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AN INPUT-OUTPUT ANALYSIS OF THE ECONOMIC IMPACT OF OHIO'S LAKE ERIE FISHERY AND OTHER RESOURCES ON A NORTHERN OHIO REGIONAL ECONOMY

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Introduction

The general objective of this study is to examine the economic impact of the Lake Erie fishery and other Lake Erie industries on the Northern Ohio regional economy. This objective is accomplished by developing an input-output (I/O) model of the Northern Ohio regional economy for 1978. The year 1978 was the most recent for which all data were available when the study was undertaken. The model is then used to analyze interindustry linkages within the regional economy, to examine the economic impact of Lake Erie industries and the Lake Erie sport fishery, and to examine the allocation of the Lake Erie fishery between sport anglers and commercial fishermen.

Lake Erie is the fourth largest of the five Great Lakes, covering 9,940 square miles of surface, 3,277 of which are managed by Ohio. The Lake offers a tremendous diversity of uses and resources. However, the diversity of the set of resources of Lake Erie result in competing uses of the Lake's resources.

Competing uses of the Lake's resources result because of the great numbers of users desiring to exploit a specific resource, and also due to the use of one resource interfering with the use of another. For example, since the mid-1970s, sport fishing effort has increased markedly on Lake Erie,[1/] while there has been a relative decline in commercial fishing effort and value of catch. Reasons for this change include changes in the population of various fish species, change in demand for sport fishing, and changes in management regulations by the Ohio Department of Natural Resources (ODNR). Sport and commercial fishing is a problem because of fishing in common waters and fishing for the same species. Sport anglers typically harvest yellow perch, walleye, white bass, freshwater drum, smallmouth bass, channel catfish, and salmonids while the commercial industry harvests yellow perch, white bass, shad, freshwater drum, carp and channel catfish.

Poor water quality has affected the utilization of Lake Erie beaches, especially near large cities and large industrial complexes. Beaches in these areas had to close during summer months in the mid-1970s because of undesirable water quality. The lake also serves as a vital transportation link in the St. Lawrence Seaway. Lake Erie harbors are a vital link in the state's transportation network. However, annual dredging of 6.7 million cubic yards of Lake-bottom materials to clear shipping and boating channels serving Lake Erie's ports and harbors affects water quality. In addition, construction along the shoreline can greatly increase sedimentation and erosion into the Lake.

The Study Region

The study region is composed of seventeen counties of Northern Ohio: Ashtabula, Cuyahoga, Erie, Geauga, Huron, Lake, Lorain, Lucas,

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1/ Lake Erie, unless stated otherwise, refers to Ohio waters of Lake Erie.

Mahoning, Medina, Ottawa, Seneca, Summit, Trumbull, Wood, Portage and Sandusky (Figure 1). There are three reasons for the selection of this region. First, these counties are those most directly impacted by the economic activities of Lake Erie. Sport fishing effort is largely concentrated in the western basin (Ottawa, Lucas, Sandusky and Erie Counties). In 1977, the largest percentage of Lake Erie sport angler hours at 54.1 and 14.9 percent originated from Ottawa and Erie counties, respectively. Commercial fishing activities, based on the number of licenses issued or license revenue are concentrated in Erie, Ottawa, Ashtabula, Lucas, and Lorain counties. Of the 116 commercial fishing licenses issued in 1979, 114 were allocated to the seventeen counties in this region, with Ottawa and Erie showing the largest numbers. Those industries most affected by water transportation or water availability are likely to be found in the counties adjacent to the lake.

Second, the counties in this region represent some of the most industrialized and populous counties in Ohio. Counties such as Cuyahoga, Summit, Lucas, and Lorain have ranked very highly in manufacturing employment. These four counties plus Mahoning are the core counties for the five standard metropolitan statistical areas (SMSAS) in Northern Ohio. Since the neighboring counties are integrated with the core counties through labor markets, impacts in the core counties can be felt more directly in the related SMSA than in other counties.

The third reason for the selection of this region is that these counties form a contiguous region. Wood and Seneca counties are included to form a contiguous region.

Commercial and Sport Fishing Industry

The commercial fishing industry in Ohio is a very small industry (Table 1). Since 1970, there has been little trend in annual harvest by the commercial industry.

Sport fishing on Lake Erie has increased substantially since 1975 (Table 2). Total estimated harvest of all species was 4.6 million pounds in 1975, 8.2 million pounds in 1977, and 9.2 million pounds in 1981. The increase in sport fishing activity has also been reflected in the numbers of licensed charter boats. When a charter boat license was first required in 1974, there were only 35 boats licensed. In 1981 there were 266 boats licensed.

The increase in sport fishing activity has come about in part due to favorable policies by the Ohio Department of Natural Resources (ODNR) to enhance sport fishing activity. In 1972 commercial fishermen were prohibited from harvesting walleye. In 1980, there was an increase in the minimum length limit for white bass from 9 to 11 inches, and the mesh size of gill nets was restricted to 2 7/8 inches stretch mesh. In 1982, the 1981 gill net maximum depth of 30 meshes was reduced to a maximum of 15, and the minimum size limit for yellow perch was increased from 8 to 8 1/2 inches. Under 1984 Ohio legislation, the walleye has

Figure 1. The Study Region

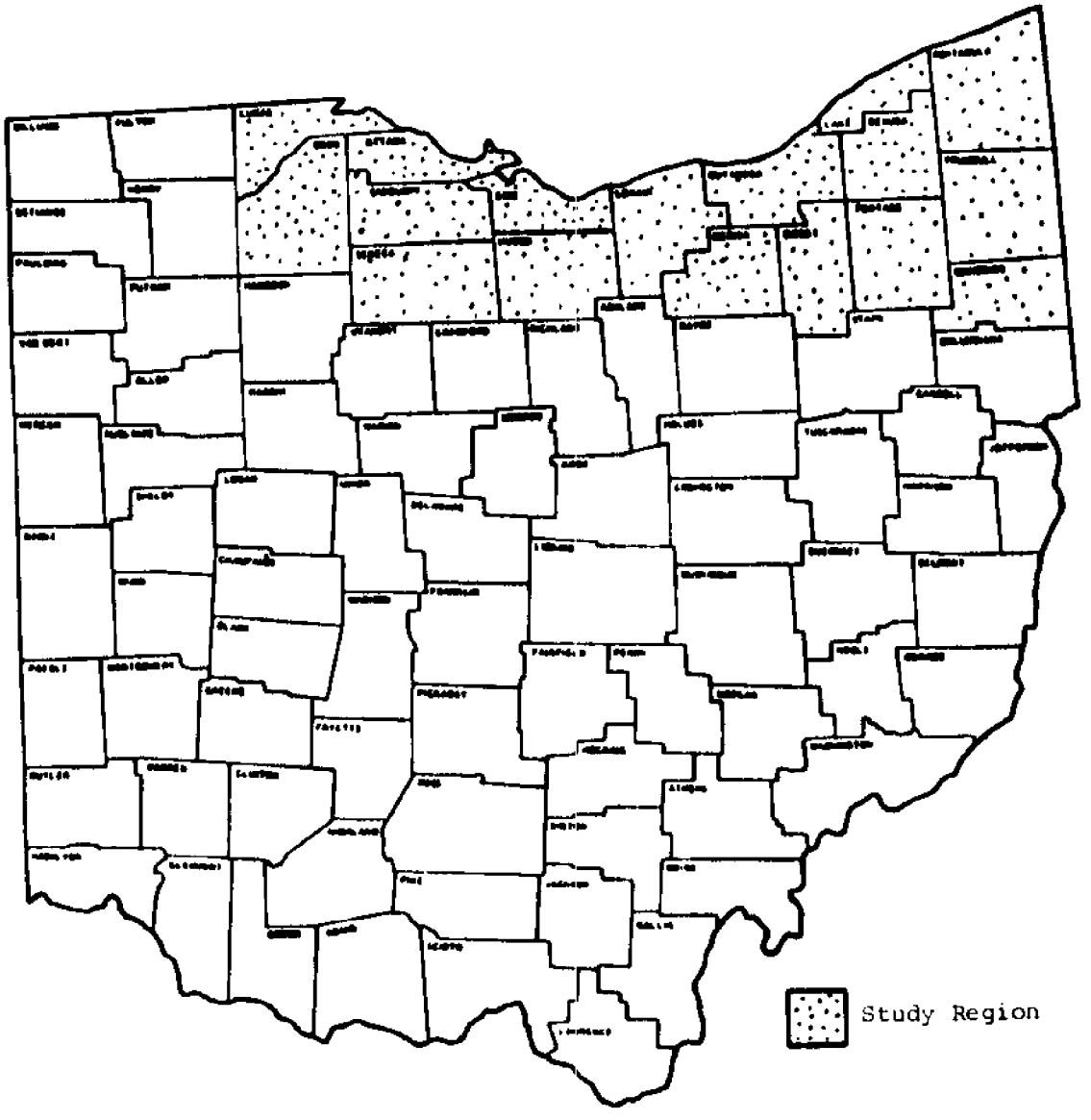

Table 1. Ohio Commercial Fish Production, Total and for Selected Species for Selected Years (Million Pounds and Thousand Dollars)

	1960		1970		1975		1980		1981	
	Lbs.	$	Lbs.	$	Lbs.	$	Lbs.	$	Lbs.	$
All Species	18.0	1,632	8.4	1,101	7.3	1,625	7.6	2,213	6.7	3,088
Freshwater Drum	5.0	149	1.0	52	.8	35	9.9	28	1.0	51
Yellow Perch	5.3	424	2.4	357	1.5	758	2.8	1,368	2.0	2,130
White Bass	1.9	255	1.1	273	1.7	486	1.6	552	1.0	568
Carp	3.2	97	3.0	152	2.8	184	1.4	106	2.0	138

Source: Commercial, 1980, 1981, GLFC, 1979, USFWS, 1975, 1970, 1960.

been made a game fish and gill net fishing rights are to be purchased by ODNR from current holders of these fishing rights.

These regulatory policies have the objective of increased welfare of the people of Ohio. The determination of the value of the alternative uses of Lake Erie and its resources and their impacts on the regional economy will provide information policy makers need to make better policy decisions.

Other Lake Erie Industries

There are many industries besides sport and commercial fishing on the Lake. In 1977, an estimated 26 percent (70,200) of the boats registered in Ohio used Lake Erie as the principal recreation location (Public, 1979). Sand and gravel from the bottom of the Lake are used for nourishing the beaches and to prevent erosion, and are also used as inputs for other regional industries. The Lake serves as a vital transportation link in the St. Lawrence Seaway. Ohio Lake Erie commercial ports handled 94 million tons of cargo and 317,600 passengers in 1978 (Table 3). In 1977, there were a total of forty-four water intakes in Lake Erie for municipalities and industries.

In the next section, the conceptual basis for the input-output model is presented. This is followed by the specification of the input-output model in the third section. A fourth section contains an overview of the 17 county study region. The economic analysis of Lake Erie (the economic impact of its resources, the economic impact of sport fishing and the allocation of Lake Erie to sport vs. commercial fishing) is presented in a fifth section. Finally, conclusions and implications of the study results are developed.

Table 2. Ohio Lake Erie Sport Fish Harvest, Total and for Selected Species, for Selected Years (No. Millions and Million Lbs.)

	1960		1975		1977		1978		1980		1981	
	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.
All Species	5.7		11.8	4.6	15.8	8.2	15.6	7.6	15.5	8.0	16.6	9.2
Freshwater Drum	0.2		1.0	1.3	0.4	0.6	0.7	0.8	0.4	0.4	0.4	0.6
Yellow Perch	5.2	1.3	8.1	1.8	11.0	2.3	11.4	2.5	11.8	3.0	11.3	2.1
Walleye	*		0.1	0.2	2.2	4.6	1.6	3.3	2.2	4.0	3.0	5.8
White Bass	0.2		2.0	1.1	1.5	0.6	1.5	0.7	0.7	0.4	1.5	0.6

* Less than 50,000

Sources: Lake Erie Fisheries Investigations, 1980; Ohio Department of Natural Resources, 1964; Status, 1979, 1981, 1982.

Table 3. Freight and Passenger Traffic Through Ohio Lake Erie Ports (million short tons and thousands of people) 1960-1978

	1960	1965	1970	1975	1978
			Freight		
Total	86.9	98.8	101.7	87.0	94.2
Ashtabula	10.2	11.1	11.9	8.7	12.8
Cleveland	17.8	22.0	22.9	18.1	19.7
Conneaut	7.2	8.8	15.5	19.2	17.4
Fairport	2.8	2.0	2.7	3.0	2.5
Huron	2.2	1.2	2.9	2.1	2.4
Lorain	7.0	6.5	8.8	7.7	8.2
Sandusky	5.7	2.2	5.1	4.5	3.6
Toledo	34.0	45.0	31.9	23.6	27.6
			Passenger		
Total	426.5	341.5	310.8	343.5	317.6
Ashtabula	—	—	--	--	--
Cleveland	154.3	37.8	15.2	140.2	127.8
Conneaut	—	—	--	--	--
Fairport	—	—	--	--	--
Huron	—	—	--	--	--
Lorain	—	—	--	--	--
Sandusky	246.9	297.1	280.0	187.2	179.0
Toledo	25.4	16.6	15.6	16.0	10.8

Source: USCE

The Input-Output Model

Economic activity is a complicated web of interdependent behavior. A change in any part of the economy will lead to changes in other sectors of the economy. Consequently, the measurement of the impact of a particular economic activity such as fishing requires a tracing out of changes that occur elsewhere in the economy as a result of this economic activity. To estimate the impact of the Lake Erie fishery and other Lake Erie industries on this region, it is necessary to know how these activities and the rest of the economy are related to each other.

One technique that is used to study these impacts is input-output (I/O) analysis. I/O analysis was pioneered by Wassily Leontief (1951), whose first book on I/O economics was "The Structure of the American Economy, 1914-1939." Most of the modern work in I/O analysis owes much to the "Tableau Economique" of Quesnay (1758) and the "Elements

d'economie politique pure" of Walras (1784). Recently, a large number of I/O tables have been published on national, regional, county and city economies.

I/O analysis is a method of arranging economic information at the sectoral level on the basis of the linkage between the microeconomics of the firm and the macroeconomics of the economy. All I/O models consist of three parts: an interindustry flow table, a technical coefficients matrix and an interdependence coefficients matrix. The flow table is the base of an I/O model, from which the technical and interdependence coefficients are derived. A mathematical specification of the I/O model is found in Appendix A.

The flow table describes the demand and supply relationships of an economy in equilibrium by showing final demand for goods and services and the interindustry transactions required to satisfy this demand. In the flow table, the entire economy under consideration is divided into sectors comprised of processing sectors, final demand sectors and primary input sectors. The processing sectors as either producing or purchasing sectors, are endogenous, and the final demand and primary input sectors are exogenous. Each sector consists of a set of relatively homogenous industries aggregated according to a predetermined classification. Each of these sectors produces a certain amount of output. This output may be used within the sector, sold to the other sectors as inputs, or flow to final demand sectors.

The I/O model has been used to study fisheries impacts. Harris and Norton (1978) examined the income and employment effects of commercial fisheries. Lambert (1975) estimated the direct employment and value-added impact of Lake Erie commercial fishing in Canada on the Ontario economy for 1972. Ditton, Graefe and Lapotka (1980) used existing I/O models of the Houston-Galveston region of Texas and of the state of Texas for 1972 to estimate the impact of bay and gulf private boat fishing on the regional and state economies in 1978. King and Shellhammer (1981) used the California Interindustry Fisheries (CIF) model containing 19 fish harvesting sectors, 9 fish processing sectors, and 35 nonfishery sectors to examine the economic impact of the California fisheries. More recently, Briggs, Townsend and Wilson (1982), used the input-output framework in the analysis of Maine's fisheries.

Hushak, Ro and Husain (1983), Kakish (1981), and Ro (1982) used I/O models to examine regional economic impacts in Ohio. Strang (1970) analyzed a recreation-oriented economy in Northern Wisconsin. Brucker and Cole (1979) used the I/O methodology as a framework for analyzing the impact of changes in Sussez County. Williams, Tyner and Waldrop (1976) used I/O for the study of the structure of the Mississippi economy.

The I/O approach is preferable to other forms of impact models for the issues of concern in this study. First, all sectors of concern can

be incorporated simultaneously and the relationships among sectors examined. Second, the estimated impacts are based on industry specific multipliers or requirements rather than on average multipliers. Economic base and econometric models do not provide sectoral multipliers but only aggregate multipliers.[2/]

Regional economic base and econometric models strictly require a set of primary data or secondary data on the region under study, while I/O analysis can reasonably be implemented through the adaptation of the national I/O model to a regional economy. In this study, primary data were collected for only three out of the 43 endogenous sectors (defined later).

Impact Coefficients (Multipliers)

Since the input-output model was first pioneered by Leontief (1951), a number of methodological improvements have been made. The concept of impact coefficients is one of the important outcomes of these improvements. Impact coefficients or multipliers are quantitative measures of the effect that a change in the final demand for goods and services of a particular sector have on output, employment and income of the whole economy. The output multiplier measures the amount of output generated by a one dollar change in final demand for the output of a particular sector. The employment multiplier is the ratio of the total employment effect (direct plus indirect effect) to the direct employment effect in response to a change in final demand for a particular sector. The income multiplier is the ratio of the total income effect (direct plus indirect) to the direct income effect for a particular sector in response to a change in final demand.

Adjusted Output Multiplier, Total Income and Employment Effects

The output, income and employment multipliers are useful in examining changes in the economy resulting from a final demand change in a given sector. In examining the total contribution (impact) of the Lake Erie sectors to the regional economy, however, it is necessary to evaluate changes in the regional economy as related to output changes rather than to final demand changes in the Lake's economic sectors. The adjusted output multiplier and the adjusted total income and employment effect allow such evaluation. The income and employment multipliers are the same for evaluation of final demand and output changes. The mathematical formulation of the impact and adjusted multipliers is presented in Appendix A.

2/ More discussion on the limitation of the economic base model is provided in Prescott and Lewis (1975), Richardson (1978) and Shaffer (1979). More details on the concepts as well as limitations of econometric models are provided in Theil *et al.* (1965), Glickman (1971) and Richardson (1978).

Generation of the Northern Ohio Regional Input-Output Model

In this study, the 1972 U.S. national input-output model updated to 1978 prices is used to generate the 40 sector regional input-output table. The charter fishing and marina and boat sales sectoral flows are derived from a primary survey. Commercial fishing is derived from a published study. There are two broad exogenous sectors: the final demand and the primary input sectors. See Appendix B for the detailed specification of the regional input-output model.

Primary Survey Data Collection for Charter Fishing and Marina and Boat Sales

In this section, the sampling procedures, the data collected, and the estimation of the transactions and the technical coefficients for charter fishing and marina and boat sales are discussed. The purposes of the survey are threefold: (1) to determine input requirements for each sector, (2) to identify sectors of origin of purchases and sectors of distribution of sales by sampled firms, and (3) to determine the total amount of the regional transactions that occur outside the region. Lists of all establishments in marine services and supplies, charter fishing, boat dealers and bait dealers in the study region were obtained. The list for marine services and supplies was obtained from the Lake Erie Marine Trades Association, while the list of charter captains was obtained from the Ohio Department of Natural Resources' charter license applications list. The list of bait dealers was obtained from the Ohio Department of Natural Resources and the boat dealers list was obtained from the Ohio Boat Dealers Association. Sampled firms were randomly selected from the lists and mailed survey questionnaires in June, 1982.

The Charter Fishing Industry

Charter boat operators (captains) are defined as persons who advertised themselves to the public as charter boat operators and offered charter fishing experience on Lake Erie. The firms included those who offer charter guide and boat rental services.

A list of charter operators was obtained from the list of applicants for the Ohio Lake Erie fishing guides for 1981. A sample of 165 out of the 249 firms (captains), 66 percent, were randomly selected and mailed a survey questionnaire with a self-addressed, stamped return envelope in June 1982. Of the 165 questionnaires sent, 15 were returned in a usable form, 4 were returned due to address changes and 7 were filled out in a manner that rendered them incomplete and hence unusable. Of the 7 "incompletes" some were totally blank, and some gave reasons such as gone out of business or unable to disclose financial figures.

In early August, a follow-up letter and a duplicate survey instrument were sent to those not responding. In the second mailing, 8 returned usable questionnaires, 6 were returned for address changes and

12 questionnaires were returned either incomplete or blank. The two mailings resulted in a 26 percent response rate and a usable response rate of 13.9 percent.

Marina and Boat Sales

Due to significant overlap between marina operators and bait dealers, marine services and supplies was initially defined to include bait dealers, fish tackle dealers, fish cleaning establishments, launching service operators, docking site operators and boat ramp operators. The marine services list contained 225 firms and the bait dealers list contained 301 names. It was not possible to identify overlapping firms because the marine services firm name was not the name in which the bait dealer license was held in many cases.

During the summer of 1982, survey mail questionnaires were sent to a sample of 251 firms in this industry, about 50 percent of the names on both lists. Of the 251 sampled firms surveyed, 12 returned usable questionnaires, 9 questionnaires were returned for reasons of address changes and 19 questionnaires were returned incomplete. Of the 19 incomplete questionnnaires, ten firms were reported to have gone out of business.

A follow-up letter and a duplicate copy of the survey questionnaire were sent to nonresponding firms in early August. The second mailing resulted in 7 returned usable questionnaires, 4 were returned for changes in mailing address and 13 were returned incomplete. The two mailings resulted in an over-all response rate of 19 percent and a usable response rate of 7.6 percent.

The boat dealers industry is defined to include only firms that are boat retailers, and does not include boat rental firms or boat manufacturers. A list of Ohio boat dealers was obtained from the Ohio Boat Dealers Association. Using the U.S. Postal Service zip codes, a list was made of boat dealers who operated in the counties of the study region. A total of 182 boat dealers was identified as operating within the study region. From this list a sample of 120 firms (66 percent) was selected and mailed a survey questionnaire in June 1982. Of the firms surveyed, 10 returned usable questionnaires, 2 were returned due to changes in mailing address and 9 were returned incomplete. The 9 incomplete questionnaires included 3 firms that had gone out of business. In August, a follow-up letter with a duplicate copy of the questionnaire was sent to nonrespondents. This resulted in 5 returned usable questionnaires, 1 questionnaire was returned due to address change and 4 were returned incomplete. The two mailings resulted in a total response rate of 23 percent and a usable response rate of 12.5 percent.

When the lists of the marine services and supplies and the boat dealers were obtained, it was clear that there was some overlap between the two lists. However, because they were in different form, it was

difficult to determine the extent of overlap. After the survey responses started coming in, it was realized that the extent of overlap was great enough to bias the results unless it was corrected. Many firms provide both marine services and boat sales. To avoid any double counting and subsequent overestimation, the marine services and supplies and the boat dealers industry were aggregated into one sector, called marina and boat sales.

To accomplish this aggregation, additional data were necessary to estimate the actual number of firms in each of these industries. Help was obtained from both ODNR and the Lake Erie Marine Trades Association (LEMTA). A revised list of boat dealers was obtained. This list indicated that there were 120 boat dealers resident in the region. Discussion with staff at ODNR confirmed that at least one-half of these boat dealers were basically involved in boat dealership. We therefore estimated that one-half of the 120 boat dealers were full time boat dealers and the other one-half were also part of marine supplies and services.

Information from LEMTA indicated that there were 183 establishments involved in marine services and supplies, and approximately 118 establishments were mainly involved in bait dealership. Adding the number of firms in the three industries, a total of 361 firms was estimated as constituting the marina and boat sales sector. The aggregation of these sectors was necessary to avoid double counting and is valid because these sectors have relatively homogenous output. A boat dealer, for example, may also sell other boating services and fishing tackle, while a marine supplies firm sells boats. The aggregation of the marine supplies and services sector and the boat dealers sector results in a 21.3 percent response rate and a usable response rate of 10 percent for the aggregated sector.

The Data Collected

Sample instruments are in Appendix C. Survey questionnaires were sent to the various establishments requesting that they report their sales and purchases information for 1981. The year 1981 was used because it was expected that many firms would not be able to provide data for 1978, the year for which the model is developed. A second reason for the selection of 1981 as the survey year is that the sport fishing sector was not fully developed in 1978. The charter industry was similarly still growing in 1978. There were 73 charter captains in 1978 compared to 249 in 1981. The questionnaires did not insist on exact figures but asked for estimates when exact figures were not available.

This type of data collection has typically faced problems of no response. This is partly attributed to unwillingness on the part of respondents to furnish sensitive financial information. However, the 13.9 percent usable response rate for the charter industry and the 10 percent rate for marina and boat sales are comparable with other studies. In the California Interindustry Fisheries study by King and

Shellhammer (1981), the usable response rate for the fish harvesters was 20 percent, and the rate for fish processors was 9 percent.

How representative is this sample of the various industries? Because a study involving these sectors has not been undertaken in Ohio before, and because no state agency has total output data for any of these sectors, it is very difficult to assess the representativeness of the sample used in this study.

The sample size and the mean of the sample estimates are important factors for determining sample representativeness. For the boat dealers (only), the sample mean sales is $1.5 million, compared to an estimate of the mean of $800,000 by the Lake Erie Marine Trades Association[3/] (LEMTA). The large divergence between the two estimates suggests that relatively large firms responded to the questionnaire. The mean sales estimate obtained from LEMTA for the marine supplies and services is $300,000, while the survey sample mean is $302,595.

The charter industry is the most homogeneous sector among all the sectors surveyed. To obtain an independent estimate of gross sales, the total number of days or trips fished reported by the Ohio Department of Natural Resources Division of Wildlife (creel census data) was multiplied by an estimated daily charter rate. This figure was divided by the number of charter captains to arrive at an estimated annual charter sales. The estimated mean of $5735.50 compared well with the sample estimate of $5160.00.

Based on the auxillary data obtained, the firms surveyed probably do adequately represent the various industries.

Estimation of the Transactions and the Technical Coefficients

The transactions and the technical coefficients for charter fishing and marina and boat sales are estimated from the survey responses. In addition to information about their purchases, the business respondents were asked to allocate their sales among local and nonlocal individuals, businesses and governments (state, local and federal). These estimates were accepted as sales data for these firms. The sales and purchases figures were reconciled and from these data the interindustry transactions data were generated.

In deriving the interindustry transactions table, the mean value of each item for the responding firms from a sector was assumed to represent the value for an average firm in that sector. Each purchase by a firm, as recorded on the questionnaire, was determined to be from a certain economic sector and coded as such. If more than one item on the questionnaire was coded as a purchase from a given sector, all purchases from that sector were summed. Sales by firms were also assigned according to the sector to which they were sold. Anything purchased out

3/ This figure is an impression of the President of Lake Erie Marine Trades Association.

of the region was recorded as an import. All imports were summed to create the import cell for each sector. All average sector purchases, mean taxes, mean payments to households and mean imports were summed to obtain average total expense (purchases) for surveyed firms. This was compared and reconciled with the mean sales calculated from the questionnaire. The next step was to multiply the average firm purchases and sales data by the total number of firms in that industry to derive the total purchases and sales data for the two sectors.

A few adjustments were necessary to reconcile sales and purchases data in order to maintain equality of sales and purchases. To accomplish this reconciliation, two tables were developed: "the columns only" (purchases table) and "the rows only" (sales table). In most cases, the sales data were considered more reliable, and were used. But when the rows only table was used in constructing the transactions matrix, some of the purchases were not accounted for. In such instances additional information from industry people was used to reconcile the two data sources. Ten percent of the total expenditure on new boat purchases by the charter industry was allocated to current expenditures, i.e., a 10 percent depreciation rate was used for new boat purchases. Since most captains reported boat capital expenditures, only those who purchased new boats were treated this way. The technical coefficients for the surveyed sectors were calculated from the survey sectors' transactions table.

The Commercial Fishing Sector

The commercial fishing sector is included in the national I/O table, but is aggregated together with forestry products. This aggregation makes it necessary to derive coefficients for commercial fishing by other means. The disaggregation of commercial fishing and forestry involves removing all fishing activities from the (original) aggregated sector, and creating a separate row and column for commercial fishing. To accomplish this, complete transactions data on the inputs and outputs for 19 commercial fish harvesting sectors in a California study was assembled (King and Shellhammer, 1981). Based on a detailed examination of the inputs, outputs, and technology used in these sectors, three sectors (Wetfish Seiners, Herring Gillnetters and other Gillnetters) were selected as those that most closely approximated the commercial fishing activities of Ohio's Lake Erie. The three sectors were aggregated into one sector.

Based on knowledge of the Ohio commercial fishing industry and after consultations with experts in the industry, it was determined that the purchases data from the California commercial fishing study adequately represent the purchases patterns of the Ohio commercial fishermen. The distribution of the output of the Ohio Commercial fishermen was, however, found to differ from that of the California commercial fishermen. Consultations with industry experts in the Ohio commercial fishing industry indicated that a dollar of commercial fishing output is distributed to other sectors in the region as $.92 to food processing,

$.05 to wholesale and $.03 to commercial fishing. Using this information, the row coefficients are developed for the commercial fishing sector, while the column coefficients are derived from the California study. The forestry sector is the residual of the original sector minus commercial fishing.

The complete regional I/O model is composed of 43 endogeneous sectors, 2 of which are generated from a primary survey approach, one from secondary data sources and the remaining 40 from the 1972 U.S. national I/O model updated to 1978 prices. The regional transactions, technical coefficients and interdependence coefficients are presented in Appendices D, E and F, respectively.

An Overview of the Regional Economy

The sectoral output, employment and income for the region are presented in Table 4. Except for the agricultural sectors (livestock and crops), charter fishing, marina and boat sales and commercial fishing, the regional outputs for all sectors were computed as the national productivity of labor (output-employment ratio) multiplied by the regional employment (Appendix equation B.3). The outputs for the livestock and crops sectors were obtained from Ohio Farm Income, OARDC (1979). The output for the charter fishing and marina and boat sales sectors were obtained from the primary survey of the respective regional industries, while the output for the commercial fishing sector was obtained from ODNR (Status, 1979).

Employment for the livestock sector was estimated as the livestock sectoral output divided by the national per capita livestock productivity, or the output-employment ratio. Employment for the crops sector was estimated similarly. The employment data for marina and boat sales were obtained from the survey responses while those of commercial fishing and charter fishing were obtained from ODNR. In 1978, 125 commercial fishing and 83 (in 1982 there were 342) charter fishing licenses were issued. Since both the commercial fishermen and charter captains do not work full time during the year, it was necessary to adjust the respective employment data to reflect only full time employment equivalents. For the commercial fishing industry, it was assumed that an average commercial fisherman works full time for four months and approximately half time for two to three months.[4/] Based on this assumption, 52 man-years of employment was estimated for this sector. For charter fishing, it was estimated that an average charter captain worked only half time during the year. This resulted in an estimated 42 man-years of employment for the sector. Employment data for the remaining sectors were obtained from the Ohio County Business Patterns data on tape, USDC (1980). The regional income for all sectors was estimated as the sectoral employment multiplied by the sectoral average

4/ The estimated full time employment equivalents for the charter and commercial fishermen were derived after consultations with ODNR, Division of Wildlife.

Table 4: Sectoral Output, Employment and Income for the Region, 1978

	Output[a/] ($ million)	Employment[b/] (man years)	Income[c/] ($ million)
Lake Erie Sectors:			
Commercial fishing	2.5[e/]	52	.4
Charter fishing	2.0	42	.7
Other Lake Erie Sectors:			
Water transportation	178.0	2,324	51.5
Mineral extraction	87.7	1,167	23.3
Marina and boat sales	91.9	3,790	25.5
Other Industries:			
Livestock	261.2[d/]	4,729	155.6
Crops	3,507.6[d/]	45,347	366.6
Forestry products	351.8	3,104	26.6
Other mining	288.9	970	29.3
Construction	7,473.3	66,767	1,034.3
Food and kindred products	2,778.0	17,179	240.5
Textiles	1,372.9	14,925	220.0
Wood and lumber	317.8	3,151	38.4
Furniture and fixtures	429.8	6,277	84.1
Paper and allied products	950.1	9,598	158.9
Printing and publishing	1,148.5	22,257	327.6
Chemicals and allied products	7,042.3	21,875	421.7
Rubber and leather products	4,744.5	48,711	600.0
Stone, clay, and glass products	1,723.6	20,460	317.5
Primary iron and steel mfg.	11,081.2	67,128	1,010.8
Primary nonferrous metals	3,008.4	21,099	328.6
Heating, plumbing fabricated metals	5,297.9	54,215	730.4
Other fabricated products	2,301.0	20,561	312.0
High technology machinery	1,387.2	16,638	255.7
Miscellaneous machinery	6,876.3	64,933	1,017.9
Electric and electronic equipment	4,912.6	57,990	1,103.6

Table 4 continued

	Output[a/] ($ million)	Employment[b/] (man years)	Income[c/] ($ million)
Motor vehicle equipment	13,823.9	87,957	1,722.2
Boat-ship building and repair	125.9	2,518	45.3
Other manufacturing	371.8	6,259	19.7
Non-water transportation	2,618.8	44,261	630.8
Communication	859.6	21,704	349.6
Electricity, gas and sanitary	5,112.0	17,648	294.6
Wholesale	7,751.2	95,838	1,366.9
Retail	3,401.6	194,979	1,441.1
Finance and insurance	6,301.1	60,693	712.8
Real estate	3,429.5	17,852	165.0
Hotel and lodging	353.5	13,599	69.0
Eating and drinking establishments	3,938.0	81,385	373.2
Auto repair services	1,706.5	10,604	104.9
Recreation and amusement	504.5	15,028	87.2
Education services	603.8	16,053	188.8
Health services	20,546.8	106,470	1,305.0
Miscellaneous services	10,610.1	326,003	1,279.2
Total	149,705.8	1,713,779	30,629.1

a/ Computed by Appendix equation B.3.
b/ USDC (1980).
c/ Computed by Appendix equation B.4.
d/ OARDC (1979).
e/ Commercial (1979).

annual labor earnings in the region (Appendix equation B.4). The sectoral average annual labor earnings were obtained from the Ohio Bureau of Employment Services ($OBES_b$, 1979).

In Table 4, it is shown that in 1978 the region generated a total of $149.7 billion of output, 1.7 million man-years of employment and $30.6 billion in income. From the output information, it is estimated that a worker in the region produced an average of $87,357 output and earned an average income of $17,868.

Multipliers

The sectoral output multipliers for the endogenous sectors in the region are listed in Table 5. The motor vehicle equipment sector has the largest output multiplier of 2.37. This means that a one dollar increase in final demand for the output of the motor vehicle equipment industry will result in an additional $1.37 of output in the regional economy. A high output multiplier for a sector usually implies that the sector has a great deal of interdependence with other sectors in the region, and that a major proportion of its inputs are supplied by industries within the region. This means that an increased final demand for a sector's output will result in relatively large increases in the output of other sectors.

The income multiplier is the total income change in an economy due to a one dollar change in income of a particular sector in an economy, or the total income effect divided by the direct income effect. The size of the income multiplier is affected by the percentage of the total industry's expenses paid to households in the form of wages, salaries, interest, rents and profits. The income multiplier is divided into direct, indirect and total income effects (Table 6).

The direct income effect is the proportion of each dollar of output that goes directly to households in the form of wages, salaries, interests, dividends, rents and profits. The direct income effects are largest for livestock, retail, communications, boat-ship building and repair, and charter fishing. The implication of a high direct income effect is that a high proportion of expenses is paid directly to the household (value added) sector. For example, in the livestock sector, each dollar of output results in direct payment of $.59 to households. The size of the direct income effect also reflects the degree of labor or capital intensity of a sector. The capital intensive sectors such as chemicals and allied products, other manufacturing, auto repair services, and primary iron and steel manufacturing have relatively low direct income effects.

The total income effect is defined as the direct income effect multiplied by the interdependence coefficients (Brucker and Cole, 1979). The total income effects are usually largest for the more labor intensive sectors. In Table 6, it is shown that labor intensive sectors such as retail and communications have large total income effects. For the

Table 5: Ranked Output Multipliers for Regional Endogenous Sectors, 1978

Endogenous Sectors	Output Multipliers
Motor vehicle equipment	2.37
Charter fishing	2.24
Livestock	2.13
Water transportation	2.12
Food and kindred products	2.06
Textiles	2.03
Boat-ship building and repair	2.03
Heating, plumbing, fabricated metals	2.01
Other manufacturing	1.99
Primary nonferrous metals	1.96
Finance and Insurance	1.96
Furniture and fixtures	1.94
Auto repair services	1.93
Marina and boat sales	1.92
Electric and electronic equipment	1.89
Rubber and leather	1.87
Chemicals and allied products	1.85
Other fabricated products	1.83
High technology machinery	1.81
Miscellaneous machinery	1.81
Mineral extraction	1.79
Recreation and amusement	1.78
Paper and allied products	1.77
Eating and drinking establishments	1.77
Stone, clay and glass products	1.76
Primary iron and steel mfg.	1.74
Miscellaneous services	1.74
Construction	1.72
Hotel and lodging	1.67
Non-water transportation	1.67
Commercial fishing	1.67
Crops	1.64
Electricity, gas and sanitary	1.63
Other mining	1.62
Printing and publishing	1.62
Wood and lumber	1.50
Education services	1.44
Health services	1.42
Communication	1.40
Real estate	1.40
Wholesale	1.37
Retail	1.35
Forestry products	1.33

Table 6. Ranked Income Multipliers, Direct, Indirect and Total Income Effects for Regional Endogenous Sectors, 1978

Endogenous Sectors	Income Multiplier	Income Effects (per $ of final demand) Direct	Indirect	Total
Motor vehicle equipment	3.22	.13	.29	.42
Marina & boat sales	2.87	.28	.51	.79
Textiles	2.72	.16	.28	.44
Livestock	2.69	.59	1.01	1.60
Water transportation	2.58	.28	.44	.72
Food and kindred products	2.58	.09	.13	.22
Other Manufacturing	2.37	.05	.08	.13
Boat-ship bldg. & repair	2.28	.35	.47	.82
Primary nonferrous metals	2.25	.11	.14	.25
Charter fishing	2.24	.34	.42	.76
Furniture & fixtures	2.22	.20	.24	.44
Heating, plumbing, fabricated metals	2.20	.14	.16	.30
Finance & insurance	2.09	.11	.13	.24
Chemicals & allied products	1.97	.06	.06	.12
Paper & allied products	1.95	.17	.16	.33
Rubber & leather	1.92	.13	.12	.25
Electric & electronic equip.	1.90	.23	.21	.44
Eating & drinking	1.87	.09	.08	.17
Auto repair service	1.87	.06	.05	.11
Other fabricated metals	1.82	.14	.12	.26
Construction	1.82	.14	.12	.26
Primary iron & steel mfg.	1.80	.09	.07	.16
Recreation & amusement	1.80	.17	.14	.31
Stone, clay, glass products	1.78	.18	.15	.33
Miscellaneous machinery	1.77	.15	.12	.27
High technology machinery	1.76	.18	.14	.32
Mineral extraction	1.74	.27	.19	.46
Miscellaneous services	1.72	.12	.09	.21
Hotel & lodging	1.64	.20	.12	.32
Electricity, gas & sanitary	1.64	.06	.04	.10
Wood & lumber	1.64	.12	.08	.20
Crops	1.61	.10	.07	.17
Non-water transportation	1.59	.24	.14	.38
Commercial fishing	1.57	.18	.10	.28
Printing & publishing	1.55	.29	.15	.44
Other mining	1.52	.10	.05	.15

Table 6, continued

Endogenous Sectors	Income Multiplier	Income Effects (per $ of final demand) Direct	Indirect	Total
Educational services	1.35	.20	.07	.27
Health services	1.32	.06	.02	.08
Real estate	1.30	.05	.02	.07
Communication	1.28	.41	.11	.52
Wholesale	1.25	.18	.05	.23
Forest products	1.24	.08	.02	.10
Retail	1.24	.42	.10	.52

capital intensive sectors, such as electricity, gas and sanitary, auto repair services, and chemicals and allied products, the total income effects are lower.

The indirect income effect is the difference between the total income effect and the direct income effect. The indirect income effect is highest for livestock. A high indirect income effect usually implies that a sector is highly interdependent with the rest of the economy, and thus its purchases will produce increased incomes in many sectors. From Tables 5 and 6, it is seen that all the sectors with high indirect income effects also have high output multipliers.

The sectoral income multipliers shown in column one of Table 6 ranked by size. Motor vehicle equipment has the highest income multiplier of 3.22. A $1 increase in the income of the motor vehicle equipment industry will generate additional income of $2.22 in the regional economy.

The employment multiplier measures the total employment change in the economy per unit change in employment in a given sector. The employment multiplier, like the output and income multipliers, can be divided into direct and indirect effects (Table 7). The direct employment effect measures the change in employment of a particular industry in response to a change in final demand. It is estimated as the ratio of total sectoral employment to total sectoral output. More labor intensive sectors will hire more people per unit increase in final demand, and this results in a higher direct employment effect. For example, the direct employment effects are highest for retail, marina and boat sales, hotel and lodging, miscellaneous services and recreation and amusement. Sectors with low direct employment effects are usually the capital intensive sectors.

The total employment effect is defined as the direct employment effects multiplied by the interdependence coefficients. The total employment effect measures the total employment change directly and indirectly resulting from a final demand change in a particular regional

Table 7. Ranked Employment Multipliers, Direct, Indirect and Total Employment for Regional Endogenous Sectors, 1978

Endogenous Sectors	Employment Multipliers	Employment Effects (man-yrs/$million of final demand) Direct	Indirect	Total
Chemicals & allied products	3.47	3.1	7.7	10.8
Motor vehicle equipment	3.12	6.4	13.6	20.0
Food & kindred products	3.00	6.18	12.3	18.5
Other mining	2.84	3.36	6.1	9.5
Charter fishing	2.83	20.6	37.7	58.3
Auto repair services	2.62	6.2	10.0	16.2
Finance & insurance	2.58	9.6	15.2	24.77
Electricity, gas & sanitary	2.50	3.5	5.3	8.75
Primary nonferrous metals	2.31	7.0	9.2	16.2
Construction	2.21	8.9	10.8	19.7
Primary iron & steel mfg.	2.15	6.1	7.0	13.1
Health services	2.11	5.18	5.7	10.9
Water transportation	2.09	13.1	14.3	27.4
Textiles	2.00	10.87	10.8	21.7
Heating, plumbing & fabricated metals	1.92	10.2	9.4	19.6
Other fabricated metals	1.91	8.9	8.1	17.0
Miscellaneous machinery	1.88	9.4	8.3	17.7
Real estate	1.88	5.2	4.6	9.8
Electric & electronic equip.	1.85	11.8	10.0	21.8
Paper & allied products	1.84	10.1	8.5	18.6
Rubber & leather	1.83	10.3	8.5	18.8
Livestock	1.74	18.1	13.4	31.5
Stone, clay, glass products	1.73	11.87	8.63	20.5
High technology machinery	1.73	12.0	8.8	20.8
Other manufacturing	1.71	16.8	11.9	28.7
Furniture & fixtures	1.69	14.60	10.1	24.67
Mineral extraction	1.61	13.3	8.1	21.4
Wood & lumber	1.57	9.9	5.6	15.5
Boat-ship bldg. & repair	1.55	20.0	11.0	31.0
Non-water transportation	1.54	16.9	9.1	26.0

Table 7, continued

Endogenous Sectors	Employment Multipliers	Employment Effects (man-yrs/$million of final demand) Direct	Indirect	Total
Marina & boat sales	1.53	41.2	21.9	63.1
Forestry products	1.51	8.82	4.5	13.3
Crops	1.51	12.9	6.6	19.5
Commercial fishing	1.50	20.8	10.4	31.2
Wholesale	1.47	12.36	5.84	18.2
Printing & publishing	1.46	19.4	8.9	28.3
Recreation & amusement	1.44	29.8	13.1	42.9
Eating & drinking est.	1.42	20.7	8.7	29.4
Miscellaneous services	1.31	30.7	9.5	40.2
Communications	1.27	25.2	6.8	32.0
Education services	1.22	26.6	5.9	32.5
Hotel & lodging	1.22	38.5	8.5	47.0
Retail	1.09	57.2	5.1	62.3

sector. The marina and boat sales sector has the largest total employment effect of 63.1. This means that a one million dollar change in the output of the marina and boat sales sector will generate a total of 63.1 man-years of employment in the region.

The indirect employment effect is the difference between the total employment effect and the direct employment effect. The sectors with high indirect employment effects are usually relatively capital intensive, and tend to have higher output multipliers. The large indirect employment effect for charter fishing is probably due to a large interaction with marina and boat sales.

The employment multiplier is defined as the ratio of direct and indirect employment to direct employment (Table 7). The sectors with high employment multipliers are the capital intensive sectors. These capital intensive sectors have low direct employment effects and relatively high indirect employment effects. Also, sectors with high direct employment effects (labor intensive sectors) have high total employment effects. Labor intensive sectors are most capable of generating high total employment effects, but because they do not interact very much with other sectors in the economy, these sectors have less capacity to generate indirect effects.

The Lake Erie Economic Sectors

The Lake Erie economic sectors are commercial fishing, charter fishing, water transportation, mineral extraction and marina and boat sales (Table 4). These sectors are defined as industries that are closely tied to Lake Erie economic activities. In addition, part of amusement and recreation is considered to be a Lake Erie sector.

The Lake Erie sectors are relatively small in terms of output, employment and income. These five sectors together produced $362.1 million of output, $101.4 million of income and generated 7,375 man-years of employment in 1978 and accounted for less than 0.5 percent of the total regional output, income and employment.

Water transportation had the largest output and income in 1978, with an average worker being paid $22,160 annually and producing $76,592 of output. Marina and boat sales recorded the largest employment. Among the Lake Erie sectors, the charter fishing, water transportation and marina and boat sales sectors have high multipliers. Charter fishing and water transportation are both ranked among the top fifteen sectors with respect to output multipliers. Marina and boat sales, charter fishing and water transportation are ranked among the top fifteen sectors for income multipliers.

Among the Lake Erie sectors, the highest direct income effect per $1 of income is $.34 for charter fishing (Table 6). Others with relatively high direct income effects are water transportation and marina and boat sales. The lowest direct income effect is shown by the commercial

fishing sector, where a $1 increase in final demand results in additional payment of $.18 to households in the form of wages, rents, profits, etc.

The indirect income effects for the Lake Erie sectors are relatively high. High indirect effects signal capital intensity and indicate that a sector has relatively high interdependencies with other regional sectors.

Charter fishing is the only Lake Erie sector ranked in the top fifteen in employment multipliers (Table 7). Water transportation and mineral extraction also have relatively high employment multipliers. The direct employment effect is relatively high for the Lake Erie sectors. Marina and boat sales, charter fishing and commercial fishing all have relatively high direct employment effects.

The interrelationships among the five endogenous Lake Erie sectors and the rest of the regional economic sectors, as measured by the impact of an increase of $100 in final demand for each of the five Lake Erie sectors, are shown in Table 8. In column one, the results for the charter fishing sector are shown. This column represents the charter fishing column of the interdependence coefficient matrix (Appendix F) multiplied by $100.0. The greatest output effect is shown for the marina and boat sales sector (70.53). The charter industry buys a substantial amount of its inputs (boats, boating supplies, bait, tackle, dockage, etc.) from marina and boat sales.

A $100 increase in final demand for the commercial fishing sector will have the greatest effect on finance and insurance. With respect to marina and boat sales (column 3), the effect is greatest on the marina and boat sales sector itself. This may be explained by significant internal purchases within the sector. For water transportation, the largest impact is on water transportation itself, while for mineral extraction, the greatest effect is on chemicals and allied products.

In Table 9 is shown how the Lake Erie sectors' output is distributed among other endogenous sectors under the assumption that final demand increases by $100 in every sector. Such an increase may yield different results from a proportional increase in final demand for all sectors, because the sectors are very different in size (see Table 5). The respective figures represent each Lake Erie sector's row of the interdependence coefficients matrix multiplied by $100. For example, in column one, the charter fishing sector sells virtually nothing to other endogenous sectors in the region. It sells nearly everything to final demand (households and exports).

Commercial fishing sells $3.10 for internal use per $100 increase in final demand for all endogenous sectors and sells $.11 to food and kindred products. A high proportion of the commercial fishing sector's output goes to food and kindred products, but that sector is so large compared to commercial fishing that its sales are a small proportion of food and kindred products' input purchases.

Table 8. The Lake Erie Sectors' Input Purchases Per $100 of Sectoral Final Demand, 1978

	Charter Fishing	Commercial Fishing	Marina and Boat Sales	Water Transportation	Mineral Extraction
Lake Erie Sector					
Charter fishing	101.31	*	.27	*	*
Commercial fishing	*	103.10	*	*	*
Other Lake Erie Sectors					
Marina and boat sales	70.53	.01	124.30	.03	.02
Water Transportation	.04	.06	.05	131.43	.19
Mineral extraction	.02	.03	.02	.06	101.42
Other Industries					
Livestock	.01	.13	.02	.03	.02
Crops	.03	.28	.05	.09	.06
Forestry products	.03	.10	.05	.07	.05
Other mining	.21	.12	.14	.26	.38
Construction	3.50	1.42	4.80	5.10	3.10
Food and kindred products	.18	2.67	.02	.42	.28
Textiles	.12	.19	.01	.70	.42
Wood and lumber	.14	.12	.02	.21	.13
Funiture and fixtures	.07	.10	.13	.08	.01
Paper & allied products	.20	.50	.25	.52	.83
Printing and publishing	.03	.39	.41	.52	.28
Chemicals and allied products	1.37	7.07	1.62	14.20	12.00
Rubber and leather products	.23	.52	.32	.75	4.50
Stone, clay and glass products	.40	.45	.59	.70	.64
Primary iron and steel mfg.	1.27	3.27	2.13	3.90	6.30

Table 8, continued

	Charter fishing	Commercial Fishing	Marina and Boat Dealers	Water Transportation	Mineral Extraction
Primary nonferrous metals	.44	1.36	.70	1.40	1.70
Heating, plumbing and fabricated metals	.55	3.87	.88	.81	1.00
Other fabricated products	.26	.48	.41	1.40	1.30
Miscellaneous machinery	.79	1.24	1.32	2.20	9.50
High technology machinery	.21	1.42	.34	.65	.63
Electric and electronic equipment	.62	2.00	.98	1.70	.98
Motor vehicle equipment	.11	.15	.15	.70	1.20
Boat-ship building and repair	5.11	7.30	9.00	5.30	.01
Other manufacturing	.08	2.23	.11	.30	.21
Non-water transportation	.54	.81	.72	3.40	2.00
Communications	.36	2.46	.42	1.20	.40
Electricity, gas & sanitary	6.60	1.37	3.90	3.70	7.30
Wholesale	.94	3.65	1.30	4.20	5.20
Retail	.23	3.23	.31	.42	.43
Finance and insurance	8.10	8.36	6.90	7.10	2.30
Real estate	3.97	1.22	6.40	5.00	4.30
Hotel and lodging	.06	.09	.08	.12	.22
Eating and drinking establishments	.52	.58	.65	.92	.63
Auto repair services	.25	.29	.31	.90	1.50
Recreation and amusement	.03	.10	.04	.08	.04
Education services	.01	.01	.02	.03	.02
Health services	.01	.01	.01	.01	*
Miscellaneous services	14.65	4.70	21.10	11.30	7.20

* Less than .005.

Source: The figures are the column elements of the regional interdependence coefficients matrix (Appendix F) multiplied by 100.

Table 9. Distribution of Lake Erie Sectors' Output Among Regional Sectors Per $100 Change in Final Demand for All Sectors

	Charter fishing	Commercial Fishing	Marina and Boat Sales	Water Transportation	Mineral Extraction
Lake Erie Sector					
Charter fishing	101.31	*	70.50	.04	.02
Commercial fishing	*	103.10	.01	.06	.03
Other Lake Erie Sectors					
Marina and boat sales	.28	*	124.30	.05	.03
Water Transportation	*	*	.04	131.40	.06
Mineral extraction	*	*	.02	.02	101.41
Other Industries					
Livestock	*	.02	.03	.21	.09
Crops	*	*	.20	.28	.23
Forestry products	*	*	.01	.06	.09
Other mining	*	*	.02	.01	.61
Construction	*	*	.02	.20	3.36
Food and kindred products	*	.11	.03	.28	.12
Textiles	*	*	.02	.26	.07
Wood and lumber	*	*	.01	.20	.07
Funiture and fixtures	*	*	.02	.22	.08
Paper and allied products	*	*	.02	.02	.08
Printing and publishing	*	*	.03	.07	.08
Chemicals and allied products	*	*	.02	.44	.03
Rubber and leather products	*	*	.02	.31	.15
Stone, clay and glass products	*	*	.02	.34	2.00
Primary iron and steel mfg.	*	*	.01	.64	.23

Table 9, continued

	Charter fishing	Commercial Fishing	Marina and Boat Sales	Water Transportation	Mineral Extraction
Primary nonferrous metals	*	*	.02	.13	.08
Heating, plumbing and fabricated metals	*	*	.02	.30	.10
Other fabricated products	*	*	.02	.21	.09
Miscellaneous machinery	*	*	.01	.17	.06
High technology machinery	*	*	.02	.16	.06
Electric and electronic equipment	*	*	.02	.14	.08
Motor vehicle equipment	*	*	.02	.22	.10
Boat-ship building and repair	*	*	.02	.21	.09
Other manufacturing	*	*	.03	.20	.10
Non-water transportation	*	*	.02	.16	.04
Communications	*	*	.02	.03	.03
Electricity, gas and sanitary	*	*	.01	.19	.06
Wholesale	*	*	.02	.07	.02
Retail	*	*	.03	.05	.02
Finance and insurance	*	*	.07	.08	.03
Real estate	*	*	.01	.05	.04
Hotel and lodging	*	*	.04	.11	.04
Eating and drinking establishments	*	.02	.02	.13	.04
Auto repair services	*	*	.02	.11	.06
Recreation and amusement	*	*	.04	.10	.04
Education services	*	*	.02	.07	.03
Health services	*	*	.02	.06	.03
Miscellaneous services	.01	*	.03	.18	.09

* Less than .005.

Source: The figures are the row elements of the regional interdependence coefficients matrix (Appendix F) multiplied by 100.

For a $100 increase in final demand for all sectors, marina and boat sales sells $70.00 of output to charter fishing, and $24.00 is used internally by marina and boat sales. The water transportation sector makes it largest output sales to itself ($31.40). The mineral extraction sector makes its largest output sales to construction ($3.36). The information from Tables 8 and 9 is summarized in Table 10.

The Lake Erie sectors depend very much on miscellaneous services, finance and insurance, and boat-ship building and repair for input purchases (Table 10). The charter fishing, commercial fishing, and the marina and boat sales sectors tend to depend on the same sectors for input purchases. The water transportation and mineral extraction sectors both depend on chemicals and allied products as their largest input supplier. The charter fishing and the marina and boat sales sectors are quite dependent on each other for input purchases and output sales. The outputs of the remaining Lake Erie sectors are sold mainly to other industries in the region. The output sales show much greater diversity than the input purchases patterns.

Economic Impacts of the Lake Erie Endogenous Sectors

In 1978, the five endogenous Lake Erie sectors (Table 5) together generated $362.1 million output, $101.4 million income and 7,375 man-years of employment. If these sectors were eliminated and not replaced by any alternative activities in 1978, the region would have lost this output, income and employment plus the indirect effects these sectors create through their linkages with other regional economic sectors. The total (direct and indirect) impacts of these five sectors on the regional economy as estimated using the adjusted output multiplier and the adjusted income and employment effects are presented in Table 11.

In column one is shown the total output impact and the distribution of the impact among the Lake Erie endogenous sectors. It is estimated that water transportation made the largest contribution of $287.1 million to the region's output in 1978. The sectoral impacts are estimated by Appendix equation A.20, as the total sectoral output (Table 5) multiplied by the sectoral adjusted output multiplier.

The commercial fishing sector sells a significant proportion (92 percent) of its total output to food and kindred products. If the commercial fishing impact on the regional output was limited to the value estimated by equation A.20, its impact would be underestimated. While the commercial fishing sector purchases inputs from several sectors in the economy, nearly all of its output goes to food and kindred products. This forward linkage supports incorporating the processing value added into the impact of the commercial fishing industry. To incorporate this forward linkage, the dollar value of commercial fishing output sold by food and kindred products ($5.72 million) is multiplied by the adjusted output multiplier of the food and kindred products sector to obtain the

Table 10. Sectors Most Closely Related to the Lake Erie Endogenous Sectors in Terms of Input Purchases and Output Sales, 1978

Lake Erie Sectors	Top 3 Related Sectors		
	1	2	3
Input Purchases			
Charter fishing	Marina and boat dealers	Miscellaneous services	Finance and insurance
Commercial fishing	Finance and insurance	Boat and ship building	Chemical & allied products
Marina and boat dealers	Miscellaneous services	Boat and ship building	Finance and insurance
Water transportation	Chemical & allied products	Miscellaneous service	Finance and insurance
Mineral extraction	Chemical & allied products	Other machinery	Electricity, gas and sanitary
Output Sales			
Charter fishing	Marina and boat dealers	Miscellaneous services	**
Commercial fishing	Food and kindred products	Eat and drink	Livestock
Marina and boat dealers	Charter fishing	Finance and insurance	Recreation and amusement
Water transportation	Primary iron and steel manufacturing	Chemical & allied products	Stone, clay and glass products
Mineral extraction	Stone, clay and glass products	Other mining	Construction

Source: Summarized from Tables 8 and 9.

** Sector interacts with only 2 endogenous sectors for total output sales. Sales go mainly to final demand sectors.

Table 11. Total Output, Income and Employment Impacts of the Endogenous Lake Erie Fishery and Other Lake Erie Endogenous Sectors, 1978.

Endogenous Sectors	Total Output[a/] ($ Millions)	Total Income[b/] ($ Millions)	Total Employment[c/] (Man-Years)
Commercial fishing	9.83	1.03	103.5
Charter fishing	4.51	1.55	117.39
Water transportation	287.11	97.51	3,710.76
Mineral extraction	154.79	39.78	1,850.55
Marina and boat sales	141.95	58.41	4,665.38
Estimated overlap	-3.15	-1.08	-82.17
Total for Lake Erie sectors	595.01	197.20	10,365.42
Amusement and recreation	80.76	14.06	1,946.50
Total	675.77	211.26	12,311.92

Source:

a/ Calculated by Appendix equation A.20.

b/ Calculated by Appendix equation A.22.

c/ Calculated by Appendix A.21.

estimate of $9.83 million in Table 11.[5/] This estimate is based on the assumption that elimination of the commercial fishing sector in the region will reduce the output of the food and kindred products sector by $5.72 million. It is therefore an upperbound estimate. If it is assumed that the elimination of the commercial fishing sector does not affect the output of the food and kindred products (i.e. food and kindred products increases its imports to make up for the loss of Lake Erie commercial fish inputs) the estimate of the commercial fishing

5/ The value of the commercial fishing output sold by food and kindred products is estimated as the output of commercial fishing sold directly to food and kindred products ($2.3 million) divided by the weighted average of the technical coefficients of food and kindred products (.402) for the commercial fishing sector. The weighted average technical coefficients for the food and kindred products sector was calculated from the King and Shellhammer (1981) study of California commercial fisheries. The technical coefficients from King and Shellhammer are preferred to the technical coefficients of food and kindred products from this study since it is more disaggregated and could provide a much more accurate estimate of the value of commercial fishing output to the food and kindred products sector.

sector's impact on regional output is $4.05 million. The $4.05 million is estimated as the sectoral adjusted output multiplier for commercial fishing multiplied by the sectoral output change, and is considered to be the lower bound of commercial fishing's impact. Throughout the analysis, the upper bound estimate is used.

There is a substantial overlap between charter fishing and marina and boat sales. This overlap is estimated as the direct and indirect input requirements per dollar of final demand of charter fishing from marina and boat sales (the marina and boat sales element of the charter fishing column in Table 8 divided by 100), multiplied by the total output impact of charter fishing as estimated by equation A.20. The estimated total regional output impact is adjusted downwards by the estimated output overlap to obtain the adjusted regional output impact of $595 million.

For water transportation, the estimated income impact is $97.5 million. The income impacts are estimated by Appendix equation A.22 as the total output multiplied by the ratio of sectoral total income effects (Table 6) to the sectoral diagonal element of the interdependence coefficients matrix (Table 8). For commercial fishing, the total income impact was calculated similarly to the output impact to reflect its extensive sales to the food and kindred products sector. The $5.72 million sold to food and kindred products is used in equation A.22 to obtain $1.03 million shown for commercial fishing in Table 11.[6/] Like the output impact, the regional total income impact is adjusted to reflect the overlap between charter fishing and marina and boat sales.

It is estimated that in 1978 marina and boat sales generated (directly and indirectly) a total of 4,665.4 man-years of employment in the region. The sector impacts are estimated by Appendix equation A.21, as the total sectoral output change (Table 5), multiplied by the adjusted sectoral total employment effects, defined as the ratio of total employment effect (Table 7) to the diagonal element of the interdependence coefficients matrix (Table 8) of a given endogenous sector.

The employment impact of the commercial fishing sector is estimated as 103.5 man-years. This is estimated by equation A.21, and is similar to the estimation of the income impacts, except that total employment effect (Table 7) is used instead of total income effect.[7/] The regional employment impact, like output and income, is adjusted downwards to remove the employment overlap between charter fishing and marina and boat sales.

Amusement and Recreation. Lake Erie and its resources offer many recreational and amusement opportunities. For example, the state

6/ The lower bound estimate is $0.68 million.

7/ The lower bound employment impact estimate is 69.6 man-years of employment.

operates six state parks along Lake Erie's shoreline, which offer swimming, boating, hunting, camping, cabins and natural trails. It is estimated that these state parks annually attract more than three million visitors (Public, 1979). The amusement and recreation services sector is defined to include dance halls, studios, schools, theatrical producers, bands, orchestras, entertainers, bowling alleys, billiards and pool establishments, commercial sports, public golf courses, coin operated amusement devices, amusement parks, membership sports and recreation clubs (Executive Office of the President, 1972, pp. 317-19). Based on the output, income and employment distribution of the components of this sector and the size of the sector, ten percent of the recreational and amusement sector is estimated to be directly tied to Lake Erie and its resources. Based on this assumption, and using Appendix equations A.20, A.22, and A.21 respectively, it is estimated that an additional $80.8 million of output, $14.1 million of income and 1,946.5 man-years of employment are attributable to Lake Erie and its resources.

When these estimates are added to the economic impact of the five Lake Erie endogenous sectors (Table 11), the estimated economic impact of Lake Erie on the region's output, income and employment are respectively, $675.8 million, $211.3 million and 12,311.9 man-years, accounting for 0.4, 0.7, and 0.7 percent of the regional output, income and employment, respectively, in 1978.

Lake Erie Sport Fishing

Ohio Lake Erie sport fishing is defined to include private boat fishing and charter boat fishing in this study. This excludes all shore fishing activities in the region. The economic impact of sport fishing activities estimated in this section is not an addition to the Lake Erie economic impacts estimated in the previous section. Sport anglers purchase major portions of their supplies from the marina and boat sales and charter industries.

Sport fishing is considered as part of the final demand sector in this study. Because this is an exogenous sector, its impacts on output, income and employment are estimated through direct purchases from the processing sectors in the regional economy. The magnitude of the impact of sport fishing activity on the regional economy is directly related to the degree of its interactions with other regional processing sectors. The 1981 expenditures data for private boat anglers were developed from the surveys conducted by Winslow (1982). Respondents were asked to allocate their fishing expenditures among regional economic sectors from which they purchase their fishing inputs. Private boat anglers who were residents of the study region were assumed to make their total fishing expenditures within the study region. Anglers who resided outside of the study region were asked to indicate the percentage of their total fishing expenditures made within 20 miles of the launch site. From these private boat angler responses, the import component of private boat fishing expenditures was estimated.

Private boat angler expenditures per person per fishing day were estimated and distributed among the economic sectors from which purchases were made. Using 1981 total (western and central basin) private boat angler hours of 10,515,751 (Status, 1982) and survey information on angler hours per day, total expenditures per person per season were blown up to get total private boat angler expenditures for 1981 of $65.0 million (Table 12). The 1981 private boat angler expenditures were adjusted downwards to reflect 1978 prices and 1978 angler hours. The consumer price indices ($USDC_b$, 1979) for the respective sectors from which private boat anglers buy inputs were used to deflate the 1981 expenditures to 1978 prices. Expenditures were then adjusted from 1981 to 1978 levels by the ratio of 1978 to 1981 angler hours. The 1978 total private boat angler expenditure is estimated as $37.8 million. The survey responses indicate that about 30 percent or $11.2 million of 1978 expenditures was imported from outside the study region.

Charter boat fishing is small compared to private boat fishing. In 1981, ODNR estimated lake-wide total charter fishing hours of 181,400, of which 132,000 were devoted to walleye fishing. The expenditure estimates for charter boat anglers are derived from the expenditure pattern of the private boat anglers. It is assumed that expenditures per day on hotel and lodging, retail, imports, miscellaneous services, and eating and drinking are similar for both the private boat anglers and charter boat anglers. The private boat angler expenditures per day in these sectors were used as estimates of charter boat angler expenditures per day. Charter boat anglers were assumed to purchase their bait and tackle from the marina and boat sales sector. The estimated direct

Table 12. Total Private Boat Angler Expenditures by Sector, 1981 and 1978 ($ Million)

Regional Sectors	1981[a/] Expenditures	1978[b/] Expenditures	% of Total (1978)
Marina and boat sales	25.7	15.2	40.2
Boat-ship building and repairs	2.3	1.3	3.5
Charter fishing	0.4	0.2	.6
Eating and drinking	5.9	3.4	9.0
Retail	8.6	4.9	13.0
Hotel and lodging	2.4	1.4	3.6
Miscellaneous services	.3	.2	.5
Imports[c/]	19.3	11.2	29.7
Total	65.0	37.8	100.0

a/ Computed from responses.

b/ 1981 expenditures adjusted for relative prices and sport anglers hours change between 1978 and 1981.

c/ Private boat angler expenditures outside the study region.

expenditures on bait and tackle were derived from the private boat angler expenditures survey.

Boat purchases and boating supplies from marina and boat sales were excluded because boating services are rented from the charter industry. Expenditures by charter boat anglers on charter fishing (charter captains) were assumed to equal the $2.04 million total output of the charter fishing sector (Table 4) less $.21 million total direct expenditures reported by private boat anglers in the charter fishing industry (Table 12). Based on this assumption, it is estimated that charter boat anglers spent $1.83 million directly in the charter fishing industry in 1978.

Estimated Economic Impact of Private Boat Fishing

In 1978 private boat anglers expended an estimated $37.8 million, of which $26.6 million was spent in the region. In Table 13 is shown the sectoral distribution of the private boat angler expenditures for 1978. The largest expenditures were for the output of marina and boat sales (40 percent). A major proportion of the private boat fishing inputs (boat, boating supplies, tackle, dockage, etc.) are components of the marina and boat sales sector.

Each sector's impact on output is estimated as direct spending multiplied by the sectoral output multiplier. Marina and boat sales

Table 13. Impacts of Private Boat Angler Expenditures on Total Regional Output, Income and Employment 1978

Regional Sectors	Direct Spending[a/] ($ Millions)	Output[b/] ($ Millions)	Income[c/] ($ Millions)	Employment[d/] (Man-Years)
Marina and boat sales	15.20	29.20	12.00	959.10
Boat-ship building and repairs	1.30	2.64	1.07	40.00
Charter fishing	0.21	0.47	0.16	12.30
Eating and drinking	3.40	6.02	0.58	100.00
Retail	4.90	6.61	2.55	305.27
Hotel and lodging	1.40	2.34	0.45	65.80
Miscellaneous services	0.18	0.31	0.04	7.11
Total	26.60	47.59	16.85	1,489.31

a/ Computed from survey responses.
b/ Computed as the output multiplier multiplied by direct spending.
c/ Computed as total income effects (Table 6) multiplied by direct spending.
d/ Computed as total employment effects (Table 7) multiplied by direct spending.

generated the largest output impact of $29.2 million (Table 13). The estimated total impact of private boat angler expenditures in 1978 is $47.6 million in output.

The impact on regional income is estimated as direct spending multiplied by the sectoral total income effects per one dollar change in final demand (Table 6). It is estimated that in 1978 private boat angler expenditures in the region generated $16.8 million of income throughout the regional economy. The sector with the greatest income impact was marina and boat sales at $12.0 million.

The total employment created in the regional economy due to the expenditures of private boat anglers in 1978 is 1,489.3 man-years. Each sector's total employment impact is estimated as the direct spending multiplied by the sectoral total employment per one million dollars of output (Table 7). Marina and boat sales generated the largest employment impact.

Estimated Economic Impact of Charter Fishing

In Table 14, charter angler expenditures in the region and the estimated economic impact of these expenditures on regional output, income and employment are presented. In 1978 charter boat anglers spent

Table 14. Impacts of Charter Boat Angler Expenditures on Total Regional Output, Income and Employment, 1978

Sectors	Direct Spending[a/] ($ Millions)	Output[b/] ($ Millions)	Income[c/] ($ Millions)	Employment[c/] (Man-Years)
Charter fishing	1.83	4.09	1.39	106.69
Eating and drinking	0.10	0.18	0.02	2.94
Retail	0.16	0.22	0.08	9.97
Hotel and lodging	0.04	0.07	0.01	1.88
Miscellaneous services	0.01	0.02	0.002	0.40
Marina and boat sales	0.01	0.02	0.01	0.63
Total	2.15	4.60	1.51	122.51

a/ Derived from private boat angler survey responses using 1978 charter boat angler hours.

b/ Computed as the output multiplier multiplied by direct spending.

c/ Computed as total income effects (Table 6) multiplied by direct spending.

d/ Computed as total employment effects (Table 7) multiplied by direct spending.

$2.15 million in the region. The largest expenditures of the charter anglers were for the output (services) of the charter fishing industry.

The estimated impact of charter angler expenditures on regional output is estimated as the direct spending by charter anglers in that sector multiplied by the sectoral output multiplier. This is summed for all sectors to obtain the total regional output impact estimated at $4.6 million. Charter fishing has the highest output impact among all the sectors from which charter boat anglers make direct purchases.

As a result of the charter angler expenditures, regional income and employment increased throughout the region in 1978 by $1.5 million and 122.5 man-years, respectively. The total income (employment) impact for each sector is estimated as the total direct spending multiplied by sectoral total income (employment) effects per one dollar change in final demand.

Estimated Total Economic Impact of Ohio Lake Erie Sport Fishing

To estimate the total impact of Ohio Lake Erie sport fishing on regional output, income and employment, the impacts of the private boat anglers (Table 13) and of the charter anglers (Table 14) are summed in Table 15. The two sport fishing activities resulted in total direct expenditures of $28.7 million in 1978. The total impact of this expenditure on the region's output, income and employment in 1978 is estimated, respectively, as $52.2 million, $18.3 million and 1616.0 man-years.

Allocation of Lake Erie to Commercial Versus Sport Fishing

The economic impact of potential policies and regulations of the ODNR on the commercial fishing sector, on sport fishing and on the

Table 15. Total Economic Impact of Ohio Lake Erie Sport Fishing, 1978

Sectors	Direct Spending ($ Millions)	Output ($ Millions)	Income ($ Millions)	Employment (Man-Years)
Marina and boat sales	15.21	29.22	12.01	959.73
Boat, ship building repair	1.30	2.64	1.07	40.00
Charter fishing	2.04	4.60	1.51	122.51
Eat and drink	3.50	6.20	0.60	102.94
Retail	5.06	6.83	2.63	315.24
Hotel and lodging	1.44	2.41	0.46	68.13
Miscellaneous services	0.19	0.33	0.04	7.51
Total	28.74	52.23	18.32	1,616.05

Source: From Tables 13 and 14.

regional economy are analyzed in this section under two alternative policy scenarios: (1) the allocation of the total Lake Erie fish harvested in 1978 to sport anglers, with no commercial fish harvest, and (2) the allocation of the total Lake Erie fish harvested in 1978 to commercial fishing, eliminating sport fishing in the region. The base scenario, to which the alternatives are compared, is the actual 1978 distribution of fish harvests between sport and commercial fishing analyzed in the previous two sections. These scenarios are used to examine the trade-off in economic impacts.

In these analyses, it is assumed that commercial fishing effort will change proportionally to harvest. For sport fishing, however, changes in effort from no response to proportional response are examined for scenario one. For scenario two, the sport fishing response is assumed to be proportional.

Allocation to Sport Fishing (Scenario One)

In this scenario, the total Lake Erie fish harvested in 1978 is allocated to sport anglers with no commercial fish harvests. Sport anglers and commercial fishermen together harvested fish valued at $9.3

Table 16. Estimated Lake Erie Fish Harvests of Major Species and Price Per Pound, 1978[a/]

Species	Sport Harvests lbs.	%	Commecial Harvests lbs.	%	Average Price Per lb.	Total Value of Harvests[c/]
Yellow Perch	2,549,000	56	1,961,000	44	$ .67	2,961,400
Walleye	3,339,000	100	0	0	$1.25[b/]	4,173,750
White Bass	737,500	31	1,623,000	69	$ .63	1,486,800
Drum	800,000	43	1,176,000	57	$ .05	102,800
Channel Catfish	189,500	48	204,500	52	$ .54	212,760
All others	na	na	4,114,500	100	$ .11	452,595
Total	7,605,000	46	9,079,000	54		9,390,105

a/ The 1978 estimated Lake Erie fish harvests data is found in Status (1979).

b/ Commercial fishermen were not allowed to take walleye in 1978. The average price per lb. estimate is the price received by Canadian commercial fishermen for walleye in 1978.

c/ Total value of harvests is estimated as the average price per pound multiplied by total pounds of specie harvested. The monetary value for the sport angler harvests are based on dock value prices received by commercial fishermen in 1978.

na = not available

million in 1978 when valued at dockside prices (Table 16). The sport angler share was $6.4 million (68.6 percent). The commercial fishing share was $2.5 million.[8/] Under this scenario, the $2.5 million fish harvested by commercial fishermen would be made available to sport anglers.

The commercial fishing impact of this policy on the economy will be not only the loss of $2.5 million commercial fishing output, but also the output, income and employment that this sector creates directly and indirectly through its linkages with other regional economic sectors. The total economic impacts on output, income and employment are estimated using the estimated output of food and kindred products resulting from commercial fishing purchases and Appendix equations A.20, A.22 and A.21, respectively, and presented in Table 11. This policy would result in a decrease of $9.83 million in output, $1.03 million in income and 103.5 man-years of employment (Table 17). The distribution of these decreases will be largest in sectors that are most closely related to the commercial fishing (Table 8) and food processing sectors.

Lake sport anglers gain an additional $2.5 million of fish to be harvested. It is not likely that all of these fish would be harvested by sport anglers. Some species are currently not sought by sport anglers. From Table 16, it is estimated that 86 percent or $2.1 million (yellow perch $1.10 million, white bass $0.88 million and catfish $0.09 million) of the commercial fish harvested in 1978 are species sought by

Table 17. The Net Economic Impact Due to the Elimination of the Commercial Fishing Sector from the Region, 1978

	Commercial Fishing[a/]	Sport Fishing[b/]	Net Economic Impacts
	Expected Decreases	Expected Increases	
Output ($ millions)	9.83	0 to 20.37	-9.83 to 10.54
Income ($ millions)	1.03	0 to 7.14	-1.03 to 6.11
Employment (man-years)	103.5	0 to 630.26	-103.5 to 526.76

a/ From Table 11.

b/ The estimated maximum output, income and employment increases are calculated as 39 percent of the output, income and employment impacts in Table 15.

8/ The estimated total value of the commercial fish harvests in Table 16 is $2.9 million. This is different from the ODNR value of $2.5 million. This discrepancy may be due to the use of average (fish) price per pound in the estimates of Table 16. In this study the ODNR estimate of $2.5 million for commercial fishing and $6.4 million for sport fishing is used throughout the analysis.

sport anglers. If sport anglers made no additional expenditures to harvest these fish, then the expected increase in economic impact from sport fishing is zero (Table 17, column 2). Since the primary species made available from this policy is yellow perch, which is harvested in the autumn, it is not obvious that sport anglers will make major new expenditures to harvest these fish.

If sport anglers increase expenditures for the newly available fish in proportion to those expenditures on which the model is based, then an additional $2.5 million of fish allocated to sport fishing implies a 39 percent increase in sport angler expenditures over 1978 expenditures, or an increase of $11.2 million. This increase would result in an additional $20.4 million of output in the regional economy, or 39 percent of the total output impact in Table 15. The maximum impact of the sport angler expenditures on the region's income is $7.1 million in 1978, while the estimated maximum employment impact is 630.3 man-years.

In the last column of Table 17 are shown the net economic impacts of the elimination of commercial fishing from the region and allowing the sport sector to harvest the $2.5 million commercial harvest. These estimates are negative or positive depending upon the amount of additional sport angler expenditures. Two factors would keep sport anglers from increasing expenditures by $11.2 million. First, about 15 percent of the value of fish species released to sport fishing is of species not sought by sport anglers. Second, yellow perch fishing is concentrated in the autumn after the peak sport fishing season. If the region is to break even from this policy scenario, sport anglers would have to increase their expenditures by at least $5.4 million to generate a total economic impact large enough to offset the loss of commercial fishing activity. This means that sport angler expenditures would have to increase by about 19 percent of 1978 sport angler expenditures.

Allocation to Commercial Fishing (Scenario 2)

Under alternative policy scenario 2, the total $9.3 million of Lake Erie fish harvested in 1978 is allocated to the commercial fishing sector, in effect eliminating sport fishing activity in the region, or an additional $6.4 million of fish to be harvested by commercial fishermen. It is assumed that the allocation of the sport fishing harvests to commercial fishing would directly increase commercial fishing output by $6.4 million over its 1978 level of $2.5 million, which is 2.56 times the 1978 commercial fishing output. The estimated increases in regional output, income and employment due to the increased commercial fishing activity in the regional are estimated by Appendix equations A.20, A.22 and A.21, respectively, or as 2.56 multiplied by the respective output, income and employment impacts of the commercial fishing sector in Table 11.

As shown in Table 18, the allocation of the total Lake Erie fish harvests to commercial fishing would increase regional output, income and employment from commercial fishing, respectively, by $25.16 million, $2.64 million and 265.0 man-years. These estimates like those in Table

11 take account of the extensive forward linkages of the commercial fishing sector to food and kindred products.

Elimination of sport fishing from the region would imply the elimination of sport angler expenditures and their estimated impact that is presented in Table 15 and is repeated in Table 18. The net losses in regional output, income and employment from policy scenario 2 are estimated respectively as $27.1 million, $15.7 million and 1,351.0 man-years.

Summary

The analysis of the trade-off between commercial and sport fishing in the region implies that for every $1 million commercial fish allocated to sport fishing, food and kindred products output declines by $2.3 million ($5.72 million 2.5), which reduces regional output by an estimated $3.9 million, income by $0.41 million, and employment by 41.4 man-years. At the same time sport anglers are expected to respond to changes in fish available for harvest. This expected response ranges from zero response to a response proportional to the new allocation of fish (Table 17). If sport anglers do not increase expenditures, the region loses the decrease in commercial generated output, income, and employment. If sport anglers make a proportional increase in expenditures of $4.5 million, the region would gain $8.2 million in output, $2.8 in income and 253.2 man-years of employment from sport fishing. At this upper bound, the net gain to the region would be $4.3 million of output, $2.4 million of income, and 211.8 man-years of employment. How much sport anglers increase their expenditures depends on their response to increased availability of yellow perch in the autumn.

Table 18. The Net Economic Impacts of Elimination of Sport Fishing Activity in the Region, 1978

	Commercial Fishing[a/] Expected Increases	Sport Fishing[b/] Expected Decreases	Net Economic Impacts
Output ($ millions)	25.16	52.23	-27.07
Income ($ millions)	2.64	18.32	-15.68
Employment (man-years)	265.0	1,616.05	-1,351.05

a/ The estimated output, income and employment increases are calculated by Appendix equations A.20, A.22 and A.21, respectively, or as 2.56 multiplied by commercial fishing estimates in Table 11.

b/ From Table 15.

Conclusions

The general objective of this study was to examine the economic impact of the Lake Erie fishery and other Lake Erie industries on the Northern Ohio regional economy. This objective was accomplished by developing a 43 sector input-output model for a seventeen county region in Northern Ohio: Ashtabula, Cuyahoga, Erie, Geauga, Huron, Lake, Lorain, Lucas, Mahoning, Medina, Ottawa, Sandusky, Seneca, Summit, Trumbull, Portage and Wood.

The five Lake Erie endogenous sectors (commercial fishing, charter fishing, water transportation, mineral extraction, and marina and boat sales) and the portion of amusement and recreation attributable to Lake Erie generated $412.5 million of output, $110.1 million of income and generated 8877 man-years of employment in 1978. If these sectors were eliminated and not replaced by any alternative activities in the region in 1978, the total (direct and indirect) impact on output, income and employment of the regional economy are respectively $675.8 million, $211.3 million and 12,312 man-years.

Lake Erie sectors make their major input purchases from finance and insurance, miscellaneous services, chemicals and allied products, and boat-ship building and repair. The Lake Erie sectors sell their output to a large number of economic sectors.

Lake Erie sport anglers expended $28.7 million in 1978. The estimated total economic impact of these expenditures on the region's output, income and employment in 1978 are, respectively, $52.2 million, $18.3 million and 1,616.0 man-years of employment. This estimate cannot be added to the estimated economic impact of the six endogenous sectors because sport anglers make large purchases from marina and boat sales and charter fishing.

The economic impact of alternative allocations of the Lake Erie fishery between commercial and sport fishing and on the regional economy were analyzed under two alternative policy scenarios: allocation of the total 1978 Lake Erie fish harvest to sport anglers and allocation of the total 1978 Lake Erie fish harvest to commercial fishing. A reallocation of $1 million from commercial to sport fishing would reduce food and kindred products output by an estimated $2.3 million, and total regional output, income and employment, respectively, by $3.9 million, $0.5 million and 41.4 man-years.

The expected sport angler response to this reallocation ranges from zero if sport anglers make no additional expenditures to $4.5 million if sport anglers increase expenditures in proportion to the increased allocation of fish. The total impact of the reallocation from sport fishing is zero to $8.2 million of output, zero to $2.8 million of income and zero to 253.2 man-years of employment. Since further reallocations to sport fishing are primarily yellow perch and white bass, and fishing is dominated by walleye activity, sport anglers are not likely to make

increases in expenditure in proportion to the additional fish allocations implied by the model. The yellow perch harvest is concentrated in the autumn after the peak sport fishing summer period.

The net economic impact of reallocating $1 million of fish from commercial to sport fishing is the sum of the commercial and sport impacts. The net impacts are $-3.9 to 4.3 million of output, $-0.4 to 2.4 million of income, and -41.4 to 211.8 man-years of employment.

In conclusion, the total economic impact of Lake Erie on this 17 county regional economy is small when measured by this standard. However, the economic sectors of Lake Erie contain a vital link between Ohio and international water transportation and form the basis for a large recreation industry which has been growing rapidly in recent years with the return of large walleye populations. The results of the model support past reallocations of the Lake Erie fishery from commercial to sport fishing. When the remaining species to be reallocated are examined, caution about further reallocations from commercial to sport is needed because sport anglers might not increase effort to harvest additional yellow perch or white bass. Continued monitoring of the response of sport anglers to changes in the availability of these species is vital to future allocation decisions.

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Appendix A

Mathematical Specification of the Input-Output Model

The transactions table is the basic foundation of the input-output model. It is from this table that the technical coefficients matrix is derived. The transactions table records total sales and purchases made by economic sectors of a given region during a given period of time, usually one year. Each economic sector is a producer of goods and services as well as a purchaser of goods and services for use in its production process.

The table shown in Figure A1 represents an input-output transactions (gross flows) table. Entries in an input-output transactions table are arranged in rows and columns. Along each row is distributed the sales of a given producing sector to all other purchasing sectors and to final demand sectors. The columns show the purchases of a given sector from all other producing sectors and from primary input sectors.

As shown in Figure A1, the transactions table can be divided into four quadrants. Quadrant I represents final demand and contains all exogenous sectors which determine the level of output in the economy. The exogenous sectors are household expenditures, private investment, government expenditures and exports. Quadrant II represents the processing sectors. These are the endogenous sectors that sell their output to other processing sectors and final demand. Quadrant III represents the payment sectors. It includes payments to households in terms of wages, interest and profits; payment of taxes to governments; payments for imports, and capital consumption or depreciation. Quadrant IV represents the direct transactions between final demand sectors (Quadrant I) and payment sectors (Quadrant III). It shows the primary inputs and imports purchased directly by the final demand sectors.

The transactions table can be expressed by a linear equation system including sets of output equations, input equations, and identity equations:

$$(A.1)\quad X_i = \sum_{j=1}^{k} x_{ij} + \sum_{j=k+1}^{n} f_{ij} \quad ; \forall\ i=1,n$$

$$(A.2)\quad X_j = \sum_{i=1}^{k} x_{ij} + \sum_{i=k+1}^{m} r_{ij} \quad ; \forall\ j=1,m$$

$$(A.3)\quad X_i = X_j \quad ; \forall\ i=j;\ i,j=1,k$$

$$(A.4)\quad \sum_{i=k+1}^{m} x_i = \sum_{j=k+1}^{n} x_j ;\ i=k+1,m;\ j=k+1,n$$

where,

X_i = total output of sector i

Figure A1. Input-Output Transactions Table

Output To / Inputs From		Purchasing Sectors 1 . . . . . j . . . . . n	Final Demand: Households	Final Demand: Private Investments	Final Demand: Government	Final Demand: Export	Total Gross Output
Producing Sectors	1	X_{11} . . . . . X_{1j} . . . . . X_{1n}	C_1	I_1	G_1	E_1	X_1
	.	. Quadrant II .	.	. Quadrant I		.	.
	i	X_{i1} . . . . . X_{ij} . . . . . X_{in}	C_i	I_i	G_i	E_i	X_i
	.	.	.	.	.	.	.
	n	X_{n1} . . . . . X_{nj} . . . . . X_{nn}	C_n	I_n	G_n	E_n	X_n
Household		L_1 . . . . . L_j . . . . . L_n	L_C	L_I	L_G	L_E	L
Depreciation		D_1 . . Quadrant III . . D_n	D_C	Qudrant IV		D_E	D
Government		G'_1 . . . . . G'_j . . . . . G'_n	G'_C	G'_I	G'_G	G'_E	G'
Imports		M_1 . . . . . M_j . . . . . M_n	M_C	M_I	M_G	M_E	M
Total Gross Outlays		X_1 . . . . . X_j . . . . . X_n	C	I	G	E	X

X_j = total inputs used by sector j

$\Sigma_{j=1}^{k} x_{ij}$ = total intermediate output sold by sector i to itself and to all other endogenous sectors

$\Sigma_{i=1}^{k} x_{ij}$ = total intermediate inputs purchased by sector j from itself and from all other endogenous sectors

$\Sigma_{j=k+1}^{n} f_{ij}$ = total final demand for output of sector i

$\Sigma_{i=k+1}^{m} r_{ij}$ = total primary inputs purchased by sector j from all primary input sectors

Equation A.1 shows how the output of a given sector is used by k endogenous intermediate sectors ($\Sigma_{j=1}^{k} x_{ij}$) and n-k exogenous final demand sectors ($\Sigma_{j=k+1}^{n} f_{ij}$). The final demands include household purchases, exports, government purchases, gross inventory accumulation and gross private capital formation [Miernyk, 1965; Richardson, 1972; Jones, Jr., 1978]. The final demand sectors are the autonomous sectors which determine the level of output of an economy. The final demand sectors in a small economy's I-O model are in general summarized into four sectors: "Household," "Private Investment," "Government" and "Export" demand sectors; Figure A1. "Household," "Private Investment" and "Government" sectors are often aggregated further into a single "Consumption" sector.

Equation A.2 shows input purchases by an endogenous sector from all other endogenous sectors ($\Sigma_{i=1}^{k} x_{ij}$) and primary input sectors ($\Sigma_{i=k+1}^{m} r_{ij}$). The primary inputs include payments to households in the form of wages, salaries, rental income, interest income and profits; payments to government; imports of goods and services; inventory depletion; and capital consumption or depreciation [Miernyk, 1965; Jones, Jr., 1978]. Primary input sectors of a small scale economy's I-O analytical system are commonly aggregated into Labor, Depreciation, Government and Imports. The first three sectors are often represented by a single "Value Added" sector.

The total amount of each primary input employed is subject to the constraint that the total amount of the primary inputs used by the k endogenous sectors be equal to the total amount of that resource available within the economy under consideration; i.e.,

$$(A.5) \quad \bar{r}_i = \Sigma_{j=1}^{k} r_{ij} \; ; \forall \; i=k+1,m$$

where $\bar{r}_i$ stands for the total amount of primary input i available within the considered economy.

As an equilibrium condition of the economy under consideration, equation A.3 states that total output must be equal in value terms to

total inputs for a given endogenous sector. Equation A.4 simply shows that total final demand must be equal in value terms to total primary inputs for the entire economy in equilibrium. Equation A.4 further implies that as a whole the direct transactions between the final demand and primary input sectors must be in equilibrium. Stated by equations A.3 and A.4 together is then that for the entire economy in equilibrium the total input in value terms must be the same as the total output; i.e., $\Sigma_{i=1}^{m} X_i = \Sigma_{j=1}^{n} X_j$.

The Technical Coefficients Matrix

The matrix of the elements x_{ij} in the flow table is called the transtions matrix. From this transactions matrix, the technical coefficients matrix can be defined. The i,jth element of the technical coefficients matrix (a_{ij}) is

$$(A.6) \quad a_{ij} = x_{ij} / X_j \; ; \forall \, i,j=1,k$$

The technical coefficient indicates what proportion of total inputs used by sector j is purchased from sector i, or it shows direct purchase of a given endogenous sector from itself and every other endogenous sector per unit of output.

By rewriting equation A.6 as $x_{ij} = a_{ij} X_j$, and imposing the identity equation A.3, equation A.1 can be restated as

$$(A.7) \quad X_i = \Sigma_{j=1}^{k} a_{ij} X_j + \Sigma_{j=k+1}^{n} f_{ij}$$

This equation shows the production relationship in the I-O table using the technical coefficients.

The technical coefficients matrix for primary inputs can be established in a similar way. The element of the technical coefficients matrix for the primary input (v_{ij}) is defined as

$$(A.8) \quad v_{ij} = r_{ij} / X_j \; ; \forall \; i=k+1,m; \; j=1,k$$

It shows the amount of the primary input used as a proportion of total input by the jth endogenous sector. Since equation A.8 implies that $r_{ij} = v_{ij} X_j$, it follows from equation A.5 that

$$(A.9) \quad \bar{r}_i = \Sigma_{j=1}^{k} v_{ij} X_j \; ; \forall \; i=k+1,m$$

where $\bar{r}_i$ is the total amount of the primary inputs available to all endogenous and exogenous sectors. Equation A.9 states the primary input

constraint on the whole economy under consideration in terms of the technical coefficients for primary input use.

The Interdependence Coefficients Matrix

Changes in the final demand have indirect effects in addition to direct effects on the sectoral outputs through successive rounds of transactions based on the interrelation of the endogenous sectors. The technical coefficient shows only the direct effect. The total effect as the sum of the direct and the cumulative indirect effects can be measured by interdependence coefficients.

The interdependence coefficient is defined from the technical coefficients matrix. Equation A.7 can be restated in matrix form as:

(A.10) $X = AX + F$

where X = k x 1 column vector of sectoral total outputs (X_i)

A = k x k matrix of technical coefficients (a_{ij})

F = k x 1 column vector of total final demand ($F_i = \sum_{j=k+1}^{n} f_{ij}$).

Equation A.10 can be restated as:

(A.11) $F = (I - A) X$, or

(A.12) $X = (I - A)^{-1} F$, or

(A.13) $X = BF$

where I is a k x k identity matrix, and B stands for $(I - A)^{-1}$, the k x k interdependence coefficients matrix with elements b_{ij}.

The matrix (I - A) in equation A.11 is called the Leontief I-O matrix [Miernyk, 1965]. This matrix is inverted as in equation A.12 to obtain a matrix of direct and indirect requirements of intermediate inputs per dollar of final demand. The interdependence coefficient b_{ij} indicates the sum of the final demand change and direct and indirect changes in the requirements of intermediate inputs used by the jth sector as a result of a one dollar change in final demand of the ith sector. The direct changes in input requirements are given by the technical coefficients matrix A. The indirect changes in input requirements can be obtained as B - (I + A), the total requirements less the initial change in final demand and the direct requirements.

The primary input constraint (equation A.9) can also be restated in matrix form as

(A.14) $R = VX$

where R is a (m-k) x 1 vector of total primary inputs available and V stands for the (m-k) x k matrix of the technical coefficients for primary input use with elements v_{ij}. Substitution of equation A.13 into equation A.14 yields

(A.15) $R = VBF$, or

(A.16) $R = ZF$

where Z (=VB) is the matrix with the elements z_{ij}; i=k+1,m; j=1,k. The element z_{ij} shows the total change (direct and indirect) in the use of primary input i per one dollar change in final demand for the output of sector j.

Impact Coefficients (Multipliers)

The output multiplier indicates how total production will change throughout the economy as final demand is changed in any one sector of the economy. The output multiplier for a given endogenous sector j is

(A.17) $$\lambda_j^o = \sum_{i=1}^{k} b_{ij}$$

The output multiplier for sector j is the sum of the elements in column j of the interdependence coefficients matrix.

The employment multiplier for a given sector indicates total employment changes in the economy resulting from a unit change in direct employment in that sector. The basic assumption underlying the employment multiplier is that, for each endogenous sector, a linear relationship exists between employment and output [Richardson, 1972; Jones, Jr., 1978]. The employment multiplier is computed from the direct and indirect employment effects estimated via an I-O model. The employment multiplier for a given sector j is

(A.18) $$\lambda_j^u = \left(\sum_{i=1}^{k} (U_i / X_i)\, b_{ij}\right) / (U_j / X_j)$$

where U is the employment of each endogenous sector.

The denominator in equation A.18 is average employment per unit of output in sector j, or the direct employment effect per unit change in final demand. The numerator is the sum of interdependence coefficients for sector i weighted by average employment per unit of output in each endogenous sector [Doeksen and Schreiner, 1974].

The most common I-O employment multipliers are the Type I and Type II. The employment multiplier defined here is the Type I. The Type II employment multiplier is the ratio of direct, indirect and induced employment effects resulting from a unit change in final demand to direct effects. The direct, indirect, and induced employment effects are estimated by multiplying the column vector of the interdependence

coefficients matrix with the household sector endogenous by a row vector of average employment per unit of output in each endogenous sector. The direct and indirect effects for the Type I multiplier are estimated on the basis of the interdependence coefficients matrix with the household sector exogenous. For more details, see Jones, Jr. (1978), Palmer, et al. (1978), Richardson (1972), and Miernyk (1965).

The income multiplier measures the total change in income throughout the economy resulting from a unit change in income in a given sector in response to a final demand change. The basis of the income multiplier is that a certain amount of income is generated with each change in the output of each endogenous sector [Jones, Jr., 1978]. The income multiplier for a given sector j is the ratio of total (direct plus indirect) income effect to direct income effect resulting from a change in final demand

$$(A.19) \quad \lambda^{y}_{j} = (\Sigma^{k}_{i=1} (Y_i / X_i) b_{ij}) / (Y_j / X_j)$$

where Y is income of individual endogenous sectors.

The direct income coefficient for sector j, the denominator in equation A.19, is the average income per unit of output in sector j. The total (direct plus indirect) income effect, the numerator in equation A.19, is obtained by multiplying the column vector of the direct input coefficients by average income for each sector [Doeksen and Schreiner, 1974].

There are Type I and Type II income multipliers, which are similar to Type I and Type II employment multipliers. The income multiplier defined in equation A.19 is the Type I multiplier. The type II income multiplier is the ratio of the direct, indirect and induced income effects resulting from a unit change in final demand to the direct income effect. The Type I income multiplier is computed from the interdependence coefficients matrix with the household sector exogenous, while the Type II multiplier is estimated from the interdependence coefficients matrix with the household sector endogenous. For details, see Richardson (1972) and Jones, Jr. (1978).

Adjusted Impact Coefficients

In the estimation of the total economic impact of the Lake Erie economic sectors, the change must be measured by output rather than final demand. Several of the impact coefficients must be modified (adjusted) to obtain unbiased estimates of the total impacts when the change is measured by output rather than final demand: the output multiplier and the total and direct employment and income effects.

The output multiplier, λ^{o}_{j}, measures the total output change from a unit change in final demand. It includes the direct and indirect output produced as a result of the change in final demand in addition to the change in final demand. The direct and indirect output produced per

unit change in final demand is equal to the diagonal element of sector j minus one ($b_{jj} - 1$). The diagonal element (b_{jj}) is thus an appropriate deflator in order to convert the output multiplier to one which can be applied to output rather than to final demand. The adjusted output multiplier is defined as

$$(A.20) \quad \lambda_j^{o*} = \lambda_j^{o} / b_{jj} = \sum_{i=1}^{k} b_{ij} / b_{jj}$$

The employment (A.18) and income (A.19) multipliers are not affected by the measurement of change by output rather than final demand. However, the total effects (numerator) and the direct effects (denominator) of both multiplier are affected, because they are measured per unit of final demand. As with the output multiplier, deflation of the direct and total effects by the diagonal element b_{jj} converts the direct and total effects to adjusted direct and adjusted total effects which estimate these effects per unit of output:

$$(A.21) \quad \lambda_j^{u} = \left(\sum_{i=1}^{k} (U_i / X_i)(b_{ij} / b_{jj}) \right) / \left((U_j / X_j) / b_{jj} \right)$$

$$(A.22) \quad \lambda_j^{y} = \left(\sum_{i=1}^{k} (Y_i / X_i)(b_{ij} / b_{jj}) \right) / \left((Y_j / X_j) / b_{jj} \right)$$

Price Adjustment

Problems of the I-O model's static nature can be reduced through the price adjustment on the technical coefficients matrix. The out-of-date technical coefficients matrix (A_o) can be updated to a matrix for time t (A_t) by pre-multiplying by a diagonal matrix of price indices (P) for all endogenous sectors and post-multiplying by a diagonal matrix of the reciprocals of the price indices (P^{-1}) [Stone and Brown, 1962],

$$(A.23) \quad A_t = P A_o P^{-1}$$

This relative price adjustment multiplies each row by the price index for sector i and each column by the inverse of the price index for sector j. As a result of this adjustment, each technical coefficient (a_{ij}) is increased by the increased cost of purchasing from sector i (p_i) and decreased by the increased value of the output for sector j ($1 / p_j$); i.e., $a_{ij}^{t} = p_i \, a_{ij}^{o} \, (1 / p_j)$. In this price adjustment, it is assumed that price differences operate uniformly along rows [Czamanski and Malizia, 1969], that substitution of one product for another operates uniformly along the rows [Stone and Brown, 1965; Czamanski and Malizia, 1969], and that changes in the production function operate uniformly along the columns [Stone and Brown, 1962, 1965].

Appendix B

Regional I-O Model: Empirical Generation

The regional I-O model of the seventeen county northern Ohio region is derived from the 1978 U.S. national I-O model updated from the 1972 model. Presented are the detailed step-by-step procedures of this derivation. The overall presentation follows the sequential order of research procedures visualized in Figure B1.

Selection of Economic Sectors (Step 1)

Industries reported in the 1978 Ohio County Business Patterns (USDC, 1978) data for the study region are grouped into 40 endogenous sectors according to the following two categories: (1) industries producing similar and closely related products, and (2) the conformity with the level of aggregation used by the Bureau of Economic Analysis (BEA) in preparing the U.S. national I-O model for 1972. In addition, the charter fishing, commercial fishing, and marina and boat sales sectors were developed from primary data surveys or from other research. The 43 regional endogenous sectors are listed in Table B1.

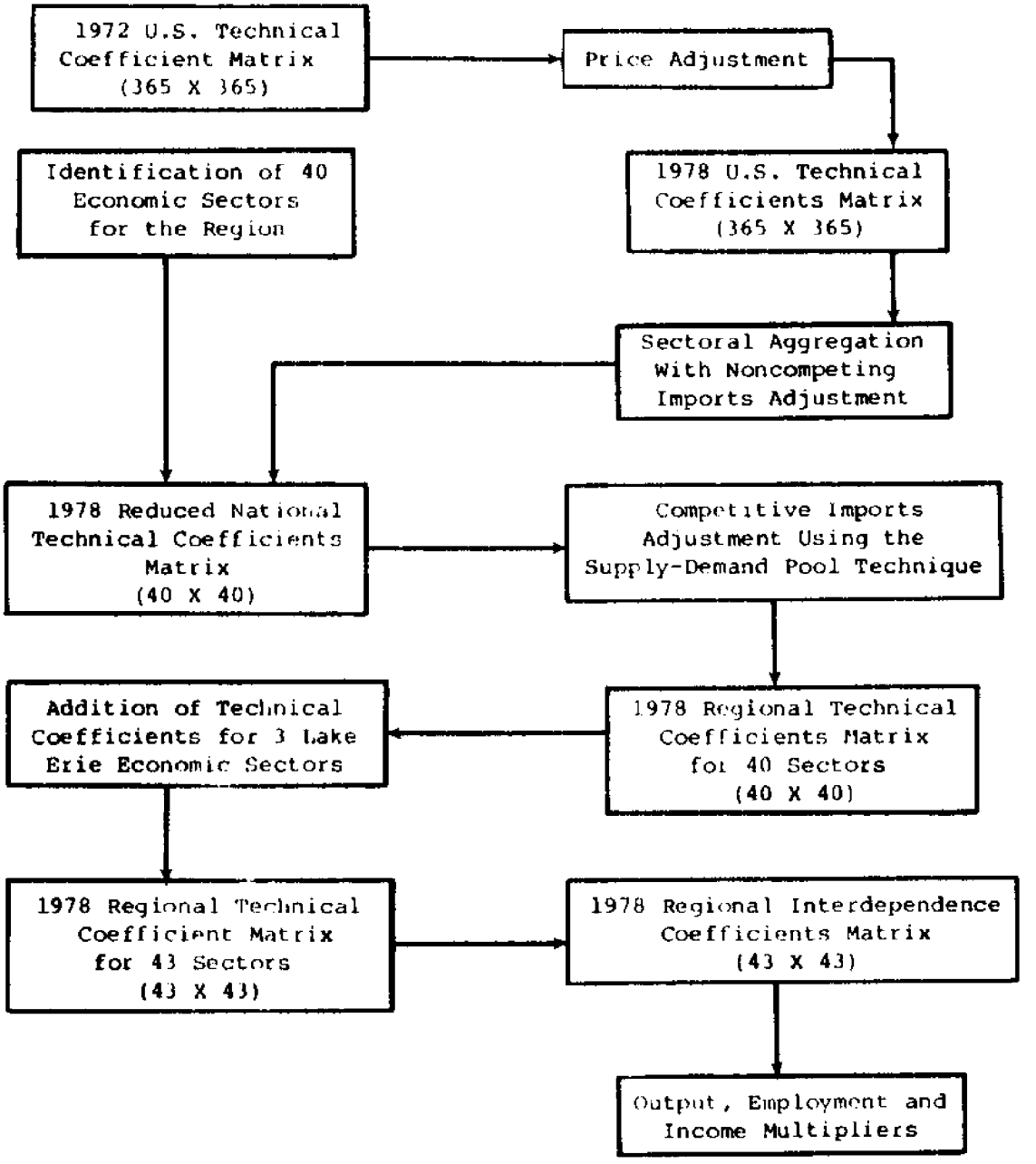
In addition to the 43 endogenous sectors listed in Table B1, the regional I-O model in this study includes Value Added and Imports as the primary input sectors, and Consumption and Exports as the final demand sectors. Entries for the primary input sectors are wages and value added, and imports, respectively. Private purchases and purchases by federal, state, and local governments are the elements of the consumption demand vector. Exports are defined as residuals.

Reduced National Input-Output Model (Step 2)

The most recent national technical coefficients matrix is for 1972 at two different Standard Industrial Classification (SIC) levels: 2-digit and 4-digit. The matrix at the 2-digit SIC level includes 85 endogenous sectors [Ritz, 1979] or 97 endogenous sectors [SA, 1981], and the matrix at the 4-digit SIC level includes 496 endogenous sectors [USDCa, 1979] or 365 endogenous sectors. The 365 sector matrix is not published, but is available on computer readable magnetic tape.

The major problem in deriving the regional technical coefficients from the national ones is product and industry mix [Miernyk, 1965; Richardson, 1972]. This problem is attributable to the possible differences between regional and national production functions and between regional and national industrial compositions. The differences in the production functions, according to Boisvert and Bills (1976), can possibly be corrected by using highly disaggregated national coefficients, because the input structure of industries at the 4-digit SIC level is more similar throughout the nation than at the 2-digit SIC

Figure B1. The Research Procedures



Adapted from Ro, 1982.

Table B1. Aggregated Endogenous Sectors in the Northern Ohio Regional I/O Model

Sectors	Bureau of Economic Analysis Classification	Standard Industrial Classification
Lake Erie Sectors		
Commercial fishing	3	9
Charter fishing	76	n/a
Other Lake Erie Sectors		
Water transportation	65	44
Mineral Extraction	9	14
Marina and boat sales	69	n/a
Other Industries		
Livestock	1	2
Crops	2	1
Forestry Products	3	8
Other mining	56,7,8,10	10-13
Construction	11-12	15-17
Food and kindred products	14	20
Textiles	16-19	22-23
Wood and lumber	20-21	24
Furniture and fixtures	22-23	25
Paper and allied products	24-25	26
Printing and publishing	26	27
Chemicals and allied products	27-31	28
Rubber and leather products	32-34	30-31
Stone, clay, glass products	35-36	32
Primary iron and steel mfg.	37	33
Primary nonferrous metals	38-39	33
Heat, plumbing, fabricated metals	40-41	33
Other fabricated products	42	34
High technology machinery	50-52	35
Miscellaneous machinery	43-49	35
Electric and electronic equipment	53-58,62	36
Motor vehicle equipment	59-61	37
Boat-ship building and repair	61	37
Other manufacturing	64,13,15	38,39
Non-water transportation	65	40-43,45-47
Communication	66-67	48
Electricity, gas and sanitary	68	49
Wholesale	69	50,51
Retail	69	52-57,59
Finance and insurance	70	60-64,67

Table B1, continued

Sectors	Bureau of Economic Analysis Classification	Standard Industrial Classification
Real Estate	71	65-66
Hotel and lodging	72	70
Eating and drinking establishments	74	58
Auto repair services	75	75,76
Recreation and amusement	76	79,84
Education services	77	82,83
Health services	77	80
Miscellaneous services	4,73,77,78,79	72,3,78,88,86,89,81

n/a = not available.

Source: Executive Office of the President, 1972, and USDC, 1979.

level; see also Miernyk (1965). At the 4-digit SIC level of sectoral disaggregation, the national coefficients reflect more reliable regional coefficients. Two recent empirical comparisons between I-O models derived from the 2-digit SIC national model and the 4-digit SIC national model with regional survey models confirm this [Brucker and Hastings, 1983, and Cartwright et al., 1981]. For this reason, the present study uses the U.S. national coefficients at the 4-digit SIC level. In his recent study, Kakish (1981) updated the 1972 U.S. national coefficients for 365 sectors at the 4-digit SIC level to 1978. These updated national coefficients are available for the present study on the computer readable magnetic tape. The updating procedure was discussed earlier. For the price indices used in the price adjustment, see Appendix B in Apraku (1983).

The difference in the industrial composition between regional and national economies, on the other hand, can be partially corrected by making an adjustment on the national technical coefficients with regional weights representing the importance of individual sectors in the region. The use of some measure of gross output or value added is considered to be ideal in this weighting scheme, but figures on regional gross output and value added at the 4-digit SIC level are not available in practice, and the weighting scheme often relies exclusively on disaggregated employment data [Shen, 1960; Boisvert and Bills, 1976]. The present study uses regional employment as regional weights in computing the regional technical coefficients from the national coefficients.

Except for agricultural employment, the 1978 regional employment figures are available at the 4-digit SIC level in USDC (1980). Agricultural employment is estimated as regional agricultural output divided by national per capita agricultural productivity. The 1978 data on regional agricultural output and national per capita agricultural productivity are available at the 4-digit SIC level in OARDC (1979) and USDCb (1979), respectively. For the complete figures on 1978 regional employment, see Appendix D in Apraku (1983).

In order to obtain the regional technical coefficients, the 365 sector matrix of the U.S. national technical coefficients is aggregated to 40 endogenous sectors identified in the region (Table B1). The theoretical rationale and the computer program used in this study are described more fully in Kakish and Morse (1983). For those sectors with zero employment, the technical coefficient is transferred to the import row as a noncompetitive import. Of the 365 endogenous sectors of the U.S. national economy 56 sectors had zero production in the region in 1978. The intermediate inputs from these 56 sectors are excluded from the regional transactions and allocated directly to regional imports.

The national technical coefficients for the remaining 309 endogenous sectors are aggregated following the conventional two steps: the aggregation by columns and then rows [Bosivert and Bills, 1976; Kakish and Morse, 1983]. The technical coefficients for a number of individual

sectors in the original national matrix (a^*_{gq}) are aggregated by columns, weighting each sector by employment at the 4-digit SIC level (U_q)

$$(B.1) \quad a^*_{gj} = \Sigma_{q\varepsilon\sigma_j} a^*_{gq} \, (U_q \, / \, \Sigma_{q\varepsilon\sigma_j} U_q), \; \sigma_j \varepsilon \sigma$$

where σ is the set of 247 endogenous sectors, and σ_j is a subset of σ. This aggregation of a number of columns into one column results in a new non-square matrix (247x40) of the national technical coefficients. The second step aggregates the rows in the non-square matrix (247x40) to yield a square matrix (40x40)

$$(B.2) \quad a^*_{ij} = \Sigma_{g\varepsilon\sigma_i} a^*_{gj}, \; \sigma_i = \sigma_j, \; \sigma_i \varepsilon \sigma$$

This reduced matrix of the national technical coefficients reflects the difference between regional and national industrial composition when it is used in computing the regional technical coefficients matrix [Boisvert and Bills, 1976]. While this matrix has been adjusted for noncompetitive imports, it has not been adjusted for competitive imports. Some of the regional technical coefficients need to be adjusted downward to reflect the fact that regional output is inadequate to service all of the intermediate demand and final demand. This is done in Step 3.

Complete Regional I-O Model (Step 3)

Regional Sectoral Output

In order to generate the regional transactions matrix, complete information on the outputs of all endogenous sectors in the region is needed. Published data provide sectoral outputs for the agriculture (livestock and crops) and the surveyed sectors. For the remaining sectors, sectoral outputs (X_i) are computed on the basis of the regional sectoral employment (U_i) and national sectoral average productivity of labor as the national sectoral output (X^*_i) divided by the national sectoral employment (U^*_i); i.e.,

$$(B.3) \quad X_i = X_j = U_i \, (X^*_i \, / \, U^*_i) \quad , \; \forall \; i=j$$

This procedure was suggested by Jones et al. (1972).

Equation B.3 provides more precise estimates of sectoral outputs of the regional economy if it is applied to highly disaggregated information on output and employment. The 1978 information on the national output is available only at the 2-digit SIC level, however. For this reason, equation B.3 is estimated on the basis of the 1972 national output and employment figures available at the 365 sector level. The estimation includes three steps. First, the 1972 national productivities of labor are computed for the 365 sectors and then updated to 1978. The national productivities of the 40 sector level are shown in Table B2. The 1972 national output figures are available in USDC$_a$ (1979). The

1972 national employment figures are available from $USDC_b$ (1973), $USDL_a$ (1979), $USDL_b$ (1979), USDL (1973) and USDL (1972), see Appendix C in Apraku (1983).

Second, the 1978 regional outputs for the 365 sectors are defined as the regional sectoral employment multiplied by the 1978 national sectoral productivity. Finally, these computed outputs are aggregated to 40 endogenous sectors of the regional economy.

Regional Sectoral Income

Information on income by sector is also not available from the published data. Sectoral incomes for all endogenous sectors within the region (Y_i) are estimated as the regional sectoral employment (U_i) multiplied by the sectoral average annual wage rates or per capita average annual earnings (W_i)

$$(B.4) \quad Y_i = U_i W_i$$

The sectoral per capita average annual earnings are obtained from information on the sectoral per capita average weekly earnings provided in OBESb (1979). Average annual earnings assume 52 weeks per year and 40 hours per week.

Regional Total Consumption Demand

Information on regional consumption demand is not directly available from published data. Consumption demand is the total final demand with export demand excluded. This includes household consumption demand and government consumption demand representing all other consumption demands than exports. Regional total household consumption demand ($f_{.h}$) is estimated as the national total household consumption demand ($f^*_{.h}$) multiplied by the ratio of regional total to national total per household income

$$(B.5) \quad f_{.h} = f^*_{.h} \left(\Sigma_{i=1}^{m} Y_i \;/\; \Sigma_{i=1}^{m} Y_i^*\right)$$

Similarly, regional total government consumption demand ($f_{.g}$) is the national total government consumption demand ($f^*_{.g}$) multiplied by the ratio of regional total to national total output

$$(B.6) \quad f_{.g} = f^*_{.g} \left(\Sigma_{i=1}^{m} X_i \;/\; \Sigma_{i=1}^{m} X_i^*\right)$$

The sum of these two different consumption demands defines the regional total consumption demand other than exports ($f_{..}$)

$$(B.7) \quad f_{..} = f_{.h} + f_{.g}$$

The 1978 information on the national final demand is obtained by updating the 1972 information available in USDCa (1979).

Table B2. 1978 U.S. National Per Capita Productivity Indices (1972 = 100) at the 40 Sector Level of Disaggregation

Regional Endogenous Sector	1972[1/] Productivity (1972 $)	1978[2/] Productivity (1978 $)	1978 Index[3/] (1972 = 100)
LIVSTOCK	40,704	64,136	157.6
CROPS	34,163	61,197	179.1
FORESPRO	2,245	7,261	323.4
MINE-OTR	25,673	66,173	257.8
MINEXTRA	2,911	4,509	154.9
CONSTRUC	165,998	295,202	177.8
FOODKIND	120,622	202,283	167.7
TEXTILES	59,236	82,245	138.8
WOODLUMB	22,105	42,583	192.6
FURNFIXT	11,054	17,103	154.7
PAPRPROD	27,379	47,256	172.6
PRNPUBHS	16,695	32,354	193.8
CHEMPROD	86,847	196,733	226.5
RUBLETHR	26,620	42,648	160.2
STCLYGLS	21,016	36,328	172.9
PRIRSTMG	35,378	70,998	200.6
PRNFMETL	28,126	50,509	179.6
HEATPLFB	26,860	47,145	175.5
OTHERFAB	15,919	27,654	173.7
MACHNERY	43,043	77,991	181.2
MACHNHIT	20,659	30,571	147.9
ELETELTN	53,813	71,781	133.4
MOTVEQUP	80,732	118,894	147.3
BOTSHBLD	4,372	6,672	152.6
OTHERMFG	6,938	11,443	164.9
WATRTRAN	7,455	10,832	145.3
OTHRTRAN	52,688	76,555	145.3
COMMUNIC	30,668	37,845	123.4
ELECTGAS	58,383	111,195	190.5
WHOLSALE	103,883	184,808	177.9
RETAIL	1,488	2,117	142.2
FININSUR	77,469	105,513	136.2
REALESTA	174,919	238,240	136.2
HOTLOGIN	8,350	13,210	158.2
EATDRINK	48,721	81,169	166.6
AUTOSERS	24,551	40,092	163.3
RECAMUSE	12,719	17,756	139.6
WSUXAWEA	12,201	21,206	173.8
HEALTSER	55,305	9,605	173.7
MISCSERV	110,121	174,211	158.2

1/ $USDC_a$ (1979) and Appendix C of Apraku (1983).
2/ $USDC_a$ (1979), Appendix A and $USDC_b$ (1979).
3/ 1978 productivity divided by 1972 productivity.

Regional Technical Coefficients Matrix (Step 3[a])

At this point, the reduced matrix of the national technical coefficients does not contain the noncompetitive imports, but it still contains the competitive imports in its elements. The competitive imports are the regional goods and services imported from outside the region due to the region's insufficient production capacity. The regional technical coefficients matrix is obtained from the reduced national matrix by adjusting these competitive imports through the application of the supply-demand pool technique.

The supply-demand pool technique is a method of generating the regional technical coefficients from the national ones on the basis of the concept of commodity balance of the regional economy under consideration. This approach begins by finding an initial estimate of regional transactions ($\hat{x}_{ij}$) as the product of the regional total input in a given sector j (X_j, equation B.6) and the national technical coefficients (a_{ij}); i.e.,

$$(B.8) \quad \hat{x}_{ij} = a^*_{ij} X_j$$

The regional consumption demand vector ($\hat{f}_{i.}$) is estimated as the region's share of the nation's consumption demand vector

$$(B.9) \quad \hat{f}_{i.} = f^*_{i.} (f_{..}/f^*_{..})$$

where $f_{..}$ and $f^*_{..}$ stand for the total regional and national consumption demand, respectively, and $f^*_{i.}$ is the national consumption demand for the output of sector i. In this expression, $\hat{f}_{i.}$ is defined as the estimated regional consumption demand for the output of sector i.

The commodity balances for individual industries within the region ($\hat{e}_i$) can be estimated as

$$(B.10) \quad \hat{e}_i = X_i - \hat{X}_i$$

where $\hat{X}_i$ are the estimates of the regional total output requirements from an individual sector i; i.e., $\hat{X}_i = \sum_{j=1}^{k} \hat{x}_{ij} + \hat{f}_{i.}$. When the commodity balance is positive or zero (i.e., $\hat{e}_i \geq 0$), imports are assumed to be zero, and the regional technical coefficients are set equal to the national ones ($a_{ij} = a^*_{ij}$). Regional transactions are set equal to the initial estimates ($x_{ij} = \hat{x}_{ij}$) and exports are set equal to the estimated commodity balances ($e_i = \hat{e}_i$).

If the commodity balance of the ith sector is negative ($\hat{e}_i < 0$), the region is assumed to import a part of its input needs for sector i, and the regional technical coefficients (a_{ij}) are set equal to

$$(B.11) \quad a_{ij} = a^{*}_{ij} \, (X_i \, / \, \hat{X}_i).$$

The ratio $(X_i \, / \, \hat{X}_i) < 1$ when $\hat{e}_i < 0$ from equation B.10.

Further consequences of the adjustment by equation B.11 are

$$(B.12) \quad x_{ij} = a_{ij} \, X_j$$

$$(B.13) \quad e_i = 0$$

$$(B.14) \quad \pi_{ij} = \hat{x}_{ij} - x_{ij}$$

where π_{ij} are sectoral imports from sector i by endogenous sectors.

APPENDIX C

Sample Instruments

OSU

The Ohio State University

Department of
Agricultural Economics
and Rural Sociology

2120 Fyffe Road
Columbus, Ohio 43210

Phone 614 422-7911

May 19, 1982

Dear Sir,

Enclosed is a questionnaire which is part of a research project being conducted by the Ohio State University Sea Grant Program. The purpose of this study is to gather information which can be used to evaluate the impact of Lake Erie resources, in particular, the fishery, on the northern Ohio regional economy.

One purpose of this study is to examine how marine supplies and services is related to other Lake Erie activities and to other industries in the northern Ohio economy. Our means of examining these relationships is through information about purchases you make from persons or industries and sales you make to these and other persons or industries. The information you provide about your firm is vital to our analysis of the role of marine services and supplies in Lake Erie activities and the northern Ohio economy.

We urge you to do your best to complete all questions. The two tables are very important to a successful completion of our objectives. Please complete these tables as best you can, making estimates whenever necessary for the year 1981.

We have enclosed for you a map showing the study region. Please use this as a guide for the appropriate questions.

We ask you to complete the questionnaire and return it at your earliest convenience in the enclosed self-addressed envelope. Your responses will be kept completely confidential. The information you provide will not be used in any way where your firm can be identified from its use. The information you provide will be separated from any identification of your firm as soon as it is received.

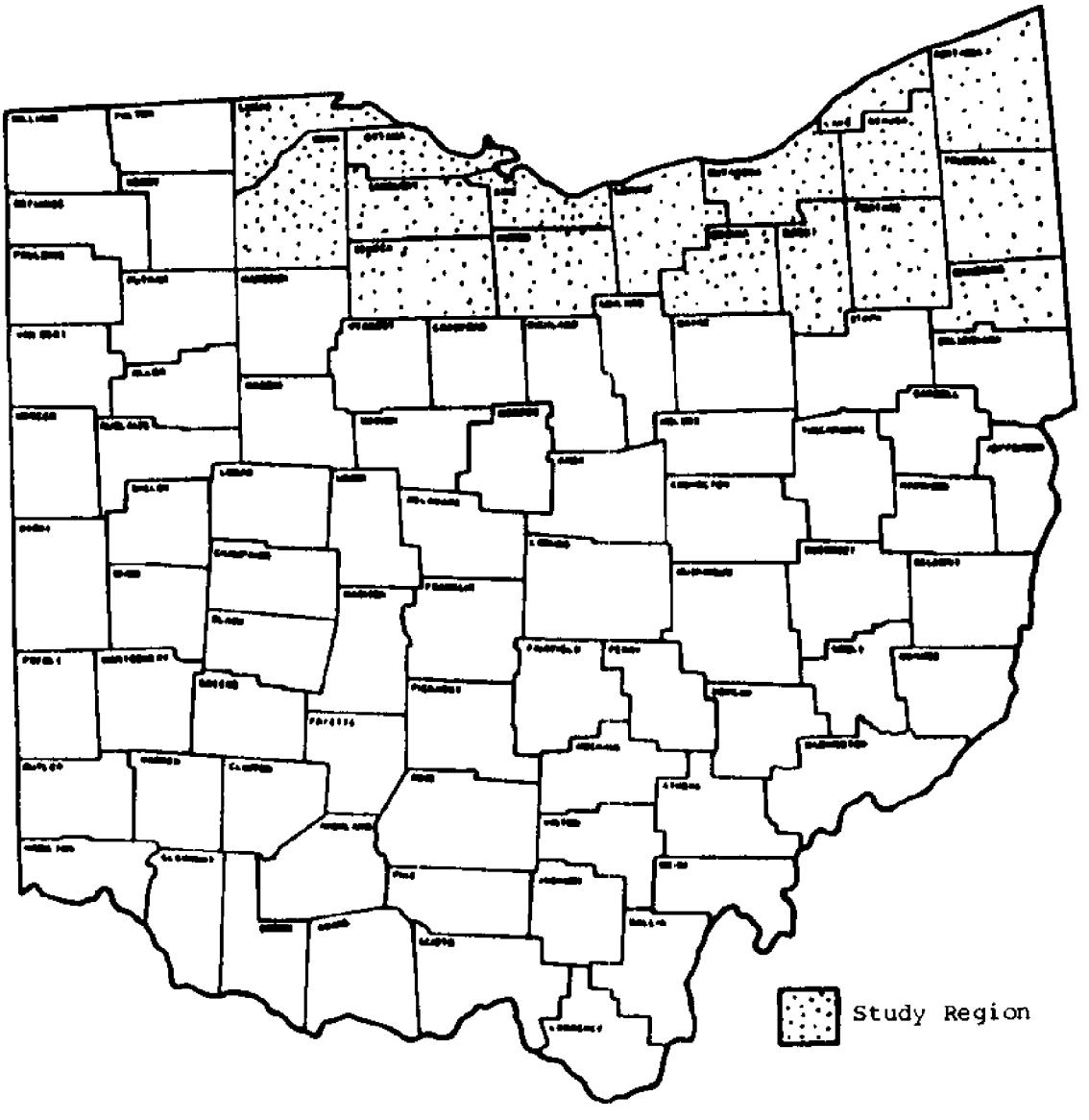
Thank you for your cooperation.

Sincerely,

Leroy J. Hushak
Professor

Kofi K. Apraku
Graduate Research Associate

LJH/bm
Enclosures


Study Region

Instructions: In responding to the questionnaire, we ask you to respond to all the questions. Where exact figures are not available, please give your best estimates. The enclosed map shows the study region.

1. What were your 1981 sales from this business establishment?

   $_____

2. What percentage of your 1981 sales were made locally (at your place of business within the region shown on the map)?

   _____%

3. In the table below, please indicate the dollar amount or percentage of your 1981 sales to the listed groups.

SALES TABLE

Sales Made To	1981 Dollar Sales
Other charter fishing firms (boat rental, charter guides, etc.)	
Marine services and supplies (bait, fish tackle, fish cleaning, launching service, boat ramp)	
Individual sport anglers	
Other (please specify)	

4. What was your average employment for 1981?

   _____ persons

5. What was the total amount of wages paid in 1981?

   $_____

6. What was the total amount of your 1981 business purchases?

   $_____

7. In the table below, we have listed various types of supplier industries from which you may have purchased materials, parts, supplies and services. Please state the value of purchases from each industry in 1981. We also ask you to estimate the proportion of purchases made from firms within the region (shown on the map).

PURCHASES TABLE

Supplying Industries	1981 Purchases ($)	% of 1981 purchases from within the region
Other charter fishing firms		
Marine supplies and services		
Insurance, finance (insurance costs, financial services, interests)		
Electric, gas, sanitary services, auto repair, services		
Miscellaneous services (advertising, etc.)		
State and local government (taxes, license fees, etc.)		
Federal government (taxes)		
Boat dealers (boat retailers)		
Other (please specify)		

OSU

The Ohio State University

Department of
Agricultural Economics
and Rural Sociology

2120 Fyffe Road
Columbus, Ohio 43210

Phone 614 422-7911

August 5, 1982

Dear Survey Participant:

Several weeks ago we sent you a questionnaire asking for information about your firm. Unfortunately, by the time we sent the questionnaire, the 1982 summer fishing activity was in full swing. Enclosed is a second copy of the questionnaire. We hope that as the summer activity eases up, you will find time to complete and return the questionnaire.

Thank you for your cooperation.

Sincerely,

Leroy J. Hushak
Professor

Kofi K. Apraku
Graduate Research Associate

LJH/bm

APPENDIX D

Regional Transactions Table for the Seventeen Northern Ohio Counties

Appendix D.

	LIVSTOCK	CROPS	FORESPRO	MINE-OTR	MINEXTRA	CONSTRUC	FOODKIND	TEXTILES	WOODLUMB	FURNFIXT
LIVSTOCK	14295.13	64946.78	317.72	0.0	0.0	0.0	118070.94	407.76	0.0	0.0
CROPS	65318.43	116066.86	0.0	0.87	0.0	1987.90	195485.75	20.59	0.32	3.01
FORESPRO	0.0	4848.49	15856.57	0.29	0.0	13855.55	76889.73	1198.58	0.0	0.0
MINE-OTR	0.0	897.95	42.22	2650.03	22.28	0.0	266.69	76.88	46.72	151.74
MINEXTRA	6.53	5848.16	244.54	1606.49	1177.50	14042.38	38.89	0.0	0.0	0.0
CONSTRUC	1749.71	32876.77	1394.04	4795.48	700.22	2466.20	7800.65	3101.47	659.51	1280.14
FOODKIND	38194.07	63.14	97.81	31.79	9.74	1218.15	428285.69	589.36	85.94	151.31
TEXTILES	6.83	5510.44	218.15	117.91	44.64	6860.51	1222.32	318203.56	66.43	15139.83
WOODLUMB	19.33	3009.52	3.87	58.09	0.0	226053.19	436.15	215.55	21226.37	6645.27
FURNFIXT	0.0	0.0	0.0	0.0	0.0	22823.54	0.0	0.0	30.54	3630.41
PAPRPROD	295.36	792.72	413.78	372.51	271.18	29447.02	78553.75	13671.79	2132.84	5353.53
PRNPUBBS	59.02	750.63	449.32	65.31	42.36	1920.65	23943.66	1680.48	95.03	1314.96
CHEMPROD	3057.55	405619.12	7404.02	10598.67	5793.11	129565.86	35625.20	154193.44	8962.98	7089.32
RUBLETHR	4208.70	24925.02	6616.58	9839.78	3385.60	79912.25	38430.43	51073.37	1878.73	22884.70
STCLYGLS	70.25	477.03	920.80	324.53	67.44	518047.86	75850.69	1845.23	6422.83	3974.18
PRIMSTMC	42.05	568.23	0.0	5362.17	2598.98	69726.12	1489.01	944.58	1892.08	57285.91
FRNFMETL	0.0	0.0	81.28	314.13	385.19	75398.37	117912.62	0.0	219.31	6013.37
HEATPLFB	322.52	371.81	16.19	2093.72	370.90	385847.87	9273.00	0.0	3762.22	7000.77
OTHERFAB	284.39	5969.94	313.85	836.62	747.49	79045.37	13973.39	182.60	7776.81	28125.59
MACHNERY	1256.14	30614.36	1609.37	10539.71	6928.87	49666.64	3869.77	13432.84	616.28	1326.56
MACHNBIT	59.54	715.55	35.54	876.53	91.82	84642.87	3280.83	1620.97	1191.57	458.67
ELETELTN	96.89	3177.89	182.61	1071.28	228.64	136761.87	627.83	6649.15	499.96	945.70
MOTVEQUP	122.74	1273.26	16.54	490.88	520.98	1517.09	490.39	16.48	84.67	48.57

Appendix D. Continued

OTHERMFG	19.89	284.12	26.74	1103.67	120.77	5288.26	288.91	270.47	825.46	993.74
WATRTRAN	119.35	5043.95	98.17	94.56	87.45	6262.65	3272.80	1219.17	942.31	159.48
OTHRTRAN	5119.86	21824.57	1117.13	2281.37	748.37	91032.36	52051.57	26718.78	4342.59	6570.48
COMMUNIC	446.31	5535.00	396.89	249.46	65.16	14625.30	4786.51	2750.00	554.31	864.89
ELECTGAS	2499.21	26401.73	3684.25	18122.49	4017.58	11381.87	26791.13	18041.80	4369.29	5335.48
WHOLSALE	7427.65	123443.06	12836.98	9915.22	2862.09	318969.06	132802.75	78356.37	18457.00	21447.66
RETAIL	473.99	1564.39	4920.65	234.37	144.71	329837.44	1586.69	200.45	148.17	95.43
FININSUR	3869.57	37815.67	1925.34	3241.30	1129.44	37927.14	13037.20	6723.28	2134.49	3784.14
REALESTA	4992.42	264971.25	3343.06	12173.66	2604.42	35647.77	15298.30	20889.28	2521.71	4577.20
HOTLOGIR	2345.84	16658.71	23003.08	48.61	893.15	13.17	851.14	2085.30	1937.47	28648.91
EATDRINK	11418.48	48730.58	93436.12	1398.83	3168.93	329.72	18135.80	5183.71	13498.70	105995.81
AUTOSERS	2662.14	17916.35	107343.06	107.35	821.00	618.65	105169.25	3447.18	14748.26	145560.87
RECAMUSE	198.38	874.45	2170.36	25.06	75.48	6.94	446.16	27549.90	633.89	1480.49
EDUCSERS	130.40	1793.11	2368.60	25.94	42.76	8.72	306.41	73.07	143.14	837.14
HEALTSER	0.0	0.0	0.0	0.0	0.0	0.0	41.90	0.0	0.0	0.0
MISCSERV	30527.76	198509.37	329922.81	4257.58	23657.03	9793.58	112745.69	50993.28	120332.58	489369.62
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARNBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.77

Appendix D. Continued

	PAPRPROD	PRNPUBBS	CHEMPROD	RUBLETHR	STCLYGLS	PRIRSTMC	PRNFMETL	HEATPLFB	OTHERFAB	MACHINERY
LIVSTOCK	0.0	0.0	154.93	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CROPS	44.65	60.53	11528.31	166.06	8.42	129.81	63.18	158.94	48.32	240.67
FORESPRO	26.60	20.67	10450.84	18.98	125.83	35.40	0.0	0.0	0.0	13.75
MINE-OTR	182.42	3.45	62352.93	2016.44	3380.04	65154.71	4299.06	1287.39	110.45	240.67
MINEXTRA	264.13	0.0	14852.30	2215.71	29784.86	17501.26	619.74	47.68	299.13	0.0
CONSTRUC	4426.80	4286.19	44000.57	25041.80	14130.57	132504.44	10447.75	18298.93	9894.45	21433.68
FOODKIND	246.08	445.62	42127.30	1162.42	517.10	1168.32	824.31	826.47	497.02	2200.44
TEXTILES	2297.33	1190.99	3246.52	203214.37	4216.07	3257.15	574.61	7173.37	1976.59	3314.42
WOODLUMB	502.60	0.0	1746.50	2879.95	6770.34	12037.28	1278.59	5038.32	6226.60	4779.08
FURNFIXT	0.0	0.0	0.0	0.0	0.0	3894.41	0.0	0.0	0.0	0.0
PAPRPROD	214515.62	100482.00	69958.57	55957.39	26856.36	9948.45	7683.55	36035.06	13828.83	8162.26
PRNPUBBS	1342.49	82957.00	17084.73	3463.53	915.26	10149.98	11615.59	2892.68	1247.16	4311.49
CHEMPROD	50565.09	19375.14	1750466.00	936214.56	76296.12	279937.50	65132.75	75590.62	85129.12	105628.06
RUBLETHR	20140.14	6182.36	67451.56	198679.25	56253.48	10479.51	23432.75	32534.49	56640.00	57768.47
STCLYGLS	821.83	945.21	36901.89	21915.13	189375.12	76743.56	11401.99	21424.77	15285.78	42695.45
PRIRSTMC	2625.12	342.25	19746.73	56450.82	8566.59	2185591.00	166342.69	1329731.00	338584.69	868345.19
PRNFMETL	2188.07	1977.71	137917.25	3126.67	6593.00	176192.69	754450.87	294018.37	110661.37	147305.81
HEATPLFB	0.0	2.30	3704.27	29852.80	2678.57	72164.62	8956.13	173713.31	37849.74	109038.75
OTHERFAB	2181.61	1427.58	14648.07	51932.53	8675.19	108406.31	41748.14	109968.81	86744.44	71631.25
MACHINERY	5183.73	3696.28	48394.97	32092.22	4995.17	296787.06	98709.94	78965.37	26293.94	706431.31
MACHNEIT	1449.85	428.39	6253.60	11757.03	5691.53	75905.62	22626.48	81979.87	20065.03	165363.19
ELETELTN	285.22	7279.17	8493.07	9954.09	10998.68	144270.25	7551.18	34960.95	11516.68	184053.19
MOTVEQUP	55.15	89.58	288.74	5337.63	296.47	7363.96	60.17	10511.06	197.89	11442.38

Appendix D. Continued

BOTSHBLD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERMFG	617.56	1648.09	3536.88	4168.98	1961.53	6998.14	8288.23	1891.29	1868.44	3926.41
WATRTRAN	626.11	168.79	15810.06	5923.96	3097.42	42862.15	562.58	2617.17	844.48	1602.20
OTHRTRAN	17273.70	25768.82	126677.62	97869.19	57589.23	160886.59	40896.75	70128.44	39154.43	54639.72
COMMUNIC	2168.52	7974.81	13331.16	11439.14	4812.68	14383.74	4124.57	9933.59	4981.74	21069.23
ELECTGAS	11557.92	7383.69	179699.58	81772.58	67882.94	374937.62	65647.19	58383.55	35186.91	62526.94
WHOLSALE	35586.81	27495.82	174347.31	132249.94	58242.58	401628.25	93499.31	167978.37	68894.58	211298.58
RETAIL	266.83	929.13	2359.19	1684.32	668.78	3198.14	3584.83	1881.29	898.58	4153.33
FININSUR	2998.58	7887.87	32284.63	26749.85	11283.68	49293.84	14817.16	27999.47	14876.28	32944.73
REALESTA	12494.72	22775.84	98815.19	34768.16	17896.99	14598.15	20998.91	48677.38	28557.45	51843.36
HOTLOGIN	1529.66	8489.29	10331.12	11638.41	1973.89	16388.14	3471.74	6835.58	4438.28	2915.59
EATDRINK	8343.39	11758.31	39162.48	27428.82	9638.71	27528.52	12987.44	19782.41	9678.16	44871.76
AUTOSERS	1761.48	3761.33	10295.91	8382.98	9328.43	16786.34	4741.38	8344.21	4688.97	13699.58
RECAMUSE	79.11	353.74	767.62	435.48	168.92	944.18	255.72	823.17	178.28	1595.32
EDUCSERS	127.31	118.38	2859.19	2173.81	939.48	3882.41	983.76	2643.66	669.58	781.39
HEALTSER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MISCSERV	24489.88	61846.56	291412.19	188994.94	55836.77	285542.37	66817.44	111213.81	54872.88	158592.69
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMISS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix D. Continued

	MACHNEIT	ELETELTN	MOTVEQUP	BOTSHBLD	OTHERMFG	WATRTRAN	OTHERTRAN	COMMUNIC	ELECTGAS	WHOLSALE
LIVSTOCK	0.0	0.0	0.0	0.0	0.0	1.96	39.28	0.0	0.0	0.0
CROPS	47.17	176.85	359.42	5.92	3224.51	2.85	134.51	18.91	61.34	96.76
FORESPRO	4.16	14.74	193.54	5.29	185.60	0.0	91.66	8.60	511.20	1224.70
MINE-OTR	217.80	530.21	2087.42	2.64	13.62	7.48	10.48	0.0	143065.81	0.0
MINEXTRA	0.0	39.30	0.0	7.05	99.28	0.0	0.0	0.0	0.0	0.0
CONSTRUC	2495.67	13106.89	31781.30	389.16	1457.95	2805.97	9873.21	33814.14	197989.69	21525.25
FOODKIND	389.82	1935.57	3151.86	49.87	197.81	73.88	1893.46	173.65	434.52	5379.37
TEXTILES	1592.57	9324.16	185033.81	555.78	7016.67	531.78	2566.51	294.86	639.01	5898.71
WOODLUMB	474.44	3163.73	5833.71	436.89	5205.25	0.0	151.90	0.0	0.0	658.86
FURNFIXT	0.0	5683.91	981.50	1638.50	0.0	0.0	0.0	0.0	0.0	0.0
PAPRPROD	8892.29	38018.82	23168.96	97.53	9900.73	55.98	3226.47	574.24	1876.12	33345.74
PRNPUBBS	1158.36	6499.40	10735.85	170.78	458.84	149.55	6070.58	4114.26	8526.90	21571.76
CHEMPROD	25418.64	117873.56	157396.37	3432.41	19798.85	12369.54	144096.44	900.85	257647.31	100386.56
RUBLETHR	16726.11	92293.50	361911.44	330.72	22743.37	224.14	29740.09	338.70	5398.32	18564.27
STCLYGLS	6965.39	66384.31	176379.94	1278.43	2083.37	6.23	730.67	28.37	603.22	3387.30
PRIRSTMC	122049.12	279032.25	1383572.00	14387.83	16399.95	1921.51	468.78	7.74	731.02	325.55
PRNFMETL	59428.53	313120.94	312629.00	2972.98	11638.29	288.95	0.0	642.15	1242.23	0.0
HEATPLFB	26375.84	102285.81	1018079.94	6844.30	4331.45	0.0	843.28	0.0	0.0	0.0
OTHERFAB	27792.23	87705.12	412451.81	2510.65	8560.35	1233.41	2189.39	3.44	654.34	1682.02
MACHNERY	39019.26	78621.62	382012.12	12819.10	884.58	1287.00	4035.71	0.0	14686.92	2232.36
MACHNEIT	83749.81	32659.14	271005.06	1746.81	1123.67	343.25	1738.94	73.07	429.41	7859.78
ELETELTN	57705.56	512259.12	474645.87	7294.92	5970.11	1102.56	6513.17	15650.70	15034.54	4674.01
MOTVEQUP	1323.44	8641.31	2892070.00	228.96	193.72	396.48	26702.18	423.80	1068.42	3147.01

Appendix D. Continued

BOTSHELD	0.0	0.0	0.0	720.26	0.0	7213.00	0.0	0.0	0.0	0.0
OTHERMFG	2825.83	7128.22	4893.68	208.18	18780.41	272.03	1052.79	434.12	1364.92	3697.35
WATRTRAN	414.79	1031.65	2594.23	41.69	165.84	42475.43	1749.42	20.63	4416.81	2061.83
OTHRTRAN	15413.16	68823.87	134493.37	949.47	6654.64	2882.17	301255.94	3828.86	25345.54	137398.81
COMMUNIC	3888.47	16231.32	18275.28	373.67	1424.11	1072.47	29808.18	11119.51	14388.20	90681.94
ELECTGAS	13507.68	56762.18	98288.37	1183.22	3890.83	2079.42	8139.58	9669.29	935811.81	65777.19
WHOLSALE	36783.81	158515.69	765845.94	4984.52	19264.53	3096.35	77587.12	2212.73	47981.78	136406.62
RETAIL	1144.48	1753.81	7962.69	135.14	157.66	93.47	24439.46	398.88	2591.81	22253.87
FININSUR	6952.91	31488.11	81093.38	841.95	3987.88	6827.53	55808.58	9285.88	41223.58	74993.44
REALESTA	19188.16	83783.43	24592.84	453.81	5120.18	4544.11	31615.21	21316.61	87836.89	121392.58
BOTLOGIN	2345.84	16658.71	23003.68	48.61	803.18	13.17	851.14	2085.58	1937.47	28648.91
EATDRINK	11418.48	48738.58	93436.12	1398.83	3168.93	329.72	18135.88	5183.71	13498.78	135995.81
AUTOSERS	2662.14	17916.33	107343.86	187.53	821.88	618.65	185169.25	3447.18	14748.26	145568.67
RECAMUSE	198.38	874.48	2178.36	25.86	75.48	6.94	466.16	27549.98	633.89	1488.49
EDUCSERS	136.48	1793.11	2388.68	25.94	42.76	8.72	386.41	73.87	143.14	837.14
HEALTSER	0.0	0.0	0.0	0.0	0.0	0.0	41.98	0.0	0.0	0.0
MISCSERV	36327.76	198389.37	329922.81	4257.58	25657.83	9793.58	112743.69	58993.28	128332.58	489569.62
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARNBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.77

Appendix D. Continued

	RETAIL	FININSUR	REALESTA	HOTLOGIN	EATDRINK	AUTOSERS	RECAMUSE	EDUCSERS	HEALTSER	MISCSERV
LIVSTOCK	0.0	0.0	0.0	0.0	12597.94	0.0	1613.67	275.35	20752.28	3214.89
CROPS	57.83	453.69	583.82	257.71	47669.58	25.60	23379.00	16.30	19129.09	3823.90
FORESPRO	34.02	315.06	5240.36	618.64	49481.07	10.24	31.28	6.04	4520.30	4031.87
MINE-OTR	0.0	0.0	20.58	65.75	0.0	0.0	0.0	221.61	1171.17	1114.07
MINEXTRA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.61
CONSTRUC	21148.12	41594.20	243206.81	10039.21	15669.34	11220.46	10279.94	13385.30	367171.62	2041517.00
FOODKIND	530.66	4492.75	442.41	986.64	763654.56	168.93	1675.23	413.63	286340.44	17899.39
TEXTILES	571.48	3736.61	61.73	2647.86	1682.77	2464.24	1045.00	36.23	131663.94	28764.22
WOODLUMB	0.0	6.30	0.0	107.82	0.0	0.0	1.51	0.0	534.22	583.56
FURNFIXT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAPRPROD	16651.13	21146.82	857.39	1581.54	25738.82	1600.73	589.54	1287.99	38258.17	20286.66
PRNPUBBS	3280.18	168891.00	2805.38	2903.34	4509.02	346.98	3650.68	14745.15	72283.69	74568.37
CHEMPROD	35710.63	33276.64	30492.18	6821.04	11640.75	6146.93	2773.71	5483.46	64619.73	110176.19
RUBLETHR	6810.12	5437.93	4427.55	2256.78	11959.73	25099.70	1683.80	612.98	211036.37	31374.33
STCLYGLS	952.47	434.78	37.73	739.18	7348.32	20261.68	43.90	1148.50	34231.00	12700.39
PRIMSTMC	47.62	144.93	17.15	5.30	0.0	0.0	0.0	5.43	102.73	1230.78
PRMFMETL	0.0	0.0	0.0	0.0	1012.07	0.0	0.0	0.0	0.0	848.81
HEATPLFB	0.0	0.0	171.48	221.29	4056.15	22954.59	0.0	0.0	7910.52	7766.66
OTHERFAB	1241.61	113.42	13.72	137.87	930.79	15247.88	91.83	40.46	3328.58	24361.00
MACHNERY	387.79	220.54	260.65	22.98	1449.19	4302.17	100.92	25.56	801.33	37591.90
MACHNBIT	1313.04	1833.65	89.17	3.89	409.55	73814.37	420.32	281.39	1376.64	19087.73
ELETELTN	1779.87	7574.04	1224.35	362.88	433.18	18340.60	1888.67	2219.11	410217.19	66812.31
MOTVEQUP	881.03	2218.02	147.47	98.58	0.0	356209.94	606.19	120.77	7417.48	9241.48

Appendix D. Continued

BOTHEALD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	106.10
OTHERMFG	479.63	7790.06	665.33	857.25	3855.62	276.66	1909.86	1962.48	47093.30	33040.13	
WATRTRAN	445.62	743.34	498.12	137.87	1334.98	310.89	129.68	157.60	3944.99	8653.13	
OTHRTRAN	10538.34	31052.31	7630.76	1665.72	39982.59	8534.37	2760.09	5287.82	183339.25	120128.50	
COMMUNIC	21525.71	119584.12	7973.71	826.14	7690.93	6858.56	3013.39	4033.65	93467.44	83799.25	
ELECTGAS	94266.81	112438.56	43774.84	21176.77	70580.87	12164.17	7373.34	15177.58	420018.00	450232.75	
WBOLSALE	23090.47	32488.98	13169.49	3578.19	258577.56	88432.56	9704.71	4164.07	366314.12	104484.25	
RETAIL	8554.91	11115.31	7143.76	1216.41	161.46	19572.23	1177.70	497.86	8813.25	26833.17	
FINRNSUR	45354.34	1327372.00	54296.71	9233.22	34130.71	16495.82	8289.34	5138.67	198852.00	186791.56	
REALESTA	159207.94	244719.62	308975.44	34751.76	120081.62	44994.34	31755.63	45249.28	573667.06	283488.75	
BOTLOGIN	527.26	11455.58	432.12	57.62	0.0	157.00	449.59	103.06	45120.80	20806.58	
EATDRINK	16965.39	137164.44	13402.70	1727.58	0.0	4935.29	14245.98	3923.14	194393.44	125189.62	
AUTOSERS	24298.06	37290.49	14830.30	2612.41	1740.60	4718.57	2431.60	3617.60	54079.22	65358.75	
RECAMUSE	479.63	2892.25	236.64	28.99	28649.01	83.62	59427.34	2647.23	4561.39	8562.42	
EDUCSERS	1248.41	932.58	130.32	45.25	874.95	22.18	90.32	222.82	4212.09	9748.15	
HEALTSER	0.0	10472.59	75.45	0.0	0.0	0.0	0.0	0.0	172531.62	1920.44	
MISCSERV	220563.75	1013453.50	89881.75	34513.49	155519.75	42381.77	48631.32	32348.27	1051031.00	635698.87	
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	530.51	
MARNBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26525.47	
COMMFISB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Appendix D. Continued

	CHARTER	MARNBOAT	COMMFISH
LIVSTOCK	0.0	0.0	0.0
CROPS	0.0	0.0	0.0
FORESPRO	0.0	0.0	0.0
MINE-OTR	0.0	0.0	0.0
MINEXTRA	0.0	0.0	0.0
CONSTRUC	0.0	0.0	0.0
FOODKIND	0.0	0.0	51.19
TEXTILES	0.0	0.0	0.0
WOODLUMB	0.0	0.0	0.0
FURNFIXT	0.0	0.0	0.0
PAPRPROD	0.0	0.0	0.0
PRNPUBRS	0.0	0.0	0.0
CHEMPROD	0.0	0.0	102.37
RUBLETER	0.0	0.0	0.0
STCLYGLS	0.0	0.0	0.0
PRIMSTMG	0.0	0.0	0.0
PRNFMETL	0.0	0.0	0.0
HEATPLFB	0.0	0.0	76.78
OTHERFAB	0.0	0.0	0.0
MACHNERY	0.0	0.0	0.0
MACHNELT	0.0	0.0	25.59
ELETELTN	0.0	0.0	25.59
MOTVEQUP	0.0	0.0	0.0

Appendix D. Continued

BOTSHBLD	0.0	6623.30	179.15
OTHERMFG	0.0	0.0	51.19
WATRTRAN	0.0	0.0	0.0
OTHRTRAN	0.0	0.0	0.0
COMMUNIC	0.0	0.0	51.19
ELECTGAS	68.33	1278.67	0.0
WHOLSALE	0.0	0.0	51.19
RETAIL	0.0	0.0	76.78
FININSUR	64.87	3642.82	153.56
REALESTA	0.0	3486.43	0.0
HOTLOGIN	0.0	0.0	0.0
EATDRINK	0.0	0.0	0.0
AUTOSERS	0.0	0.0	0.0
RECAMUSE	0.0	0.0	0.0
EDUCSERS	0.0	0.0	0.0
HEALTSER	0.0	0.0	0.0
MISCSERV	32.33	12878.64	25.59
CHARTER	23.27	261.37	0.0
MARNBOAT	1144.11	17827.72	0.0
COMMFISH	0.0	0.0	76.78

APPENDIX E

1978 Regional Technical Coefficients Matrix (43 X 43) for the Seventeen Northern Ohio Counties

Appendix E.

	LIVSTOCK	CROPS	FORESPRO	MINE-OTR	MINEXTRA	CONSTRUC	FOODKIND	TEXTILES	WOODLUMB	FURNFIXT
LIVSTOCK	0.054739	0.018516	0.000983	0.0	0.0	0.0	0.042502	0.000297	0.0	0.0
CROPS	0.250853	0.033090	0.0	0.000003	0.0	0.000266	0.070369	0.000015	0.000001	0.000007
FORESPRO	0.0	0.001380	0.045866	0.000001	0.0	0.001854	0.027678	0.000873	0.0	0.0
MINE-OTR	0.0	0.000256	0.000120	0.009170	0.000254	0.0	0.000096	0.000056	0.000147	0.000333
MINEXTRA	0.000025	0.001665	0.000695	0.005359	0.013426	0.001879	0.000014	0.0	0.0	0.0
CONSTRUC	0.006700	0.009373	0.003962	0.016394	0.007984	0.000330	0.002808	0.002259	0.002075	0.002978
FOODKIND	0.146253	0.000618	0.000278	0.000118	0.000111	0.000163	0.154170	0.000371	0.000176	0.000352
TEXTILES	0.000025	0.001571	0.000620	0.000408	0.000509	0.000918	0.000440	0.231768	0.000209	0.035220
WOODLUMB	0.000074	0.000858	0.000011	0.000201	0.0	0.030248	0.000157	0.000157	0.066784	0.015459
FURNFIXT	0.0	0.0	0.0	0.0	0.0	0.003054	0.0	0.0	0.000159	0.000492
PAPRPROD	0.001131	0.000226	0.001176	0.001289	0.003092	0.002736	0.028277	0.009958	0.006708	0.012454
PRNPUBBS	0.000226	0.000214	0.001277	0.000226	0.000483	0.000257	0.008619	0.001224	0.000299	0.003059
CHEMPROD	0.011708	0.115640	0.021043	0.036675	0.066054	0.017337	0.012824	0.112309	0.028200	0.016492
RUBLETHR	0.016116	0.007106	0.018805	0.034049	0.037691	0.010693	0.013841	0.037200	0.005911	0.053237
STCLYCLS	0.000269	0.000136	0.002617	0.001123	0.000769	0.068249	0.027016	0.001344	0.020208	0.009245
PRIRSTMC	0.000161	0.000162	0.0	0.019247	0.029634	0.009330	0.000536	0.000688	0.005953	0.133265
FRNFMETL	0.0	0.0	0.000231	0.001087	0.004392	0.010089	0.042445	0.0	0.000698	0.013989
HEATPLFB	0.001235	0.000106	0.000046	0.007245	0.004229	0.051630	0.003338	0.0	0.011837	0.016286
OTHERFAB	0.001089	0.001702	0.000892	0.002895	0.008523	0.010577	0.005036	0.000133	0.024468	0.065429
MACHNERY	0.004810	0.008728	0.004574	0.036471	0.078995	0.003843	0.001393	0.009784	0.001939	0.003086
MACHNELT	0.000228	0.000204	0.000101	0.001995	0.001047	0.011326	0.001181	0.001180	0.003749	0.001067
ELETELTN	0.000371	0.000906	0.000519	0.003707	0.002607	0.018300	0.000226	0.004843	0.001573	0.002200
MOTVEQUP	0.000470	0.000363	0.000047	0.001491	0.005930	0.000203	0.000155	0.000012	0.000172	0.000113

Appendix E. Continued

BOTSHBLD	0.0	0.0	0.000307	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERMFC	0.000075	0.000081	0.000076	0.003826	0.001877	0.000440	0.000104	0.000197	0.001024	0.000916
WATRTRAN	0.000457	0.001458	0.000279	0.000327	0.000655	0.000838	0.001178	0.000888	0.001077	0.000371
OTHRTRAN	0.019685	0.005994	0.003175	0.007895	0.008533	0.012181	0.018737	0.019461	0.013663	0.015285
COMMUNIC	0.001709	0.001578	0.001128	0.000863	0.000743	0.001957	0.001723	0.002003	0.001744	0.002012
ELECTGAS	0.009570	0.007527	0.010471	0.062710	0.045809	0.001523	0.009644	0.013141	0.013747	0.012412
WHOLSALE	0.028442	0.035193	0.036484	0.013548	0.032634	0.042681	0.047865	0.057072	0.048632	0.049894
RETAIL	0.001815	0.000446	0.013985	0.000811	0.001878	0.042931	0.000569	0.000146	0.000441	0.000222
FININSUR	0.011754	0.010781	0.005472	0.011216	0.012878	0.005075	0.004693	0.004897	0.006722	0.008617
REALESTA	0.019117	0.075342	0.009507	0.042125	0.029696	0.004770	0.005507	0.015213	0.007934	0.010648
HOTLOGIN	0.000018	0.000018	0.000025	0.000549	0.001184	0.000187	0.000497	0.001452	0.000961	0.003329
EATDRINK	0.000400	0.000370	0.000273	0.002448	0.001058	0.004785	0.002253	0.003524	0.003248	0.005164
AUTOSERS	0.002920	0.002629	0.002033	0.004085	0.010664	0.002940	0.004487	0.003352	0.004605	0.004767
RECAMUSE	0.000011	0.000006	0.0	0.000877	0.000032	0.000092	0.000106	0.000152	0.000268	0.000106
EDUCSERS	0.0	0.0	0.000005	0.000000	0.000039	0.000036	0.000053	0.000365	0.000090	0.002006
HEALTSER	0.004685	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MISCSERV	0.036160	0.035327	0.023549	0.030733	0.040435	0.044039	0.044254	0.023774	0.017755	0.030576
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARNBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.000048	0.0	0.0	0.0

Appendix E. Continued

	PAPRPROD	PRNPUBBS	CHEMPROD	RUBLETHR	STCLYGLS	PRIMSTMC	PRNFMETL	MEATPLFB	OTHERFAB	MACHINERY
LIVSTOCK	0.0	0.0	0.000022	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CROPS	0.000047	0.000044	0.001637	0.000035	0.000005	0.000011	0.000021	0.000050	0.000021	0.000035
FORESPRO	0.000028	0.000018	0.001484	0.000004	0.000073	0.000003	0.0	0.0	0.0	0.000002
MINE-OTR	0.000192	0.000003	0.008854	0.000425	0.002077	0.003521	0.001429	0.000243	0.000048	0.000035
MINEXTRA	0.000278	0.0	0.002109	0.000467	0.017288	0.001483	0.000206	0.000009	0.000130	0.0
CONSTRUC	0.004689	0.003732	0.006248	0.005278	0.008198	0.011228	0.006132	0.003437	0.004300	0.003117
FOODKIND	0.000259	0.000388	0.005982	0.000245	0.000300	0.000099	0.000274	0.000156	0.000216	0.000320
TEXTILES	0.002418	0.001037	0.000461	0.042831	0.002446	0.000276	0.000191	0.001354	0.000859	0.000482
WOODLUMB	0.000529	0.0	0.000248	0.000687	0.003928	0.001829	0.000425	0.000951	0.002706	0.000695
FURNFIXT	0.0	0.0	0.0	0.0	0.0	0.000330	0.0	0.0	0.0	0.0
PAPRPROD	0.225783	0.087498	0.009082	0.011794	0.015581	0.000843	0.002554	0.005673	0.006879	0.001187
PRNPUBBS	0.001419	0.072231	0.002426	0.000758	0.000531	0.000860	0.003861	0.000395	0.000542	0.000627
CHEMPROD	0.053221	0.016878	0.248563	0.201539	0.044264	0.023721	0.021650	0.014268	0.036996	0.015361
RUBLETHR	0.021198	0.005383	0.009578	0.040189	0.032636	0.000888	0.007789	0.006141	0.024615	0.008401
STCLYGLS	0.000865	0.000823	0.005246	0.004619	0.109868	0.006503	0.003798	0.004044	0.006643	0.006209
PRIMSTMC	0.002763	0.000298	0.002804	0.011898	0.004970	0.185200	0.053292	0.288746	0.143633	0.125116
PRNFMETL	0.002383	0.001722	0.019584	0.000659	0.003825	0.014930	0.250778	0.055497	0.048092	0.021422
MEATPLFB	0.0	0.000002	0.000526	0.006292	0.001554	0.006115	0.002977	0.032789	0.016449	0.015857
OTHERFAB	0.002212	0.001243	0.002088	0.010756	0.005033	0.009186	0.013877	0.020757	0.037698	0.010417
MACHINERY	0.005456	0.003148	0.006872	0.006764	0.002898	0.025142	0.032811	0.014985	0.011427	0.102733
MACHNBIT	0.001526	0.000373	0.000888	0.002478	0.003382	0.006432	0.007521	0.015474	0.008720	0.024048
ELETELTR	0.000216	0.006338	0.001206	0.002098	0.006381	0.012225	0.002510	0.006599	0.005005	0.026766
MOTVEGUP	0.000037	0.000078	0.000041	0.001133	0.000172	0.000624	0.000020	0.001984	0.000086	0.001664

Appendix E. Continued

BOTSHELD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERMFG	0.000650	0.001435	0.000585	0.000877	0.001138	0.000393	0.001093	0.000340	0.000812	0.000571
WATRTRAN	0.000659	0.000140	0.002245	0.001249	0.001797	0.003632	0.000187	0.000494	0.000367	0.000233
OTHRTRAN	0.018181	0.022437	0.017988	0.020615	0.033411	0.013633	0.013594	0.013237	0.017016	0.007946
COMMUNIC	0.002274	0.006943	0.001893	0.002411	0.002328	0.001229	0.001371	0.001875	0.002165	0.003064
ELECTGAS	0.012165	0.006429	0.025517	0.017235	0.039383	0.031771	0.021821	0.011005	0.015257	0.009093
WHOLSALE	0.037456	0.023940	0.024757	0.027874	0.033796	0.034032	0.031879	0.031705	0.029593	0.030727
RETAIL	0.000280	0.000809	0.000335	0.000355	0.000388	0.000271	0.001165	0.000340	0.000387	0.000684
FININSUR	0.003156	0.006868	0.004578	0.003458	0.006546	0.004177	0.004759	0.005285	0.006465	0.004791
REALESTA	0.013151	0.019831	0.012782	0.007228	0.009919	0.001237	0.006986	0.007678	0.008934	0.007423
HOTLOGIN	0.001610	0.007222	0.001467	0.002453	0.001148	0.001386	0.001154	0.001294	0.001984	0.000424
EATDRINK	0.003819	0.010238	0.005561	0.005781	0.005892	0.002332	0.004317	0.003734	0.004206	0.006700
AUTOSERS	0.001854	0.003275	0.001462	0.001750	0.005412	0.000914	0.001576	0.001575	0.002003	0.001985
RECAMUSE	0.000078	0.000388	0.000109	0.000096	0.000098	0.000080	0.000085	0.000061	0.000074	0.000232
EDUCSERS	0.000134	0.000163	0.000406	0.000458	0.000545	0.000329	0.000327	0.000499	0.000291	0.000162
HEALTSER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MISCSERV	0.025692	0.053856	0.041386	0.039834	0.031929	0.017417	0.022216	0.020992	0.020847	0.021900
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARNBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMPTSER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix E. Continued

	MACHNBIT	ELETELTN	MOTVEQUP	BOTSHBLD	OTHERMFG	WATRTRAN	OTHRTRAN	COMMUNIC	ELECTGAS	WHOLSALE
LIVSTOCK	0.0	0.0	0.0	0.0	0.0	0.000011	0.000015	0.0	0.0	0.0
CROPS	0.000034	0.000036	0.000026	0.000047	0.008672	0.000016	0.000059	0.000022	0.000012	0.000005
FORESPRO	0.000003	0.000003	0.000014	0.000042	0.000284	0.0	0.000035	0.000010	0.000100	0.000158
MINE-OTR	0.000157	0.000112	0.000151	0.000021	0.000042	0.000042	0.000004	0.0	0.027986	0.0
MINEXTRA	0.0	0.000008	0.0	0.000056	0.000267	0.0	0.0	0.0	0.0	0.0
CONSTRUC	0.001799	0.002668	0.002299	0.003090	0.003921	0.015761	0.003770	0.039335	0.038730	0.002777
FOODKIND	0.000281	0.000394	0.000228	0.000396	0.000532	0.000415	0.000723	0.000202	0.000085	0.000694
TEXTILES	0.001148	0.001898	0.013385	0.004413	0.018869	0.002987	0.000980	0.000343	0.000125	0.000761
WOODLUMB	0.000342	0.000644	0.000422	0.003469	0.013999	0.0	0.000058	0.0	0.0	0.000085
FURNFIXT	0.0	0.001157	0.000071	0.013010	0.0	0.0	0.0	0.0	0.0	0.0
PAPRPROD	0.006410	0.007739	0.001676	0.000298	0.026627	0.000314	0.001232	0.000668	0.000367	0.004560
PRNPUBES	0.000835	0.001323	0.000778	0.001356	0.001234	0.000040	0.002318	0.004786	0.001668	0.002783
CHEMPROD	0.018323	0.023994	0.009939	0.027254	0.053247	0.069479	0.055022	0.001047	0.050400	0.012951
RUBLETHR	0.012057	0.018787	0.026180	0.002626	0.061166	0.001259	0.011356	0.000394	0.001056	0.002395
STCLYCLS	0.005021	0.013513	0.012789	0.010151	0.005603	0.000035	0.000279	0.000033	0.000118	0.000437
PRIMSTMG	0.087979	0.056799	0.100085	0.114242	0.044186	0.018793	0.000179	0.000009	0.000143	0.000042
FBMFMETL	0.042839	0.063738	0.022615	0.023606	0.031308	0.001623	0.0	0.000747	0.000243	0.0
HEATPLFB	0.019013	0.020821	0.073646	0.034345	0.011649	0.0	0.000322	0.0	0.0	0.0
OTHERFAB	0.020034	0.017853	0.029836	0.019935	0.014954	0.006928	0.000836	0.000004	0.000128	0.000217
MACHINERY	0.028127	0.016004	0.021847	0.101786	0.002379	0.007229	0.001541	0.0	0.002873	0.000286
MACHNBIT	0.060371	0.006648	0.019604	0.013878	0.003822	0.001928	0.000664	0.000085	0.0000B4	0.001014
ELETELTN	0.041597	0.104274	0.034335	0.057923	0.016036	0.006193	0.002487	0.018206	0.002941	0.000603
MOTVEQUP	0.000954	0.001759	0.209207	0.001818	0.000521	0.00[illegible]	0.018196	0.000493	0.000209	0.000406

Appendix E. Continued

BOTSHBLD	0.0	0.0	0.0	0.005719	0.0	0.040515	0.0	0.0	0.0	0.0
OTHERMFG	0.002037	0.001451	0.000354	0.001653	0.056588	0.001528	0.000482	0.000585	0.000267	0.000477
WATRTRAN	0.000299	0.000210	0.000260	0.000331	0.000446	0.238582	0.000668	0.000824	0.000864	0.000266
OTHRTRAN	0.011112	0.014010	0.009729	0.007539	0.017897	0.016189	0.115032	0.004454	0.004958	0.017726
COMMUNIC	0.002803	0.003304	0.001322	0.002967	0.003830	0.006024	0.011382	0.012935	0.002813	0.011699
ELECTGAS	0.009737	0.010333	0.007110	0.009395	0.010464	0.011680	0.003108	0.011248	0.183060	0.008486
WHOLSALE	0.026515	0.032267	0.055342	0.039578	0.051810	0.017392	0.029626	0.002574	0.009386	0.017598
RETAIL	0.000825	0.000337	0.000576	0.001073	0.000424	0.000525	0.000332	0.000464	0.000507	0.002871
FININSUR	0.005012	0.004408	0.003696	0.004462	0.010725	0.030406	0.021810	0.010802	0.008864	0.009675
REALESTA	0.013826	0.010948	0.001779	0.003597	0.013770	0.025524	0.012072	0.024797	0.007245	0.015661
HOTLOGIN	0.001691	0.003391	0.001664	0.000386	0.002140	0.000074	0.000325	0.002426	0.000379	0.003695
EATDRINK	0.008231	0.008291	0.006759	0.011107	0.008501	0.001852	0.006925	0.005937	0.002639	0.017545
AUTOSERS	0.001919	0.003647	0.007765	0.000854	0.002208	0.003430	0.040158	0.004010	0.002885	0.018779
RECAMUSE	0.000143	0.000178	0.000157	0.000199	0.000203	0.000039	0.000178	0.032048	0.000124	0.000191
EDUCSERS	0.000094	0.000365	0.000167	0.000206	0.000115	0.000049	0.000117	0.000085	0.000028	0.000108
HEALTSER	0.0	0.0	0.0	0.0	0.0	0.0	0.000016	0.0	0.0	0.0
MISCSERV	0.026331	0.040408	0.023866	0.033806	0.069002	0.055010	0.043051	0.059319	0.023539	0.063160
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARNBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000017

Appendix E. Continued

	RETAIL	FININSUR	REALESTA	HOTLOGIN	EATDRINK	AUTOSERS	RECAMUSE	EDUCSERS	HEALTSER	MISCSERV
LIVSTOCK	0.0	0.0	0.0	0.0	0.003459	0.0	0.003198	0.000456	0.001010	0.000303
CROPS	0.000017	0.000072	0.000170	0.000729	0.012105	0.000013	0.046533	0.000027	0.000931	0.000285
FORESPRO	0.000010	0.000050	0.001528	0.001750	0.012565	0.000004	0.000062	0.000010	0.000220	0.000380
MINE-OTR	0.0	0.0	0.000006	0.000186	0.0	0.0	0.0	0.000367	0.000057	0.000105
MINEXTRA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000001
CONSTRUC	0.006217	0.006601	0.070915	0.028399	0.003979	0.006575	0.020378	0.022167	0.017870	0.192411
FOODKIND	0.000156	0.000713	0.000129	0.002791	0.193919	0.000099	0.003320	0.000685	0.013936	0.001687
TEXTILES	0.000168	0.000593	0.000018	0.005793	0.000407	0.001444	0.002071	0.000060	0.000408	0.002711
WOODLUMB	0.0	0.000001	0.0	0.000305	0.0	0.0	0.000003	0.0	0.000026	0.000055
FURNITXT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAPRPROD	0.004895	0.003356	0.000250	0.004474	0.006536	0.000938	0.000772	0.002133	0.001862	0.001912
PRNPUBES	0.001554	0.026803	0.000816	0.008213	0.001145	0.000215	0.007235	0.024419	0.003518	0.007028
CHEMPROD	0.010498	0.005281	0.000891	0.024953	0.002956	0.003602	0.005497	0.009081	0.003145	0.010384
RUBLETHR	0.002002	0.000863	0.001291	0.006384	0.003037	0.014708	0.003337	0.001015	0.010271	0.002957
STCLYCLS	0.000280	0.000069	0.000011	0.002091	0.001866	0.011873	0.000087	0.001902	0.001666	0.001197
PRIRSTMC	0.000014	0.000023	0.000005	0.000015	0.0	0.0	0.0	0.000009	0.000005	0.000116
FRNFMETL	0.0	0.0	0.0	0.0	0.000257	0.0	0.0	0.0	0.0	0.000080
HEATPLFB	0.0	0.0	0.000050	0.000626	0.001030	0.013451	0.0	0.0	0.000385	0.000732
OTHERFAB	0.000365	0.000018	0.000004	0.000398	0.000084	0.008935	0.000182	0.000067	0.000162	0.002296
MACHNERY	0.000114	0.000035	0.000076	0.000065	0.000368	0.002521	0.000200	0.000042	0.000039	0.003543
MACENEIT	0.000386	0.000291	0.000020	0.000811	0.000184	0.043254	0.000833	0.000466	0.000067	0.001799
ELETELTR	0.000528	0.001202	0.000357	0.001683	0.000110	0.018759	0.003743	0.003675	0.019965	0.006297
MOTVEQUP	0.000259	0.000352	0.000043	0.000256	0.0	0.208783	0.000805	0.000200	0.000361	0.000871

Appendix E. Continued

BOTHERLD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000010
OTHERMFG	0.000141	0.001222	0.000194	0.002425	0.000074	0.000162	0.003786	0.003250	0.002292	0.003114
WATRTRAN	0.000131	0.000118	0.000119	0.000390	0.000039	0.000182	0.000257	0.000261	0.000192	0.000759
OTHRTRAN	0.003098	0.004928	0.002225	0.004712	0.010183	0.003861	0.006470	0.008757	0.008923	0.011322
COMMUNIC	0.006328	0.018978	0.002325	0.002337	0.001959	0.004819	0.005972	0.006680	0.004549	0.007898
ELECTGAS	0.027712	0.017844	0.012764	0.059905	0.017925	0.007128	0.015009	0.025135	0.020442	0.042434
WHOLSALE	0.006788	0.005156	0.003840	0.010122	0.065662	0.051820	0.019233	0.006896	0.017838	0.009849
RETAIL	0.001633	0.001764	0.002083	0.003441	0.000041	0.011469	0.002334	0.000824	0.000398	0.002529
FIRINSUR	0.013383	0.210454	0.015832	0.026119	0.000667	0.009783	0.016428	0.008510	0.009678	0.010865
REALESTA	0.046803	0.038837	0.090092	0.098306	0.030493	0.027538	0.062934	0.074936	0.027920	0.026711
HOTLOGIN	0.000158	0.001818	0.000126	0.000168	0.0	0.000092	0.000091	0.000172	0.002196	0.001961
EATDRINK	0.004811	0.021768	0.003908	0.004887	0.0	0.002892	0.028233	0.006497	0.009461	0.011799
AUTOREPS	0.007149	0.003918	0.004091	0.007890	0.000442	0.002765	0.004819	0.005991	0.002632	0.006160
RECAMUSE	0.000141	0.000459	0.000049	0.000082	0.007275	0.000049	0.009938	0.004384	0.000222	0.000887
EDUCSERS	0.000367	0.000148	0.000038	0.000128	0.000146	0.000013	0.000179	0.000369	0.000205	0.000918
HEALTSER	0.0	0.001662	0.000022	0.0	0.0	0.0	0.0	0.0	0.000397	0.000181
MISCSERV	0.064840	0.160835	0.026208	0.097632	0.039492	0.024835	0.096379	0.053571	0.031154	0.059914
CHARTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000050
MARNBOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002500
COMMISR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix E. Continued

	CHARTER	MARNBOAT	COMMFISH
LIVSTOCK	0.0	0.0	0.0
CROPS	0.0	0.0	0.0
FORESPRO	0.0	0.0	0.0
MINE-OTR	0.0	0.0	0.0
MINEXTRA	0.0	0.0	0.0
CONSTRUC	0.0	0.0	0.0
FOODKIND	0.0	0.0	0.020000
TEXTILES	0.0	0.0	0.0
WOODLUMB	0.0	0.0	0.0
FURNFIXT	0.0	0.0	0.0
PAPRPROD	0.0	0.0	0.0
PRNPUBRS	0.0	0.0	0.0
CHEMPROD	0.0	0.0	0.040000
RUBLETHR	0.0	0.0	0.0
STGLYGLS	0.0	0.0	0.0
PRIMSTMC	0.0	0.0	0.0
PRNFMETL	0.0	0.0	0.0
HEATPLFB	0.0	0.0	0.030000
OTHERFAB	0.0	0.0	0.0
MACHNERY	0.0	0.0	0.0
MACHNEIT	0.0	0.0	0.010000
ELETELTR	0.0	0.0	0.010000
MOTVEAUP	0.0	0.0	0.0

Appendix E. Continued

BOTSHELD	0.0	0.072000	0.070000
OTHERNFC	0.0	0.0	0.020000
WATRTRAN	0.0	0.0	0.0
OTHRTRAN	0.0	0.0	0.0
COMMUNIC	0.0	0.0	0.020000
ELECTGAS	0.033500	0.013900	0.0
WHOLSALE	0.0	0.0	0.020000
RETAIL	0.0	0.0	0.030000
FININSUR	0.031800	0.039600	0.060000
REALESTA	0.0	0.037900	0.0
BOTLOGIN	0.0	0.0	0.0
EATDRINK	0.0	0.0	0.0
AUTOSERS	0.0	0.0	0.0
RECAMUSE	0.0	0.0	0.0
EDUCSERS	0.0	0.0	0.0
HEALTSER	0.0	0.0	0.0
MISCSERV	0.015850	0.140000	0.010000
CHARTER	0.011410	0.002180	0.0
MARNBOAT	0.560900	0.193800	0.0
COMMFISH	0.0	0.0	0.030000

APPENDIX F

1978 Regional Interdependence Coefficients Matrix
(43 X 43) for the Seventeen Northern Ohio Counties

Appendix F.

	LIVSTOCK	CROPS	FORESPRO	MINE-OTR	MINEXTRA	CONSTRUC	FOODKIND	TEXTILES	WOODLUMB	FURNITXT
LIVSTOCK	1.072129	0.020703	0.001108	0.000165	0.000192	0.000226	0.055004	0.000723	0.000160	0.000271
CROPS	0.292114	1.040453	0.000542	0.000536	0.000628	0.000848	0.101715	0.001156	0.000466	0.000712
FORESPRO	0.006285	0.002269	1.047414	0.000479	0.000540	0.002362	0.033142	0.001971	0.000336	0.000557
MINE-OTR	0.001833	0.002554	0.001106	1.012750	0.003836	0.001513	0.001929	0.003257	0.001642	0.003305
MINEXTRA	0.000996	0.002302	0.000965	0.006135	1.014175	0.003569	0.001186	0.000704	0.000671	0.000856
CONSTRUC	0.034275	0.031980	0.014586	0.037049	0.031153	1.020208	0.027929	0.022341	0.013666	0.023884
FOODKIND	0.187712	0.006138	0.001599	0.002410	0.002817	0.003178	1.194630	0.004934	0.002419	0.003883
TEXTILES	0.003076	0.003435	0.002444	0.003516	0.004216	0.003485	0.003418	1.303670	0.001550	0.050848
WOODLUMB	0.001664	0.002131	0.000569	0.001697	0.001363	0.033726	0.001563	0.001163	1.072312	0.018166
FURNITXT	0.000115	0.000107	0.000059	0.000139	0.000121	0.003193	0.000099	0.000084	0.000220	1.008780
PAPRPROD	0.011966	0.004182	0.003605	0.005018	0.008386	0.009068	0.048939	0.022423	0.012257	0.022391
PRNPUBRS	0.004372	0.002294	0.002470	0.002070	0.002853	0.002196	0.013472	0.004035	0.001706	0.005743
CHEMPROD	0.085199	0.173383	0.041303	0.076405	0.119584	0.048698	0.064575	0.223907	0.055417	0.071577
RUBLETHR	0.026991	0.012136	0.022326	0.040053	0.045370	0.018639	0.025854	0.056049	0.010799	0.064513
STCLYGLS	0.010136	0.004494	0.004946	0.006137	0.006424	0.081239	0.040230	0.006319	0.026763	0.016571
PRIRSTMC	0.008462	0.006683	0.003378	0.040493	0.063372	0.044480	0.014327	0.009884	0.022048	0.194395
PRNFMETL	0.015346	0.006912	0.002579	0.009863	0.017080	0.025534	0.072680	0.009003	0.007463	0.033539
HEATPLFB	0.005214	0.002923	0.001496	0.011916	0.010343	0.057376	0.007401	0.002968	0.015389	0.022665
OTHERFAB	0.004898	0.003714	0.002001	0.006228	0.013418	0.016305	0.009795	0.002909	0.029122	0.074106
MACHNERY	0.012094	0.013437	0.006788	0.045719	0.095117	0.012852	0.009129	0.018548	0.003449	0.014642
MACHNEIT	0.002631	0.001954	0.001063	0.005263	0.006335	0.015633	0.004296	0.003881	0.006163	0.005793
ELETELTN	0.003956	0.003681	0.002032	0.008781	0.009851	0.025081	0.003967	0.010181	0.004378	0.008944
MOTVEQUP	0.003972	0.002305	0.001409	0.004408	0.012268	0.003873	0.002936	0.003342	0.002899	0.003658

Appendix F. Continued

BOTHBLD	0.000120	0.000129	0.000361	0.000064	0.000097	0.000101	0.000220	0.000122	0.000093	0.000104
OTHERMFG	0.000722	0.000583	0.000356	0.004584	0.002146	0.001194	0.000609	0.000897	0.001547	0.001787
WATRTRAN	0.002116	0.002767	0.000698	0.001231	0.001941	0.002006	0.002802	0.002604	0.002056	0.002165
OTHRTRAN	0.037285	0.015391	0.007798	0.016651	0.020180	0.025402	0.037877	0.040005	0.023262	0.032230
COMMUNIC	0.005892	0.004319	0.002805	0.003389	0.004677	0.005235	0.005859	0.006165	0.004129	0.005735
ELECTGAS	0.030382	0.023418	0.019835	0.089792	0.073452	0.020368	0.031899	0.037492	0.027552	0.038228
WHOLSALE	0.062144	0.049105	0.044113	0.027471	0.051893	0.061594	0.080105	0.091515	0.062661	0.077178
RETAIL	0.004886	0.002783	0.015785	0.003210	0.004315	0.044860	0.003784	0.002370	0.001821	0.002421
FINIRSUR	0.027517	0.020717	0.010269	0.020366	0.023698	0.013645	0.016508	0.015334	0.013543	0.019304
REALESTA	0.067294	0.095125	0.016101	0.054744	0.043408	0.017130	0.027784	0.033229	0.015987	0.023714
HOTLOGIN	0.000963	0.000789	0.000488	0.001291	0.002231	0.001218	0.001703	0.003078	0.001723	0.004848
EATDRINK	0.005628	0.004608	0.002656	0.006337	0.006365	0.009785	0.007926	0.010193	0.006791	0.010928
AUTOSERS	0.009070	0.005972	0.004106	0.007038	0.014607	0.007430	0.010692	0.009321	0.008111	0.009660
RECAMUSE	0.000445	0.000328	0.000194	0.000389	0.000467	0.000528	0.000578	0.000678	0.000612	0.000595
EDUCSERS	0.000184	0.000168	0.000093	0.000238	0.000254	0.000286	0.000275	0.000698	0.000222	0.002311
HEALTSER	0.005129	0.000147	0.000030	0.000047	0.000055	0.000038	0.000389	0.000042	0.000031	0.000047
MISCSERV	0.085097	0.063676	0.038616	0.055481	0.071988	0.075427	0.088418	0.063893	0.037788	0.064951
CHARTER	0.000005	0.000004	0.000002	0.000003	0.000004	0.000004	0.000005	0.000004	0.000002	0.000004
MARNBOAT	0.000267	0.000200	0.000121	0.000174	0.000226	0.000237	0.000278	0.000201	0.000119	0.000204
COMMFISH	0.000165	0.000006	0.000002	0.000003	0.000003	0.000004	0.001046	0.000006	0.000003	0.000005

Appendix F. Continued

	PAPRPROD	PRNPUBRS	CHEMPROD	RUBLETER	STCLYCLS	PRIMSTMC	FRNFMETL	HEATPLFB	OTHERFAB	MACHINERY
LIVSTOCK	0.000221	0.000311	0.000737	0.000369	0.000256	0.000154	0.000228	0.000203	0.000215	0.000247
CROPS	0.000727	0.000851	0.003616	0.001284	0.000740	0.000461	0.000649	0.000584	0.000644	0.000687
FORESPRO	0.000551	0.000391	0.002771	0.000989	0.000638	0.000352	0.000451	0.000412	0.000462	0.000445
MINE-OTR	0.002196	0.001879	0.013778	0.004667	0.005305	0.009178	0.004549	0.004246	0.003221	0.002516
MINEXTRA	0.000778	0.000280	0.003279	0.001473	0.020103	0.002336	0.000841	0.001013	0.000946	0.000690
CONSTRUC	0.021709	0.025303	0.029329	0.027275	0.028272	0.026999	0.024935	0.023308	0.022275	0.019468
FOODKIND	0.003362	0.004617	0.012533	0.005498	0.003881	0.002304	0.003474	0.003025	0.003256	0.003773
TEXTILES	0.006452	0.003212	0.002526	0.050574	0.006863	0.001454	0.001941	0.003450	0.003743	0.002360
WOODLUMB	0.001587	0.001814	0.001492	0.001867	0.005854	0.002472	0.001791	0.002534	0.004212	0.001933
FURNFIXT	0.000075	0.000093	0.000184	0.000183	0.000109	0.000526	0.000126	0.000225	0.000133	0.000170
PAPRPROD	1.295160	0.124207	0.018723	0.022557	0.026511	0.004284	0.008176	0.011458	0.013270	0.005395
PRNPUBRS	0.003547	1.079779	0.005338	0.003396	0.002627	0.002652	0.007265	0.002763	0.002752	0.002540
CHEMPROD	0.110967	0.045851	1.352039	0.305874	0.097582	0.055727	0.060226	0.052228	0.081253	0.046136
RUBLETER	0.032070	0.011682	0.017569	1.050925	0.043872	0.005665	0.015399	0.012435	0.031675	0.014686
STCLYCLS	0.004467	0.004224	0.011585	0.010656	1.127637	0.012874	0.010142	0.011478	0.013812	0.012794
PRIMSTMC	0.010567	0.005814	0.014134	0.027963	0.017874	1.246498	0.110395	0.391037	0.205302	0.195100
FRNFMETL	0.009032	0.006569	0.038718	0.018455	0.012303	0.032434	1.344646	0.092786	0.078294	0.046180
HEATPLFB	0.002318	0.002407	0.003689	0.010000	0.003273	0.011553	0.008523	1.040337	0.022175	0.023361
OTHERFAB	0.004791	0.003212	0.005247	0.014467	0.008752	0.014726	0.022801	0.029837	1.044899	0.017662
MACHINERY	0.010770	0.006580	0.014628	0.014214	0.009451	0.039135	0.055018	0.034723	0.024886	1.125364
MACHNBIT	0.003657	0.002076	0.003294	0.003199	0.006167	0.011207	0.014346	0.022880	0.013879	0.032262
ELETELTR	0.002760	0.010624	0.004837	0.006392	0.011289	0.020724	0.009570	0.017844	0.012199	0.039799
MOTVEQUP	0.002319	0.002684	0.002812	0.003936	0.004288	0.002847	0.002375	0.005142	0.002596	0.004561

Appendix F. Continued

BOTSHBLD	0.000086	0.000049	0.000200	0.000147	0.000154	0.000271	0.000068	0.000136	0.000097	0.000081
OTHERMFG	0.001329	0.002201	0.001295	0.001689	0.001943	0.001267	0.002108	0.001225	0.001592	0.001364
WATRTRAN	0.001770	0.000724	0.004422	0.003139	0.003441	0.006405	0.001347	0.003018	0.002070	0.001700
OTHRTRAN	0.033521	0.034921	0.033709	0.037665	0.051006	0.025859	0.029158	0.029693	0.031548	0.026268
COMMUNIC	0.005448	0.010240	0.005149	0.005860	0.005713	0.003928	0.004633	0.005190	0.005191	0.006077
ELECTGAS	0.030004	0.020242	0.053192	0.042520	0.067715	0.058077	0.049920	0.041169	0.039826	0.030166
WHOLSALE	0.059579	0.039593	0.045049	0.051029	0.053479	0.054164	0.057498	0.060795	0.052259	0.053569
RETAIL	0.002191	0.002931	0.002701	0.002625	0.002852	0.002280	0.003530	0.002431	0.002366	0.002342
FININSUR	0.010351	0.014975	0.013539	0.014934	0.016216	0.011726	0.013958	0.014784	0.015287	0.012738
REALESTA	0.026378	0.033387	0.027507	0.021597	0.022482	0.009368	0.018602	0.018658	0.019245	0.017158
BUTLOGIR	0.002828	0.005680	0.002648	0.003755	0.002191	0.002428	0.002454	0.002780	0.003146	0.001578
EATDRINK	0.008241	0.014816	0.011039	0.011468	0.010635	0.006562	0.009975	0.009878	0.009006	0.011756
AUTOSERS	0.006029	0.007200	0.005677	0.006289	0.010879	0.004469	0.005791	0.005779	0.005949	0.005445
RECAMUSE	0.000685	0.000987	0.000568	0.000588	0.000552	0.000413	0.000507	0.000492	0.000487	0.000728
EDUCSERS	0.000319	0.000261	0.000684	0.000755	0.000784	0.000535	0.000606	0.000804	0.000542	0.000325
HEALTSER	0.000030	0.000043	0.000041	0.000042	0.000041	0.000029	0.000035	0.000036	0.000037	0.000032
MISCSERV	0.055868	0.081862	0.077388	0.076305	0.063234	0.042209	0.053793	0.052308	0.052514	0.048994
CHARTER	0.000003	0.000005	0.000004	0.000004	0.000004	0.000002	0.000003	0.000003	0.000003	0.000003
MARNBOAT	0.000173	0.000257	0.000243	0.000240	0.000199	0.000133	0.000169	0.000164	0.000165	0.000154
COMMFISH	0.000004	0.000005	0.000012	0.000006	0.000004	0.000003	0.000004	0.000004	0.000004	0.000004

Appendix F. Continued

	MACHNRIT	ELETELTN	MOTVEQUP	BOTHHOLD	OTHERMFG	WATRTRAN	OTHRTRAN	COMMUNIC	ELECTGAS	WHOLSALE
LIVSTOCK	0.000275	0.000310	0.000328	0.000361	0.000570	0.000305	0.000327	0.000367	0.000159	0.000397
CROPS	0.000767	0.000856	0.000874	0.000991	0.010523	0.000906	0.000917	0.002285	0.000531	0.000948
FORESPRO	0.000508	0.000575	0.000619	0.000674	0.001103	0.000721	0.000627	0.000472	0.000594	0.000788
MINE-OTR	0.002492	0.002486	0.003238	0.002941	0.002769	0.002661	0.001429	0.000807	0.035779	0.000827
MINEXTRA	0.000617	0.000800	0.001023	0.000939	0.001052	0.000614	0.000368	0.000261	0.000636	0.000178
CONSTRUC	0.019551	0.024357	0.024676	0.024311	0.033584	0.051039	0.023955	0.060618	0.060346	0.022681
FOODKIND	0.004170	0.004668	0.004863	0.005488	0.005660	0.004279	0.004778	0.003819	0.002372	0.006036
TEXTILES	0.003621	0.003385	0.025850	0.008315	0.031260	0.006980	0.003603	0.001387	0.001060	0.001992
WOODLUMB	0.001543	0.002078	0.002188	0.005478	0.017320	0.002137	0.000988	0.002065	0.002073	0.000984
FURNITXT	0.000175	0.001422	0.000310	0.013431	0.000162	0.000095	0.000089	0.000217	0.000198	0.000076
PAPRPROD	0.012899	0.015662	0.009425	0.006149	0.042521	0.005247	0.005427	0.003257	0.003318	0.006118
PRNPUBBS	0.002968	0.003979	0.003617	0.003872	0.004399	0.005245	0.005212	0.007013	0.003586	0.004644
CHEMPROD	0.052190	0.064436	0.061046	0.067703	0.122432	0.141711	0.096142	0.011263	0.092258	0.026981
RUBLETER	0.019415	0.028056	0.043831	0.011798	0.075066	0.007565	0.017812	0.003237	0.005647	0.005133
STCLYCLS	0.011290	0.021983	0.025485	0.019026	0.012933	0.007866	0.004573	0.005686	0.006026	0.003356
PRIRSTMC	0.146984	0.188422	0.222200	0.204616	0.078130	0.039068	0.009589	0.005738	0.006789	0.003655
PRNFMETL	0.076005	0.105865	0.064300	0.057042	0.055515	0.014401	0.005958	0.005227	0.005500	0.002543
HEATPLFB	0.026297	0.028648	0.103873	0.065024	0.017721	0.008151	0.005223	0.004361	0.004343	0.002448
OTHERFAB	0.027942	0.026168	0.048534	0.030514	0.021724	0.013857	0.003883	0.001968	0.002098	0.001623
MACHNERY	0.043718	0.030082	0.046145	0.127332	0.011770	0.021790	0.005308	0.002121	0.007681	0.001976
MACHNRIT	1.069016	0.012313	0.033911	0.022985	0.007071	0.006542	0.004725	0.001841	0.001930	0.002959
ELETELTN	0.035200	1.122204	0.068100	0.075614	0.023974	0.017477	0.007197	0.023371	0.006841	0.003138
MOTVEQUP	0.003656	0.005473	1.269958	0.005029	0.003724	0.007054	0.027669	0.002647	0.002216	0.006682

Appendix F. Continued

BOTSHBLD	0.000079	0.000076	0.000108	1.005849	0.000107	0.033884	0.000083	0.000034	0.000090	0.000049
OTHERMFG	0.002992	0.002474	0.001469	0.002703	1.054132	0.003010	0.001008	0.001186	0.000843	0.000950
WATRTRAN	0.001607	0.001426	0.002230	0.002060	0.001953	1.314341	0.001578	0.000359	0.001913	0.000678
OTHRTRAN	0.024207	0.029195	0.030892	0.023419	0.035814	0.034280	1.137109	0.009611	0.012483	0.024316
COMMUNIC	0.005850	0.006854	0.005959	0.006802	0.008238	0.012441	0.015884	1.015157	0.005222	0.013956
ELECTGAS	0.036749	0.033361	0.036860	0.035272	0.035951	0.037458	0.016588	0.022578	1.235048	0.019656
WHOLSALE	0.048906	0.056783	0.101719	0.069326	0.079513	0.041659	0.047052	0.011602	0.021285	1.026370
RETAIL	0.002650	0.002555	0.003165	0.003220	0.003224	0.004181	0.012782	0.003744	0.003761	0.004775
FINIRSUR	0.013380	0.016180	0.018412	0.014250	0.023106	0.071407	0.035710	0.018478	0.016471	0.016646
REALESTA	0.025222	0.023855	0.015868	0.015993	0.030378	0.050206	0.025553	0.036454	0.017326	0.024980
HOTLOGIN	0.002952	0.004909	0.003982	0.001964	0.003779	0.001204	0.001181	0.002967	0.000975	0.004198
EATDRINK	0.013403	0.014234	0.018549	0.017631	0.015452	0.009240	0.012146	0.009760	0.006032	0.020432
AUTOSERS	0.005648	0.008145	0.015326	0.005415	0.007658	0.009065	0.048334	0.006190	0.005652	0.021589
RECAMUSE	0.000630	0.000740	0.000759	0.000818	0.000872	0.000800	0.001026	0.036340	0.000496	0.000988
EDUCSERS	0.000328	0.000634	0.000560	0.000537	0.000430	0.000315	0.000294	0.000267	0.000149	0.000225
HEALTSER	0.000035	0.000043	0.000041	0.000039	0.000069	0.000144	0.000094	0.000048	0.000038	0.000046
MISCSERV	0.054862	0.074225	0.068872	0.069147	0.111676	0.113553	0.075622	0.081250	0.047749	0.081661
CHARTER	0.000003	0.000004	0.000004	0.000004	0.000006	0.000007	0.000004	0.000005	0.000003	0.000005
MARNBOAT	0.000172	0.000233	0.000216	0.000217	0.000351	0.000357	0.000238	0.000255	0.000150	0.000256
COMMF155	0.000005	0.000005	0.000006	0.000006	0.000006	0.000004	0.000005	0.000003	0.000002	0.000023

Appendix F. Continued

	RETAIL	FININSUR	REALESTA	HOTLOGIN	EATDRINK	AUTOSERS	RECAMUSE	EDUCSERS	HEALTHER	MISCSERV
LIVSTOCK	0.000170	0.000671	0.000144	0.000407	0.014910	0.000209	0.005688	0.000744	0.002130	0.000746
CROPS	0.000445	0.001659	0.000561	0.001688	0.033957	0.000559	0.056426	0.000996	0.003296	0.001454
FORESPRO	0.000484	0.001166	0.002144	0.002631	0.020266	0.000458	0.001432	0.000537	0.001208	0.001419
MINE-OTR	0.001432	0.001615	0.000898	0.003229	0.001583	0.001535	0.001367	0.001760	0.001268	0.002417
MINEXTRA	0.000179	0.000315	0.000364	0.000438	0.000427	0.000627	0.000411	0.000276	0.000258	0.000889
CONSTRUC	0.028723	0.063838	0.088770	0.066866	0.025911	0.025376	0.039672	0.045699	0.037155	0.218063
FOODKIND	0.002325	0.009560	0.002019	0.006392	0.233523	0.003039	0.014256	0.003612	0.020272	0.006372
TEXTILES	0.000993	0.002669	0.000714	0.009124	0.002056	0.008938	0.004611	0.001008	0.009887	0.003237
WOODLUMB	0.000991	0.002184	0.002959	0.002656	0.001060	0.001333	0.002162	0.001614	0.001379	0.007391
FURNFIXT	0.000693	0.000286	0.000280	0.000213	0.000086	0.000153	0.000197	0.000151	0.000146	0.000699
PAPRPROD	0.007943	0.012549	0.002079	0.009868	0.019666	0.006047	0.005375	0.007539	0.005707	0.007106
PRNPUBBS	0.003298	0.039397	0.002321	0.011764	0.005319	0.002426	0.011377	0.027883	0.005530	0.009701
CHEMPROD	0.023177	0.025304	0.021209	0.053422	0.028848	0.033338	0.031719	0.023794	0.019684	0.036385
RUBLETHR	0.004063	0.005267	0.003914	0.010920	0.010524	0.028832	0.008224	0.003977	0.014232	0.009513
STCLYGLS	0.003208	0.006395	0.007472	0.008815	0.012027	0.021643	0.006215	0.006511	0.006380	0.019736
PRIRSTMC	0.002818	0.005371	0.004748	0.005765	0.005266	0.063358	0.005648	0.004898	0.005618	0.013981
FRNFMETL	0.002813	0.003953	0.003082	0.004407	0.016088	0.021298	0.004499	0.003842	0.005258	0.008513
HEATPLFB	0.002212	0.004569	0.005398	0.005304	0.004027	0.038883	0.004409	0.003284	0.003652	0.014188
OTHERFAB	0.001487	0.002375	0.001887	0.002628	0.002895	0.022325	0.002475	0.001617	0.002095	0.007828
MACHNERY	0.001589	0.002996	0.001838	0.003035	0.003567	0.016433	0.003338	0.001928	0.002336	0.008467
MACHNEIT	0.001644	0.002691	0.001851	0.002187	0.001825	0.054849	0.003013	0.002016	0.001543	0.006347
ELETELTR	0.002675	0.006646	0.003346	0.005056	0.002485	0.028442	0.008352	0.006853	0.024797	0.014382
MOTVEQUP	0.002969	0.004148	0.001889	0.003632	0.002078	0.267041	0.004021	0.002878	0.002281	0.004409

Appendix F. Continued

BOTSHBLD	0.000039	0.000089	0.000031	0.000079	0.000091	0.000060	0.000075	0.000047	0.000045	0.000333
OTHERMFG	0.000565	0.002706	0.000534	0.003274	0.001571	0.000950	0.005167	0.003902	0.002887	0.003979
WATRTRAN	0.000480	0.000798	0.000492	0.001145	0.001290	0.001111	0.000997	0.000703	0.000644	0.001763
OTHRTRAN	0.007215	0.015328	0.006654	0.012786	0.023264	0.018269	0.014440	0.014982	0.015551	0.022346
COMMUNIC	0.008257	0.027942	0.004141	0.005774	0.005421	0.007646	0.010066	0.008937	0.006739	0.011117
ELECTGAS	0.041927	0.046147	0.022821	0.037794	0.035200	0.025541	0.035095	0.039658	0.033890	0.064679
WHOLSALE	0.013117	0.020663	0.012318	0.022878	0.008537	0.003110	0.036641	0.015725	0.027993	0.030238
RETAIL	1.003494	0.006191	0.006523	0.007437	0.002581	0.013716	0.006256	0.003582	0.002682	0.012841
FININSUR	0.020929	1.275105	0.024713	0.040720	0.018639	0.020187	0.030983	0.016215	0.016902	0.020219
REALESTA	0.057510	0.068024	1.104141	0.118788	0.046340	0.040699	0.092429	0.089454	0.038073	0.040265
HOTLOGIN	0.000374	0.003420	0.000471	1.000937	0.000893	0.001656	0.001782	0.000804	0.002804	0.002742
EATDRINK	0.007452	0.032950	0.006578	0.009763	1.004874	0.009780	0.036048	0.009739	0.012599	0.016641
AUTOSERS	0.009011	0.011275	0.006042	0.010827	0.005596	1.008834	0.008987	0.008485	0.005220	0.010058
RECAMUSE	0.000625	0.002181	0.000366	0.000573	0.000472	0.000594	1.111872	0.005389	0.000706	0.001602
EDUCSERS	0.000476	0.000461	0.000120	0.000320	0.000289	0.000251	0.000389	1.000469	0.000328	0.001093
HEALTSER	0.000852	0.002185	0.000075	0.000097	0.000117	0.000047	0.000187	0.000046	1.000515	0.000238
MISCSERV	0.081812	0.237139	0.044855	0.129605	0.075130	0.059041	0.139351	0.074048	0.071303	1.093979
CHARTER	0.000005	0.000014	0.000003	0.000007	0.000004	0.000003	0.000008	0.000004	0.000004	0.000063
MARNBOAT	0.000257	0.000745	0.000141	0.000407	0.000236	0.000185	0.000438	0.000233	0.000224	0.003456
COMMFISH	0.000002	0.000009	0.000002	0.000006	0.000206	0.000004	0.000013	0.000003	0.000018	0.000004

Appendix F. Continued

	CHARTER	MARNBOAT	COMMFISH
LIVSTOCK	0.000155	0.000205	0.001381
CROPS	0.000355	0.000459	0.002768
FORESPRO	0.000350	0.000476	0.001059
MINE-OTR	0.002113	0.001427	0.001262
MINEXTRA	0.000206	0.000282	0.000338
CONSTRUC	0.035034	0.048444	0.014158
FOODKIND	0.001765	0.002242	0.026763
TEXTILES	0.001249	0.001838	0.001938
WOODLUMB	0.001427	0.002059	0.001265
FURNFIXT	0.000790	0.001350	0.001031
PAPRPROD	0.002083	0.002560	0.005080
PRNPUBHS	0.003897	0.004147	0.003904
CHEMPROD	0.013734	0.016233	0.070757
RUBLETHR	0.002358	0.003252	0.005253
STCLYGLS	0.004078	0.005907	0.004529
PRIRSTMC	0.012735	0.021340	0.032739
PRMFMETL	0.004432	0.007019	0.013655
HEATPLFB	0.005527	0.008825	0.038748
OTHERFAB	0.002637	0.004189	0.004888
MACHNERY	0.007998	0.013230	0.012464
MACHNBIT	0.002190	0.003413	0.014266
ELETELTN	0.006276	0.009869	0.020096
MOTVEQUP	0.001157	0.001548	0.001455

Appendix F. Continued

BOTSHBLD	0.051094	0.090034	0.072620
OTHERMFG	0.000807	0.001107	0.022845
WATRTRAN	0.000451	0.000386	0.000657
OTHRTRAN	0.005410	0.007277	0.008181
COMMUNIC	0.003640	0.004205	0.024603
ELECTCAS	0.066612	0.039196	0.013748
WHOLSALE	0.009490	0.013429	0.036519
RETAIL	0.002348	0.003199	0.032344
FININSUR	0.081094	0.069082	0.083617
REALESTA	0.039775	0.064075	0.012224
BOTLOGIN	0.000675	0.000860	0.000935
EATDRINK	0.005225	0.006510	0.005838
AUTOSERS	0.002514	0.003171	0.002975
RECAMUSE	0.000388	0.000484	0.001082
EDUCSERS	0.000196	0.000269	0.000180
HEALTSER	0.000164	0.000157	0.000155
MISCSERV	0.146574	0.211128	0.047891
CHARTER	1.013108	0.002763	0.000003
MARNBOAT	0.705309	1.242962	0.000148
COMMFISH	0.000002	0.000002	1.030930