percent expanded waybills for 1980, yielding both the difference in total tons and the percentage difference between the actual total movement of rail traffic in Michigan and the projections.

Table 5 indicates the projected total output in Michigan for 1980, given the estimated final demands. Table 5 also shows the percentage change in total output from 1976 to 1980.

The actual expanded 1 percent waybills for 1976 and 1980 are shown in Table 4. For example, in 1976, 1,211,200 tons of agricultural products moved over Michigan rail lines. The 1980 total output in the agricultural products sector increased 28.24% over 1976 in constant dollars. Thus, it is estimated that rail movements over Michigan's rail system should also increase by 28.24%, or 342,042 tons. Consequently, the model estimated that rail traffic in the agricultural products sector is 1,211,200 plus 342,042 tons, or 1,553,242 tons. This procedure is carried out for each commodity sector yielding the 1980 projections of Michigan rail traffic shown in Table 6.

To evaluate the rail traffic forecasting ability of the input-output model, it is necessary to compare the projected rail flows to the actual 1980 rail flows. Table 6 shows this comparison. The projected total rail flow in Michigan for 1980 is 67,099,985 tons, while the actual rail

Table 5

1980 Total Output Projections: Michigan (Thousands of 1976 Dollars)

Sector	Industry	Projected Final Demand	Projected Output	Percent Change in Output
1	Livestock and Products	15,453	620,264	-10.59
2	Other Agricultural Products	446,292	904,850	28.24
3	Mining	1,231,017	1,911,251	9.94
4	Construction	2,550,125	4,003,351	-31.54
5	Food and Kindred Products	3,777,201	4,236,337	-13.03
6	Lumber, Furniture, Paper, Printing	2,176,523	4,684,377	-8.27
7	Chemicals, Drugs, Plastics	2,186,434	3,718,038	-34.14
8	Petroleum Refinery	397,726	693,082	-26.05
9	Rubber, Leather, Stone, Glass, Clay	390,786	1,934,431	-34.39
10	Primary and Fabricated Metals	3,603,676	11,109,276	-24.77
11	Machinery, Except Electrical	2,164,602	4,733,203	-28.85
12	Electrical Equipment	447,245	1,167,093	-25.81
13	Motor Vehicles and Parts	17,207,784	24,013,737	-40.31
14	Aircraft and Other Transportation Equipment	365,729	462,489	-25.19
15	Transportation and Communication	5,542,140	7,059,890	-2.77
16	Utilities	2,888,712	4,893,818	16.32
17	Wholesale, Retail, Miscellaneous Manufacturing, Including Textiles	11,459,264	14,255,054	-20.36
18	Financial, Insurance, Real Estate	8,381,690	10,838,032	3.91
19	Selected Services	6,883,459	11,186,377	-8.67
20	Government Enterprises	405,714	1,102,926	2.12
	Total		113,527,874	-21.51

Table 6

Comparison Between 1980 Actual and Projected Rail Traffic Movements in Michigan (Tons)

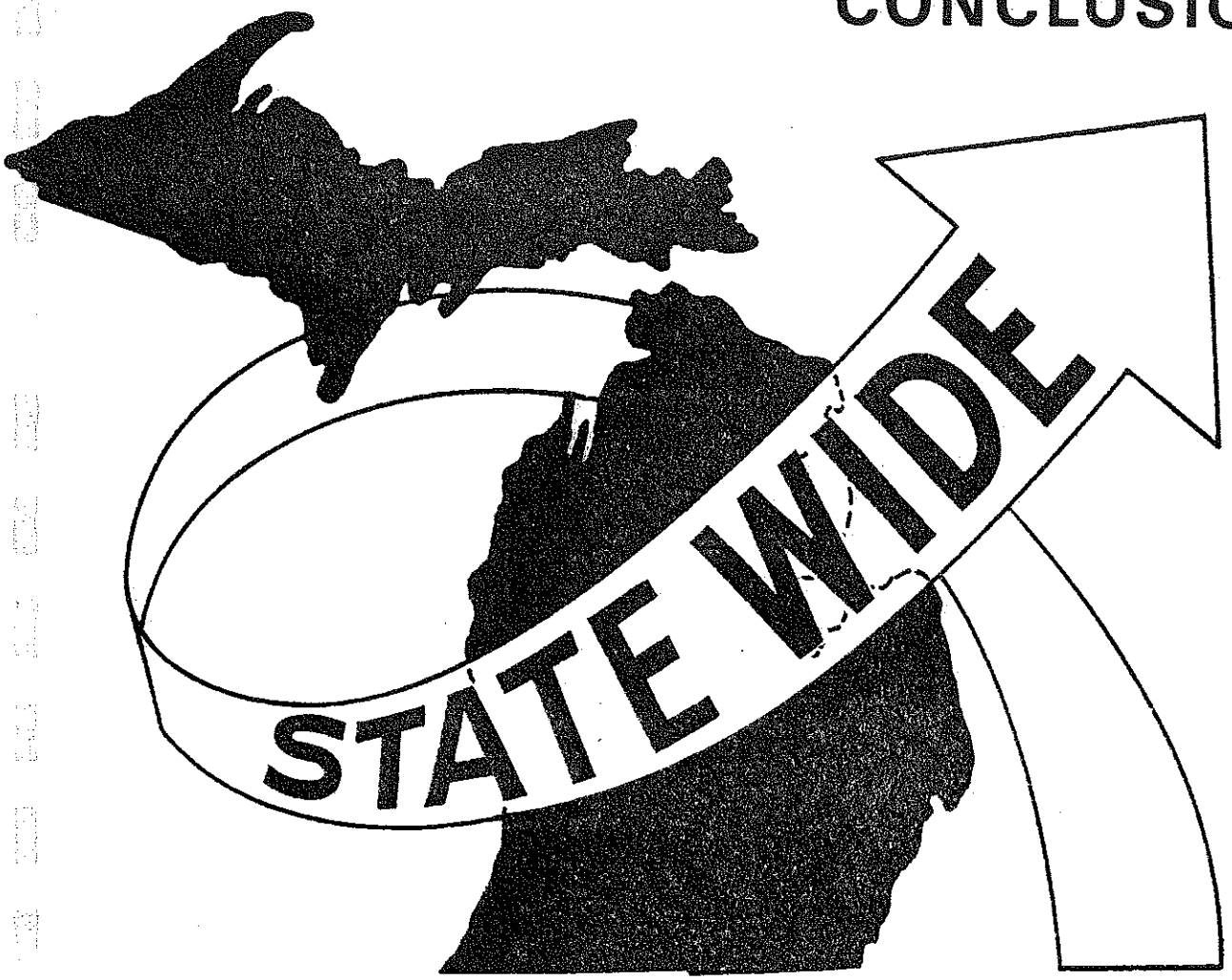
Sector	Industry	Projected	Actual	Difference	Percent Difference
1	Livestock and Products	0	0	0	0.00
2	Other Agricultural Products	1,553,242	1,545,000	8,242	0.53
3	Mining	34,786,225	35,463,300	-677,075	-1.91
4	Construction	0	0	0	0.00
5	Food and Kindred Products	3,023,685	2,667,800	355,885	13.34
6	Lumber, Furniture, Paper, Printing	4,226,826	4,021,100	205,726	5.12
7	Chemicals, Drugs, Plastics	2,753,145	2,713,700	39,445	1.45
8	Petroleum Refinery	1,863,835	1,679,000	184,835	11.01
9	Rubber, Leather, Stone, Glass, Clay	1,701,004	1,798,500	-97,496	-5.42
10	Primary and Fabricated Metals	4,532,607	3,684,100	848,507	23.03
11	Machinery, Except Electrical	172,396	111,400	60,996	54.75
12	Electrical Equipment	99,414	97,000	2,414	2.49
13	Motor Vehicles and Parts	7,881,825	8,170,800	-288,975	-3.54
14	Aircraft and Other Transportation Equipment	123,511	129,800	-6,289	-4.85
15	Transportation and Communication	0	0	0	0.00
16	Utilities	0	0	0	0.00
17	Wholesale, Retail, Miscellaneous Manufacturing, Including Textiles	4,382,270	4,224,800	157,470	3.73
18	Financial, Insurance, Real Estate	0	0	0	0.00
19	Selected Services	0	0	0	0.00
20	Government Enterprises	0	0	0	0.00
	Total	67,099,985	66,306,300	793,685	1.20

flow in 1980 was 66,306,300 tons. This actual total does not include 1,638,200 tons of hazardous materials. Projected rail traffic exceeds the actual by 793,685 tons, or 1.3%. Table 6 also includes a comparison of projected versus actual rail traffic for each commodity sector. Most of the commodity sectors were projected within a percentage range believed to yield confidence in the use of the model on a regional or line-by-line basis.

Only two sectors -- number 10, primary and fabricated metals and number 11, machinery (except electrical) -- produced estimates substantially different from actual figures on a percentage basis. In the machinery sector, while the percent difference between the projection and actual rail traffic is 54.75%, the actual tonnage difference is only 60,996 tons. This absolute tonnage difference represents only 0.09% of total traffic.

The waybill sample represents an additional source of variability. Small absolute totals of rail traffic are less likely to be accurately reflected in the 1% sample. While this presents problems to decision makers in a few cases, the 1% waybill sample is the best systemwide data available to rail planners.

CONCLUSION



CONCLUSION

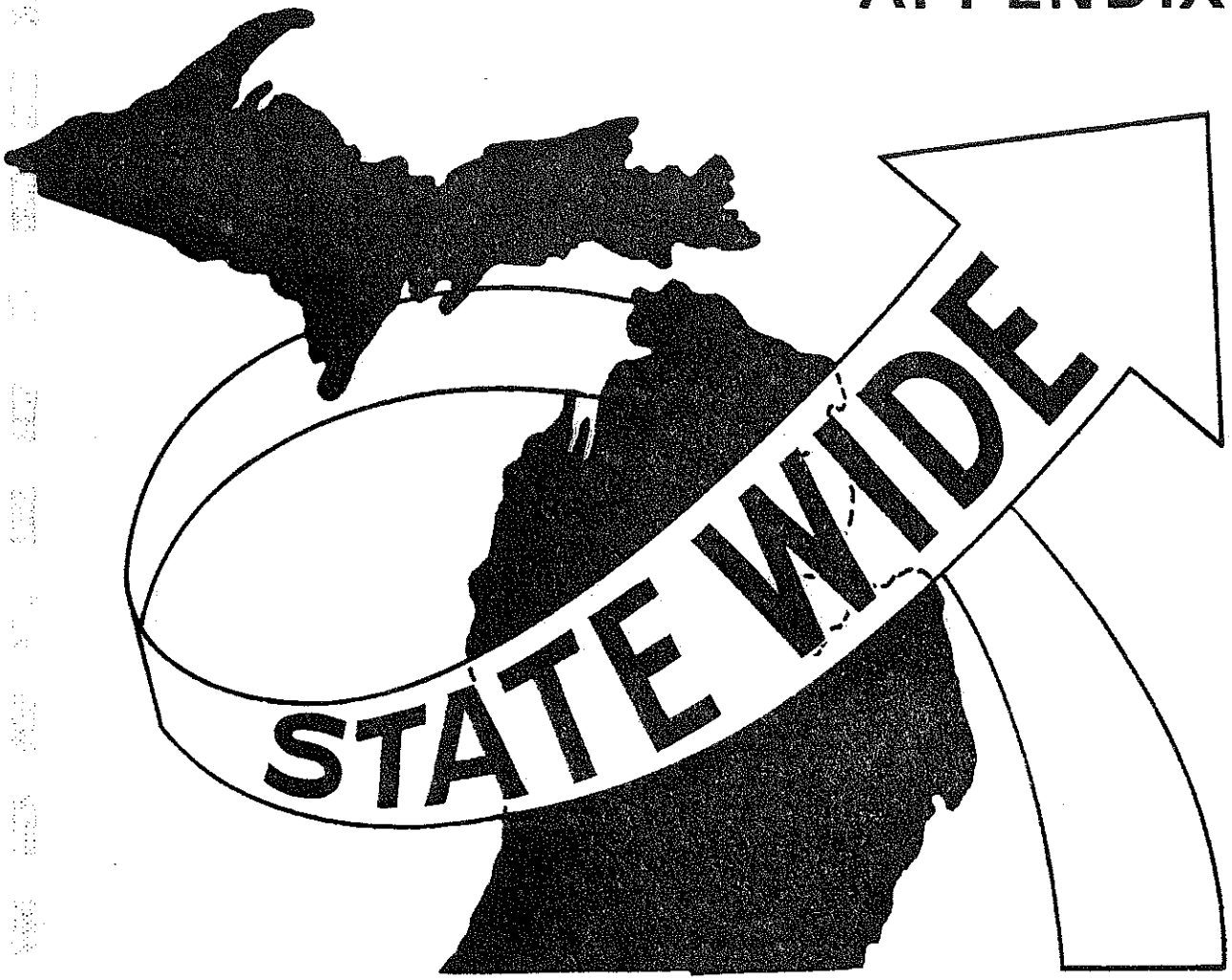
This report summarizes a procedure for using an input-output model of Michigan in making commodity specific rail freight traffic projections. The reasonably favorable outcome of a test of the procedure over a four-year period suggests that the techniques described in this report defines a useful framework for further development of a commodity-specific freight system planning capability.

The integration of commodity specific freight demand forecasting into the Statewide Transportation Modeling System has long been an objective of the Transportation Planning Procedures Section. Further development and testing will focus on:

- more comprehensive testing of the reliability of the input-output projections over time;
- possible refinements in the input-output structure of the Michigan economy as represented in the transaction matrix and particular aggregation of sectors in the model;
- construction of a comprehensive multi-modal commodity flow data base; and
- the geographic distribution of production and its relationship to known commodity flow data.

Summaries of these efforts will be the subject of future reports in this series.

APPENDIX A



APPENDIX A

This appendix provides a brief technical summary of the structure of input-output models, which is taken from Jordan.[1] Further discussions relating to theoretical issues and the applicability of input-output techniques can be found in references included in the bibliography.

The input-output method, developed by Leontief and expanded by others (Dorfman, Samuelson, and Solow, 1958) is a system of accounts that represent the transactions among the sectors of the economy. By using this accounting method, it is possible to demonstrate how outputs in dollars from each producing sector are distributed among other sectors in and outside Michigan. In terms of transportation requirements, the input-output table also identifies required inputs for each sector.

Following is a description of the input-output matrices and their analytical use.[2] The 20-sector, input-output model of Michigan used in this study is reproduced in Appendix B.

To use an input-output table, the first step is the construction of the transactions or interindustry matrix (Appendix B, Table 1). The structure of a transactions matrix is outlined in Figure A.1. The three

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1 Jordan, Jeffrey L., "Using a Regional Input-Output Model to Forecast Rail Freight Traffic: With Applications for the Subsidy-Abandonment Decision", unpublished Ph.D. Dissertation: Department of Agricultural Economics, Michigan State University, 1982.

2 This discussion follows the layout example from: Pratt, Smith, and Conner. The mathematical formulation is from Jones, 1978; and Adiarte and Venegas, 1980.

		Consuming Sectors 1 2 . . . . . N	Final Demand Sectors 1 2 . . . . . K	Total Output
Producing Sectors	1 2 . . . N	x_{ij}	y_{ik}	$X_{i.}$
Primary Input Sectors	1 . . M	w_{mj}		w_{m}
Total Inputs		$X_{.j}$	$Y_{.k}$	

Figure A-1

Structure of the Intersectoral Transaction Table
(Source: Hwang and Maki, 1979)

major sectors of this table are the producing sector (X), primary inputs (W), and final demands (Y). The numerical entries are represented in constant dollar terms, where:

N = the number of producing sectors;

K = the number of final demand sectors;

M = the number of primary input sectors;

X_{ij} = the purchase of the output of the ith producing sector by the jth consuming sector for the purpose of producing the output of jth sector, i = 1,2, ... N; j = 1, 2, ... N;

Y_{ik} = the final demand of sector k for the output from the ith producing sector or primary input class, i = 1, 2, ... N+M; k = 1, 2, ... K;

W_{mj} = the purchase of the mth sector of primary input by the jth consuming sector for the purpose of producing the output of the jth sector, m = 1,2, ...M; j = 1,2, ... N;

$X_{i.}$ = total output of the ith sector, i = 1,2, ... N;

$X_{.j}$ = total input of the jth sector, j = 1,2, ... N;

$Y_{i.}$ = total final demand for the output of the ith sector, i = 1,2, ... N+M;

$Y_{.k}$ = total final demand of the sector k, k = 1,2, ... K;

$W_{.j}$ = the purchase of total primary inputs by the jth consuming sector for the purpose of producing the output of the corresponding jth producing sector, j = 1,2 ... N.

The interrelationships in the economy expressed in the transactions matrix are as follows:

$$(1) \quad X_i = \sum_{j=1}^{n} X_{ij} + Y_i$$

The sectors of the economy are arrayed horizontally and vertically, in identical order. The purchasing sector is listed horizontally and the selling sector vertically. Thus, the distribution of a sector's product sales is read across its "row" in the matrix and the distribution of a sector's input purchases is read down its "column". The transactions matrix quantifies the intersectoral flows in thousands of dollars. The Michigan table is divided into the processing sectors, 1-20, and the payments and final demand sectors, 21-23. Row/Column 24 represents the total sales and total purchases, by sector, in the economy.

Second, it is necessary to obtain the direct requirements or technical coefficients matrix (Appendix B, Table 2). Derivation of these coefficients assumes a linear relationship between purchases of an endogenous sector and the level of output of that sector. The technical coefficients are found by dividing each column entry for the processing

sectors by the corresponding column total. Each element in the coefficient matrix indicates the dollar value of inputs required from each selling sector (horizontal) in order to produce one additional dollar of output in the purchasing sector (vertical).

$$(2) \quad a_{ij} = X_{ij}/X_{.j} = \text{amount of industry i's output necessary to produce one unit of industry j's output.}$$

where:

a_{ij} = technical coefficient (direct requirements coefficients);

X_{ij} = value of sales from industry i to industry j;

X_j = total output of industry j: X_j is the same as X_i in equation (1), where i=j; corresponding row and column totals in the processing sector are equal.

Technical coefficients are computed for each industry in the processing sector, yielding the following matrix:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots\cdots\cdots & a_{1n} \\ a_{21} & a_{22} & \cdots\cdots\cdots & a_{2n} \\ & & & \\ a_{n1} & a_{n2} & \cdots\cdots\cdots & a_{nn} \end{bmatrix}$$

Using the direct requirements matrix A, which expresses intermediate product purchases as a proportion of the purchasing sectors output, the distribution of output between purchasing sectors and final demand for all sectors can be represented by the matrix equation:

$$AX + Y = X \qquad (3)$$

where:

X = total output vector of the economy;

Y = final demand vector facing the economy:

Equation (3) can be rearranged to show:

$$X - AX = Y \quad (4)$$

or

$$(I-A)X = Y \quad (5),$$

where I = the identity matrix.

This system of linear equations can be solved to yield output X as a function of final demand Y. The solution requires the inversion of the matrix (I-A) to yield:

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

The inverse matrix for the 20 sector Michigan models is reproduced as Table B-3.

BIBLIOGRAPHY

* Adiarte, Rosario G. and Ernesto C. Venegas. "State of Michigan Input-Output Model", Mimeograph, Minnesota: Minnesota Energy Agency, 1980.

* Chenery, Hollis B. and Paul G. Clark. Interindustry Economics, New York: John Wiley and Sons, Inc., 1959

* Creary, Joan P., Saul H. Hymans, and Harold T. Shapiro. "The Michigan Economy in 1982", Research Seminar in Quantitative Economics: Forecasts, Ann Arbor, Michigan: The University of Michigan, 1981.

* Diamond, J. and D. Chapelle. "Application of an Input-Output Model on Secondary Data in Local Planning: The Case of Manistee County", Agricultural Experiment Station Research Report No. 409, East Lansing, Michigan: Michigan State University, 1981.

* Dorfman, R., Paul Samuelson, and R. Solow. Linear Programming and Economic Analysis, New York: McGraw Hill, 1958.

* Hwang, Henry H. and Wilbur R. Maki. "A User's Guide to the Minnesota Two-Region Input-Output Computer Model: With Reference to the 1970 Minnesota 35-Sector Model", St. Paul, Minnesota: Department of Agricultural and Applied Economics, University of Minnesota, 1976.

*Jordan, Jeffrey L., "Using a Regional Input-Output Model to Forecast Rail Freight Traffic: With Applications for the Subsidy-Abandonment Decision", unpublished Ph.D. Dissertation: Department of Agricultural Economics, Michigan State University, 1982.

* Leontief, Wassily. Studies in the Structure of the American Economy: Theoretical and Empirical Explorations in Input-Output Analysis, New York: International Arts and Sciences Press, Inc., 1953.

* Leontief, Wassily. The Structure of the American Economy, 1919-1939: An Empirical Application of Equilibrium Analysis, New York: International Arts and Sciences Press, Inc., 1941.

* Michigan Department of Commerce, Energy Administration. "A 44-Sector Input-Output model of the Michigan Economy", Energy Issue Analysis Series, Lansing, Michigan, March 1980.

* Pratt, James E., Dennis K. Smith, and M. C. Conner. "Input-Output Analysis: An Introductory Self-Learning Package", Agricultural Economics Staff Paper No. SP-76-14, Blacksburg, Virginia: Virginia Polytechnic Institute and State University, 1976.

* Pratt, James E. and Stanley R. Thompson. "Integrating a Regional Economic Model with Commodity Flow Data for Transportation Analysis", Agricultural Economics Staff Paper No. 79-90, East Lansing, Michigan: Michigan State University, 1979.

* Richardson, Harry W. Input-Output and Regional Economics, New York: John Wiley and Sons, 1972.

* Schaffer, W. A. and K. Chu. "Non-Survey Techniques for Constructing Regional Interindustry Models", Papers of the Regional Science Association, Vol. 23, pp. 83-99, 1969.

* Scheppach, Raymond C. State Projections of the Gross National Product, 1970, 1980, Massachusetts: Lexington Books, D. C. Heath and Company, 1972.

*Survey Research Center, the University of Michigan. "1982 Forecast Issue", Economic Outlook, U.S.A., Vol. 9, No. 1, Winter 1982.

APPENDIX B

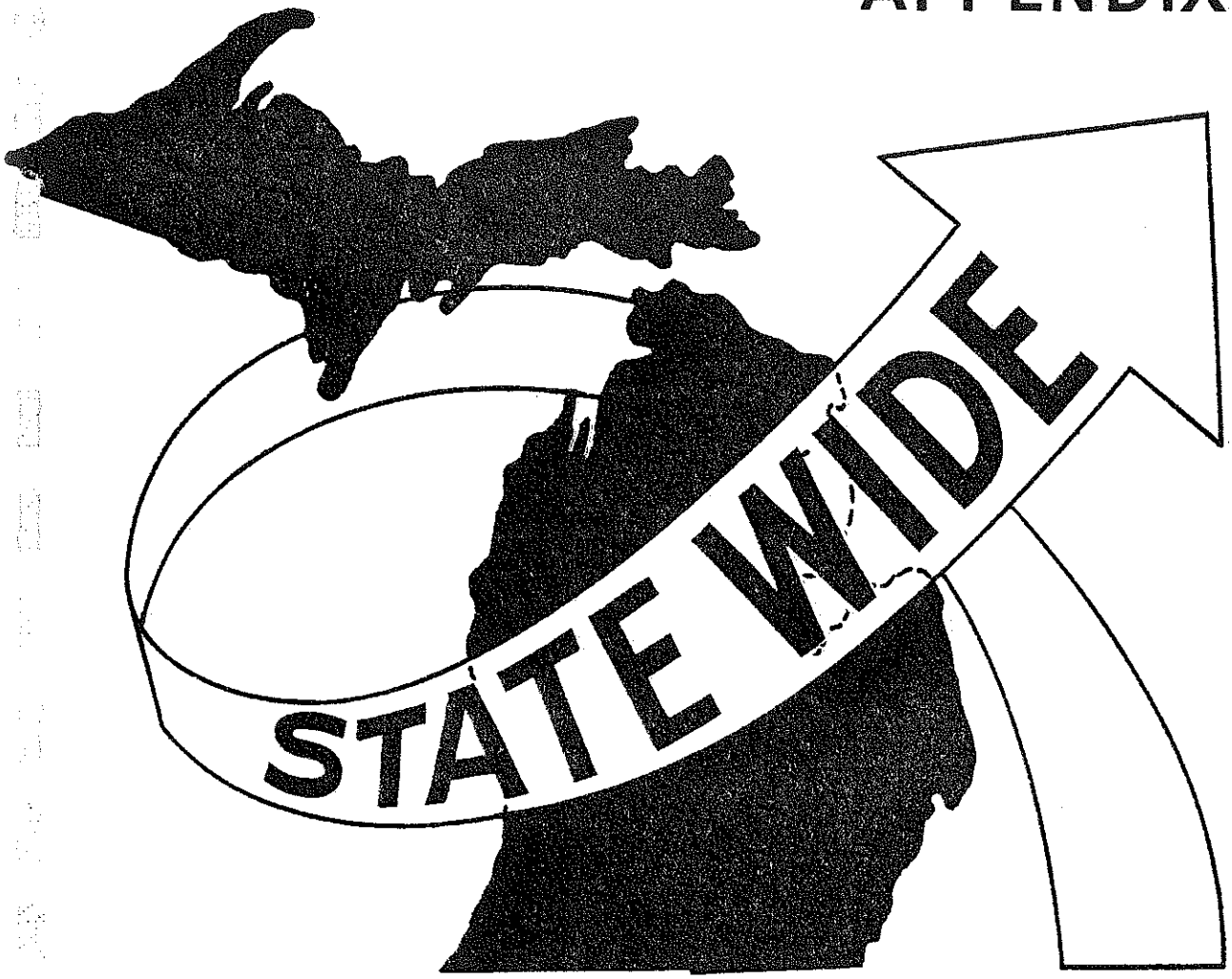

Table B-1

20-Sector

• TRANSACTIONS MATRIX

ROW/COL	1 LIVESTOCK & PRODS.	2 OTHER AG PRODUCTS	3 MINING	4 CONSTRUCT	5 FOOD & KIN PRODUCTS	6 LUMB FURN PAP PRINT	7 CHEM DRUGS PLASTICS	8 PETROLEUM REFINERY	9 RUB LEA ST GLASS CLAY	10 PRIMARY & FAB METALS
1	67450.	18059.	0.	0.	531158.	0.	429.	0.	401.	0.
2	108562.	36014.	0.	8230.	215160.	23659.	3488.	0.	0.	0.
3	28.	2045.	107843.	37500.	773.	4490.	29704.	98534.	50796.	358976.
4	4184.	7000.	33557.	1807.	15250.	22694.	20440.	16563.	15284.	120552.
5	66352.	932.	0.	0.	303719.	9078.	21850.	582.	9442.	735.
6	521.	3915.	8329.	245605.	126751.	905662.	70184.	6216.	73511.	261791.
7	1974.	39213.	33949.	69384.	33664.	99824.	556754.	23044.	170469.	193937.
8	1227.	6896.	6757.	41695.	3096.	6328.	41841.	24923.	3551.	16540.
9	744.	2837.	36395.	395536.	88573.	50606.	46492.	3796.	188386.	121822.
10	1289.	2039.	46626.	765518.	111688.	106630.	81291.	5045.	44958.	2753885.
11	274.	6903.	59360.	117219.	11073.	21195.	24026.	3363.	25851.	478318.
12	151.	475.	4234.	71684.	108.	1971.	1083.	207.	2537.	92046.
13	146.	169.	1246.	206.	116.	514.	1081.	111.	2086.	384083.
14	1.	145.	189.	15.	0.	424.	45.	0.	1178.	28392.
15	8832.	7036.	24514.	87247.	84391.	67971.	40919.	42729.	47393.	218810.
16	1861.	4739.	47880.	3795.	30855.	43145.	52728.	17791.	45792.	262853.
17	20412.	26107.	23690.	355987.	120308.	128587.	63558.	9098.	94704.	449691.
18	9476.	31905.	99728.	45473.	31722.	59157.	54108.	21706.	30413.	141541.
19	8104.	29754.	55286.	291098.	145093.	115706.	222607.	31061.	72009.	87210.
20	61.	66.	927.	2412.	2475.	9211.	3088.	408.	2059.	8454.
21	144931.	330892.	207600.	1625300.	633300.	1099200.	520100.	36100.	567800.	3379700.
22	165785.	116477.	417027.	717989.	1153026.	550144.	414284.	464522.	367579.	1964567.
23	58816.	19538.	492300.	921500.	1070100.	1251200.	1338500.	106700.	706900.	3095400.
24	671181.	693156.	1707437.	5805200.	4712399.	4577396.	3608600.	912499.	2523099.	14419303.

20-Sector

TRANSACTIONS MATRIX

ROW/COL	11 MACHINERY	12 ELECTRICAL EQUIP.	13 MOTOR VEH AND PARTS	14 ACFT,OTH TRANS EQP	15 TRANS. & COMM	16 UTILITIES	17 WHOLE,RET. MISC. MANF	18 F.I.R.E.	19 SELECTED SERVICES	20 GOVT ENTERPRISE
1	0.	0.	0.	0.	181.	0.	2699.	34043.	2991.	0.
2	0.	0.	0.	0.	4578.	0.	21878.	49309.	11593.	132.
3	0.	142.	0.	0.	2313.	80964.	609.	5943.	0.	178.
4	22115.	5331.	100911.	2591.	163077.	137207.	60108.	511778.	116953.	125697.
5	326.	0.	0.	0.	19469.	62.	45387.	6863.	22407.	0.
6	29600.	25639.	149107.	14726.	15539.	4401.	218199.	47901.	600948.	3710.
7	13791.	16965.	163191.	2261.	7795.	4301.	136760.	24657.	114346.	8107.
8	9052.	1154.	22258.	922.	52786.	13471.	42487.	17734.	19321.	2872.
9	87195.	35466.	837908.	7731.	18614.	1762.	87874.	10345.	83559.	1991.
10	941614.	145897.	5348975.	90196.	120530.	6998.	97604.	14646.	67122.	1159.
11	993683.	36945.	1713336.	53795.	20226.	3741.	53539.	32208.	104679.	2049.
12	159220.	131058.	463869.	14537.	18043.	4074.	32963.	9817.	37262.	663.
13	65365.	7441.	9773407.	7876.	5346.	272.	9214.	9110.	102709.	881.
14	24943.	3008.	13757.	42116.	15466.	0.	7276.	2065.	650.	67.
15	47731.	12395.	368084.	6709.	239161.	43114.	173209.	81200.	167233.	43084.
16	33844.	9284.	155278.	3734.	65305.	769971.	218780.	49800.	175554.	70477.
17	177521.	43045.	922993.	23269.	104056.	18247.	543400.	105766.	341303.	7491.
18	76018.	18678.	164848.	8042.	129784.	28459.	623667.	714756.	399654.	23141.
19	144679.	47566.	1109533.	19945.	360683.	46719.	1043373.	488154.	784424.	39180.
20	3955.	1198.	25185.	552.	71472.	269075.	144531.	84581.	63948.	1000.
21	2038800.	413900.	5382800.	195900.	1899327.	645309.	7585348.	1815491.	6613108.	582092.
22	865348.	310589.	3911059.	188401.	2081113.	552092.	1502391.	629369.	844696.	104281.
23	2119800.	442400.	6409800.	153100.	1779289.	1519980.	5268352.	5634509.	1336892.	52348.
24	7854600.	1708101.	37036299.	836403.	7194153.	4150219.	17919648.	10380045.	12011352.	1070600.

20-Sector

TRANSACTIONS MATRIX

ROW/COL	21 PER CONSUM EXPEN.	22 INVESTMENT INVENTORY	23 NET EXPORT FED,ST,LOC	
1	13336.	291.	139.	671177.
2	278690.	515.	-68650.	693158.
3	34562.	453298.	438628.	1707326.
4	0.	2632790.	1669311.	5805200.
5	3319191.	97000.	919731.	4843126.
6	1392473.	194500.	524855.	4924083.
7	2092485.	301400.	1022973.	5131244.
8	516658.	-4200.	55722.	903091.
9	547837.	71100.	56307.	2782876.
10	137619.	490800.	2947761.	14329890.
11	87931.	276800.	2544573.	6671087.
12	269394.	67500.	190296.	1573192.
13	1527419.	1747800.	25404421.	39051019.
14	69785.	16600.	409953.	636075.
15	1870518.	239663.	3272213.	7194156.
16	1732216.	0.	354534.	4150216.
17	13398758.	534419.	252475.	17764885.
18	7433163.	128915.	105688.	10380042.
19	5723002.	-191.	1146357.	12011362.
20	312435.	0.	63503.	1070596.
21	523462.	0.	4933470.	41173930.
22	21522338.	1158637.	1992024.	41993738.
23	559311.	211122.	8620566.	43168423.
24	63362583.	8618759.	56856850.	0.

Table B-2

20-Sector

COEFFICIENT MATRIX

ROW/COL	1 LIVESTOCK & PRODS.	2 OTHER AG PRODUCTS	3 MINING	4 CONSTRUCT	5 FOOD & KIN PRODUCTS	6 LUMB FURN PAP PRINT	7 CHEM DRUGS PLASTICS	8 PETROLEUM REFINERY	9 RUB LEA ST GLASS CLAY	10 PRIMARY & FAB METALS
1	0.10019450	0.02605330	0.00000000	0.00000000	0.11271499	0.00000000	0.00011888	0.00000000	0.00015893	0.00000000
2	0.16174773	0.05195656	0.00000000	0.00141769	0.04565827	0.00516866	0.00096658	0.00000000	0.00000000	0.00000000
3	0.00004172	0.00295027	0.06316075	0.00645973	0.00016404	0.00098091	0.00823145	0.10798258	0.02013238	0.02489552
4	0.00623379	0.01009874	0.01965343	0.00031127	0.00323614	0.00495784	0.00566425	0.01815125	0.00605763	0.00836046
5	0.09865858	0.00134457	0.00000000	0.00000000	0.06445104	0.00198322	0.00605498	0.00063781	0.00374222	0.00005097
6	0.00077624	0.00564808	0.00487807	0.04230776	0.02689734	0.19785529	0.01944909	0.00681206	0.02913520	0.01815559
7	0.00294108	0.05657168	0.01988302	0.01195204	0.00714371	0.02180803	0.15428532	0.02525373	0.06756334	0.01344982
8	0.00182812	0.00994870	0.00395739	0.00718235	0.00065699	0.00138245	0.01159480	0.02731291	0.00140740	0.00114707
9	0.00110849	0.00409287	0.02131557	0.06813478	0.01879573	0.01105563	0.01288367	0.00416000	0.07466453	0.00844854
10	0.00192050	0.00294162	0.02730760	0.13186764	0.02370088	0.02329490	0.02252702	0.00552877	0.01781856	0.19098600
11	0.00010824	0.00995880	0.03476556	0.02019207	0.00234976	0.00463036	0.00665798	0.00368548	0.01024573	0.03317206
12	0.00022498	0.00068527	0.00247974	0.01234824	0.00002292	0.00043059	0.00030012	0.00022685	0.00100551	0.00638353
13	0.00021753	0.00024381	0.00072975	0.00003549	0.00002462	0.00011229	0.00029956	0.00012164	0.00082676	0.02663672
14	0.00000149	0.00020919	0.00011069	0.00000258	0.00000000	0.00009263	0.00001247	0.00000000	0.00046689	0.00196903
15	0.01315889	0.01015067	0.01435719	0.01502911	0.01790829	0.01484927	0.01133930	0.04682635	0.01878365	0.01517480
16	0.00277272	0.00683684	0.02804203	0.00065372	0.00654762	0.00942566	0.01461176	0.01949701	0.01814911	0.01822924
17	0.03011206	0.03766396	0.01387460	0.06132209	0.02553010	0.02809174	0.01761292	0.00997042	0.03753479	0.03118674
18	0.01411840	0.04602860	0.05840801	0.00783315	0.00673160	0.01292372	0.01499418	0.02378742	0.01205383	0.00981608
19	0.01207424	0.04292540	0.03237953	0.05014435	0.03078963	0.02527769	0.06168791	0.03403949	0.02853990	0.00604814
20	0.00009088	0.00009522	0.00054292	0.00041549	0.00052521	0.00201228	0.00085573	0.00044712	0.00081606	0.00058630
21	0.21593430	0.47737017	0.12158575	0.27997313	0.13439015	0.24013653	0.14412792	0.03956169	0.22504071	0.23438720
22	0.24700491	0.16803865	0.24424152	0.12368032	0.24467920	0.12018711	0.11480463	0.50906576	0.14568552	0.13624563
23	0.08763061	0.02818702	0.28832689	0.15873699	0.22708179	0.27334318	0.37091947	0.11693163	0.28017133	0.21467057
24	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000

20-Sector

COEFFICIENT MATRIX

ROW/COL	11 MACHINERY	12 ELECTRICAL EQUIP.	13 MOTOR VEH AND PARTS	14 ACFT,OTH TRANS EQP	15 TRANS. & COMM	16 UTILITIES	17 WHOLE,RET. MISC. MANF	18 F.I.R.E.	19 SELECTED SERVICES	20 GOVT ENTERPRISE
1	0.00000000	0.00000000	0.00000000	0.00000000	0.00002516	0.00000000	0.00015062	0.00327966	0.00024901	0.00000000
2	0.00000000	0.00000000	0.00000000	0.00000000	0.00063635	0.00000000	0.00122089	0.00475036	0.00096517	0.00012330
3	0.00000000	0.00008313	0.00000000	0.00000000	0.00032151	0.01950837	0.00003399	0.00057254	0.00000000	0.00016626
4	0.00281555	0.00312101	0.00272465	0.00309779	0.02266799	0.03306018	0.00335431	0.04930403	0.00973687	0.11740800
5	0.00004150	0.00000000	0.00000000	0.00000000	0.00270623	0.00001494	0.00253281	0.00066117	0.00186549	0.00000000
6	0.00376849	0.01501024	0.00402597	0.01760635	0.00215995	0.00106043	0.01217652	0.00461472	0.05003167	0.00346535
7	0.00175579	0.00993208	0.00440624	0.00270324	0.00108352	0.00103633	0.00763185	0.00237542	0.00951983	0.00757239
8	0.00115245	0.00067560	0.00060098	0.00110234	0.00733735	0.00324585	0.00237097	0.00170847	0.00160856	0.00268261
9	0.01110114	0.02076341	0.02262397	0.00924315	0.00258738	0.00042456	0.00490378	0.00099662	0.00695667	0.00185970
10	0.11988058	0.08541474	0.14442520	0.10783797	0.01675388	0.00168618	0.00544676	0.00141098	0.00558821	0.00108257
11	0.12650969	0.02162928	0.04626099	0.06431708	0.00281145	0.00090140	0.00298773	0.00310288	0.00871501	0.00191388
12	0.02027092	0.07672731	0.01252471	0.01738038	0.00250801	0.00098163	0.00183949	0.00094576	0.00310223	0.00061928
13	0.00832188	0.00435630	0.26388725	0.00941651	0.00074310	0.00006554	0.00051418	0.00087765	0.00855099	0.00082290
14	0.00317559	0.00176102	0.00037145	0.05035372	0.00214980	0.00000000	0.00040603	0.00019894	0.00005412	0.00006258
15	0.00607682	0.00725660	0.00993847	0.00802125	0.03324380	0.01038837	0.00966587	0.00782270	0.01392291	0.01024285
16	0.00130881	0.00543528	0.00419259	0.00446436	0.00907751	0.18552539	0.01220895	0.00479767	0.01461567	0.06582944
17	0.02260090	0.02520050	0.02492131	0.02782032	0.01446397	0.00439664	0.03032426	0.01018936	0.02841504	0.00699701
18	0.00967815	0.01093495	0.00445098	0.00961498	0.01804021	0.00685723	0.03480353	0.06885866	0.03327302	0.02161498
19	0.01841965	0.02784730	0.02995799	0.02384616	0.05013558	0.01125700	0.05822508	0.04702812	0.06530689	0.03659630
20	0.00050353	0.00070136	0.00068001	0.00065997	0.00993473	0.06483393	0.00806550	0.00814842	0.00532396	0.00093106
21	0.25956764	0.24231588	0.14533850	0.23421724	0.26400981	0.15548794	0.42329782	0.17490204	0.55057149	0.54370633
22	0.11017086	0.18183292	0.10560070	0.22525146	0.28927839	0.13302720	0.08384043	0.06063259	0.07032481	0.09740126
23	0.26988007	0.25900108	0.17306805	0.18304573	0.24732432	0.36624091	0.29399863	0.54282125	0.11130237	0.04889595
24	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000

20-Sector

COEFFICIENT MATRIX

ROW/COL	21 PER CONSUM EXPEN.	22 INVESTMENT INVENTORY	23 NET EXPORT FED,ST,LOC
1	0.00021047	0.00003376	0.00000244
2	0.00439834	0.00005975	-0.00120742
3	0.00054546	0.05259435	0.00771460
4	0.00000000	0.30547205	0.02935989
5	0.05238409	0.01125452	0.01617626
6	0.02197627	0.02256705	0.00923117
7	0.03302399	0.03497023	0.01799208
8	0.00815399	-0.00048731	0.00098004
9	0.00864606	0.00824945	0.00099033
10	0.00217193	0.05694555	0.05184531
11	0.00138774	0.03211599	0.04475403
12	0.00125163	0.00783175	0.00334693
13	0.02410601	0.20279022	0.44681373
14	0.00110136	0.00192603	0.00721027
15	0.02952086	0.02780714	0.05755178
16	0.02733815	0.00000000	0.00623555
17	0.21146168	0.06200649	0.00444054
18	0.11731155	0.01495749	0.00185884
19	0.09032148	-0.00002216	0.02016216
20	0.00493091	0.00000000	0.00111689
21	0.00826137	0.00000000	0.08677002
22	0.33966952	0.13443200	0.03503578
23	0.00882715	0.02449564	0.15161878
24	1.00000000	1.00000000	1.00000000

Table B-3

20-Sector

LEONTIEF MATRIX

ROW/COL	1 LIVESTOCK & PRODS.	2 OTHER AG PRODUCTS	3 MINING	4 CONSTRUCT	5 FOOD & KIN PRODUCTS	6 LUMB FURN PAP PRINT	7 CHEM DRUGS PLASTICS	8 PETROLEUM REFINERY	9 RUB LEA ST GLASS CLAY	10 PRIMARY & FAB METALS
1	0.89950550	-0.02605330	0.00000000	0.00000000	-0.11271499	0.00000000	-0.00011888	0.00000000	-0.00015893	0.00000000
2	-0.16174773	0.94804344	0.00000000	-0.00141769	-0.04565827	-0.00516866	-0.00096658	0.00000000	0.00000000	0.00000000
3	-0.00004172	-0.00295027	0.93683925	-0.00645973	-0.00016404	-0.00098091	-0.00823145	-0.10798258	-0.02013238	-0.02489552
4	-0.00623379	-0.01009874	-0.01965343	0.99968873	-0.00323614	-0.00495784	-0.00566425	-0.01815125	-0.00605763	-0.00836046
5	-0.09385858	-0.00134457	0.00000000	0.00000000	0.93554896	-0.00198322	-0.00605498	-0.00063781	-0.00374222	-0.00095097
6	-0.00077624	-0.00564808	-0.00487807	-0.04230776	-0.02689734	0.80214471	-0.01944909	-0.00681206	-0.02913520	-0.01815559
7	-0.00294108	-0.05657168	-0.01988302	-0.01195204	-0.00714371	-0.02180803	0.84571468	-0.02525373	-0.06756334	-0.01344982
8	-0.00182812	-0.00994870	-0.00395739	-0.00718235	-0.00065699	-0.00138245	-0.01159480	0.97268709	-0.00140740	-0.00114707
9	-0.00110849	-0.00409287	-0.02131557	-0.06813478	-0.01879573	-0.01105563	-0.01288367	-0.00416000	0.92533547	-0.00844854
10	-0.00192050	-0.00294162	-0.02730760	-0.13186764	-0.02370088	-0.02329490	-0.02252702	-0.00552877	-0.01781856	0.80901400
11	-0.00040824	-0.00995880	-0.03476556	-0.02019207	-0.00234976	-0.00463036	-0.00665798	-0.00368548	-0.01024573	-0.03317206
12	-0.00022498	-0.00068527	-0.00247974	-0.01234824	-0.00002292	-0.00043059	-0.00030012	-0.00022685	-0.00100551	-0.00638353
13	-0.00021753	-0.00024381	-0.00072975	-0.00003549	-0.00002462	-0.00011229	-0.00029956	-0.00012164	-0.00082676	-0.02663672
14	-0.00000149	-0.00020919	-0.00011069	-0.00000258	0.00000000	-0.00009263	-0.00001247	0.00000000	-0.00046689	-0.00196903
15	-0.01315889	-0.01015067	-0.01435719	-0.01502911	-0.01790829	-0.01484927	-0.01133930	-0.04682635	-0.01878365	-0.01517480
16	-0.00277272	-0.00683684	-0.02804203	-0.00065372	-0.00654762	-0.00942566	-0.01461176	-0.01949701	-0.01814911	-0.01822924
17	-0.03041206	-0.03766396	-0.01387460	-0.06132209	-0.02553010	-0.02809174	-0.01761292	-0.00997042	-0.03753479	-0.03118674
18	-0.01111840	-0.01602860	-0.05840801	-0.00783315	-0.00673160	-0.01292372	-0.01499118	-0.02378742	-0.01205383	-0.00981608
19	-0.01207424	-0.04292540	-0.03237953	-0.05014435	-0.03078963	-0.02527769	-0.06168791	-0.03403949	-0.02853990	-0.00604814
20	-0.00009088	-0.00009522	-0.00054292	-0.00041549	-0.00052521	-0.00201228	-0.00085573	-0.00044712	-0.00081606	-0.00058630

20-Sector

LEONTIEF MATRIX

ROW/COL	11 MACHINERY	12 ELECTRICAL EQUIP.	13 MOTOR VEH AND PARTS	14 ACFT,OTH TRANS EQP	15 TRANS. & COMM	16 UTILITIES	17 WHOLE,RET. MISC. MANF	18 F.I.R.E.	19 SELECTED SERVICES	20 GOVT ENTERPRISE
1	0.00000000	0.00000000	0.00000000	0.00000000	-0.00002516	0.00000000	-0.00015062	-0.00327966	-0.00024901	0.00000000
2	0.00000000	0.00000000	0.00000000	0.00000000	-0.00063635	0.00000000	-0.00122089	-0.00475036	-0.00096517	-0.00012330
3	0.00000000	-0.00008313	0.00000000	0.00000000	-0.00032151	-0.01950837	-0.00003399	-0.00057254	0.00000000	-0.00016626
4	-0.00281555	-0.00312101	-0.00272465	-0.00309779	-0.02266799	-0.03306018	-0.00335431	-0.04930403	-0.00973687	-0.11740800
5	-0.00004150	0.00000000	0.00000000	0.00000000	-0.00270623	-0.00001494	-0.00253281	-0.00066117	-0.00186549	0.00000000
6	-0.00376849	-0.01501024	-0.00402597	-0.01760635	-0.00215995	-0.00106043	-0.01217652	-0.00461472	-0.05003167	-0.00346535
7	-0.00175579	-0.00993208	-0.00440624	-0.00270324	-0.00108352	-0.00103633	-0.00763185	-0.00237542	-0.00951983	-0.00757239
8	-0.00115245	-0.00067560	-0.00060098	-0.00110234	-0.00733735	-0.00324585	-0.00237097	-0.00170847	-0.00160856	-0.00268261
9	-0.01110114	-0.02076341	-0.02262397	-0.00924315	-0.00258738	-0.00042456	-0.00490378	-0.00099662	-0.00695667	-0.00185970
10	-0.11988058	-0.08541474	-0.14442520	-0.10783797	-0.01675388	-0.00168618	-0.00544676	-0.00141098	-0.00558821	-0.00108257
11	0.87349031	-0.02162928	-0.04626099	-0.06431708	-0.00281145	-0.00090140	-0.00298773	-0.00310288	-0.00871501	-0.00191388
12	-0.02027092	0.92327269	-0.01252471	-0.01738038	-0.00250801	-0.00098163	-0.00183949	-0.00094576	-0.00310223	-0.00061928
13	-0.00832188	-0.00435630	0.73611275	-0.00941651	-0.00074310	-0.00006554	-0.00051418	-0.00087765	-0.00855099	-0.00082290
14	-0.00317559	-0.00176102	-0.00037145	0.94964628	-0.00214980	0.00000000	-0.00040603	-0.00019894	-0.00005412	-0.00006258
15	-0.00607682	-0.00725660	-0.00993847	-0.00802125	0.96675620	-0.01038837	-0.00966587	-0.00782270	-0.01392291	-0.04024285
16	-0.00436881	-0.00543528	-0.00419259	-0.00446436	-0.00907751	0.81447461	-0.01220895	-0.00479767	-0.01461567	-0.06582944
17	-0.02260090	-0.02520050	-0.02492131	-0.02782032	-0.01446397	-0.00439664	0.96967574	-0.01018936	-0.02841504	-0.00699701
18	-0.00967815	-0.01093495	-0.00445098	-0.00961498	-0.01804021	-0.00685723	-0.03480353	0.93114134	-0.03327302	-0.02161498
19	-0.01841965	-0.02784730	-0.02995799	-0.02384616	-0.05013558	-0.01125700	-0.05822508	-0.04702812	0.93469311	-0.03659630
20	-0.00050353	-0.00070136	-0.00068001	-0.00065997	-0.00993473	-0.06183393	-0.00806550	-0.00814842	-0.00532396	0.99906594

Table B-4

20-Sector
INVERSE MATRIX

ROW/COL	1 LIVESTOCK & PRODS.	2 OTHER AG PRODUCTS	3 MINING	4 CONSTRUCT	5 FOOD & KIN PRODUCTS	6 LUMB FURN PAP PRINT	7 CHEM DRUGS PLASTICS	8 PETROLEUM REFINERY	9 RUB LEA ST GLASS CLAY	10 PRIMARY & FAB METALS
1	1.13273844	0.03171879	0.00040322	0.00033732	0.13817490	0.00074747	0.00140329	0.00036580	0.00102821	0.00019534
2	0.19944936	1.06112956	0.00072885	0.00230990	0.07629053	0.00741021	0.00235485	0.00061705	0.00106032	0.00050685
3	0.00229381	0.00648962	1.07152871	0.01503636	0.00294965	0.00401308	0.01442494	0.12080270	0.02629579	0.03526087
4	0.01317304	0.01694859	0.02885985	1.00674361	0.00912656	0.01061088	0.01214822	0.02704678	0.01222668	0.01557565
5	0.12047448	0.00579399	0.00068640	0.00114141	1.08423861	0.00334541	0.00834784	0.00141220	0.00547532	0.00065573
6	0.01175515	0.01650720	0.01558915	0.06732613	0.04395611	1.25367720	0.03793432	0.01694893	0.04774875	0.03397629
7	0.02081888	0.07473260	0.03072762	0.02790105	0.01993724	0.03638668	1.18835848	0.03681951	0.09082141	0.02479830
8	0.00510590	0.01254632	0.00572696	0.00891585	0.00272770	0.00294993	0.01500966	1.03004637	0.00356214	0.00272070
9	0.00705966	0.00882153	0.02942492	0.07941871	0.02533135	0.01775688	0.02005872	0.01131840	1.08561236	0.01685901
10	0.01260634	0.01408293	0.05247813	0.17910717	0.03927680	0.04286018	0.04156006	0.02152981	0.03582644	1.26087100
11	0.00519639	0.01541140	0.04737640	0.03427717	0.00736573	0.01024489	0.01344713	0.01224782	0.01759043	0.05378833
12	0.00118786	0.00199338	0.00518904	0.01625071	0.00113850	0.00168034	0.00173030	0.00187038	0.00256371	0.01123178
13	0.00148287	0.00198935	0.00131253	0.00808788	0.00233970	0.00251666	0.00329719	0.00200221	0.00348316	0.04675874
14	0.00017908	0.00040174	0.00049767	0.00066894	0.00022967	0.00033884	0.00023441	0.00025717	0.00077148	0.00293116
15	0.02254404	0.01648040	0.02128006	0.02474414	0.02677536	0.02298433	0.01926324	0.05532443	0.02641723	0.02427851
16	0.00973669	0.01439708	0.04228703	0.01207671	0.01456335	0.01912414	0.02691627	0.03297709	0.03078111	0.03319959
17	0.05078442	0.04961190	0.02528511	0.07959686	0.04282335	0.04256864	0.03002120	0.01978052	0.05045635	0.04845057
18	0.03286972	0.06038003	0.07347579	0.02082099	0.01992107	0.02349833	0.02704514	0.03959730	0.02323380	0.02118863
19	0.03713335	0.06438661	0.05097411	0.07128215	0.05087645	0.04122965	0.08761052	0.05371806	0.04942429	0.02234433
20	0.00198564	0.00258104	0.00477151	0.00301784	0.00274270	0.00485527	0.00403788	0.00409438	0.00423976	0.00401833
21	1.68857513	1.47640405	1.51160305	1.65906090	1.61078533	1.55179904	1.55520363	1.48877691	1.51861874	1.65960971

20-Sector

INVERSE MATRIX

ROW/COL	11 MACHINERY	12 ELECTRICAL EQUIP.	13 MOTOR VEH AND PARTS	14 ACFT,OTH TRANS EQP	15 TRANS. & COMM	16 UTILITIES	17 WHOLE,RET. MISC. MANF	18 F.I.R.E.	19 SELECTED SERVICES	20 GOVT ENTERPRISE
1	0.00015335	0.00018045	0.00019535	0.00016292	0.00060066	0.00010994	0.00082395	0.00433870	0.00087283	0.00022359
2	0.00032830	0.00044448	0.00043847	0.00044674	0.00128163	0.00030138	0.00207901	0.00648793	0.00208864	0.00075447
3	0.00590491	0.00481251	0.00878659	0.00541126	0.00286050	0.02733242	0.00153544	0.00221062	0.00191899	0.00154787
4	0.00766463	0.00770198	0.01001200	0.00799607	0.02805164	0.05280341	0.00897575	0.05618034	0.01586672	0.12505524
5	0.00045390	0.00056649	0.00068817	0.00047722	0.00335523	0.00026280	0.00326928	0.00154364	0.00274903	0.00053581
6	0.01432399	0.02879250	0.02080240	0.03232279	0.01012934	0.00768598	0.02211723	0.01437083	0.07086115	0.01676426
7	0.00869138	0.01912827	0.01721100	0.00991454	0.00460227	0.00524097	0.01227861	0.00660271	0.01649368	0.01412837
8	0.00217716	0.00169575	0.00217577	0.00215693	0.00848272	0.00521032	0.00322912	0.00283483	0.00271920	0.00482535
9	0.01818902	0.02813685	0.03973042	0.01595644	0.00651780	0.00605597	0.00766985	0.00665849	0.01160719	0.01299272
10	0.18160444	0.12645699	0.26507581	0.16361291	0.02985916	0.01469984	0.01229399	0.01463135	0.01879168	0.02693036
11	1.15515802	0.03419212	0.08551952	0.08701896	0.00673438	0.00505091	0.00580372	0.00705341	0.01387138	0.00791476
12	0.02737490	1.08539537	0.02293771	0.02361224	0.00396581	0.00257330	0.00281511	0.00248009	0.00473164	0.00327337
13	0.02031742	0.01202435	1.37001937	0.02107500	0.00306226	0.00119258	0.00218262	0.00269046	0.01357617	0.00299655
14	0.00136009	0.00246481	0.00151714	1.05377600	0.00246731	0.00011902	0.00054586	0.00033240	0.00024455	0.00029134
15	0.01278651	0.01339855	0.02249500	0.01488298	1.03828175	0.01936319	0.01370801	0.01228799	0.01946197	0.01758858
16	0.01306009	0.01366206	0.01785100	0.01314464	0.01561553	1.23709158	0.01924763	0.00980577	0.02328240	0.08527121
17	0.03741849	0.03805484	0.05195105	0.04267608	0.02179709	0.01244857	1.03682692	0.01906272	0.03805254	0.02084587
18	0.01841082	0.01938105	0.01696498	0.01860899	0.02505797	0.01557214	0.04318020	1.07915927	0.04313851	0.03025379
19	0.03195441	0.04219456	0.05765916	0.03844135	0.06244532	0.02570918	0.07101132	0.06168658	1.08161250	0.05526973
20	0.00238071	0.00267749	0.00349431	0.00266324	0.01212721	0.08091566	0.01056962	0.01012645	0.00833498	1.00778917
21	1.56271254	1.48136147	2.01542521	1.55435728	1.28729558	1.51979914	1.28016325	1.32054459	1.39027575	1.46825240