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GROWTH POTENTIAL OF MUSKINGUM COUNTY, OHIO:

AN ECONOMIC BASE AND INPUT-OUTPUT STUDY

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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* * * * * *

The Ohio State University
1968

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With all the love and indebtedness I dedicate this manuscript to my beloved wife, Souhair, and lovely daughters, Nashwa and Sherien. After all, their inestimable patience, efforts, sacrifice, encouragement, and love were the most valuable support I ever have and without them this achievement is unattainable.

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Studies in Quantitative Methods. Professor Francis E. Walker

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TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

LIST OF TABLES

LIST OF TABLES--Continued

LIST OF TABLES--Continued

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION

Economic development and growth have always been of great concern to economists, policy makers and the people. This concern has been growing rapidly during this century and as the gap in economic growth grows between the developed and underdeveloped areas the search becomes vigorous for measures and procedures to achieve more development for the developed areas and to push harder in the underdeveloped areas to catch up.

Many believe that the techniques used during the course of development in advanced areas can be reused in the less developed areas. This has been based on the assumption that the techniques and procedures evolved and tested in the development of the advanced areas have successfully proved their effectiveness.

This writer does not agree completely with this thought. The past experience of the advanced areas is really helpful if it can be adjusted to the environment which prevails in each underdeveloped area. It is well known that the problems facing the underdeveloped areas at the present time differ from those prevailed in the past century; moreover, the problems differ from one area to another; also, even if one problem is similar, the causes and consequences of the problem are different. Along with the time factor, the demographic,

geographic, and sociologic variables totally differ from one area to another and thus the technique that succeeds in one area may very well fail in another.

Also, this writer believes that economic growth is closely related to the quantity and quality of the resource combination available in each area and that the way in which these resources are allocated makes the difference in growth rate realized in the different areas. Therefore, the environment prevailing in any area to be developed should be examined to reveal the causes of its problems. Data on the structure of the economic system should be accumulated and the interaction between its different segments should be studied to understand better the total system. From this follows a better understanding and judgement of development techniques most suitable for the particular area.

Therefore, to stimulate a higher rate of growth in an underdeveloped area a reallocation of its resources is needed. This reallocation involves shifting the existing resources from some uses to others, bringing in new resources, or a combination of both.

The Problem

The Appalachian Region of Ohio, 28 counties in the southeastern part of the state, Figures 1 and 2, is a part of the Appalachian Region which extends in 12 states of the eastern United States and includes Alabama, Georgia, Kentucky, Maryland, North Carolina, New York, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia,

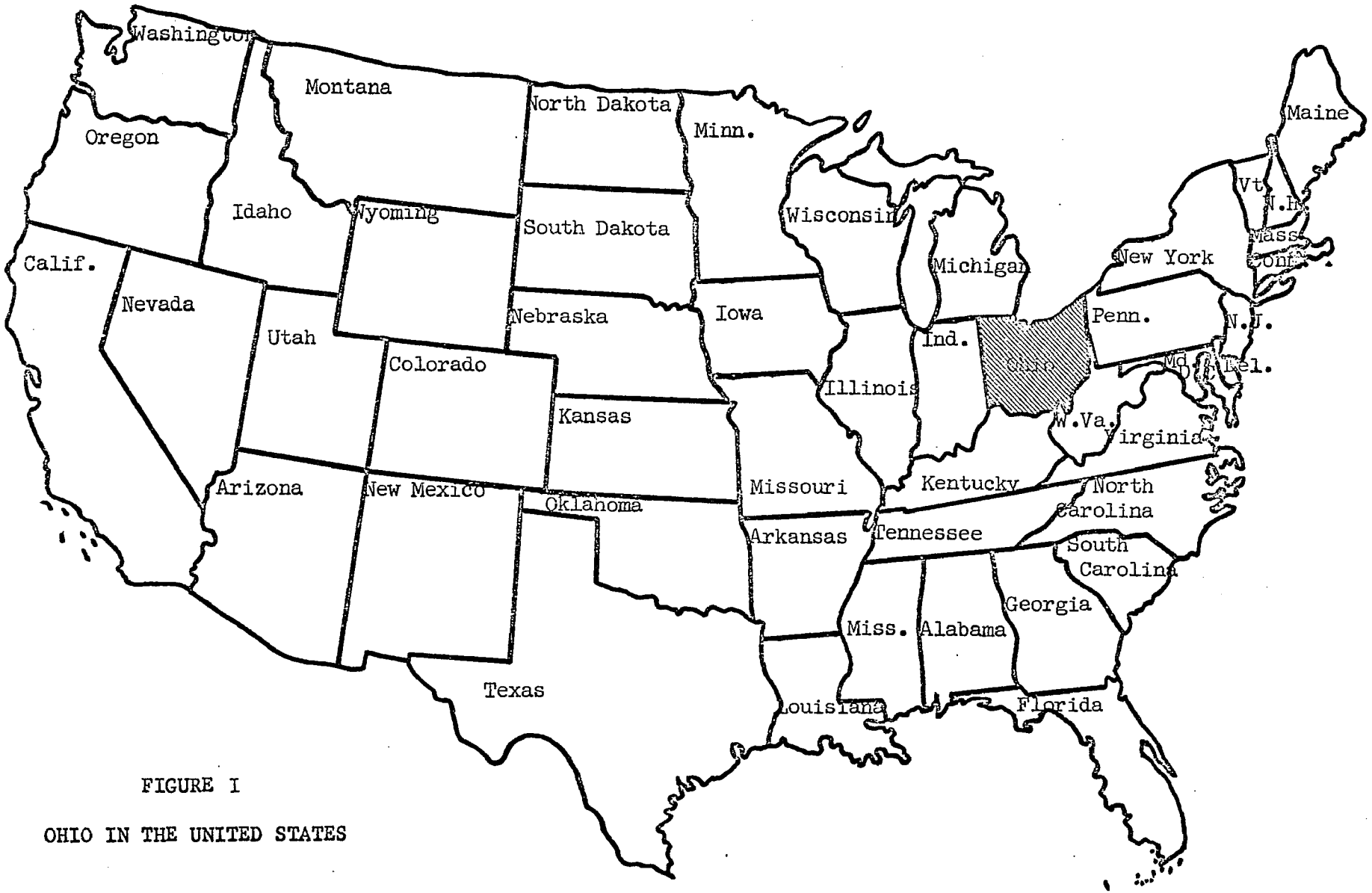
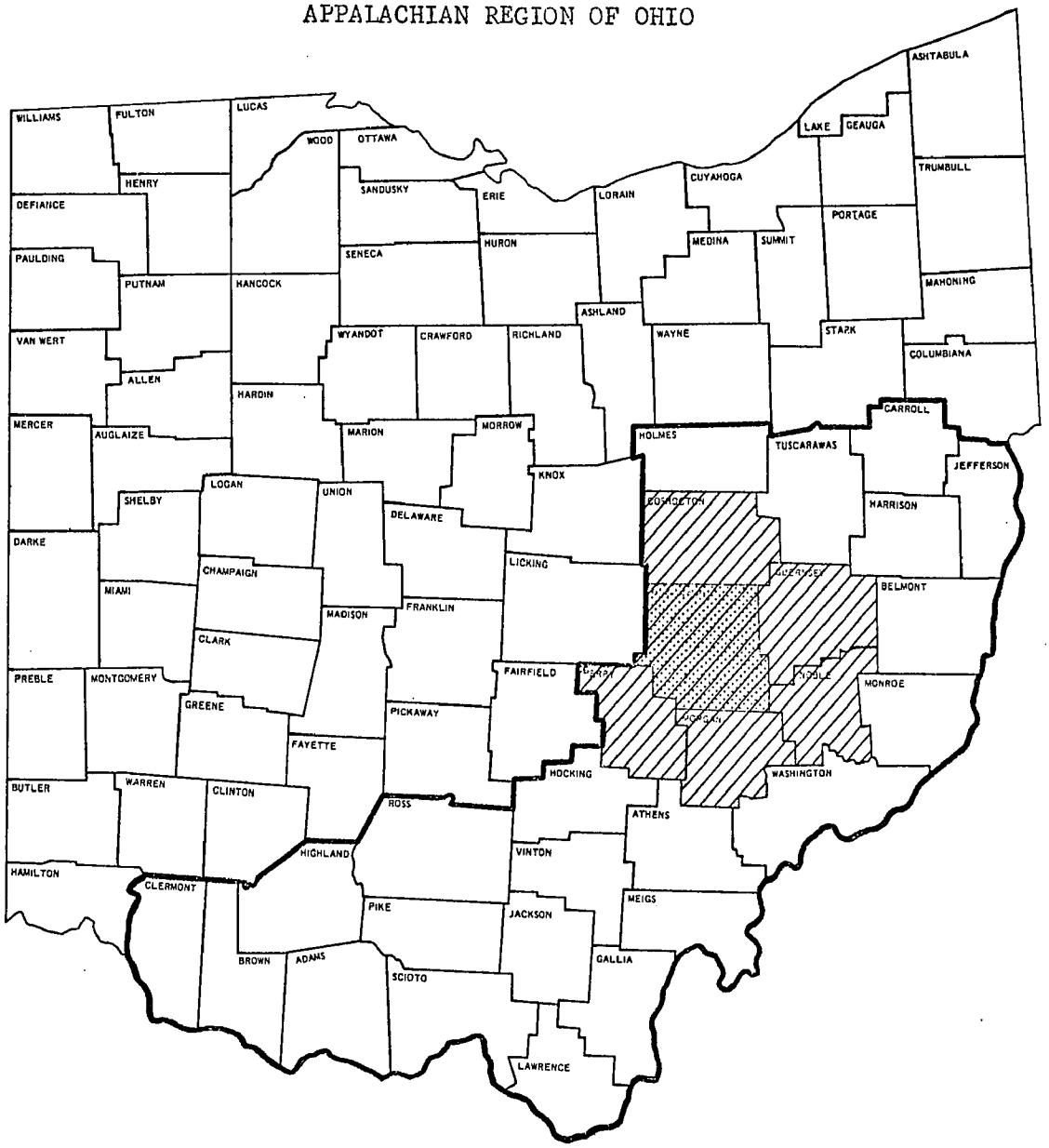


FIGURE I

OHIO IN THE UNITED STATES

FIGURE 2

APPALACHIAN REGION OF OHIO



Study Area

Muskingum County

and West Virginia. The Appalachian Regional Development Act of 1965 states that:

> ". . . while (the region) abundant in natural resources and rich in potential, lags behind the rest of the nation in its economic growth and that its people have not shared properly in the nation's prosperity. . . that regionwide development is feasible, desirable and urgently needed. . . The public investments made in the region under this Act shall be concentrated in areas where there is the greatest potential for future growth, and where the expected return on public dollars invested will be the greatest. . ."[1]

The lags in economic growth in the region are shown in the low-income status, high rate of unemployment, low percentage of the active labor force ages within the population, low level of education, and high out-migration especially for young educated people. Table 1 shows a comparison between some counties in the region and the average for the State of Ohio and the nation for some selected measures.

In 1965 the Cooperative Extension Service in each county in Ohio's Appalachian Region undertook a comprehensive study and developed a long-term program plan.[2] The common problems reported by these studies are low-income and its consequences, e.g., inadequate nutrient level and health difficulties; lack of job opportunities and underemployment; low formal education; credit availability and use; and small operational units. These problems are the most common in almost all the counties with differences in the causes and consequences of each problem in each individual county.

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[1]U. S., Congress, The Appalachian Regional Development Act of 1965, H. R. 4, 89th Congress, 1st Session, January 4, 1965.

[2]The Cooperative Extension Service, The Ohio State University, Long-Term Development Plan by County, 1965.

TABLE 1

COMPARISON BETWEEN SOME APPALACHIAN COUNTIES, STATE OF OHIO, AND THE NATION FOR SELECTED MEASURES

	% Change in Population 1950/60	Age 18-64 As % of Population (1)	Median School Years Completed	Median Income in 1959 $	1965 Average Weekly Earnings $ (2)	Unemployment Rate 1966 (3)
Adams County	- 2.5	49.4	8.6	2,829	70.03	5.5
Coshocton County	+ 3.5	53.0	10.6	4,975	109.04	3.0
Highland County	+ 5.4	51.2	9.5	3,843	77.21	2.3
Jackson County	+ 5.8	50.0	8.9	4,358	86.56	5.5
Noble County	- 6.5	49.2	9.2	3,802	101.42	3.9
Perry County	- 3.9	50.0	9.5	4,461	95.50	6.5
State of Ohio	+ 22.1	54.6	10.9	6,171	120.06	3.1
United States	+ 18.5	55.0	10.6	5,660		3.8

Source: County and City Data Book, 1967.

(1) U.S. Census of Population, 1960, Vol. I, Part 1, Table 55 and Part 37, Table 13.
(2) Ohio Bureau of Unemployment Compensation, No. C-700, August, 1966.
(3) Ohio Bureau of Unemployment Compensation, Ohio Labor Force Reports by County and U.S. Monthly Labor Review, Vol. 90, No. 12, December, 1967, Table A-2, pp. 69.

As such, a problem exists in the area. It is represented by a low economic growth which reflects the fact that the resources available are not used effectively.

Review of Literature

The purpose of this section is to present a review of literature which has particular reference to the objectives of this study. Included is review of fundamental concepts, previous empirical studies and research methods.

The United Nations experts' definition for development[3] is one of the many used by development students. It designates community development as the processes through which the efforts of a people are added to those of their government to improve the economic, social and cultural conditions of the community, to integrate them in the life of the country and to enable them to contribute fully to national progress and thus enjoy a higher level of living.

Leven[4] said that one kind of interest in regional growth and development has been characterized as self-interested. The regional parameter in which this kind would be interested is aggregate demand for goods and services in the region and thus regional development means

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[3]Inter-American Development Bank, Community Development Theory and Practice, Round Table, Mexico City, April 1966.

[4]Charles L. Leven, "Theories of Regional Growth," Problems of Chronically Depressed Rural Areas, (Agr. Policy Institute, N. C. State University, Series 19, Nov., 1965). For more discussion and bibliography on the same subject see: Research and Education for Regional and Area Development, (Ames, Iowa: Iowa State University Press, 1966).

an increase in the region's aggregate income which can be achieved either by an increase in the average income of people working or an increase in the number of workers through increasing the number of available jobs. The argument here would be that a region does better if the market for its goods outside the region expands. This would be consistent with the main thrust of most economic base thought. He added that in the view of the aggregate demand explanation of regional development, the lagging aggregate export demand is the cause for relatively low growth in aggregate income which makes one region grow at a different rate than others. Then he gave two behavioral hypotheses to validate that explanation:

1. Market hypotheses: that there are external markets for the region's products that are not being fully exploited.

2. Ignorance hypotheses: that there are producers who do not operate in the region and are unaware of the profit opportunities of producing in the region.

Supporting the aggregate demand approach, North[5] emphasizes that the timing and pace of an economy's development has been determined by the success of its export sector and the characteristics of the export industry. In his words, "the successful economy grows because the initial development (caused by an expanding external market) from export industry leads to a widening of the export base and growth in the size of the domestic market (which in turn will widen variety of residentiary industries). . ."

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[5]Douglass C. North, The Economic Growth of the U. S., 1790-1860, (New Jersey: Prentice Hall, Inc., 1961), pp. 1-7.

Tiebout[6] introduced his paper by:

> "The economic base of a community consists of those activities which provide the basic employment and income on which the rest of the local economy depends. An economic base study identifies the basic sources of employment and income and provides an understanding of the source and level of all employment and income in a community. . . it develops information which will help a community solve local problems, make better decisions, . ."

Tiebout and Lane[7] used the term local service or nonbasic sector to refer to economic activities serving the local market. They argued that an income change in the basic sector (exports) will produce a similar directional change in nonbasic income. But the change in the latter differs according to whether growth in the region is due to increase in per capital income or in total population. Per capita income growth is an increase in regional income accounted for solely by changes in per capita income of residents while population income growth implies growth in total regional income because of new residents. The former shows marginal propensity to consume and the latter shows average propensity. The writers showed that the multiplier effect of the change differs in the two cases and thus the effect on nonbasic income. They concluded that the way in which basic income is forecast makes a difference in forecasting nonbasic income.

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[6] Charles M. Tiebout, The Community Economic Base Study, Supplementary Paper No. 16, (Committee for Economic Development, Dec. 1962).

[7] C. Tiebout, and T. Lane, "The Local Service Sector in Relation to Economic Growth," Research and Education for Regional and Area Development.

Alexander's[8] conclusions in his case study of Madison, Wisconsin, confirm the conviction held by urban analysts in theory and practice that the basic-nonbasic concept is a valid approach in urban analysis. Application of the concept enabled segregation of two economic components which resembled neither each other nor the total economy. Consequently the approach enables a more meaningful analysis. Also he concluded that where time and personnel are available, the firm-by-firm technique for tabulating the basic and nonbasic component gives the most accurate measurements which can be quoted with confidence.

Park[9] mentioned that since the level of activities in the service sector is presumed to be determined by variation in the basic sector, the base multiplier can be derived by computing the ratio of the total export employment to the total area employment or regressing the latter upon the former by the least square method. Also he dichotomized the economic activities in a community in terms of their exogenous and endogenous nature and considered export, area investment sector especially in the short-run, employee compensation and property income received from outside the area, and transfer payments as exogenous variables. Then, he presented a case study in which he used a

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[8] John W. Alexander, An Economic Base Study of Madison, Wisconsin, Wisconsin Commerce Papers, I, (June 1953).

[9] Se-Hark Park, "The Economic Base Identification: An Appraisal," Land Economics, XLI, (Nov. 1965), p. 382-386.

short-run model that expressed the relation between the basic/nonbasic employment as:

$$X_i = a_i X_i + (1 - a_i) X_i$$

where X_i = total employment

a_i = export employment coefficient (percentage of export)

He presented two classifications. In the first a_i measured export only and in the second a_i measured export plus linkages employment and thus had a higher value. The multiplier was estimated as

$$k = 1 \; / \; 1 - \frac{\text{nonbasic employment}}{\text{total employment}}$$

The value of the static aggregate employment multiplier in the second case was lower than in the first case since nonbasic employment was lower.

Evans and Harrison[10] mentioned that regional multipliers, sufficiently sensitive to be used in the appraising of the impact of the water resource projects, have been developed for all 376 counties of Appalachia and have been found reliable indicators of the impact when checked against the results obtained from county input-output studies. They explained that the multiplier's first period effect of a given change is determined by the initial change in the allocation among the different factors. This effect is different than that of the second

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[10]James Evans and Robert Harrison, "Improved Evaluation Procedures in Appalachian Water Resource Planning," A paper presented into the International Conference On Water for Peace, Washington, D.C., May, 1967.

and later periods. The later effects are governed by the patterns of consumers' spending which is much the same regardless of the nature of the initial change.

Rao and Allee[11] introduced their research report by defining interindustry analysis as a technique of comprehensive analysis of a regional economy based upon the input-output flow of goods and services produced in a given region. Thus, basic information on interindustry transaction within and outside the selected area is used to reflect the nature and extent of interdependence among the various economic sectors in the region.

In a recent research monograph[12] an economic base analysis using input-output in a comprehensive approach was used to estimate the internal and external relations among the different industries in the study area. In this research external sales, exports, were considered the prime source of growth while goods and services sold within the area are treated as derived demands stemming indirectly from exports. The input-output model was used for a closed system in which consumption has been treated as derived from the demand for household services which in turn are derived from the external demand. The input-output transaction table was derived from the table of the U.S. economy supplemented by other data available locally.

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[11] Amanda S. Rao and David J. Allee, An Application of Interindustry Analysis to San Benito County, California, Giannini Foundation Research Report No. 278, Sept. 1964.

[12] Bureau of Business Research, The Ohio State University, The Columbus Area Economy Structure and Growth, 1950 to 1985, Monograph No. 126, 1967.

Weeks[13] mentioned that very few economic base studies of counties have ever been written. He determined that two major ways of conducting a base study are, (1) use of data available, (2) collection of data from field surveys. In his works, ". . . we have to take what we have, add to it our experience and judgement, mix in a liberal portion of local knowledge and common sense, and stick to a short-time horizon."

Objectives

The present study has been undertaken to investigate the present economic activities in the area. The information revealed by this investigation could be used within a framework of theoretical knowledge and experience to help achieve a more complementary program which can provide the area under study with a better allocation of its resources among the different economic activities in order to optimize the returns from their operation. The specific objectives of the study are:

1. To determine some locations within the region where development seems to be more promising.

2. To estimate the economic base and thus the present economic structure of a selected area.

3. To estimate the interrelationships between the different economic segments of the economy in that area.

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[13]Silas B. Weeks, Economic Base Study Grafton County, New Hampshire, New Hampshire Dept. of Resources and Economic Development, December 1963.

4. To identify and appraise alternatives that can be used in a complementary program to stimulate economic growth in the study area.

Procedure

This section is presented to summarize the procedure that has been used in the investigation for each of the objectives of this study. The detailed methodology will be discussed for each objective in subsequent chapters in which the analysis and results are presented.

In the second chapter a functional relationship relating income to some selected economic activities will be presented and discussed. This relationship has been used to estimate parameters used as indicators of productivity. This procedure has led to the determination of locations or activity centers with different degrees of potential growth within the study area.

Chapter III presents an economic base study for the selected area, Muskingum County. The analysis has been conducted to reveal the situation as it prevailed in the base year, 1963. The importance of each industry in providing the community with employment and the degree to which each industry serves the external market and thus constitutes the basic sector have been estimated. The data used has included that from a field survey supplemented by data available from secondary sources.

In Chapter IV the input-output model that has been used to study the structure of the economic system in the county has been presented and discussed. The derivation of the input-output transaction

table for the county from the U.S. table has been discussed, the impact of a change in the final demand on the system has been presented, and the applications of the results have been demonstrated.

The summary, conclusions and implications of this research have been presented in Chapter V.

The data required for this study have been drawn mainly from secondary sources which included published material such as different censuses and other government's publications and other unpublished materials such as the records of different government's agencies. Beside that a questionnaire, Appendix B, has been prepared to gather information pertaining to the distribution of sales of representative firms in the study area to determine the allocation of the activities of these firms between the local market and markets outside the area. For this purpose a sample of 30 business firms has been selected in Muskingum County. Nineteen of these firms were in manufacturing, 2 wholesalers, 2 retailers, 2 hospitals, one bank, one in communication, one in utilities, one in construction, and the main post office. Nineteen firms were personally interviewed while eleven small manufacturing firms were contacted by mail. The data obtained from the 30 firms were edited, tabulated and used as the basis for the allocation of employment between different demand sectors in manufacturing industry and supplemented with other information in the other industries. This will be discussed in more detail in Chapter III.

Scope of the Study

The main points in this study have covered the major segments of the economy in the study area in their general divisions with a little emphasis on the dis-aggregated levels of each activity. Therefore, the analysis and the results are concerned with the economy as a whole without discussing the details within each segment.

Limitations

Notwithstanding the efforts spent to insure the correctness and the validity of this research, the following limitations should be taken into consideration.

1. The size of the project, in terms of time, budget, and personnel, within which this study has been conducted dictated the reliance to a great extent on secondary sources of information to get the data needed.

2. The shortcomings of the secondary data are well known. Some needed data are not available, some are not in the proper form. And studying one county area adds more trouble since most of the data are published in aggregated form for the state or the nation. This lack of information has compelled the development of some systematic methods for obtaining the needed data.

3. The use of the year 1963 as a base and the 1958 input-output table as a tool for the analysis may be considered as limits on the results especially in this age in which technology is changing rapidly.

Value of the Study

The results of this research study are hoped to accomplish their purposes in two ways: (1) to demonstrate the usefulness of the methodological approach, a combination of economic base and input-output analysis, in studying the structure of the economic system and estimating the impact of any change in the system, (2) to shed some light on the interrelationships within the economic system of the area under consideration so that the policy-makers and all those who have interest in the area can gain information as to which activities need more emphasis in their planning for greater economic growth.

CHAPTER II

DETERMINATION OF ACTIVITY CENTERS WITHIN THE STUDY AREA

Resource productivity varies greatly between different regions and also between different locations within a region. This depends largely on the combination of resources available in each location. The quantity and the quality of each resource within that combination determine the patterns of production and the system of economic activities in each location. This, consequently, affects marginal value productivity of resources and leads to variation in productivity between locations even with similar production functions.

The term "activity center" is used in this study to identify different locations according to productivity of the resources available in each location. Thus, the term is used in a general sense to refer to the economic activity in each center.

The study area chosen for this study comprises 6 counties in Ohio's Appalachian Region, Figure 2. These counties are Coshocton, Muskingum, Guernsey, Noble, Morgan and Perry in the north western part of the region.[1] This area has been chosen as a survey area for the re-

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[1] A similar analysis has been conducted on another six county area in the southern part of the region. The results of that analysis are reported in Appendix A for a comparison between the two areas.

search project "State Special 163-Ohio Appalachia Regional Community Study" within which this study has been conducted.[2]

Figure 3 shows the trend in total population change in each of the counties in the study area during the present century and a projection for the years 1970 and 1980 as estimated by Ohio Department of Industrial and Economic Development.[3] The figure shows that total population has been either declining or very slightly increasing.

In addition Table 2 shows historical data in a time series, 1950, 1955, 1960 and 1964 for some selected indicators of economic activities in each county in the study area. All the values are in the constant dollar of 1957-59. The percentage changes between 1950-1964 for the same data are presented in Table 3. The data show that during this 14 year period three counties out of the six under study lost a part from their population. Meanwhile four of the six counties lost some of their labor force ranging up 21% in Noble County. Also the data show that while manufacturing industry, represented by value added, increased to a large extent, agricultural industry represented by total value of farm product sold declined in all counties.

This historical background sheds some light on the structural changes occurring in the area and reflects the picture that dominates the Appalachian Region, a low rate of economic growth disproportionately distributed throughout the region.

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[2]Ohio Agricultural Research and Development Center, Ohio Appalachia Regional Community Study, (Wooster, Ohio: 1968).

[3]Ohio Dept. of Industrial and Economic Development, Statistical Abstract of Ohio, 1960, (1960), Table A-5 and 6, pp. 5 and 6.

FIGURE 3
TOTAL POPULATION, ACTUAL 1900-1960 AND PROJECTION FOR 1970-1980
IN EACH COUNTY IN THE STUDY AREA

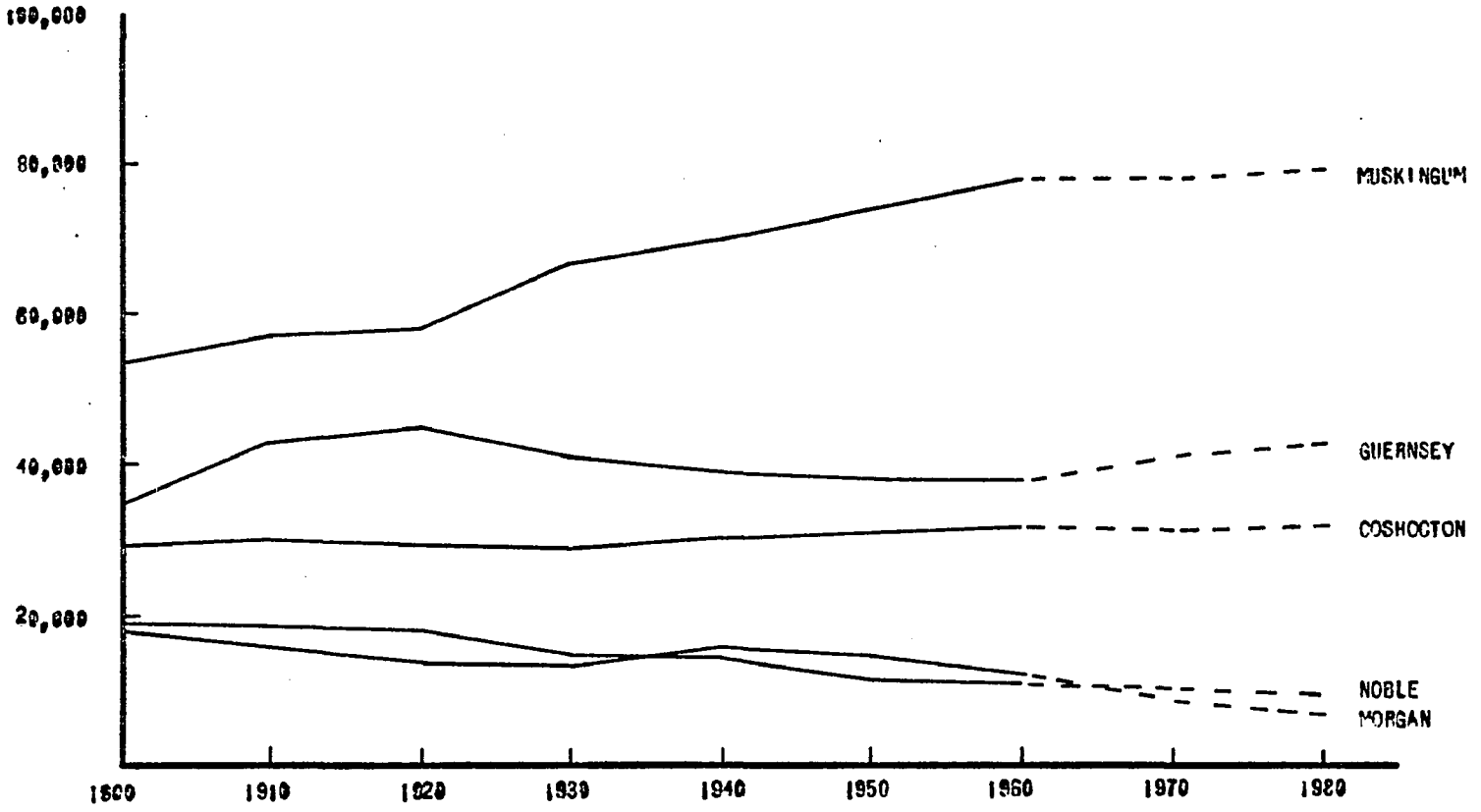

TABLE 2

SELECTED INDICATORS FOR ECONOMIC ACTIVITIES IN THE STUDY AREA

				Constant $ of 1957-59		
		Total Population (1)	Labor Force (2)	Value of Farm Pro. Sold (000$)	Value Added By Manfg. (000$)	Trade Sales & Services Receipts (000$)
Coshocton	1950	31,141	12,091	6,831	26,687	40,789
	1955	32,659	12,090	6,263	32,931	47,408
	1960	32,224	12,088	6,615	35,277	51,815
	1964	32,666	12,300	6,541	52,749	54,142
Guernsey	1950	38,452	13,629	3,833	10,199	48,795
	1955	38,767	13,619	3,463	16,233	45,882
	1960	38,579	13,610	3,854	29,915	50,455
	1964	38,713	12,400	3,626	62,304	51,132
Perry	1950	28,999	9,694	3,439	8,833	27,419
	1955	29,230	9,391	3,446	8,954	24,932
	1960	27,864	9,087	3,212	9,843	24,283
	1964	27,418	8,980	2,771	9,604	24,038
Noble	1950	11,750	4,033	3,125	694	8,748
	1955	11,825	3,847	2,402	2,750	11,504
	1960	10,982	3,641	2,357	2,814	10,876
	1964	10,516	3,200	2,277	3,623	10,164
Morgan	1950	12,836	4,505	3,539	814	11,558
	1955	12,922	4,390	3,045	6,715	12,025
	1960	12,747	4,277	3,008	6,279	13,327
	1964	12,640	4,175	2,490	5,709	13,958
Muskingum	1950	74,535	29,219	7,052	53,389	120,451
	1955	79,458	29,249	7,651	84,357	135,737
	1960	79,159	29,279	6,431	77,235	142,740
	1964	80,455	29,300	6,813	69,707	158,189

Sources: (1) 1950, and 1960, Census of Population 1960.
1955, Ohio Department of Health, July, 1955.
1964, Ohio Department of Development.
(2) 1950 and 1960, County and City Data Book.
1964, Ohio Bureau of Unemployment Compensation.

TABLE 3

PERCENTAGE CHANGE IN SELECTED INDICATORS IN THE STUDY AREA BETWEEN 1950-1964

County	Total Population	Labor Force	Agriculture	Manufacturing	Non-Manufacturing
Coshocton	4.90	1.73	- 4.25	97.65	32.74
Guernsey	0.68	- 9.02	- 5.40	510.88	4.78
Perry	- 5.45	- 7.37	- 19.42	8.72	- 12.33
Noble	- 6.11	- 20.65	- 27.14	422.04	16.18
Morgan	- 1.53	- 7.33	- 29.64	601.35	20.76
Muskingum	7.94	0.28	- 3.39	30.56	31.33

Source: Table 2

For the purpose of the present analysis, estimation of productivity in different activity centers, the six counties have been divided into three locations as the following:

(1) Coshocton and Guernsey
(2) Muskingum
(3) Noble, Morgan and Perry

The criteria used for the division have been based on the following:

a. Each location comprises adjacent counties

b. The change pattern in income over the period 1950-1964 and in particular 1960-64 has been similar for the counties in each location. This is shown in Figures 8 and 9 which are presented in Appendix A to illustrate the data for these counties in comparison with the data for the counties presented in the Appendix.

c. Population estimates in 1964 for these locations ranged from 50,574 in location (3) up to 80,455 in location (2), Table 2. A population of 40,000-60,000 is considered by many studies to be a minimum number of people to adequately support a major trade center; moreover, participation in some of the federal programs requires a minimum of about 75,000 people.[4]

d. The percentage of civilian labor force employed in major industries, shown in Figure 10, page 140 indicates similar mix of economic activities for the counties within each location. This means that the importance of major economic activities and consequently their productivity differ from one location to another.

Productivity in the Chosen Locations

The following discussion deals with a comparison between the three previously defined locations. The comparison has been based on estimation of productivity of some selected economic activities in the area. Productivity has been estimated through the determination of a functional relationship that is expected to explain the generation of income in each location as a function of the output of the selected activities in the particular location.

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[4] Cooperative Extension Services, South Dakota State University and U. S. Department of Agriculture, Some Guidelines for Organizing Economic Development Efforts in South Dakota Along Trade Area Lines, Extension Circular 651, p. 16.

The Theoretical Framework of the Model

One functional relationship is assumed to prevail in the region with all the observations (counties) as points on the function which is presented as:

$$Y = f(X_1, X_2, X_3, \ldots X_n)$$

where Y = Total income in each county
X_i = Selected economic activities

The relatively small size of the area under study along with the similarity of its environment justify this assumption.

A Cobb-Douglas production function in the form

$$Y = a\, X_1^{b_1} X_2^{b_2} \ldots X_n^{b_n}$$

has been used as the statistical model in this analysis. The main feature of this function, with the observations in logarithms, is that the exponents, b coefficients, of the variables represent elasticity of production for each individual variables. Those elasticities are assumed to be constant over the entire input-output curve which means that equal increments of input add the same percentage to total output. These estimated coefficients can be used to estimate indicators for productivity using the following equation:

$$\frac{\partial V}{\partial X_i} = \left(\frac{b_i}{\bar{X}_i}\right)(V)$$

where $\frac{\partial V}{\partial X_i}$ = marginal product of resource X_i computed as a derivative of output in respect to input.

V = value of output computed from the equation $V = a\, X_1^{b_1} X_2^{b_2} \ldots X_n^{b_n}$ when all factors are fixed at their sample mean.

b_i = regression coefficient of resource X_i.

$\bar{X}_i$ = the resource under consideration at mean level.

Therefore the use of this equation[5] estimates productivity when the variable is at mean level and all other activities are set at a magnitude equal to their mean.

Form of the Model

The theoretical model presented in the previous section has been used in this study to estimate a functional relationship between the outputs of selected economic activities and total income in the study area. It is assumed here that those activities are the major sources for income generation in the area. Hence, the estimated relation measures the importance of each of these activities and shows the effect each activity has on income. In this sense, the estimated indicators of marginal return from each activity explains how a change in the output of this activity affects or contributes to total income in the area. The variables used in this analysis are defined and explained in the following section.

The dependent variable (Y = income) is represented by Total Effective Buying Income.[6] It is the income in dollars people have available, after federal, state, and local taxes, for spending. The reasons for using this measure are:

1. It is the best estimate of income available annually and on county basis.

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[5]Heady and Dillon, Agricultural Production Functions, (Ames, Iowa: Iowa State University Press, 1961), p. 67.

[6]Effective buying income is being estimated and published annually in Sales Management, The Magazine of Marketing.

2. It represents disposable personal income thus avoiding the effect of changes in taxes on income.

The independent variables (X's) represent the major economic activities in the area as:

X_1 = Total value of farm product sold in the county.

X_2 = Value added by manufacture in the county.

X_3 = Represents non-manufacturing industries (total receipts for selected services plus total sales value of retail trade plus wholesale trade).

X_4 = Represents changes in technology over time as explained below.

X_5 and X_6 = A set of two dummy variables representing the three locations in the study area to test the hypothesis that the functional relationship is similar in all the counties but has different intercepts in each location as discussed below.

X_7 and X_8 = Interaction variables (X_5) (X_1) and (X_6) (X_1).

X_9 and X_{10} = Interaction variables (X_5) (X_2) and (X_6) (X_2).

X_{11} and X_{12} = Interaction variables (X_5) (X_3) and (X_6) (X_3).

The last three sets of variables are used to test the hypothesis that the slope of the function differs in each location as a result of the attached variable.

The following observations explain the data and variables used in this model.

1. All the data represented by dollar value, X_1, X_2 and X_3, have been deflated using the constant dollar of 1957-59 purchasing power of the dollar at consumer prices.[7]

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[7] U. S. Department of Commerce, Statistical Abstract of the U. S., 1966, p. 351.

2. The data for all the variables except X_4, X_5 and X_6 have been transformed into logarithm to estimate the actual curvilinear relation between Y and X's as a linear relation.

3. The data used are measurements of the variables agriculture (X_1), manufacture (X_2), and non-manufacture (X_3) in a time series at four points in time, 1950, 1955, 1960 and 1964, Table 2. Hence the data for each variable reflect the consequences of a number of related causes which represent technological changes. Therefore, to measure this effect and in the same time to adjust the data in relation to the passage of time, variable X_4 is used.[8] It is represented by a linear trend, 0, 1, 2 and 3, with the year 1950 as the origin. This variable has been used in its arithmetic form rather than in logarithm to measure the rate of change over time in constant terms.

4. The set of two dummy variables, X_5 and X_6, has been used in the form:[9]

$$X_5 = D_1 = \begin{cases} 1 \text{ in location (1)} \\ 0 \text{ in location (2)} \\ -1 \text{ in location (3)} \end{cases} \qquad X_6 = D_2 = \begin{cases} 0 \text{ in location (1)} \\ 1 \text{ in location (2)} \\ -1 \text{ in location (3)} \end{cases}$$

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[8] For more discussion on time series analysis see; David B. Suits, Statistics: An Introduction to Quantitative Economic Research, (Chicago: Rand McNally and Company, 1963).

[9] For more discussion on the use of dummy variables see:
- Daniel B. Suits, "Use of Dummy Variables," J. Am. Statist. Assoc., LII (Dec. 1957), 548-551.
- William G. Tomek, "Using Zero-One Variables With Time Series Data in Regression Equations," J. Farm Economics, XLV (November 1963), 814-822.
- J. Johnston, Econometric Methods, (New York: McGraw Hill Book Company, Inc., 1963) p. 221-230.

The use of dummy variables in this form restricts summation of the coefficients of the level of the function in the three locations to equal zero. Hence the coefficient in location (3) = - $(b_5 + b_6)$. In this case, the coefficient b_o estimated by the model measures the intercept of the function as an average for the study area while $(b_o + b_5)$ measures it in location (1) and $(b_o + b_6)$ measures it in location (2). In other words, that b_5 and b_6 measure deviations of the level of the function in their respective areas from the average for the whole area. As such, an independent variable representing location (3) does not appear in the model but its value is derivable from the other two variables. This is done to avoid singularity of the correlation matrix during the estimation of the coefficients.

This scheme allows the introduction of variables representing the influence of each location in the area into the regression analysis to determine regional variation in the level of the function between the three locations. But, the different environment prevailing in the three locations suggests that the slope of the function with respect to X_1, X_2, or X_3 may differ in one or more of these locations. Therefore, the three sets of interaction variables, X_7 . . . X_{12}, involving the independent variables X_1, X_2 and X_3 in logarithm and the dummy variables, X_5 and X_6 in arithmetic form, i. e., $X_7 = (x_5) \log (X_1)$ and $X_8 = (X_6) \log (X_1)$ for agriculture, X_9 and X_{10} for manufacture, and X_{11} and X_{12} for non-manufacture, are introduced into the model. Again, an independent variable representing location (3) does not appear in any of the interaction sets of variables and the interpretation of the results is the same as for the intercept, e. g., the coefficient b_1X_1

measures the slope of the function due to agriculture as an average for the whole area while b_7 and b_8 measure regional deviations of the slope in their respective locations from the average and the regional deviation in location (3) is derived as the negative summation of b_7 plus b_8.

In regard to the previous discussion, the model used in this analysis to represent the functional relationship is a form of Cobb-Douglass function with the variables X_4, X_5 and X_6 in arithmetic form and all the others in logarithm such that:

$$\begin{aligned}\log Y = {} & b_o + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 X_4 + \\ & b_5 X_5 + b_6 X_6 + b_7 X_5 \log X_1 + b_8 X_6 \log X_1 + \\ & b_9 X_5 \log X_2 + b_{10} X_6 \log X_2 + b_{11} X_5 \log X_3 + b_{12} X_6 \log X_3.\end{aligned}$$

Rearranging the equation gives:

$$\begin{aligned}\log Y = {} & b_o + b_5 X_5 + b_6 X_6 + \\ & b_1 \log X_1 + b_7 X_5 \log X_1 + b_8 X_6 \log X_1 + \\ & b_2 \log X_2 + b_9 X_5 \log X_2 + b_{10} X_6 \log X_2 + \\ & b_3 \log X_3 + b_{11} X_5 \log X_3 + b_{12} X_6 \log X_3 + b_4 X_4.\end{aligned}$$

Since $X_5 = D_1$ and $X_6 = D_2$ the model can be written:

$$\begin{aligned}\log Y = {} & (b_o + b_5 D_1 + b_6 D_2) + \\ & (b_1 + b_7 D_1 + b_8 D_2) \log X_1 + \\ & (b_2 + b_9 D_1 + b_{10} D_2) \log X_2 + \\ & (b_3 + b_{11} D_1 + b_{12} D_2) \log X_3 + b_4 X_4.\end{aligned}$$

From this model the regression coefficients for location (1) are calculated by substituting $D_1 = 1$ and $D_2 = 0$, for location (2) by substituting $D_1 = 0$ and $D_2 = 1$, and for location (3) by substituting $D_1 = D_2 = -1$.

Empirical Results

Multiple linear regression analysis has been used to estimate the parameters of the model in the form discussed above. The estimated parameters are:

$$\begin{aligned}\log Y = {} & (1.5586 + 1.0531\, D_1 + 1.2513\, D_2) + \\ & (0.0053 - 0.1296\, D_1 + 0.0607\, D_2) \log X_1 + \\ & (0.0370 + 0.0524\, D_1 - 0.0109\, D_2) \log X_2 + \\ & (0.6533 - 0.2010\, D_1 - 0.2872\, D_2) \log X_3 + 0.0197\, X_4.\end{aligned}$$

Therefore, given the data and model used in this analysis, the linear functional relationship between the dependent variable, total income, and the explanatory variables, output of the economic activities, has been determined as:

Location (1) $\log Y = 2.6117 - 0.1243 \log X_1 + 0.0894 \log X_2 + 0.4523 \log X_3 + 0.0197\, X_4$

Location (2) $\log Y = 2.8099 + 0.0660 \log X_1 + 0.0261 \log X_2 + 0.3661 \log X_3 + 0.0197\, X_4$

Location (3) $\log Y = -0.7458 + 0.0742 \log X_1 - 0.0045 \log X_2 + 1.1415 \log X_3 + 0.0197\, X_4.$

Although the estimated parameters fail the significance test at 0.05 level of significance, to test the hypothesis that these coefficients differ from zero, the model is considered reliable, at least for the purpose of this study, to shed some light on the relation between the different economic activities and income generation in the study area. The criteria used in this decision are based on:

1. The coefficient of multiple determination R^2, that explain the improvement of the closeness fit of the regression plane to the actual points relative to the fit of the plane going through the means $(\bar{Y}, \bar{X}_1, \bar{X}_2, \ldots \bar{X}_n)$, is 0.9955. This means that the regression line

of the model explains almost all the deviation in the dependent variable, due to the explanatory variables. Moreover, F test of significance for this correlation coefficient is very highly significant.

2. The sign of the estimated regression coefficients are reasonable and as expected to be.

3. The different multiple hypotheses tested to determine the significancy of the contribution to total correlation explained by the regression line due to different combinations of variables which include dummy variables show that although the contribution of any single set is insignificant, the contribution of any pair or more of these sets is significant.[10] This suggests that the whole set of dummy variables, for intercept and interactions, significantly contribute to the estimated correlation which consequently suggests the existence of regional variation in the intercept and the slope between the three locations.

Interpretation of the Results

The coefficients revealed by this time series analysis lead to general observations concerning the conduct of the different activities in the study area as an average during the period 1950-64. Since

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[10]The formula used to test that is:

$$F(I,\ n - m - 1) = \frac{R^2_m - R^2_I}{I} \times \frac{n - m - 1}{1 - R^2_m}$$

where R^2_m = R^2 for the base model.
R^2_I = R^2 for the model with the eliminated variables.
I = number of eliminated variables.
n = number of observations.
m = number of independent variables in the base model.

these coefficients represent elasticities they show the relation between a percentage change in income and a percentage change in its components, income from agriculture, from manufacture and from non-manufacture activities.

1. In location (1) increasing income has been accompanied by declining agriculture but increasing manufacture and non-manufacture activities.

2. In location (2) all the three activities have been increasing along with income. Non-manufacture has the highest coefficient followed by agriculture then manufacture.

3. In location (3) the increase in income has been accompanied by declining manufacture but increasing agriculture and non-manufacture.

4. While agriculture has been declining in location (1) its rate of increase relative to increase in income is very close in both locations (2) and (3). On contrast, manufacture has been declining in location (3) but its rate of increase relative to increase in income in location (1) is much higher than it is in location (2). In the same time non-manufacture activity has been increasing in all the three locations with highest coefficient in location (3) followed by (1) then (2).

5. Technology has been increasing slowly in the three locations.

Productivity Estimation

The coefficients determined by the functional relationship in this analysis have been used to estimate indicators for the contri-

bution of the different economic activities to income in each county in the study area. These indicators have been assumed to represent productivity of the studied activities in relation to income generation in each county. Table 4 shows these indicators. The table shows the value of income in each county as an average for the period 1950-64 calculated from the estimated functional relation and the actual figures. Productivity indicators have been calculated using $\bar{X}_i$ as an average for the same period for each county with the first row representing agriculture, the second manufacture and the third non-manufacture.

The calculated indicators show that:

1. Only in Muskingum County that the three activities have positive values with agriculture at the top and manufacture at the bottom.

2. The indicators have negative values for agriculture in Coshocton and Guernsey Counties while manufacture has the negative values in Perry, Noble and Morgan Counties.

3. Agriculture has the highest positive value in Muskingum County followed by Perry, Morgan then Noble Counties.

4. Manufacture has the highest positive value in Guernsey County followed by Coshocton then Muskingum Counties.

5. Non-manufacture has the highest positive value in Perry County followed by Morgan, Noble, Guernsey, Coshocton then Muskingum Counties.

These observations lead to the following conclusions:

1. Muskingum County is a potential center for economic development since all the activities have positive productivity. However, any

TABLE 4

PRODUCTIVITY INDICATORS IN EACH COUNTY IN THE STUDY AREA

County	Calculated V $ (1)	Actual $\bar{Y}$ $ (2)	Value of $\bar{X}_i$ (2)	b_i	Productivity Indicator (3)
Coshocton	49,500	49,964	6,562	- 0.1243	- 0.94
			36,911	0.0894	0.12
			48,539	0.4523	0.46
Guernsey	52,430	51,518	3,694	- 0.1243	- 1.76
			29,910	0.0894	0.16
			49,066	0.4523	0.48
Muskingum	126,800	127,177	6,987	0.0660	1.20
			71,172	0.0261	0.05
			139,279	0.3661	0.33
Perry	35,460	36,212	3,217	0.0742	0.82
			9,308	- 0.0045	- 0.02
			25,168	1.1415	1.61
Noble	12,670	13,079	2,540	0.0742	0.37
			2,471	- 0.0045	- 0.02
			10,323	1.1415	1.40
Morgan	16,250	15,445	3,021	0.0742	0.40
			4,879	- 0.0045	- 0.01
			12,717	1.1415	1.46

Source: (1) Calculated as $V = b_o + b_1 \log \bar{X}_1 \pm b_2 \log \bar{X}_2 + b_3 \log X_3 + b_4 X_4$.
(2) Weighted averages.
(3) Calculated as $(b_i / \bar{X}_i)$ (V).

development program should emphasis agriculture to take advantage of its high productivity, Table 5.

TABLE 5

RANKING OF THE COUNTIES IN THE STUDY AREA

County	Actual $\bar{Y}$ $	Rank based on Productivity Indicator		
		Agr.	Manfg.	Non-Manfg.
Muskingum	127,177	1	3	6
Guernsey	51,518	6	1	4
Coshocton	49,964	5	2	5
Perry	36,212	2	5	1
Morgan	15,445	3	4	2
Noble	13,079	4	6	3

Source: Table 4.

2. Guernsey and Coshocton Counties are the areas where manufacture industries should be stimulated and in the same time agricultural policies must be reviewed and studied to reveal the reasons for low productivity.

3. The negative values for agriculture indicators in location (1) and manufacture indicators in location (3) suggest that these industries have higher social costs than their contribution to income in their respective locations. This causes loss to the community and is represented by the negative value of the estimated indicators. In such situations revenue from the operation of the industry covers only a part of total costs which is known in Economic Theory as the loss

minimizing case.[11] Figure 4 shows the case. As long as MR (marginal return) is between AC (average total cost) and VC (variable costs) production is economic and should be carried on to minimize losses which are represented by the negative values of the indicator, distance between MR and AC at the different points with the minimum possible loss at the point M. Therefore, the results show that the locations with negative indicators' value operate at different points between the points L and N.

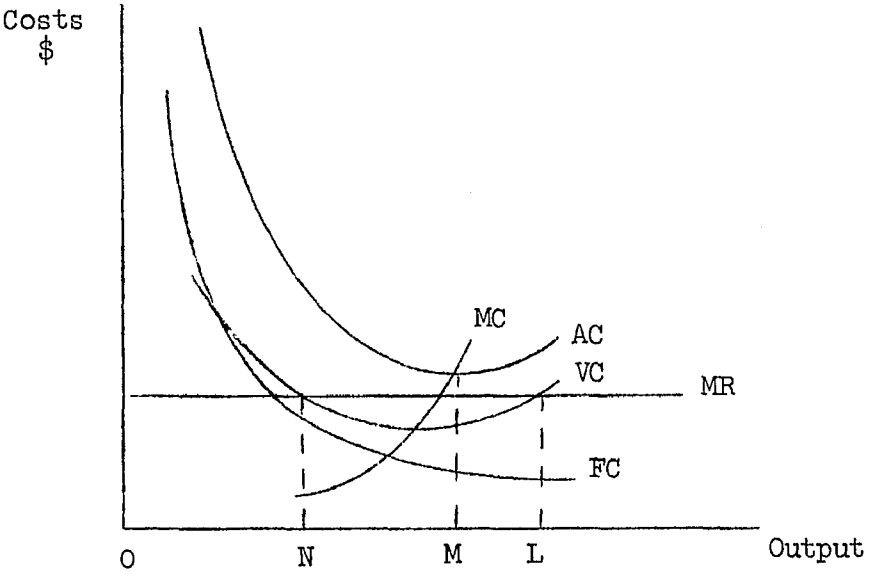

Figure 4

Loss Minimizing Situation

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[11] For theoretical presentation of this case see:

- Richard Leftwich, The Price System and Resource Allocation, Revised Edition, (New York: Holt, Rinehart and Winston, 1963), pp. 176-179.
- Earl O. Heady, Economics of Agr. Production and Resource Use, (New Jersey: Prentice-Hall, Inc., 1964), p. 330.

CHAPTER III

THE ECONOMIC STRUCTURE OF THE ACTIVITY CENTER "MUSKINGUM COUNTY"

Muskingum County with its seat in the city of Zanesville represents a core for economic activity in the study area. It serves as a center of communications and trade for much of southeast Ohio besides its advantageous economic position revealed by the analysis in the previous chapter. As such, the county has been chosen as an economic community to be studied in more detail to investigate its economic structure.

The County Situation

Muskingum County lies on the break between level land of east central Ohio and the Appalachian foothills of southeast Ohio. It consists of 664 square miles or 424,320 acres. It is surrounded by Coshocton, Guernsey, Noble, Morgan, Perry, and Licking Counties. The city of Zanesville, near the center of the county is about 50 miles from Columbus, 160 miles from Cincinnati, and 130 miles from Pittsburgh, which gives it accessibility to three great metropolitan areas.

In 1960, the county had a population of 79,159 of which 7.2% were farmers and 43.4% rural non-farm people. Between 1950-60 the county experienced an increase in rural non-farm population with a

decrease in farm population, little increase in total population, and out-migration of the group 20-29 year olds.

Low income is the major problem in the county and is considerably below the average for the state of Ohio.

The Economic Structure of the County

The approach used in this study to analyze the economic structure of the chosen activity center, Muskingum County, is an economic base study, which is represented in this chapter. The findings of this analysis would help in determining the resource base and the economic activities the base would support in the county. For the evaluation of the economic interdependence within the activity center and to an analysis of alternative activities for increasing economic opportunities for the center's community, an interindustry analysis using the input-output approach is developed and presented in the following chapter.

Economic Base Study[1]

It was not until the late 1920's that the most significant stages in the evolution of the economic base as a theoretical concept

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[1] For detail information about the economic base theory refer to:

- Richard B. Andrews, "Mechanics of the Urban Econ Base:...," A series of 12 articles published in Land Economics, XXIX, No. 2, 1953 - XXXII, No. 1, 1956.
- C. M. Tiebout, "The Urban Economic Base Reconsidered," Land Economics, XXXII (No. 1, 1956), pp. 95-99.
- Tiebout, The Community Economic Base Study.

began to take place. Since then the economic base technique increasingly is attracting economists attention.

In this study the term economic base refers to export activities which serve as the base or main support for the rest of the local economy.

The export activities, referred to as basic activity sector, refer to those activities of a community which export goods, services and capital to points outside the economic confines of the community or market them to persons who come from outside the community's economic boundaries for shopping. In this sense the base enterprises earn a dollar inflow for the community from the outsiders. In other words the increased returns realized by these activities result as a consequence of economies of scale which can be made possible by increasing the size of operation through the more efficient use of resources to conform to a demand in excess of that in a local market. Therefore, export trade from the community is the exploiter of such scale economies. Thus, this sector is affected by exogenous variables.

The rest of the local community's economy, referred to as the service activity sector,[2] refers to those activities in the community whose principal function is to provide goods, services, and capital needed for firms and persons within the community's economic boundaries.

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[2] The use of the term service here is hoped not to be confused with the term "selected services" used in the standard industrial classification and mentioned in other parts of this study. Here the term is used as a complement to the basic activity sector of the economy in the economic sense of the use of the term basic as export activity serving the external market.

Scale economies of such activities are exhausted mainly by a local market demand. This sector is directly supported by the basic activity sector of the community and affected by any change in it. Therefore, although these activities would grow along with the community, they could not independently contribute much to such growth, assuming that the community's basic/service ratio is in equilibrium in the sense of normal operating procedure of the economic system.

This is substantially true for small communities and regions. However, for larger regions it is an oversimplification. The larger the region under consideration the lesser the importance of exports as basic economic activities, and the greater the importance of other autonomous variables in the determination of the level of the community service activity sectors. Obviously, for the whole world as one community, exports do not exist and economic activities depend only on other autonomous variables.

From the relationship between basic and service activities in any small community, other relations evolve, such as basic to total employment, total employment to total population, and basic to total population. These relationships are assumed to be in equilibrium in any one community and equilibrium points change from one community to another depending on the geographical, institutional and economic environment prevailing in each particular community. Therefore, any change in the basic activity sector would lead, theoretically, to a chain of changes in those relationships in moving to the new equilibrium position.

On the basis of these relationships, the study of the economic base and the complementary activities in the community helps to reveal the following objectives:

1. Clarification of the economic mechanism within which the community operates.

2. Prediction of the economic course under changing conditions whether these changes are internal affecting the service activity sector or external affecting the basic activity sector of the community.

3. Facilitate the manipulation of the existing activities to get the most desirable economic results from the allocation of the resources available to the community.

Procedures of the Economic Base Study in Muskingum County

The following presentation is devoted to explain the procedures, sources and methods used in:

1. Measurement of the economy in the county.
2. Definition of the demand sectors.
3. Allocation of employment as a measure of the economic activity in the different segments of the economy to demand sectors.

Measurement of the Economic Activities in the County

The producing section of the economy in Muskingum County has been considered to include the various industry divisions as the

Standard Industrial Classification Code (SIC).[3] The broadest classification includes agriculture; mining; contract construction; transportation, communication and utilities; wholesale and retail trade; finance, insurance and real estate; services; manufacture; and government. In this study all the industries were treated on their aggregate level as industry divisions although in the intermediate steps of the analysis different degrees of disaggregation have been used for the different industry divisions. Limitation of data availability by different degrees for the different industry divisions was the reason for such treatments.

From the different measures ordinarily used for base measurements,[4] employment has been chosen to be used in the present study. Employment as one of the major concerns in any community especially in the region under consideration was the major motive behind this choice. The justifications of using this measure are numerous. Among them are: (1) employment besides being a major concern for each policy maker is an easy concept to understand, (2) the real effect of any changes in the economy can be observed more easily on employment, (3) employment data are available more than any other measure and also easier to gather.

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[3]The SIC was developed by the U.S. Bureau of the Budget, for use in classification of establishments by type of activity in which they engaged; for purpose of facilitating the collection, tabulation, presentation, and analysis of data relating to establishments (Executive Office of the President, Bureau of the Budget, SIC Manual, 1957).

[4]Andrews, op. cit., XXX (February, 1954), pp. 52-60.

Definition of Demand Sectors

In this study demand sectors mean the group of ultimate users of the goods and services produced in the study area. According to the economic base definition, the demand for the locally produced goods and services could originate from two main sources. External demand from outside the boundaries of the study area calling for exports and internal demand calling for local service activities. According to these definitions, demand sectors have been determined and varied according to the researchers. Leven used two sectors, investment and consumption, in the internal demand, besides export.[5] Hansen, Robson and Tiebout considered five local sectors besides two export sectors for a study in California.[6] In the present study two export sectors and three local demand sectors were designated as the following:

1. Private export (P_X), includes all the external demand except for Federal and State Government. Also included is the demand made locally by non-residents of the area--those who come into the area from outside for shopping purposes. Neither segregation nor disaggregation is used in this sector since all the factors which affect it are exogenous and not controlled by the local economy.

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[5]Sioux City Planning Commission, Economic Report, 1959, Sioux City, Iowa.

[6]W. Lee Hansen, R. Robson, and C. Tiebout, Markets for California Products, California Economic Development Agency, Sacramento, California, 1961.

2. Government export (G_X), includes Federal and State Government demand for the goods and services produced locally in the area for uses which are not locally oriented. This is presumed to be the nature of Federal and State agencies demand. This sector was separated since it is controlled and determined by the actions of government agencies which depend on completely different inducements than those affecting P_X.

3. Local Consumption (C), represents local demand by individual residents of Muskingum County for locally produced goods, either durable, except new houses or nondurable and services for their personal consumption.

4. Investment (I), represents local demand by individuals for new homes and businesses' new construction. These items were separated because of their different nature in contrast to other local demand. To acquire a new home or to construct a new plant is usually affected by factors other than those affecting other consumption items for individuals or the usual operation of a business firm. Investment by local government in schools, highways, and other public buildings and utilities are included in this sector.

5. Government (G), this sector is presented to avoid the difficulties in appraising the services rendered by the government to either individuals or business firms and also because of the different nature of these services. It includes all the services rendered by either Federal, State or local Government agencies whose volume is determined by the level of activities in the study area; e.g., post

office services. Also it includes government demand for locally produced goods and services for uses in the local area; e.g., supplies for local public schools.

These are the five ultimate demand sectors considered in this study. The first two sectors compose the external demand while the internal demand is represented by the latter three sectors.

An intermediate demand sector is also considered. That is local industries (LI) sector which includes all the demand made by business firms in the county for locally produced goods and services. This sector is considered intermediate because of the fact that the goods and services demanded have been used as inputs into further production processes to meet the demand of ultimate demand sectors for other goods and services. Thus, although the local industries sector constitutes a part of the local demand for locally produced goods and services it is not a final demand, but rather it indirectly serves the demand of the five ultimate demand sectors.

Therefore in examining the total demand of each of the ultimate demand sectors for the locally produced goods and services, two parts can be distinguished, direct demand and indirect demand. The former is represented by the direct relation between each industry division and each ultimate demand sector; e.g., the direct sale of locally produced fresh agricultural products to private export sector. The latter is represented by the relation between each industry division and each ultimate demand sector through the local industries sector; e.g., the sale of locally processed agricultural products,

which uses locally produced fresh agricultural products, to private export sector. In the first case there is a direct demand for agricultural products while in the second case the demand is indirect for agricultural products. This relation can be presented in the form:

$$D_{ji} = D^{d}_{ji} + D^{in}_{ji}$$

$$\sum_{i=1}^{10} D_{ji} = \sum_{i=1}^{10} D^{d}_{ji} + \sum_{i=1}^{10} D^{in}_{ji} = D_j$$

$$TD = \sum_{j=1}^{5} D_j = D(P_X) + D(G_X) + D(C) + D(I) + D(G)$$

where D_{ji} = Total demand of demand sector j for industry i products, with the superscript "d" referring to direct demand and "in" to indirect demand.

j = Demand sectors = 1,...,5 (P_X, G_X, C, I, and G)

i = Industry divisions = 1,...,10 (agr., mining, construction, transportation, wholesale, retail, finance, services, government, and manufacture).

TD = Total demand = total employment.

Allocation of Employment to Demand Sectors

Employment in each industry division in Muskingum County in the year 1963 has been allocated to each demand sector on the basis of sales made from each industry to each demand sector in that year.

The year 1963 has been chosen because it is the latest year for which a relatively complete set of information is available at the time of this study. The Census of Manufacture 1963, Business 1963, and Agriculture 1964 from which most of the data used in this study are obtained, have been published very recently. Therefore, the year 1963 has been considered as the source and basis for the analysis.

The allocation of employment to the various demand sectors has been accomplished on the basis of value of sales from each industry to

each demand sector. This has been done under the assumption that employment is in proportion to sales. For example if one firm employs 50 workers and the distribution of its sales is 10% to (P_X), 50% to (C), and 40% to (LI), it means that private export demand has created employment for 5 workers, local consumption demand has created employment for 25 workers and local industries demand has created employment for 20 workers in this particular firm or industry. This assumption has its weaknesses because of differences in labor requirements and economics of scale between different industry groups. But it is still the best known way to remedy the incompleteness of the data. Also, it has been used in similar studies.[7]

Because of the different types of information and methods used to allocate employment to demand sectors in the different industry divisions, the following sections have been presented to explain the specific procedure, sources and methods, used in each particular industry division.

Agriculture, Forestry and Fisheries (SIC Division A 01-09)

Lack of accurate figures for total employment in this industry as a whole and in its different segments besides the inavilability of data concerning the distribution of sales from it to the different markets were among the many problems faced in the allocation of employment in this industry division. The best possible use has been made of

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[7]-Rao and Allee, op. cit., p. 72.
-Hansen, Robson and Tiebout, op. cit., p. 21.

the available data gathered from published and unpublished sources along with the discussion with the specialists in the different segments of the industry.[8]

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[8]The sources used to furnish the needed information included:

Published Material

- Census of Agriculture, 1964, Vol. 1, Part 10, Tables 6, 7, 8, 10, 12, and 13.
- U.S. Agricultural Statistics, 1965 (Tables 468, 482, 504, and 521).
- The Ohio Commercial Farm Account Book, The Cooperative Extension Service, The Ohio State University, 1963, p. 60.
- Chio Agricultural Statistics, Annual Report, April 1965.
- 1964 Ohio Farm Income, OARDC, Wooster, Oct. 1965, p. 18 & 24.
- Livestock and Meat Statistics, USDA, Stat. Bull. No. 333, September 1965, Table 21.

Unpublished Material

- Ohio State Department of Agriculture, Division of Food Dairies and Drugs, Manufacture Grade Milk Records.
- Federal Milk Order Office Records.
- Ronald H. MacDonald, Jr., "A Study of Economic Trends, Supply Patterns, and Marketing Practices in the Ohio Poultry Industry," (Unpublished Ph.D. dissertation, Ohio State University, 1955), Tables 103 and 114.

The specialists consulted are personnel on the staff of the Department of Agricultural Economics, OSU, and/or extension service in the county area and include:

- Dr. Ralph W. Sherman, in marketing (forest products).
- Mr. Clarence C. Bowen and Mr. David Miskell, livestock specialists.
- Dr. Robert E. Jacobson, dairy products specialist.
- Dr. Ralph L. Baker, poultry products specialist.
- Mr. Ross A. Milner in marketing (crop products).
- Dr. Edwin J. Royer, fruits and vegetables products specialist.
- Mr. Appleman, Soil Conservation Services in Muskingum County.
- Mr. Walter G. Harter, farm management specialist.

Using 1964 census of agriculture data, total agricultural employment has been estimated at 2162 in the following categories:

Farm operators	1688
Hired workers	138
Family workers (manequivalent)	320
	2146
Forestry	16
	2162

The industry has been divided into five groups; forestry, livestock, dairy, poultry and crops and each group into its components. Employment has been allocated through two steps; (1) allocation among the five groups and their components and (2) allocation of employment in each group among the different demand sectors. Then the allocated figures have been aggregated to give the allocation of employment in the industry as a whole. Table 6 shows this procedure.

The allocation of employment among the five groups is based on labor efficiency coefficients, Productive Man-Work Units, developed by the Cooperative Extension Service in the Ohio State University for Ohio Commercial Farms. These coefficients represent the amount of work accomplished in a ten-hour day by an average worker employing typical production practices and equipment in the production of each agricultural product. In the absence of data concerning employment in each of these groups, this writer believes that it is the most accurate method of allocating employment since it is based on the most accurate data available which determine the average labor requirement for the production of each product. The following explains in detail the procedure used in this industry.

TABLE 6

ALLOCATION OF EMPLOYMENT IN AGRICULTURAL INDUSTRY

	Value of Sales[1] $	Production Man-Work[2] Units	%	Employment	Demand Sectors[4] P_x	C	LI
Forestry	124,037			16.00	5.28	0.16	10.56
Livestock				1,021.00	254.00	33.00	734.00
Cattle & Calves	3,038,737	39,768	21.37	459.00	115.00		344.00
Hogs	600,950	39,873	21.43	460.00	92.00		368.00
Others	344,344	8,844	4.75	102.00	47.00	33.00	22.00
Dairy	1,400,779	52.786	28.36	609.00	67.00	6.00	536.00
Poultry	371,236	5,859	3.15	67.00		56.00	11.00
Others							
Crops	1,097,828	30,388	16.33	350.00	123.00		227.00
Vegetables	26,308	1,637	0.88	19.00		19.00	
Fruits and Nursery	335,359	6,950	3.73	80.00		80.00	
Total	7,339,578	186,105	100.00	2,162.00	449.28	194.16	1,518.56
%					(20.78)	(8.98)	(70.24)

Figures in parentheses are percentages.

Sources: (1) Census of Agriculture, 1964, Statistics for the State and Countries, Ohio.
(2) Calculated by the writer using data for Muskingum County and Production Man-Work Units.
(3) Allocated according to the percentage distribution of PMWU.
(4) Allocation based on published and unpublished materials beside the discussion with specialists in each field (f.n. 8).

Forestry, employment in forestry has been estimated at 16 workers and allocated between local industries sector and private export sector by the ratio 66% and 33% respectively with a small percentage to local consumption, estimated as 1% to represent the amount consumed on the farm.

Livestock, employment here has been estimated on the basis of sales of all live animals from the farm and the following estimates have been given for the amount sold outside the Muskingum County area:

Cattle 25% Hogs 20% Lamb and Sheep 75%

These percentages have been allocated to the private export sector and the balance, 75% of cattle, 80% of hogs and 25% of lamb besides all other livestock sold have been allocated to local demand sectors according to the following:

1. Cattle and calves. The number of cattle and calves on the farm on the numeration date is given in Census of Agriculture as:

Cows including milk cows	16507
Heifers	10695
Steers and bulls	9457

Cattle and calf production has been assumed to be governed in the county by the following assumption:

a. The distribution of number on farm represents an equilibrium point and that any change will be proportionately distributed.

b. Twenty percent of cows are sold for slaughter each year and are replaced from heifers.

c. The fed heifers and steers are sold for slaughter at the age of 18 months, average. Therefore, 22.24% of them are being sold for slaughter while 77.76% are being fed at any point of time.[9]

d. One bull is required per 25 cows for breeding purposes.

e. Direct demand for live cattle and calves originates in either food processing or in agriculture, for feeding.

According to the above assumptions Table 7 shows that 47.13% are kept on the farm for breeding purposes while 33.87% are sold for slaughter. Thus, at any point of time, from cattle and calves sold locally, 75% of total sales, 64.06% is demanded for feeding purposes and 35.94% for slaughter.

TABLE 7

DISTRIBUTION OF CATTLE AND CALVES IN THE COUNTY

	Total Number	Kept For Breeding	Sold	
			Feeding	Slaughter
Cows including milk cows	16,507	13,207	--	3,300
Heifer calves	10,695	3,300	5,750	1,645
Bulls	772	660	--	112
Male calves	8,685	112	6,666	1,907
Total Number	36,659	17,279	12,416	6,964
% of Total		(47.13)	(33.87)	(19.00)
% Adjusted for the Amount Sold			(64.06%)	(35.94%)

[9]Based on the ratio of calves 1-2 years to total calves on hand, Livestock and Meat Statistics, USDA, Statistics Bull., No. 333, September 1965, Table 16, p. 7.

2. Hogs. Using the data published for the number of hogs and pigs on farms by quarters by weight groups in 1964 in the State of Ohio,[10] an average of 13.84% is kept for breeding, 75.82% weight less than 179 lbs. and 10.34% weight 180 lbs. and more. Under the assumptions; (1) this average distribution represents an equilibrium and any change will be proportionately distributed, (2) hogs for breeding are kept on the farm and are not represented in sales, (3) that the hog reaches 180 lbs. in less than 6 months, (4) that only hogs 180 lbs. and over will be slaughtered, (5) direct demand for live hogs is either for slaughter or for feeding, the allocation for local hog sales, 80% of total sales, is estimated at any point of time as:

Feeding	37.91%	(adjusted 44% of total local sales)
Slaughter	48.25%	(adjusted 56% of total local sales)

which means that at any point of time 56% of hog sales is directed for slaughter. This includes all the 180 lbs. and more category plus one-half of the less than 179 lbs. category which is replaced by a new breed.

3. Lambs and Sheep. The information gathered in the county revealed that with the exception of killing lambs and sheep on the farm or other small operations lambs and sheep killing and dressing is insignificant in the area. Therefore, the 25% of sales made locally has been considered sales for feeding in the local industries sector.

4. Horses. Employment estimated here has been allocated all to the local industries sector for use on farm in the area.

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[10] Ibid., Table 21, p. 13.

5. Others. Included in this category are honey, goat milk, furs and the likes and are allocated all to local consumption sector since the production of each item is considered small enough to meet no more than local consumption.

TABLE 8

ALLOCATION OF EMPLOYMENT IN LIVESTOCK TO DIRECT DEMAND SECTORS

	Total Employment	Demand Sectors		
		P_X	C	LI
Cattle and calves	459	115 (25)		344 (75)
Hogs	460	92 (20)		368 (80)
Sheep and lambs	63	47 (75)		16 (25)
Horses	6			6 (100)
Others	33		33 (100)	
Total	1021	254 (25)	33 (3)	734 (72)

Figures in parentheses are percentage of row's total.

Dairy Products. Employment has been estimated on the basis of milk and cream sales as 609 workers. The distribution of sales, quarts, has been calculated as the following:

Total milk production[11]	15,983,384	
To consumers and retailers	152,506	(0.95% of total prod.)
	15,830,878	
To local dairy plants[12]	14,059,000	(87.96% of total prod.)
Export (residual)	1,771,873	(11.09% of total prod.)

On this basis 11.09% has been allocated to private export, 0.95% to local consumption and 87.96% to local industries.

Poultry. Employment in this category has been estimated at 67 workers and allocated entirely to local demand sectors. The allocation is based on sales of eggs which represented about 75% of poultry and eggs cash receipts in 1964 in the State of Ohio.[13]

The findings of MacDonald[14] concerning the percentage distribution of eggs purchased and eggs sold by type of dealer in the area including Muskingum County have been used to estimate sales to the final demand sectors, Table 6.

Crops. Employment required for crop production has been estimated at 350 workers and distributed among different crops on the basis of sales value of each crop. The Census of Agriculture figures show the amount

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[11] Census of Agriculture, 1964, Table 12, p. 355.

[12] Unpublished record of Ohio State Department of Agriculture, Division of Foods Dairies, and Drugs. It represents the total milk received in the four local plants in Muskingum County in 1964.

[13] Ohio Agricultural Research and Development Center, 1964 Ohio Farm Income, (Wooster: Oct. 1965), p. 26.

[14] Macdonald, "Ohio Poultry Industry," (Unpublished Ph.D. dissertation), Tables 103 and 114.

of total production and the amount sold. The difference is assumed to be used on the farm. And since there is no grain processing in the county, sales have been allocated to private export and local industries sectors. For each crop the percentage of the amount sold to total production has been allocated to private export sector and the percentage of the amount kept on the farm has been allocated to local industries sector which means that it is to be used on other farms in the county.

Vegetables and Fruits. Statistical data for acreage and production of vegetables and fruits in this county show that it could not be used on a commercial scale because the producting units are mainly small plots producting on small scale. Therefore, sales in this category have been allocated all for local consumption sector, Table 6.

Mining, (SIC Division B 10-14)

Muskingum County is located in the mineral producing area of the State of Ohio. Thus, it is expected to be a net exporter for mineral products. The allocation of employment in mining industry has been based on a comparison between the county's situation and that of the nation in production and consumption of mineral products.

In the year 1963, cement, sand and gravel, coal and clay were the most important mineral products in Muskingum County. Table 9 shows the county production as a percent of the nation's output.

The average weighted value has been used as the indicator of mineral production in the county. The indicator for the minerals consumed locally has been based on the percentage of value added by manu-

TABLE 9

MINERAL PRODUCTION IN MUSKINGUM COUNTY
AS OF THE NATION IN 1963

	Production (Ton)				
	U.S.[1]	Muskingum[2]	%	Price per ton[2] ($)	Value of Prod. in Musk. as % of U.S.
Cement	368,406,000	58,793	0.0160	1.47	0.0235
Sand & Gravel	590,941,000	543,944	0.0921	1.00	0.0921
Coal	458,928,175	107,718	0.0235	4.001	0.0940
Clay	50,199,002	32,875	0.0655	1.75	0.1146
Total Value of Musk. Prod. as % of U.S.					0.3242
Average Weighted Value of Musk. Prod. as of U.S.					0.0810

Source: (1) U.S. Department of Interior, Mineral Facts and Problems, Bull., 630, 1965.
(2) State of Ohio, Annual Coal and Nonmetalic Mineral Report, 1963.

facture in Muskingum County in 1963, $75,359,000 of the national total $192,103,102,000. This amounted to 0.0392%. The choice of this indicator is based on the assumption that all the minerals which are consumed locally are used, in one way or another, in manufacture. Thus, value added in manufacture in the county as a percentage of that in the nation could be used to estimate the inputs used locally as a percentage of that used in the nation. A comparison between the two indicators shows:

Musk. Co. prod. of min. as % of the nation 0.0810
" " local uses " " " " " " " 0.0392 (48.34% of Prod.)
" " export " " (residual) 0.0418 (51.66% " ")

Therefore, 48.34% of employment in the mining industry has been allocated to local industries sector and 51.66% to private export sectors as in Table 10.

TABLE 10

ALLOCATION OF EMPLOYMENT IN MINING INDUSTRY

	Demand Sector	
Total Employment	P_X	LI
314*	162 (51.66)	152 (48.34)

*County and city data book, 1967, Table 2, p. 282.

Contract Construction (SIC Division C 15-17)

Contract construction industry in this study includes both building and engineering construction. Building construction involves private and public residential and nonresidential buildings.

Because of the inavilability of data that permit a direct allocation of employment in this industry, the procedure is based on the information gathered on the value of construction works in Muskingum County during the calendar year 1963 in the different construction categories and converting these values to the number of workers required to construct these given values of construction.

The construction industry has been segregated into private and public classes. Each class has been disaggregated into a number of broad subclasses (see Table 18). Information has been gathered from

the U.S. Department of Commerce and Department of Labor publications which include Construction Review, Housing Construction Statistics, and other census publications, the specific source is cited in the text for each specific item. From this information the value of new construction in the county in the year 1963 has been estimated.

Labor requirement, man-hour per $1000 of construction, for the different construction works is given in a series published by the U.S. Bureau of Labor Statistics, Table 11. The on-site labor requirement includes the man-hours for supervisory, engineering, clerical and custodial employees at the construction site in addition to the workers in the construction trade. The data shown represent the average for the non-metropolitan areas in the North Central region of the states, except as otherwise cited.

TABLE 11

ON SITE LABOR REQUIREMENT FOR DIFFERENT CONSTRUCTION WORKS

Construction Work	Man-Hour per $1000 Constr.	Year of Study	Source
School	92.9	1959	Bull No. 1299, 1961, p. 31
Federal Office Building	97.1	1959	Bull No. 1331, 1962, p. 10
Hospital	82.5	1959/60	Bull No. 1340, 1962, p. 12
Highway	91.0	1961	Monthly Labor Review, April 1963, p. 394
Public Housing*	99.1	1959/60	Bull No. 1402, 1964, p. 12
Private One-family House	68.0	1962	Bull No. 1404, 1964, p. 14
Sewer	70.6	1962/63	Bull No. 1490, 1966, p. 11

*Represents other regions.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Labor & Material Requirement For....Constructions, different bulletins.

From the value of construction and labor requirements, the total man-hour required to erect the given construction value has been calculated for the different construction work then converted to number of workers. This figure has been allocated to local investment in the demand sectors and the difference between it and the total employment in the construction industry has been allocated to private export sector.

The following explains the specific procedures used for each type of construction and demand sector.

1. Total Employment in the Construction Industry in Muskingum County. The latest figure available is in census of population 1960. Other published figures differ substantially. To get around this problem the ratio of employment in Muskingum County as of the state revealed by the census has been applied for the figures published in Construction Review for the State of Ohio in 1963, Table 12.

TABLE 12

TOTAL EMPLOYMENT IN CONSTRUCTION INDUSTRY

	1960			1963		
Source	Ohio	Musk.	% of State	Ohio	Musk.	% of State
Census of Population[1]	177,611	1,440	0.81			
Construction Review[2]	144,900			130,600	1,057*	0.81

*Estimate

Source: (1) Census of Population 1960.
(2) U.S. Department of Commerce, Business & Defense Service Administration, Construction Statistics 1915-1964, A Supplement to Construction Review, Jan. 1966, Table 40, p. 72.

2. Private Residential Building. The number of new non-farm housing units authorized in permit-issuing places in 1963 is used to represent this type of construction. (A building permit is a certificate issued by a local government unit, which authorizes the holder to build, alter or make repair to a structure).

TABLE 13

VALUE OF NEW PRIVATE RESIDENTIAL BUILDING
IN MUSKINGUM COUNTY IN 1963

Structure	No. of Units Authorized[1]	Cost per Unit $[2]	Total Cost $
1 Unit	27	$14,975	$404,325
2 Units or More	30	8,675	260,250
Total	57		$664,575

Source: (1) USDC, Bureau of Census, Housing Construction Statistics, 1889 to 1964, Table B-6, p. 428.
(2) USDC, Construction Review, Vol. 10, No. 4, p. 8.

3. Private Industrial Buildings. Industrial construction has been estimated using the published figure for new capital expenditure in census of manufacture 1963. This figure represents expenditure made during the year 1963 for permanent addition and major alteration of plants and new machinery and equipment that were chargeable to fixed assets accounts and were of a type for which depreciation accounts are ordinarily maintained. The percentage distribution between structure and machinery for the state is used to determine the value of industrial construction in the county, Table 14.

TABLE 14

VALUE OF NEW INDUSTRIAL CONSTRUCTION
IN MUSKINGUM COUNTY IN 1963

	State of Ohio[1] $	% of Total	Muskingum County[2] $
Structure	174,971,000	20.64	1,705,483*
Machinery & Equipment	672,830,000	79.36	6,557,517*
New Capital Expenditure	847,801,000	100.00	8,263,000

*Estimates

Source: (1) 1963 Census of Manufacture, Vol. I, Table 3, pp. 5-16.
(2) 1963 Census of Manufacture, Vol. III, Table 4, pp. 36-10.

4. Private Other Non-residential Buildings. The value of other non-residential buildings has been estimated using the value of this type of construction in the nation in 1963 and the percentage of population in the county to the nation's population, Table 15. This assumes that each individual in the county, as in the nation, requires the same value of construction in stores, offices, religion, etc., to serve him.

5. Farm Construction. The value of farm construction in the nation in 1963 and the value of farm land and buildings in 1964 are the basis for the estimation of the value of this type of construction, Table 16.

TABLE 15

VALUE OF NEW NON-RESIDENTIAL CONSTRUCTION, EXCLUDING INDUSTRIAL IN MUSKINGUM COUNTY IN 1963

	U.S.	Muskingum County	%
Population[1]	188,616,000	80,256	0.04255
Non-residential Constr. Exclude Industrial[2]	$5,715,000,000	$2,431,733*	0.04255

*Estimate

Source: (1) Population estimate, July 1, 1963.
- U.S.; USDC, Bureau of Census, Population estimates, Series P-25, No. 289, August 1964, Table 3, p. 12.
- Muskingum County; Ohio State Development Department, Econ. Data Series 4.12.

(2) Construction Statistics, 1915-1964, Jan. 1966, Table 14, p. 29.

TABLE 16

VALUE OF FARM CONSTRUCTION IN MUSKINGUM COUNTY IN 1963

	U.S. $	Muskingum County	%
Value of Farm Land and Building[1]	162,534,592,000	27,517,776	0.01693
Farm Construction	1,266,000,000	214,334*	0.01693

*Estimate

Source: (1) U.S.; Newspaper Enterprise Association Inc., The World Almanac 1967, New York, p. 180.
County; 1964 Census of Agriculture, Vol. 1, Part 10, p. 265.

6. Public Construction. a) The public construction work financed by state funds in Muskingum County in 1963 was in highway construction and had a value of $3,699,137 of which $3,692,651 was for the construction of 43.546 miles and the balance for maintenance.[15] b) Other public construction was financed through the local government, Table 17.

TABLE 17

LOCAL GOVERNMENT DIRECT EXPENDITURE ON CONSTRUCTION IN MUSKINGUM COUNTY IN 1962

	Expenditure ($)	Construction[a] ($)
Education	7,096,000	
Capital Outlay	1,700,000	1,340,110
Highway	1,943,000	
Capital Outlay	268,000	211,264
Sewerage	185,000	
Capital Outlay	62,000	48,875
Housing and Urban Renewal	129,000	
Capital Outlay	96,569[b]	76,125
General Public Building	159,000	159,000
Total Expenditure	14,152,000	
Total Capital Outlay	3,329,000	1,835,951

[a]Estimates: 78.83% of capital outlay which is the construction percentage out of total capital outlay for the total of Local Governments (Census of Gov. 1962, Table 16, p. 24).

[b]Estimates: 74.86% of total which is the capital outlay percentage out of total Housing & Urban Renewal for total Local Governments (Census of Gov. 1962, Table 16, p. 24).

Source: Census of Government, 1962, Table 28, p. 46.

[15]State of Ohio, Dept. of Highway Financial & Statistical Report, Fiscal year ended June 1964, p. 52.

Table 18 shows the calculation of the number of workers required to erect the estimated construction value in Muskingum County in 1963. The total man-hour required for each type of construction is converted to number of workers using the average weekly hours of work, 37.7, in construction industry in the year 1963 for the State of Ohio.[16] This average covers man-hour worked or paid for, for production, construction and non-supervisory workers and includes hours paid for holidays and vacations, and for sick leave when pay is received directly from the firm. Multiplying the weekly average by 52 weeks estimates the equivalent of one worker on annual basis at 1960.4 hours.

TABLE 18

LABOR REQUIREMENT FOR CONSTRUCTION INDUSTRY IN MUSKINGUM COUNTY IN 1963

Construction Work	Value of New Construction ($)	Labor Requirement		No. of Workers
		Man-Hour $1000	Total Man-Hours	
Private				
Residential Bldgs.	664,575	68.0	45,191	23
Industrial Bldgs.	1,705,483	82.5	140,702	72
Other Non-Res.	2,431,733	82.5	200,618	102
Farm	214,334	68.0	14,575	7
Public				
Education	1,340,110	92.9	124,496	64
Highway	3,910,401	91.0	355,846	182
Sewer	48,875	70.6	3,451	2
Housing & Ur. Re.	76,125	99.1	7,544	4
General Building	159,000	97.1	15,439	8
Total			907,862	464

Source: Calculated from Tables 11 and 13-17.

[16] U. S. Dept. of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for States and Areas, 1939-66, Bull. No. 1370-4, July 1967, p. 555.

Table 18 shows that 464 workers were required for the construction work done in Muskingum County in 1963. This figure has been allocated for the investment sector, Table 19.

TABLE 19

ALLOCATION OF EMPLOYMENT IN THE CONSTRUCTION INDUSTRY

	Demand Sector			
		Investment		
Total Employment	P_X	Individual	Business	Government
1057	593	30	174	260
(100%)	(56.10)	(2.84)	(16.46)	(24.60)

Source: Table 18

Transportation, Communication and Public Utilities (SIC Division E 40-49) Employment in this industry has been allocated separately for each group. Interviews with the major companies in the area supplemented with different published materials, such as Census of Population, Census of Transportation, Bureau of Unemployment Compensation Publications, Ohio Public Utilities Commission Reports and others, are the basis for the allocation shown in Table 20.

Allocation of railroad and railway employment is based on the distribution of operating revenue of railroad and railway in the Eastern District, including Ohio, published in the Yearbook of Railroad Information, 1964.

TABLE 20

ALLOCATION OF EMPLOYMENT IN TRANSPORTATION, COMMUNICATION, AND UTILITIES

	Total Employ.		Demand Sectors			
	1960[1]	1963[2]	P_X	C	G	LI
Railroad & Railway	275	267		25 (9.50)	10 (3.73)	232 (86.77)
Trucking & Warehousing	607	593	65 (11.02)	528 (88.98)		
Others	188	184	14 (7.56)	118 (64.30)	2 (1.16)	50 (26.98)
Communication	351	291	45 (15.30)	190 (65.22)	7 (2.54)	49 (16.94)
Public Utilities	646	536	268 (50.00)	107 (20.00)	16 (3.00)	145 (27.00)
Total	2067	1871	392 (20.95)	968 (51.74)	35 (1.87)	476 (25.44)

Figures in parentheses are percentage of row's total.

Source: (1) Census of Population, 1960.
(2) Adjusted using the figures published by Bureau of Unemployment Compensation which show a decline, between 1960-63, of 2.37% in transportation employment and 16.98% in both communication and utilities.

Allocation of trucking and warehousing employment is based on the distribution of trucks in Ohio according to area of operation reported in the Census of Transportation, 1963.

Employment in the categorty "others" is allocated according to the average distribution of the above two categories.

Employment in communication is allocated on the basis of an interview with Ohio Bell Company in the county supplemented with pub-

lished data for the same company. Operating revenue is used as the basis for allocation. One-half of message toll revenue is allocated to private export. The other one-half in addition to local service revenue are allocated to local sectors according to the distribution of number of telephones.

Allocation of employment in public utilities is based on interview with Ohio Power Company in the county supplemented with other published material concerning the operation of the same company.

Wholesale Trade (SIC Division F 50)
Retail Trade (SIC Division F 52-59)

Some disaggregation has been used in these two industries. Interviews with representative firms within each disaggregated group have been conducted and used as basis for the allocation. For the other groups the findings of a similar study[17] have been applied. Those findings are based on interviews with firms in both wholesale and retail as one group and allocate the sales of the two industries to the different demand sectors. The similarity in the nature of the study areas, San Benito County, California, and Muskingum County, Ohio as well as the similarity of the activities in the two industries in different areas justifies the use of the findings of the mentioned study in the present one. Tables 21 and 22 show the allocation in wholesale and retail trade respectively.

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[17]Rao and Allee, op. cit., p. 6.

TABLE 21

ALLOCATION OF EMPLOYMENT IN WHOLESALE TRADE

	Total Employment[1]	Demand Sectors			
		P_X	C	G	LI
Groceries & Related Prod.[2]	284	168 (59.00)	68 (26.00)	3 (1.00)	45 (16.00)
Machinery, Equipment & Supplies[2]	223	134 (60.00)			89 (40.00)
All Others[3]	1011	70 (6.89)	781 (77.30)		160 (15.81)
Total	1518	872 (24.50)	849 (55.93)	3 (0.20)	294 (19.37)

Figures in parentheses are percentage of row's total.

Source: (1) 1963 Census of Business, Vol. V, Wholesale Trade Area Statistics.
(2) Allocation based on interview.
(3) Allocation based on findings of Rao and Allee.

TABLE 22

ALLOCATION OF EMPLOYMENT IN RETAIL TRADE

	Total Employment[1]	Demand Sectors		
		P_X	C	LI
Gen. Mdse, Food Stores Apparel & Accessory[2]	1496	150 (10.00)	1346 (90.00)	
All Others[3]	2393	165 (6.89)	1850 (77.30)	378 (15.81)
Total	3889	315 (8.10)	3196 (82.18)	378 (9.72)

Figures in parentheses are percentage of row's total.

Source: (1) 1963 Census of Business, Vol. II Retail Trade Area Stat.
(2) Allocation based on interview.
(3) Allocation based on findings of Rao and Allee.

Finance, Insurance, and Real Estate (SIC Division G 60-67)

Employment is treated separately in the three groups, finance, insurance, and real estate. The latest employment figures are available for the year 1960 in Census of Population. These figures have been adjusted for the year 1963 using the change in the figures published by the Bureau of Unemployment Compensation as shown in Table 23 along with the allocation.

TABLE 23

ALLOCATION OF EMPLOYMENT IN FINANCE, INSURANCE AND REAL ESTATE

	Total Employment		Demand Sectors					
	1960	1963	P_X	G_X	C	I	G	LI
Finance	351	368	4 (1)	85 (23)	49 (13)	60 (16)	33 (9)	137 (37)
Insurance	270	270	170 (63)		64 (24)			36 (13)
Real Estate	75	67				67 (100)		
Total	696	705	174 (25)	85 (12)	113 (16)	127 (18)	33 (5)	173 (24)

Figures in parentheses are percentage of row's total.

Source: Total employment in 1960 from Census of Population. Adjusted figures for 1963. The allocation is explained in the text.

Employment in the finance group is allocated on the basis of the distribution of the assets of insured commercial banks in Ohio as of December 1963 published by the Federal Deposit Insurance Corporation.

Obligation of U.S. Government is allocated to government export while obligations of state and subdivisions are allocated to local government. Real estate loans are allocated to investment, loans to individuals are allocated to local consumption, and the rest is allocated to local industries. Private export sector is represented by 1% based on estimate reported by the biggest bank in Muskingum County in an interview.

In the insurance group, data on claims paid by insurance companies as a total in the State of Ohio published in the annual report of the Director of Insurance, are the basis for the allocation. Claims paid are considered for allocation since they represented the actual flow of benefits to policy holders. The percentage of claims paid by out-of-state companies are allocated to private export sector since it represents flow of income from outside the area under consideration. Claims paid by home companies are allocated between local industries and local consumption sectors on the basis of the distribution of claims settled by Ohio Life Insurance Companies. Industrial and group claims are allocated to local industries sector and the balance to local consumption.

Employment in real estate is considered local services and allocated to investment sector since it deals with real estate which is investment to both individuals and businesses.

Services (SIC Division H 70-89)

Service industry here is defined, in the same sense as the Census of Business defines it, to include establishments which

primarily engage in rendering a wide variety of services to individuals and business establishments. Employment in this industry is considered local in nature, serving directly the service activity sector which is represented by the internal demand sectors. Table 24 shows the allocation of employment in this industry.

TABLE 24

ALLOCATION OF EMPLOYMENT IN SERVICES

	Employment[1]	Demand Sector			
		P_X	C	G	LI
Hotel & Motels, etc.	267	267 (100)			
Personal Services	418		418 (100)		
Business Services	115				115 (100)
Auto Repair[2]	167		140 (84)	2 (1)	25 (15)
Other Repairs	101		101 (100)		
Motion Picture Theaters	36		36 (100)		
Other Amusements	138		138 (100)		
Medical & Health Services[3]	1007*	332 (33)	675 (67)		
Legal Services[4]	43*		25 (58)		18 (42)
Education	331*		331 (100)		
Non-profit Membership Organ.	321*		321 (100)		
Miscellaneous	44*		44 (100)		
Total	2988	599 (20.05)	2229 (74.73)	2	158 (5.22)

Figures in parentheses are percentage of row's total.

Source: (1) 1963 Census of Business, VII Selected Services Area Statistics.
(2) Based on the distribution of number of registered vehicles.
(3) Based on distribution of patients' residency reported by hospitals interviewed in the county.
(4) Based on the distribution of cases disposed of during the year 1963 in the county courts.
* 1964 County Business Patterns.

Government (SIC Division I 91-94)

Government agencies, Federal, State and Local provide employment opportunities for the people as any other industry although the nature of the services rendered here is different from those rendered through the private industries.

Civilian employees only are represented in this division and the allocation of employment is based on the fact that none of the government agencies have been headquartered in the county during the period of study. Thus, government employment is considered all in the service activity sector with the exception of a small percentage of employment in education which serves 1.9% of school enrollment reside outside the county. This presumes that government employment is determined basically by the level of economic activities in the local area.

Because knowledge of the distribution of the benefits each individual or business firm gains from government services are not known, employment is allocated to local government sector, Table 25.

TABLE 25

ALLOCATION OF EMPLOYMENT IN GOVERNMENT

	Employment*	Demand Sector	
		P_X	G
Federal	295		295
State	279		279
Local	1969	19 (1.9)	1950
Total	2543	19 (0.75)	2524 (99.25)

*Source: Unemployment Compensation Records.

Manufacture (SIC Division D 19-39)

In 1963 almost one-third, 33.75%, of employment in Muskingum County was in manufacture industry. Because of the importance and diversification of this industry, a questionnaire has been designed to gather the needed information, Appendix B. Thus, allocation of employment in this industry is based basically on the reply of the firms selected in the sample used for that purpose.

The SIC three digit classification has been used for most of the business firms in this industry with the exception of a few in which employmebt is small. Within each three digit group one firm has been selected to represent that particular group. In selecting these firms an attempt has been made to include all the large firms in the county. Nineteen firms are included in the sample from which twelve firms have more than 100 employees. The Directory of Ohio Manufacture in 1963, published by Ohio Department of Industrial Relations, used for the grouping and selecting of the firms. Eleven of these firms personally interviewed and the questionnaires were mailed to the rest. All the firms contacted, personally or by mail, responded with useable information. The employment covered by these responses represents 54.75% of total employment in manufacture in the county in the year 1963. Table 26 shows the SIC groups and the selected firms for the sample.

In the questionnaire all the firms have been asked to determine the percentage distribution of their annual sales among the various demand sectors, as they have been defined in this study. The reply of each firm is the basis for allocation of employment in the particular

TABLE 26

SIC GROUPS OF MANUFACTURE INDUSTRY IN MUSKINGUM COUNTY
IN 1963 AND THE SELECTED FIRMS FOR THE SAMPLE

SIC Groups	Total Employment	% of Total	Representative Firm[2]	No. of Employees	% of SIC
20 Food & Kindred Prod.	787[1]	9.07		309	39.26
Meat Packing	474		Rittberger Bros.	55	
Bread and Allied	100		Baker Bread	70	
Ice Cream & Milk	135		Meadow Gold Dairy	75	
Unclassified	78		Ballas Egg	109	
24 Lumber & Wood Prod.	68	0.78	Indus. Crate & Lum.	28	41.18
26 Paper & Allied Prod.	119	1.37	Grief Bros. Coop. Corp.	150	126.05
27 Publishing	159	1.83	Zanesville Publishing	150	94.34
32 Stone, Clay & Glass	3220[1]	37.09		1173	36.43
Glass Prod.	1063		Brockway Glass	1000	
Clay Prod.	798		Nat. Plumb. & Pottery	122	
Stone Prod.	1359		Allied Tile Co.	51	
33 Primary Metal	1221	14.06	Armco Steel	732	59.95

TABLE 26--Continued

SIC Groups	Total Employment	% of Total	Representative Firm[2]	No. of Employees	% of SIC
34 Fabricated Metal	388	4.47		414	106.70
	326		Burnham Corp.	400	
	62		Nat. Heating & Cool.	14	
35 Machinery	448	5.16		578	129.02
Farm Machinery	220		Dura Corp.	250	
Heating Equip.	146		Zanesville Mould	228	
Miscellaneous	82		Racine Hydraulic	100	
36 Elec. Machinery	2165[1]	24.94		1094	50.53
Trans. & Hard. Appl.	1416		McGraw Edison	1017	
Miscellaneous	749		Gould N. Batteries	77	
39 Miscellaneous Mfg.	107	1.23	American Match	125	116.82
TOTAL	8682[1]	100.00		4753	54.75

Source: Directory of Ohio Manufacture, 1964, Dept. of Industrial Relations.

(1) 1963 Census of Manufacture, III Area Statistics, Table 7 p. 36-26.
(2) Questionnaires--employment figures in some firms more than the SIC group due to time difference.

group for which the firm has been selected to represent. Table 27 shows the allocation aggregated at the two digit level of the SIC code.

The Economic Structure of Muskingum County in 1963

Putting together the findings of the data in the previous sections, allocation of employment in the different industries to the various demand sectors, gives a picture of the structure of the economy in the county in the year 1963. It pictures the economic activities, sources and levels in the community measured by employment. Thus, it reveals the mechanism within which economic activities in the area have been carried on. Demand for the goods and services produced in the area creates employment opportunities and thus income flow for the people in the area. The sources and levels of this demand have been revealed by the analysis and are shown in Table 28.

The first row in the table shows employment in agriculture industry division as 2162 which is 8.40% of total employment in the county in 1963. From the total number employed in this industry 20.78% or 449 workers are engaged in the production for the private export demand sector, 8.98% or 194 workers are engaged in the production for local consumption demand sector and 70.24% or 1519 for local industries demand sector. Other industry data are interpreted similarly.

The table shows that manufacture is the main source of employment in the county. It provides 33.75% of total employment. Retail trade is second and provides 15.12%. Services is third with 11.61%, followed by government 9.88%, agriculture 8.40%, transportation and

TABIE 27

ALLCCATION OF EMPLOYMENT IN MANUFACTURING

SIC Groups	Employment	Demand Sector				
		P_X	G_X	C	G	LI
Durable Goods						
24-Lumber & Wood Prod.	68					68.00 (100)
32-Stone, Clay & Glass	3220	3198 (99.31)		22 (0.69)		
33-Primary Metals	1221	1221 (100)				
34-Fabricated Metals	388	378.22 (97.48)	6.52 (1.68)	2.44 (0.63)		0.82 (0.21)
35-Machinery Except Electric	448	448 (100)				
36-Electric Machinery	2165	2114.54 (97.67)	43.32 (2.00)	7.00 (0.32)		0.14 (0.01)
39-Miscellaneous Manufacturing	107	102.72 (96)	3.21 (3)	1.07 (1)		
Nondurable Goods						
20-Food & Kindred Prod.	787	553.94 (70.39)	1.56 (0.20)	173.40 (22.03)	54.10 (6.87)	4.00 (0.51)
26-Paper & Allied Prod.	119	95.00 (80)				24.00 (20)
27-Printing & Publishing	159	52 (32.70)		27 (16.98)		80 (50.32)
Total	8682	8163.42 (94.03)	54.61 (0.63)	232.91 (2.68)	54.10 (0.62)	176.96 (2.04)

Figures in parentheses are percentage of row's total.

Source: Allocation is based on sample data.

TABLE 28

THE ECONOMIC STRUCTURE OF MUSKINGUM COUNTY IN 1963

	Employment		Demand Sector					
	Total	% of Total	P_X	G_X	C	I	G	LI
Agr., Fores. & Fisher.	2162	8.40	449.28 (20.78)	--	194.16 (8.98)	--	--	1518.56 (70.24)
Mining	314	1.22	162 (51.66)	--	--	--	--	152 (48.34)
Contract Construction	1057	4.11	593 (56.10)	--	--	464.00 (43.90)	--	--
Trans., Comm. & Utilities	1871	7.27	392 (20.95)	--	968 (51.74)	--	35 (1.87)	476 (25.44)
Wholesale Trade	1518	5.90	372 (24.50)	--	849 (55.93)	--	3 (0.20)	294 (19.37)
Retail Trade	3889	15.12	315 (8.10)	--	3196 (82.18)	--	--	378 (9.72)
Finance, Ins. & Real Es.	705	2.74	174 (24.68)	85 (12.06)	113 (16.03)	127.00 (18.01)	33 (4.68)	173 (24.54)
Services	2988	11.61	599 (20.05)	--	2233 (74.73)	--	--	156 (5.22)
Government	2543	9.88	19 (0.75)	--	--	--	2524 (99.25)	--
Manufacture	8682	33.75	8163.42 (94.03)	54.61 (0.63)	232.91 (2.68)	--	54.10 (0.62)	176.96 (2.04)
Total Employment	25729	100.0	11238.70 (43.68)	139.61 (0.54)	7786.07 (30.26)	591 (2.30)	2649.10 (10.30)	3324.52 (12.92)

Figures in parentheses represent percentage of row's total.

Source: Tables 6, 10, 19, 20, 21, 22, 23, 24, 25, and 27.

communication 7.27%, wholesale trade 5.90%, construction 4.11%, finance 2.74% and finally mining 1.22%. Figure 5 shows the relative size of employment in each industry.

Figure 6 shows the distribution of employment within agriculture and within manufacture. In agriculture dairy products rank number one and employs 28.2% of total employment in the industry followed by hogs, 21.3%, cattle and calves 21.2%, crop production 16.2%, other livestock products 4.7%, fruits and nursery 3.7%, poultry and its products 3.1%, vegetables 0.9%, and forestry 0.7%. This shows that livestock production in the county accounts for 75.4% of total employment in the agricultural division.

In manufacturing industry, stone, clay, and glass products rank first and employs 37.0% of total employment in the industry followed by electric machinery 24.9%, primary metals 14.1%, food and kindred products 9.1%, machinery except electric 5.2%, fabricated metals 4.5%, printing and publishing 1.8%, paper and allied products 1.4%, and lumber and wood products 0.8%. This shows that only 12.3% of total employment in the industry engage in the production of nondurable goods.

In addition Table 28 shows that external demand for goods and services which have been produced in the county has created job opportunities for 44.22% of total employment divided between P_X, 43.68% and G_X, 0.54%. The remaining 55.78% of employment is created by internal demand with local consumption providing 30.26% of total employment followed by local industries 12.92%, local government 10.30%, and investment 2.30%. This represents the direct demand of each demand

FIGURE 5
PERCENTAGE SHARE OF TOTAL EMPLOYMENT BY INDUSTRY DIVISION
MUSKINGUM COUNTY, 1963

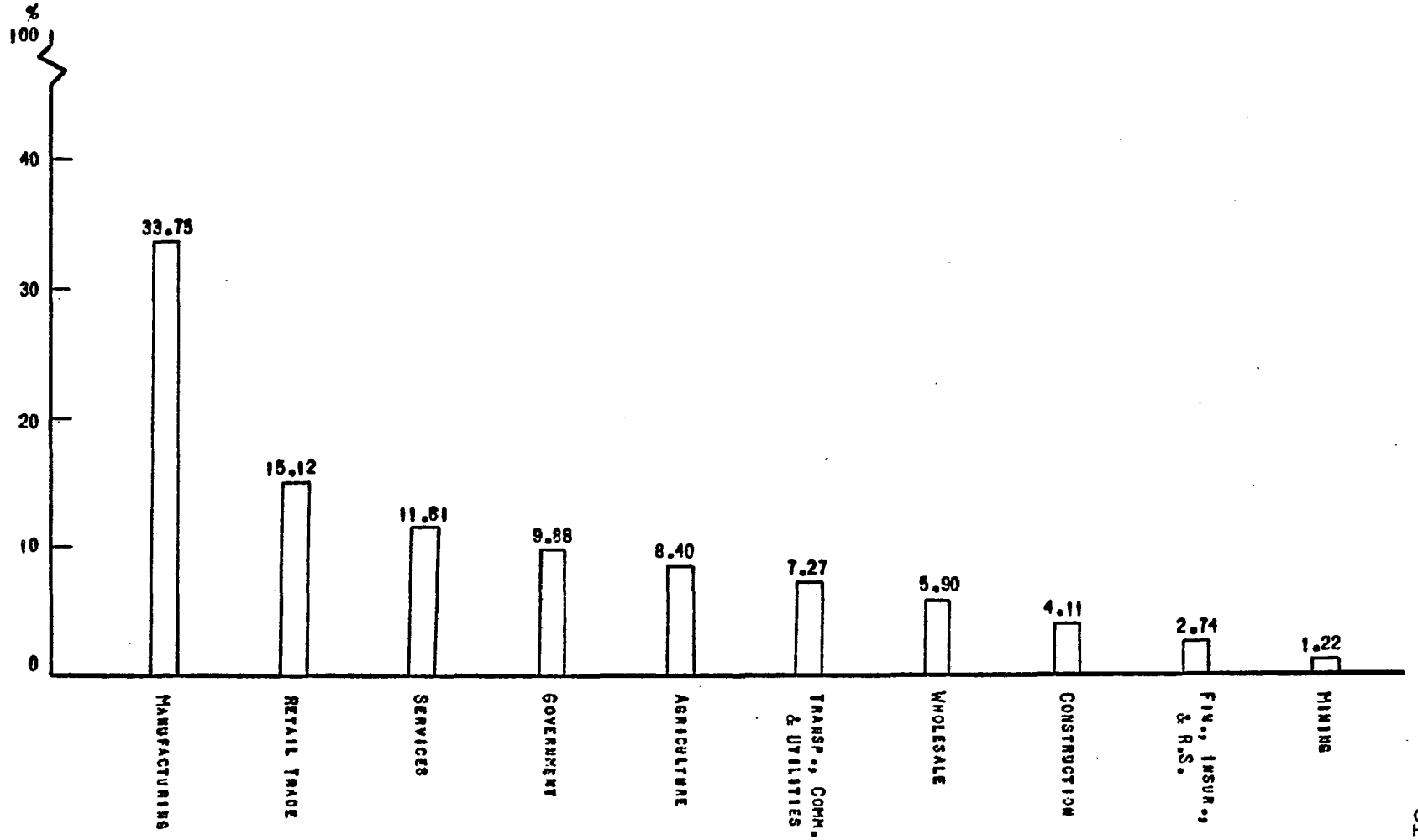
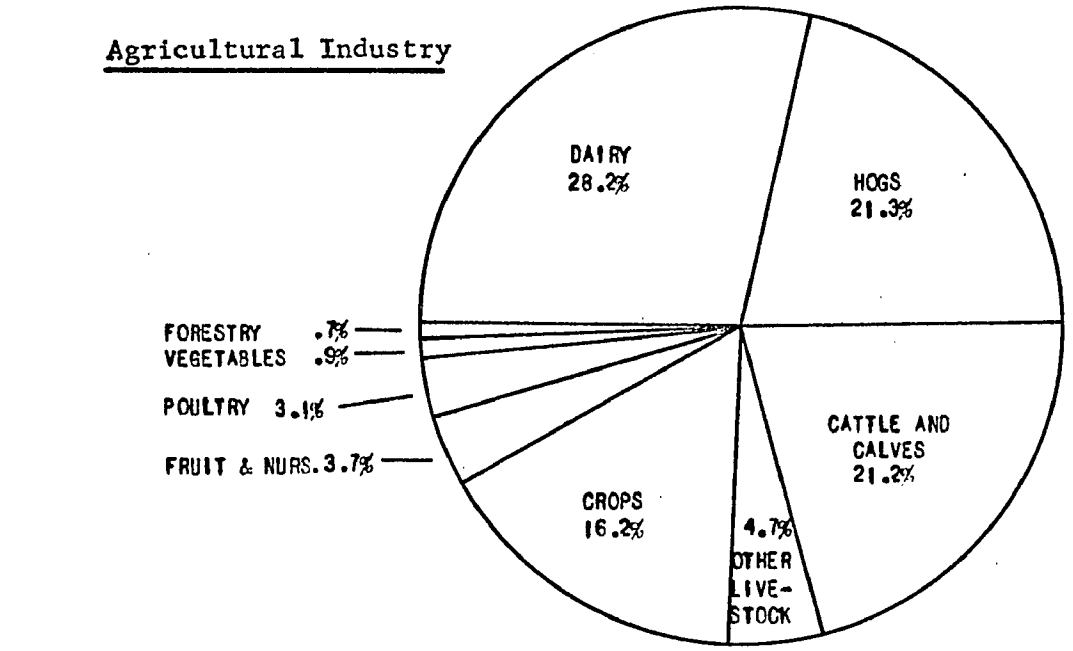
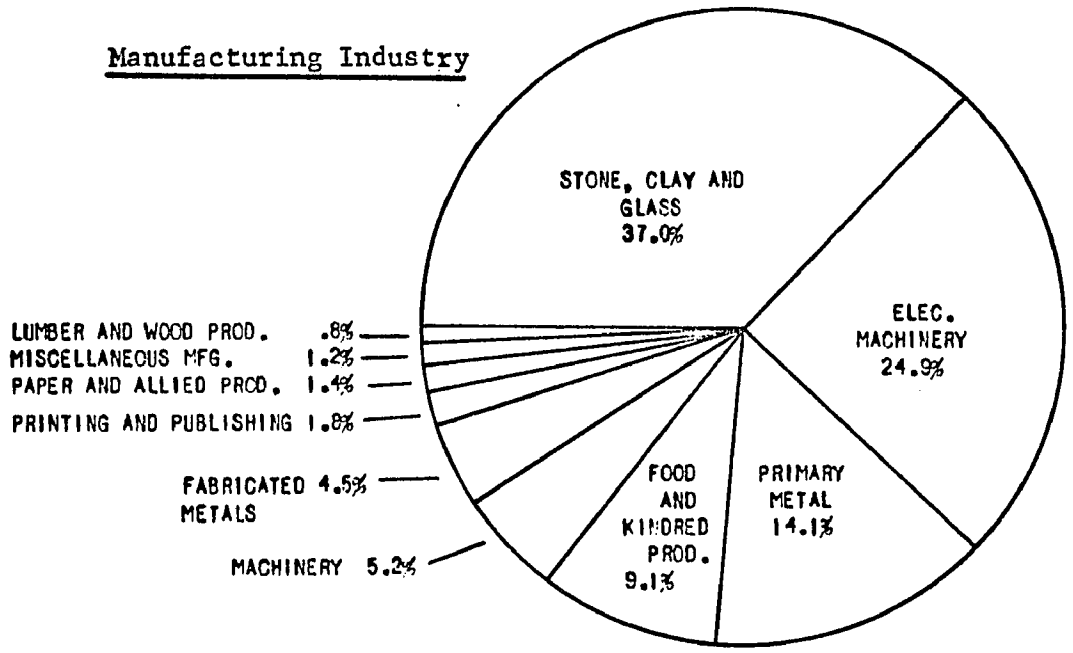


FIGURE 6
DISTRIBUTION OF EMPLOYMENT IN MUSKINGUM COUNTY, 1963





sector for the goods and services produced in each industry division, Figure 7. It shows that manufacture, construction and mining provide the biggest share in the county's economic base by exporting 95%, 56% and 52% of their respective activities. On the other hand wholesale trade; transportation, communication and utilities; services; and retail trade represent the biggest share of the service activities sector in the county and provide local consumption with 56%, 52%, 75% and 82% of their respective activities. In the same time 70% of agriculture's activities go to local industries in the county, the highest among all other industries.

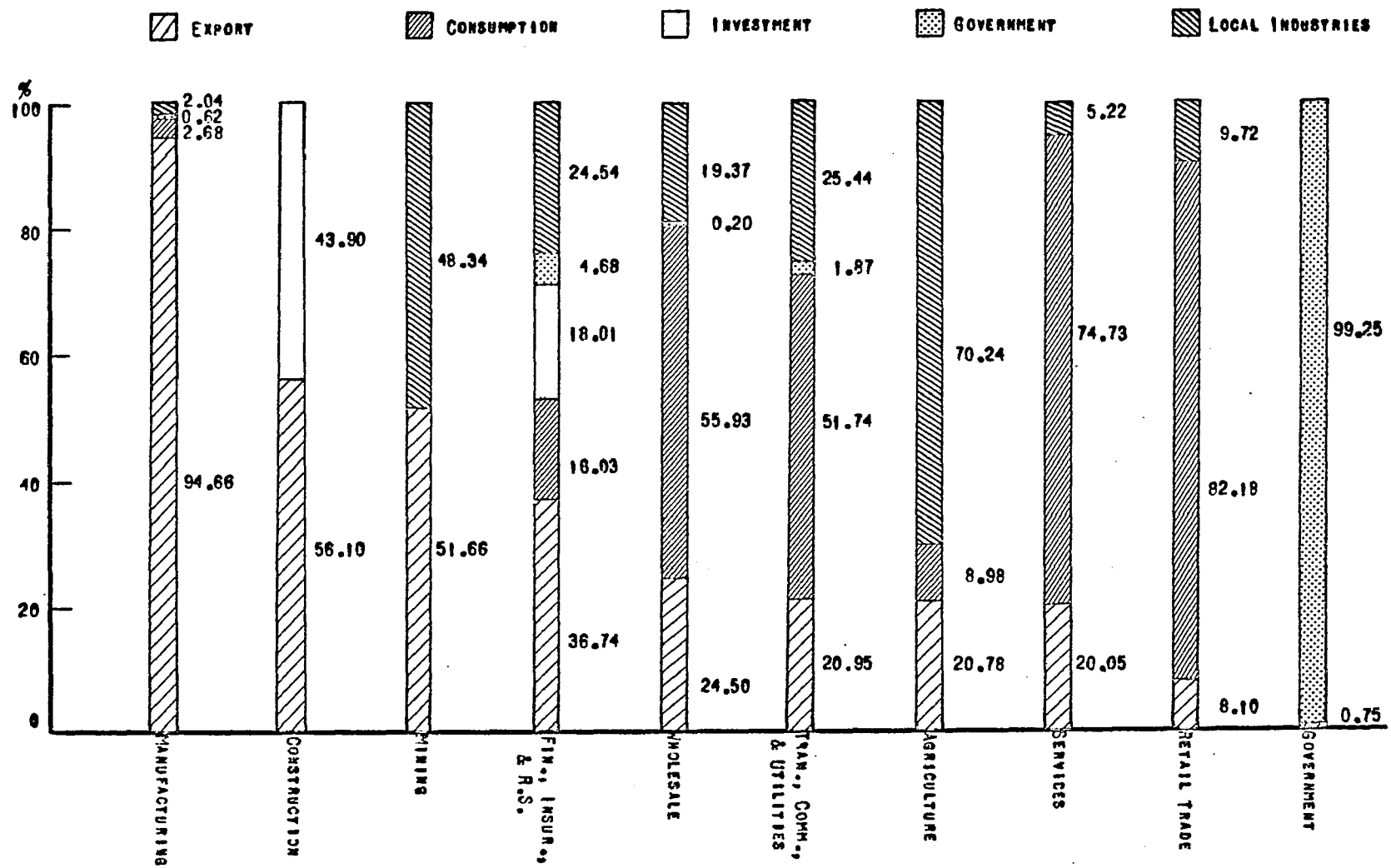
This allocation of the county's economic activities sheds the light on the economic base structure of the county and a single aggregative community multiplier using the formula:

$$\text{Multiplier} = 1 \,/\, 1 - \frac{\text{non-basic employment}}{\text{total employment}}$$

can be developed for each industry and thus utilized to determine the relation between the external demand, the exports that serve as the economic base, and the internal demand, the service activities.

However, examining the demand of local industries sector in more detail shows the interindustries transactions which are not for the final use of the goods and services demanded per se rather is to be used as an intermediate input in further production process to fulfill the demand of other demand sectors for the products produced by local industries. Thus, by linking the distribution of sales by these local industries to the five final demand sectors with the interindustry transactions expressed as input-output coefficients, in other words

FIGURE 7
PERCENTAGE DISTRIBUTION OF EMPLOYMENT IN EACH INDUSTRY TO DEMAND SECTORS
MUSKINGUM COUNTY, 1963



to solve for total output in terms of final demand, total and thus indirect demand induced by changes in final demand can be determined. Thus, precise multipliers can be estimated on a disaggregated level which will be discussed in detail in the following chapter.

CHAPTER IV

INTERRELATIONAL STRUCTURE OF THE ECONOMY IN MUSKINGUM COUNTY

The analysis in the previous chapter shows the structure of the economy in Muskingum County as it prevailed in the year 1963 which is considered to be the base for the analysis in this study. It shows the mix and the proportions of those industries that compose the economy in the county. Also it shows that employment opportunities are created in the county to produce goods and services demanded by both external and internal demand sources. Thus, it shows the activities that serve as the economic base, and the service activities in the local community besides estimating the external demand which as a function of economic activities determined outside the county differs basically from internal demand that cause interdependence relations within the local economy. Any change in the external demand affects the internal demand since it is the main source of income inflow to the county. Moreover, the change in any of the internal demand sources affects the local economy by changing its local transactions and thus affects employment and income in the area.

To analyze the local economy, given its economic base, on a disaggregative level, an input-output model is used to determine the local interrelational structure in the county and to examine the relationship between the external and internal demand in Muskingum

County economy. This analysis is presented and discussed in this chapter. At least two studies have been recently published in which a similar technique has been used for a similar environment.[1]

Input-Output Analysis[2]

Input-output analysis as an analytical tool for the structure of the economic system was developed and presented for the first time by Wassily Leontief in 1936 for the American economy.

This technique deals with the structure of the economy which comprises the operation of the various industries and sectors[3] within the economy. Within any economic structure each industry affects and is affected by each and every other industry. These effects occur at different degrees. A change in one industry or sector will affect the economy directly by that change and indirectly by changing other industries to fit with that change. This is the interdependence of the economic activities. The input-output technique reveals the structural

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[1] Rao and Allee, op. cit.
-The Ohio State University, Bureau of Business Research, The Columbus Area Economy Structure and Growth, 1950 to 1985, Monograph No. 126, Columbus, Ohio, 1967.

[2] This section is a brief presentation of the theory of the input-output technique. For more details on the subject refer to:

-William H. Mieruyk, The Elements of Input-Output Analysis, (New York: Random House, 1965).
-Hollis B. Chenery and Paul G. Clark, Interindustry Economics, (New York: John Wiley and Sons, Inc., 1959).
-Wassily Leontief, Input-Output Economics, (New York: Oxford University Press, 1966).

[3] According to C. M. Tiebout, The Community Econ. Base Study, p. 29, "Industries refer to aggregates of firms producing similar products. Sectors refer to the kind of markets that industries serve."

interdependencies which tie the highly differentiated and specialized parts of the economic system together as a whole. Thus, it presents a working model of the system and shows how each sector of the economy depends on every other sector. As such the technique can be used to determine the consequences that result from the introduction into the system of external or internal changes.

The basic tool of this technique is the input-output table. It is a square matrix in which each row represents one of the producing industries in the economy. Each industry in the economy must be represented by a row. Each producing industry as a receiver of goods from itself and other producing industries is represented by a column of the matrix. There are two forms of the table, dollar-flow table and input-output coefficients table. The first, dollar-flow table, shows the distribution of each industry's output among other industries and sectors of the economy, sales of one industry represented by a row which become purchases, inputs, for other industries or sectors, columns. The following numerical example clarifies the idea, Table 29.

TABLE 29

HYPOTHETICAL EXAMPLE FOR INPUT-OUTPUT DOLLAR FLOW TABLE

From: To:	Agriculture	Manufacture	Final Demand	Total Output
Agriculture	25 (x_{11})	20 (x_{12})	55 (Y_1)	100 (X_1)
Manufacture	14 (x_{21})	6 (x_{22})	30 (Y_2)	50 (X_2)
Primary Input	61	24		
Total Inputs	100	50		

The bracketed data represent the interindustries transactions.

Imagining an economy with two industries, agriculture has value of output 100 units and manufacturing with total value of output 50 units. Table 29 shows in each row the distribution of each industry's output between the producing industries, agriculture and manufacturing and final demand such that:

$$X_1 = x_{11} + x_{12} + Y_1$$

On the other hand each column shows the inputs to the particular industry, i.e., agriculture purchases 25 units from agriculture, 14 units from manufacture and 61 units primary inputs to produce its own 100 units. As such, this represents a production function for this particular industry such that:

$$X_1 = F\ (x_{11},\ x_{21},\ x_{31})$$

This shows the idea behind the input-output coefficients presented in the second form of the input-output tables. It shows that a fundamental relationship exists between the value of the output of an industry and the size of the inputs going into it. These relations reflect the structure of the technology in the economy taking into consideration the following assumptions:[4]

1. Diminishing returns for the production function.
2. The existence of constant return to scale.
3. A fixed coefficients of production which implies that technology remains constant.

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[4]Robert Dorfman, Paul Samuelson and Robert Solow, Linear Programming and Economic Analysis, (New York: McGraw-Hill Book Company, Inc., 1958), p. 209.

Under these assumptions the dollar-flow table can be transferred into input-output coefficients table by dividing each cell in a column, inputs to an industry, by the total output of the same industry. As such the coefficients show the ratios of each dollar-flow input to an industry, cells of a column, to the total output of that same industry, total of the column. The coefficients are used to estimate the demand for materials induced by each industry production and, furthermore, to calculate the total impact of any changes on the local economic system. Table 30 shows these coefficients for the hypothetical example of Table 29.

TABLE 30

HYPOTHETICAL EXAMPLE FOR INPUT-OUTPUT COEFFICIENTS

	Inputs to Agriculture	Inputs to Manufacture	Final Demand	Total Output
Agriculture	[0.25 (a_{11})	0.40 (a_{12})]	55	100
Manufacture	[0.14 (a_{21})	0.12 (a_{22})]	30	50
Primary Inputs	0.61 (a_{31})	0.48 (a_{32})		
	1.00	1.00		

The bracketed data represent the interindustries transactions.

Through a mathematical procedure, matrix inversion, a solution for the given final demand bill and the input-output coefficients for the particular economic unit, such as those represented by the bracketed data in Table 30, can be obtained. The total direct and indirect requirements from each industry's output to meet the given

final demand is the solution. Furthermore, the impact of any changes in the final demand on the economy can be determined using the inverted matrix in the solution. Table 31 shows the inverted matrix for the hypothetical example using the producing industries only. The derivation of the model and its solution will be discussed in the next section.

The coefficients bij in the solution shows the total direct and indirect output of industry i needed to support one unit of final demand for industry j. This output is built up linearly out of the final demands Y_1 and Y_2 such that:[5]

$$X_1 = b_{11} Y_1 + b_{12} Y_2$$

Substituting the numbers in Table 31 in this equation total output of each industry can be determined as the following:

Agriculture = (1.457) (55) + (0.662) (30) = 100

Manufacture = (0.232) (55) + (1.242) (30) = 50

TABLE 31

HYPOTHETICAL EXAMPLE FOR THE INPUT-OUTPUT INVERTED MATRIX

	Agriculture	Manufacture	Finald Demand	Total Output
Agriculture	1.457 (b_{11})	0.662 (b_{12})	55	100
Manufacture	0.232 (b_{21})	1.242 (b_{22})	30	50
Multiplier (Σbij)	1.689	1.904		

[5] Ibid., 215-218.

In addition, by adding the coefficients bij down the column for any industry a multiplier effect of that purchasing industry is obtained. This multiplier measures the change in gross output of the economy resulting from a one unit change in the final demand for the products of that industry.

As such the input-output technique can be employed for the experimental study of many theoretical and practical questions about the local economy.

Derivation of the Static Input-Output Model

In any economic system each industry has a dual role. One as a producer of output and the other as a user of inputs. On one hand each industry sells its output to other industries and to final demand. On the other hand it purchases some or all of its inputs from different industries and sectors in the economy. On the aggregate each industry's total value of inputs equals its total value of output.

Transferring the transactions between the different industries and sectors of an economic system into equation form leads to the input-output model in which the basic elements are:

i = producing industries where $i = 1, \ldots, n$.

j = purchasing industries where $j = 1, \ldots, n$.

X_i = row's total = total output of industry i.

X_j = column's total = total input to industry j.

$X_i = X_j$ only where $i = j$

x_{ij} = amount of output of industry i absorbed by industry j.

a_{ij} = input-output coefficient = output of industry i absorbed by industry j per unit of j's total output = x_{ij} / X_j.

Y_i = amount of output of industry i delivered to final demand.

Since each industry delivers its output to other industries, including itself, and to final demand, the transaction flow of the economic activities can be shown in a system of linear equations such as (1)

$$\begin{aligned} X_1 &= x_{11} + x_{12} + \dots + x_{1n} + Y_1 \\ X_2 &= x_{21} + x_{22} + \dots + x_{2n} + Y_2 \\ &\vdots \\ X_n &= x_{n1} + x_{n2} + \dots + x_{nn} + Y_n \end{aligned} \qquad (1)$$

Transferring interindustries transactions to the left side and rearrangement of the x's in system (1) gives:

$$\begin{aligned} +(X_1 - x_{11}) - x_{12} - \dots - x_{1n} &= Y_1 \\ - x_{21} + (X_2 - x_{22}) - \dots - x_{2n} &= Y_2 \\ &\vdots \\ - x_{n1} - x_{n2} - \dots + (X_n - x_{nn}) &= Y_n \end{aligned} \qquad (2)$$

Substituting $x_{ij} = (a_{ij})(X_j)$, the input-output coefficient, in system (2) yields n general equilibrium equations which represent the relationships between total output of the producing industries and the final demand for each industry's products. (3)

$$\begin{aligned} (1 - a_{11})X_1 - a_{12}X_2 - \dots - a_{1n}X_n &= Y_1 \\ - a_{21}X_1 + (1 - a_{22})X_2 - \dots - a_{2n}X_n &= Y_2 \\ &\vdots \\ - a_{n1}X_1 - a_{n2}X_2 - \dots + (1 - a_{nn})X_n &= Y_n \end{aligned}$$

In matrix form

$$\begin{bmatrix} (1 - a_{11}) & - a_{12} & \dots & - a_{1n} \\ - a_{21} & (1 - a_{22}) & \dots & - a_{2n} \\ \vdots & & \vdots & \\ - a_{n1} & - a_{n2} & & (1 - a_{nn}) \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix}$$

or $$[I - A]\ X = Y$$

where I = identity matrix of order n.

A = matrix of input-output coefficients of order n x n.

X = column vector n x 1 of total outputs.

Y = column vector n x 1 of final demands.

$[I - A]$ = the Leontief Matrix

Solving for X in terms of the given final demand bill Y gives

$$X = [I - A]^{-1} Y \text{ or } X = BY$$

where B is the inverse of the matrix $[I - A]$, the Leontief matrix. The solution is presented as:

$$\begin{aligned} X_1 &= b_{11} Y_1 + b_{12} Y_2 + - - - + b_{1n} Y_n \\ X_2 &= b_{21} Y_1 + b_{22} Y_2 + - - - + b_{2n} Y_n \\ &\vdots \qquad\qquad\qquad\qquad \vdots \\ X_n &= b_{n1} Y_1 + b_{n2} Y_2 + - - - + b_{nn} Y_n \end{aligned} \qquad (4)$$

The coefficients b_{ij} show the <u>total impact</u> any change in the final demand Y_j would have on the output X_i of each industry in the system. Thus, b_{ij}'s measure the changes required in each producing industry in the local economy to meet one unit change in the external demand, generated in the exogenous sectors, for the product of any one of the local producing industries. Therefore, the coefficient b_{ij} determines the total effect of a change in final demand while a_{ij}, the input-output coefficient in each column, determines the <u>direct effect</u> since it represents the changes required in each producing industry in the local economy to produce one unit of output of the particular industry and it represents the locally produced inputs this industry buys to produce one unit of its output. Hence $(b_{ij} - a_{ij})$ determines the <u>indirect effect</u> which is the amount of product used up by other

producing industries in order to support the production of one more unit for final demand in industry j. This means that a change in the final demand for one industry's output consequently requires a similar change in this industry's inputs which require a change in the output of the suppliers industries. This adjustment procedure goes on and on until the local producing economy fits in the new situation and at this point the total impact of the change would be realized in the economy. Thus, the summation of the total impact coefficients b_{ij} for each industry column, gives the multiplier effect of this industry as it is defined in this study.[4]

The Use of the Input-Output Model

The solution of the input-output model presented in the preceeding paragraph represents the link between the input-output and the economic base analysis as they have been used in this study. The solution for any base year, in which a balance of all transactions is assumed, can be used for predictive purposes. That is, for any projected

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[4]Chenery and Clark, op. cit., p. 52. They show that,

$$X = \left[\underline{I} - \underline{A}\right]^{-1} \quad Y = BY = (I + A + A^2 + A3 \; - - -) \; Y.$$
$$= (I + A) \; Y + (A^2 + A_3 + \; - - -) \; Y.$$

Thus, the total effect represented by the coefficients in the inverse matrix can be broken down into:

(1) Direct effect, $(I + A)\ Y$, represented by the input-output coefficient, a_{ij}.

(2) Indirect effect, $(A^2 + A^3 + \ldots)\ Y$, represented by the difference $(b_{ij} - a_{ij})$ for the off diagonal elements where $i \neq j$ and $(b_{ij} - a_{ij} - 1)$ for the diagonal elements when $i = j$.

change in exogenous demand Y, exports in a closed internal system, total output required for the projected demand can be calculated by multiplying the projected demand by the coefficients in the inverse matrix, B. This calculated output satisfies directly and indirectly the external and internal demands.

As such the input-output approach is being used in connection with the economic base approach for an internal closed system in which exports are the only exogenous demand. An alternative approach in which consumption is considered an ultimate demand, internally opened system, can be used. The former is more appropriate for the small areas since migration into and out of a small area is greatly affected by job opportunities therein. In turn, employment is greatly influenced by external demand. Therefore, consumption is likely to be derived rather than ultimate demand and is influenced by external demand for the locally produced goods and services. This means that external demand, exports, is the mover of the local economy which is the main logic of economic base analysis.

Development of Input-output Model for Muskingum County

The construction of an input-output table by gathering information from the field for any economic unit, whatever its size, is very complicated and expensive in both time and money. Thus, it is beyond the scope of this study. To get around this problem, a table has been derived[5] from the U.S. input-output table for 1958, the

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[5]A somewhat similar technique has been used in, The Columbus Area Economy, Appendix G.

latest table available at the time of the present study. The table was published by Scientific American,[6] in 1965, after it had been recomputed in cooperation with Harvard Economic Research Project (HERP) for the year 1964. Three sets of figures are recorded in the table; input-output coefficients, inverse coefficients, and dollar-flow transactions. The set that has been used for the derivation of the regional table is the dollar-flow figures.

The dollar-flow table, as it has been calculated by HERP, shows the dollar-flow corresponding to a gross national product (GNP) of $600 billion detailed by industry and by final demand sectors with imports as negative column. The table was computed in accordance with the specifications for the U.S. economy set out in the original table for the year 1958 in which GNP was $445 billion.

The cells in each row show the distribution of the output, sales, of a particular industry to each of the other industries, thus the figures in each column list the inputs, purchases, to a particular industry from all others. For each column, the inputs, a cell has been added to represent the industry's wage bill, profit, and other prime factor charges for household services which in a static model corresponds approximately to the value added in production and constitutes the industry's own contribution to the GNP above the value

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[6] The original table was developed by the U.S. Department of Commerce, Office of Business Economics, and published in Survey of Current Business, Nov. 1964. The input-output coefficients in this table reflect the real activity of the U.S. economy in 1958.

of the inputs it draws from other industries. Thus, it is the difference between the value of output and cost of inputs produced outside the given industry.

The sum of each row in the table, interindustries transactions plus deliveries to final demand, equals total output of the industry represented by the row. This total in turn equals the total of the intermediate inputs plus the primary inputs, represented by value added, which is the column total for the particular industry. Therefore, the rows and columns, outputs and inputs, that make up the total activity of the economy come into balance in the input-output flow table.

The table just described has been used to derive an interindustry transactions table for Muskingum County. With the use of this derived table along with the data in Table 28, which shows the distribution of each industry's output, measured by employment, between local industries sector, total interindustry transactions, and final demands, the input-output flow table for Muskingum County has been developed. From the latter table the input-output coefficients have been calculated.

A. The Interindustry Transactions Table for Muskingum County

The derivation of the interindustry transactions table for Muskingum County from the U.S. table included the following steps:[7]

1. From the 81 industries listed in the Scientific American U.S.

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[7]The background information, calculation, and intermediate tables used are discussed here but not presented. They are in the files of OSU Dept. of Agr. Econ.

input-output dollar-flow table, 48 industries which compose the economic activity in Muskingum County were determined. The rows and columns pertaining to only these 48 industries were used. Those 48 industries have been grouped into 15 groups within 8 industry divisions according to the Standard Industrial Classification as it is used in the previous chapter; forestry, livestock, and other agriculture; mining; construction; transportation, communication, and utilities; wholesale and retail trade; finance, insurance, and real estate; services; food product, lumber product, stone product, other durable, electric machinery, and other non-durable manufacturing. The dollar-flow between industries within each group has been combined for each column and then for the corresponding row. This step resulted in a dollar-flow table between 48 industries in the U.S. in 1964 grouped into 15 rows and 15 columns.

2. The dollar flow figures in step 1 correspond to GNP of $600 billion. Thus they have been reduced by the ratio 445/600, or (o.741667), to correspond to GNP of the year 1958 ($445 billion).

3. Since employment is used as the measure for economic activities in this study, the dollar-flow figures obtained by step 2 have been converted into employment equivalent. For this conversion the employment/output ratios for each of the 15 industry groups have been calculated using gross domestic output as given in the Scientific American table and employment in the corresponding industry group in the U.S. in 1958. Multiplying these ratios by the corresponding figures converted the table into another that shows employment required for the selected 48 interindustry transactions in the U.S. economy in 1958.

4. Under the assumptions: (1) employment/output ratio in Muskingum County is similar to that ratio for the nation, which means that the distribution of each industry's output in the county is in proportion to that of the nation, and (2) technology in the county may be different from that in the nation, which means that inputs mix and/or proportions are different. In other words the cells in each row in the flow table for the county are in proportion to the cells in the corresponding rows in the U.S. table but the columns, from which the input-output coefficients are calculated, are different.

These assumptions have been used to determine the distribution of employment in the local industries sector in Muskingum County, given in Table 28, according to the different interindustry transactions given in step 3. For this purpose the ratio between total employment in local industries sector in the county and the corresponding total in step 3 has been calculated for each of the 15 industry groups. Multiplying these ratios by the figures in the corresponding rows of the table in step 3 reduced the U.S. figures to correspond with those in the county which is used as employment required for interindustry transactions in the county in the flow table, Table 32.

To clarify the previous discussion, the calculation of one of the cells in the flow table is presented in this section. The cell in the intersection between row 6 and column 6 in Table 32, the transaction from wholesale and retail industry to itself, is the example. The wholesale and retail industry is listed as row 72 and column 72 of the U.S. table and the dollar-flow transaction has been estimated at $2098 million, step 1. Multiplying 2098 x 0.741667 reduces the figure

TABLE 32

FLOW OF GOODS AND SERVICES, MEASURED AS EMPLOYMENT, AMONG ECONOMIC SECTORS IN MUSKINGUM COUNTY IN 1963

Industry Divisions		Employment Required For Inter-Industries							
		Agriculture							
		Forestry 1	Live-Stock 2	Others 3	Mining 4	Trans. Comm. & Utilities 5	Wholesale & Retail Trade 6	Finance Insurance & R. E. 7	S
Agr. Forestry	1	0.149	0	0	0	0.014	0	0.014	
Agr. Livestock	2	2.498	132.109	63.178	0	0.050	0	29.949	
Agr. Others	3	3.278	330.999	109.445	0	1.681	67.604	7.582	
Mining	4	0	0.143	2.246	26.994	41.731	0.197	3.774	
Transportation	5	0.170	10.145	8.644	7.156	106.873	54.249	26.914	1
Wholesale & R.	6	0.705	33.502	38.385	12.264	50.978	61.714	51.774	
Finance	7	0.375	2.477	11.288	9.846	11.935	36.226	58.963	
Services	8	0.568	1.366	4.780	2.882	13.542	41.488	18.954	
Manfg. Food	9	0.006	0.666	0.003	0	0.024	0.126	0.015	
Manfg. Lumber	10	0	0.105	1.573	0.378	0.606	9.355	0.730	
Manfg. Stone	11	0	0	0	0	0	0	0	
Manfg. Other Durable	12	0	0	0	0	0	0	0	
Manfg. Elec. M.	13	0	0.001	0.002	0.001	0.008	0.009	0.002	
Manfg. Others Non-Durable	14	0.099	0.242	4.470	1.092	2.183	4.858	2.694	
Construction	15	0 (0)	0 (3.471)	0 (5.884)	0 (0.178)	0 (33.234)	0 (12.222)	0 (15.365)	(
Government	16	0 (0.271)	0 (17.915)	0 (19.720)	0 (5.505)	0 (32.806)	0 (94.853)	0 (12.364)	(
Labor	17	5.303	237.585	386.585	125.708	770.689	2,635.335	319.615	1,0
Unallocated	18	2.578	250.274	468.797	121.996	804.646	2,388.764	156.291	1,5
Total Inputs	19	16.000	1,021.000	1,125.000	314.000	1,871.000	5,407.000	705.000	2,9

Transactions

rvice 8	Manufacture: Food 9	Lumber 10	Stone 11	Other Durable 12	Elec. M 13	Other Non-Durable 14	Construction 15	Government 16	
0.142	2.599	7.464	0	0	0	0.178	0	0	
1.438	498.268	0	0	0	0	6.510	0	0	
3.698	237.773	1.046	0.187	0.150	0	10.557	0	0	
0.970	1.096	0.090	14.934	0.232	0.215	56.234	3.144	0	
7.574	13.385	2.792	50.288	7.172	10.248	64.807	5.583	(35.000)	
6.202	11.828	13.711	90.667	24.009	25.627	106.568	54.066	(3.000)	
5.787	0.948	1.138	3.441	1.220	0.437	8.453	0.466	(33.000)	
6.142	1.565	1.907	12.746	2.632	2.619	14.097	0.712	0	
0.513	2.521	0.007	0.001	0	0	0.118	0	(54.100)	
2.698	2.362	30.852	0.922	1.326	0.359	11.832	4.902	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0.032	0.002	0.002	0.003	0.013	0.034	0.012	0.019	0	
3.610	6.027	2.358	2.666	1.411	1.479	47.867	3.764	0	
0	0	0	0	0	0	0	0	0	
5.264)	(3.686)	(0.297)	(0.071)	(0.202)	(0.035)	(4.079)	(0.012)	(260.000)	
0	0	0	0	0	0	0	0	0	
2.390)	(1.617)	(1.173)	(56.497)	(31.136)	37.996	11.687	18.546	(56.777)	
6.015	3.323	5.163	1,098.657	481.253	602.102	185.444	435.393	1,687.647	1
5.525	0	0	1,888.920	1,225.244	1,483.849	137.557	530.393	413.476	1
8.000	787.000	68.000	3,220.000	1,776.000	2,165.000	666.000	1,057.000	2,543.000	2

Transactions

:e	Service 8	Manufacture: Food 9	Lumber 10	Stone 11	Other Durable 12	Elec. M 13	Other Non-Durable 14	Construction 15	Government 16
	0.142	2.599	7.464	0	0	0	0.178	0	0
	1.438	498.268	0	0	0	0	6.510	0	0
	3.698	237.773	1.046	0.187	0.150	0	10.557	0	0
	0.970	1.096	0.090	14.934	0.232	0.215	56.234	3.144	0
	107.574	13.385	2.792	50.288	7.172	10.248	64.807	5.583	(35.000)
	96.202	11.828	13.711	90.667	24.009	25.627	106.568	54.066	(3.000)
	25.787	0.948	1.138	3.441	1.220	0.437	8.453	0.466	(33.000)
	36.142	1.565	1.907	12.746	2.632	2.619	14.097	0.712	0
	0.513	2.521	0.007	0.001	0	0	0.118	0	(54.100)
	2.698	2.362	30.852	0.922	1.326	0.359	11.832	4.902	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0.032	0.002	0.002	0.003	0.013	0.034	0.012	0.019	0
	23.610	6.027	2.358	2.666	1.411	1.479	47.867	3.764	0
	0	0	0	0	0	0	0	0	0
)	(95.264)	(3.686)	(0.297)	(0.071)	(0.202)	(0.035)	(4.079)	(0.012)	(260.000)
	0	0	0	0	0	0	0	0	0
)	(52.390)	(1.617)	(1.173)	(56.497)	(31.136)	37.996	11.687	18.546	(56.777)
	1,036.015	3.323	5.163	1,098.657	481.253	602.102	185.444	435.393	1,687.647
	1,505.525	0	0	1,888.920	1,225.244	1,483.849	137.557	530.393	413.476
	2,988.000	787.000	68.000	3,220.000	1,776.000	2,165.000	666.000	1,057.000	2,543.000

	Final Demand						
Total 17	Export 18	Local Consumption 19	Investment 20	Government Purchases 21	Total Final Demand 22	Total Output (Employment) 23 (17 + 22)	
10.560	5.280	0.160	0	0	5.440	16.000	1
734.000	254.000	33.000	0	0	287.000	1,021.000	2
774.000	190.000	161.000	0	0	351.000	1,125.000	3
152.000	162.000	0	0	0	162.000	314.000	4
476.000	392.000	968.000	0	35.000	1,395.000	1,871.000	5
672.000	687.000	4,045.000	0	3.000	4,735.000	5,407.000	6
173.000	259.000	113.000	127.000	33.000	532.000	705.000	7
156.000	599.000	2,233.000	0	0	2,832.000	2,988.000	8
4.000	555.500	173.400	0	54.100	783.000	787.000	9
68.000	0	0	0	0	0	68.000	10
0	3,198.000	22.000	0	0	3,220.000	3,220.000	11
0	1,774.930	1.070	0	0	1,776.000	1,776.000	12
0.140	2,157.860	7.000	0	0	2,164.860	2,165.000	13
104.820	531.740	29.440	0	0	561.180	666.000	14
0	593.000	0	464.000	0	1,057.000	1,057.000	
(434.000)	(593.000)	(30.000)	(0)	(0)		(1,057.000)	15
0	19.000	0	0	2,524.000	2,543.000	2,543.000	
(451.253)	(19.000)	(2,072.747)	0	0		(2,543.000)	16
3,324.520	11,378.310	7,786.070	591.000	2,649.100	22,404.480	25,729.000	
(1,010.353)							
10,015.817							
11,378.310							
25,729.000							

to $1556 million to correspond with GNP of $445 billion, step 2. Gross domestic output of this industry has been estimated in the U.S. table at $126,318 million which is reduced by the same ratio to $93,686 million. Dividing total employment in the industry in U.S. in 1958 by their gross output (12,684,550/93,686) gives employment/output ratio 135.3943 worker/$1 million output. Multiplying 1556 x 135.3943 gives 210,674 which is employment required for the interindustry transaction from wholesale and retail to itself for the U.S. in 1958, step 3. Adding together the row of the interindustry transaction for the industry gives the figure 2,293,839. This means that from total employment in wholesale and retail industry, 12,684,550 in 1958 in the U.S., 2,293,839 workers were employed to service the interindustry transactions and in specific 210,674 to service the industry itself. According to step 4, 672/2,293,839 (total interindustry employment in the county/total interindustry employment in the nation) gives the ratio 0.000293. Multiplying 210,674 x 0.000293 gives 61.714 which appears in the cell in the intersection between row 6 and column 6 of the flow table for Muskingum County, Table 32. All other cells in the table have been calculated in the same manner.

B. The Input-output Flow Table of Muskingum County

Table 32 shows the flow of goods and services, measured as employment, among the economic sectors of Muskingum County developed from data for the year 1963. The entries in the table show employment required to produce goods and services in each industry division and the distribution of these employment levels according to the disposition of each industry's output among the purchasing industries and

final demand. Thus, each cell in each row shows the number of jobs required to produce goods and services purchased by the sector represented by the column in which the cell appears from the industry represented by the row. On the other hand the cells in any one column show the mix and amount of jobs required in the producing industries to supply the purchasing industry represented by the column with the inputs required to produce its output.

The table has three distinct parts: (1) the upper left part consists of 16 rows and 16 columns and represents the interindustry transactions, (2) the upper right part consists of 16 rows and columns 17-23 which is a reproduction of Table 28, and which represents final demand, (3) the lower left part consists of 2 rows and the first 16 columns represents labor inputs and unallocated items of input.

Row entries show the distribution of employment in each industry to the purchasing industries and final demands. Agriculture is disaggregated into three groups and manufacture into 6 groups according to the importance of these groups. Wholesale and retail trade are combined in one group as the Scientific American table does. Each of the remaining industry divisions is represented by a row. This makes the first 16 rows of the table and represent 16 producing industry groups.

Construction industry, row 15, and government, row 16, are represented by zero rows since the analysis in the previous chapter shows zero in the local industries sector for each of them, Table 28. The distribution of their interindustry transactions is shown in parentheses and will be discussed later.

Row 17 represents labor as a direct input of primary factors to final use of each industry. Actually it represents total payment for primary inputs, mainly labor, by each purchasing industry and thus corresponds approximately to the value added in production. On this basis the figures in the row, except in cells 9, 10 and 16, have been calculated as a ratio of the total employment in each industry which corresponds to the ratio of value added/gross domestic output for the corresponding industry as given in the Scientific American table. Then the figures have been adusted to total 10,015.817, the consumption figure. The justification for this procedure is that value added represents the contribution of direct labor only for each industry while gross domestic output represents the contribution of all inputs including labor and supplies from other industries. Total government employment is recorded in this row since it is mainly a direct input of primary factor to final use which does not enter into interindustry transactions. Thus, it makes the total consistent. The figures in cell 9, 10 and 16 are residuals.

Row 18 is an unallocated row which serves to balance the total in each row and the corresponding column. The figures in this row represent an aggregate for local inputs not otherwise explicity accounted for plus inputs imported from outside the county.

Column entries show the inputs purchased by each industry and also the purchases made by final demand sectors. Columns 1 through 16 list the industry groups in the same order as they have been listed in the rows and thus constitute the interindustry transactions table. Government, column 16, is represented by a zero column since it is

considered a final demand sector but its purchases are shown in parentheses just to balance the table. It is not added to the row's total.

Column 17 through 23 is a reproduction of Table 28 and actually shows the distribution of employment, output, between interindustry transactions, column 17, and final demand sectors, columns 18-21. The sum of total final demand entries, column 22, equals the sum of rows (15), (16), 17 and 18 for the first 16 columns plus government purchases. Therefore, the lower right part of the table is eliminated to avoid double counting for intermediate transactions.

Column 23 shows the total output, employment, in each industry, row, which equals the total inputs in row 19 of the corresponding column.

C. The Input-output Coefficients Table for the County

Table 33 has been derived by direct calculation from Table 32 of which the cells in each column have been divided by the total of the column. Thus the figure in each cell expresses the ratio of the input from the industry in whose row the cell appears to the total output of the industry in whose column the cell appears. In other words it shows the amount purchased from each producing industry for the purchasing industry to produce one unit. Measured as employment, the cells in each column show the mix and proportion of employment directly required in the different industries to create one job in the industry of the respective column. Therefore, these coefficients show the direct relations relate to change in employment in the endogenous system regardless of the final destination of its output. The table shows for example, that to increase employment in mining industry, column 4,

TABLE 33

INPUT-OUTPUT COEFFICIENTS TABLE FOR
MUSKINGUM COUNTY, 1963

Industry Divisions		Agriculture			Mining	Trans., Comm. & Utilities	Wholesale & Retail	Finance Insurance & R. E.	Service
		Forestry 1	Livestock 2	Others 3	4	5	6	7	8
Agr.	Forestry 1	0.0093125	0	0	0	0.0000075	0	0.0000199	0.0000
	Livestock 2	0.1561250	0.1293918	0.0561582	0	0.0000267	0	0.0424809	0.0004
	Others 3	0.2048750	0.3241910	0.0972844	0	0.0008985	0.0125031	0.0107546	0.0012
Mining	4	0	0.0001401	0.0019964	0.0859682	0.0223041	0.0000364	0.0053532	0.0003
Transportation	5	0.0106250	0.0099363	0.0076836	0.0227898	0.0571208	0.0100331	0.0381759	0.0360
Wholesale & R.	6	0.0440625	0.0328129	0.0341200	0.0390573	0.0272464	0.0114137	0.0734383	0.0321
Finance	7	0.0234375	0.0024261	0.0100338	0.0313567	0.0063789	0.0066998	0.0836355	0.0086
Services	8	0.0355000	0.0013379	0.0042489	0.0091783	0.0072378	0.0076730	0.0268851	0.0120
Manfg.	Food 9	0.0003750	0.0006523	0.0000027	0	0.0000128	0.0000233	0.0000213	0.0001
	Lumber 10	0	0.0001028	0.0013982	0.0012038	0.0003239	0.0017302	0.0010355	0.0009
	Stone 11	0	0	0	0	0	0	0	0
	Other Durable 12	0	0	0	0	0	0	0	0
	Elec. M. 13	0	0.0000010	0.0000018	0.0000032	0.0000043	0.0000017	0.0000028	0.0000
	Other Non-Durable 14	0.0061875	0.0002370	0.0039733	0.0034777	0.0011668	0.0008985	0.0038213	0.0079
Construction	15	0	0.0033996	0.0052302	0.0005669	0.0177627	0.0022604	0.0217943	0.0318
Government	16	0.0169370	0.0175460	0.0175280	0.0175310	0.0175330	0.0175420	0.0175370	0.0175
Labor	17	0.3314370	0.2326980	0.3436310	0.4003430	0.4119120	0.4873930	0.4533540	0.3467
Unallocated	18	0.1611250	0.2451260	0.4167080	0.3885222	0.4300620	0.4417910	0.2216890	0.5038
Total		1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000

	Manufacture									
vices 8	Food 9	Lumber 10	Stone 11	Other Durable 12	Elec. M. 13	Other Non-Durable 14	Contract Construct. 15	Govern-ment 16	Con-sumption 17	
0000475	0.0033024	0.1097647	0	0	0	0.0002673	0	0	0.0000150	1
0004813	0.6331233	0	0	0	0	0.0097748	0	0	0.0031700	2
0012376	0.3021258	0.0153824	0.0000581	0.0000845	0	0.0158514	0	0	0.0154650	3
0003246	0.0013926	0.0013235	0.0046379	0.0001306	0.0000993	0.0844354	0.0029745	0	0	4
0360020	0.0170076	0.0410588	0.0156174	0.0040383	0.0047335	0.0973078	0.0052819	0.0137630	0.0929850	5
0321961	0.0150292	0.2016324	0.0281575	0.0135186	0.0118370	0.1600120	0.0511504	0.0011790	0.3885580	6
0086302	0.0012046	0.0167353	0.0010686	0.0006869	0.0002018	0.0126922	0.0004409	0.0129760	0.0230540	7
0120957	0.0019886	0.0280441	0.0039584	0.0014820	0.0012097	0.0211667	0.0006736	0	0.2144990	8
0001717	0.0032033	0.0001029	0.0000003	0	0	0.0001772	0	0.0212740	0.0166570	9
0009030	0.0030013	0.4537059	0.0002863	0.0007466	0.0001658	0.0177658	0.0046377	0	0	10
0	0	0	0	0	0	0	0	0	0.0021130	11
0	0	0	0	0	0	0	0	0	0.0001030	12
0000107	0.0000025	0.0000294	0.0000009	0.0000073	0.0000157	0.0000180	0.0000180	0	0.000672	13
0079016	0.0076582	0.0346765	0.0008280	0.0007945	0.0006831	0.0718724	0.0035610	0	0.0028280	14
0318822	0.0046836	0.0043676	0.0000220	0.0001137	0.0000162	0.0061246	0.0000113	0.1022410	0.0028820	15
0175330	0.0020540	0.0172500	0.0175450	0.0175310	0.0175500	0.0175480	0.0175450	0.0223260	0.1991055	16
3467250	0.0042220	0.0759260	0.3411970	0.2709750	0.2781070	0.2784400	0.4119130	0.6636440	0.0378928	17
0038570	0	0	0.5866210	0.6898900	0.6853810	0.2065420	0.5017910	0.1625970	0	18
0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	

by 100 jobs this directly requires employment to increase by 8.60 more jobs in mining, 2.28 in transportation, communication and utilities, 3.91 in wholesale and retail trade, 3.14 in finance, insurance and real estate, 0.92 in services, 0.12 in lumber manufacturing, 0.35 in other manufacturing, 0.06 in construction, 40.03 in labor and 38.85 in unallocated employment.

Models for the Analysis

Now as the activities of the economy in the county have been determined in the form of input-output coefficients, the impact of any changes in the variables that determine the level of local economic activities can be estimated.

From the four final demand sectors considered in this study only local consumption depends largely on the level of local income and is very sensitive to any changes in it. On the other hand export is essentially determined by forces outside the local economy. Between these two extremes investment and government expenditure become more responsive to the level and rate of local income growth the longer the period of the analysis. Thus, local consumption can be considered endogenous while export is always exogenous, and investment and government expenditure are exogenous in the short-run but endogenous in the long run.

On this basis two models have been studied:

Model I, in which all the four final demand sectors have been considered exogenous so as to estimate the total effect of interindustry transactions.

Model II, in which export is considered the only exogenous sector and thus the only mover of the local economy.

Model II represents an internally closed economic system which is usually considered an appropriate model for small communities in which migration and thus local consumption is affected by job opportunities in the area which in turn are affected by external demand represented by exports.

Total Impact of Changes in Final Demand on the Economy of Muskingum Co.

Inverting the $[I - A]$ matrix, Table 33 subtracted from an identity matrix, for each of the two models given the total final demand represented by the exogenous sectors in the respective model has given the B matrix discussed earlier. The cells of those matrixes, Tables 34 and 35, show the total impact, direct plus indirect, a change in final demand would have on the system in each model.[8]

The matrixes $[I - A]$ are slightly different in each of the two models. The first 14 rows and 15 columns have been included in the two models. In the first model, 2 zero rows and 1 zero column have been added to give 16 x 16 matrix. The rows represent construction and government since they have no interindustry transactions but have final demand for their services. The column represents government. In the second model, row 17 and column 17 of Table 33 have been added to give 17 x 17 matrix, rows 15 and 16 in parentheses have replaced the zero

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[8]Notice that the change here is related to the final demand for the products of the endogenous system as compared to the change explained by the input-output coefficients which is related to the endogenous system itself.

TABLE 34

TOTAL IMPACT COEFFICIENTS FOR MUSKINGUM COUNTY, 1963
(MODEL I)

	Agriculture			Mining	Trans., Comm., & Utilities	Whole-sale & Retail	Finance Insurance & Real Estate	Se
	Forestry	Live-stock	Others					
Agr. Forestry	1.009568	0.000181	0.000366	0.000317	0.000106	0.000370	0.000327	0.
Agr. Livestock	0.202641	1.177007	0.074059	0.002129	0.000633	0.001447	0.055775	0.
Agr. Others	0.303640	0.423961	1.135413	0.002146	0.001913	0.014856	0.034607	0.
Mining	0.002200	0.001802	0.003351	1.095439	0.026136	0.000536	0.008163	0.
Trans. Comm. & Utilities	0.020501	0.017330	0.012045	0.029645	1.062458	0.011863	0.048137	0.
Wholesale & Retail	0.068157	0.055742	0.044824	0.048809	0.031771	1.014216	0.088359	0.
Finance, Ins., and R. E.	0.030920	0.008456	0.013353	0.038313	0.008667	0.007850	1.093480	0.
Services	0.039629	0.004328	0.006032	0.012018	0.008582	0.008384	0.031298	1.
Manfg. Food	0.000524	0.000774	0.000055	0.000007	0.000017	0.000027	0.000069	0.
Manfg. Lumber	0.001458	0.001601	0.003281	0.002833	0.000876	0.003330	0.002720	0.
Manfg. Stone	0	0	0	0	0	0	0	
Manfg. Other Durable	0	0	0	0	0	0	0	
Manfg. Elect. M.	0.000002	0.000002	0.000003	0.000004	0.000005	0.000002	0.000004	0.
Manfg. Other Non-Durable	0.008706	0.002337	0.005182	0.004567	0.001615	0.001294	0.005212	0.
Construction	0	0	0	0	0	0	0	
Government	0	0	0	0	0	0	0	
Labor*								
Employment Multiplier I	1.687946	1.693521	1.297964	1.236227	1.142779	1.064175	1.368151	1.
Rank of Multiplier	4	3	7	8	9	11	6	

*Not included.

	Manufacturing								
Services	Food	Lumber	Stone	Other Durable	Elec. M.	Other Non-Durable	Con-struction	Govern-ment	Con-sumption*
0.000289	0.004225	0.203303	0.000077	0.000161	0.000042	0.004306	0.000979	0	
0.001539	0.771073	0.046340	0.000157	0.000117	0.000052	0.016061	0.000381	0	
0.002936	0.615269	0.101812	0.000626	0.000432	0.000233	0.029508	0.001371	0	
0.002242	0.004994	0.012254	0.005610	0.000356	0.000316	0.102964	0.003852	0	
0.040618	0.034436	0.099947	0.017405	0.004719	0.005330	0.120032	0.007246	0	
0.037022	0.068020	0.408729	0.029802	0.014424	0.012424	0.193887	0.054841	0	
0.010380	0.011490	0.045668	0.001776	0.000965	0.000394	0.022140	0.001341	0	
1.013409	0.007477	0.066689	0.004514	0.001746	0.001404	0.028416	0.001617	0	
0.000179	1.003728	0.000333	0.000002	0.000001	0.000001	0.000219	0.000004	0	
0.002138	0.007895	1.834696	0.000687	0.001453	0.000376	0.036203	0.008824	0	
0	0	0	1.000000	0	0	0	0	0	
0	0	0	0	1.000000	0	0	0	0	
0.000011	0.000005	0.000057	0.000001	0.000007	1.000016	0.000022	0.000018	0	
0.008862	0.011675	0.071676	0.001039	0.000953	0.000785	1.080009	0.004275	0	
0	0	0	0	0	0	0	1.000000	0	
0	0	0	0	0	0	0	0	1.000000	
1.119625	2.540287	2.891504	1.061696	1.025334	1.021373	1.633767	1.084749	1.000000	
10	2	1	12	13	14	15			

TABLE 35

TOTAL IMPACT COEFFICIENTS FOR MUSKINGUM COUNTY, 1963
(MODEL II)

Industry Divisions	Agriculture			Mining	Trans., Comm. & Utilities	Whole-sale & Retail	Finance, Ins. & R. E.	Services
	Forestry	Live stock	Others					
Agri. Forestry	1.010094	0.000624	0.000790	0.000781	0.000568	0.000844	0.000915	0.000703
Agri. Livestock	0.235090	1.204178	0.099985	0.030799	0.028165	0.030674	0.090703	0.025247
Agri. Others	0.357291	0.468803	1.178287	0.049610	0.047511	0.063295	0.092479	0.042173
Mining	0.007642	0.006359	0.007712	1.100249	0.030820	0.005448	0.014115	0.006334
Transportation	0.179710	0.150270	0.139292	0.170588	1.197925	0.155786	0.220108	0.157171
Wholesale and Retail	0.622559	0.518485	0.488040	0.539758	0.504169	1.515730	0.688170	0.443825
Finance	0.078396	0.048152	0.051291	0.080303	0.049007	0.050693	1.144676	0.045102
Services	0.338595	0.253756	0.244952	0.276832	0.262916	0.278901	0.354193	1.231948
Manfg. Food	0.029985	0.025475	0.023591	0.026014	0.024983	0.026519	0.031734	0.021688
Manfg. Lumber	0.004971	0.004564	0.006116	0.005925	0.003995	0.006488	0.006692	0.004968
Manfg. Stone	0.002836	0.002366	0.002267	0.002513	0.002413	0.002567	0.003063	0.002073
Manfg. Other Durable	0.000138	0.000115	0.000110	0.000122	0.000118	0.000125	0.000149	0.000101
Manfg. Elec. Machinery	0.000910	0.000760	0.000729	0.000809	0.000778	0.000824	0.000986	0.000676
Manfg. Other Non-Durable	0.017132	0.009384	0.011930	0.012021	0.008845	0.008907	0.014397	0.015147
Construction	0.057147	0.051266	0.048837	0.048479	0.063528	0.049614	0.082117	0.071595
Government	0.325065	0.276907	0.259411	0.283797	0.272073	0.286355	0.343961	0.236553
Labor	1.342386	1.119914	1.072753	1.189071	1.141893	1.214684	1.449701	0.981049
Employment Multiplier II	4.609947	4.141378	3.636093	3.817671	3.639707	3.697454	4.538159	3.286353
Induced Effect*	1.197403	0.999770	0.957128	1.060097	1.019434	1.082626	1.294229	0.877531

*This row represents the indirect effect in the multiplier due to including investment, government expenditure, and consumption as endogenous variables in Model II and is calculated for each column as Employment Multiplier II-Total impact coefficients in the three rows (Construction Government and Labor) in Model II - Employment Multiplier I (Table 34).

es	Manufacturing						Con-struction	Govern-ment	Con-sumption
	Food	Lumber	Stone	Other Durable	Elec. M.	Other Non-Durable			
'03	0.004671	0.203864	0.000420	0.000427	0.000312	0.004810	0.001392	0.000869	0.000885
)47	0.798149	0.080437	0.021434	0.016616	0.016862	0.046727	0.026003	0.058906	0.054776
.73	0.659968	0.157892	0.035811	0.027663	0.027980	0.080196	0.043791	0.082895	0.091311
334	0.009556	0.017971	0.009170	0.003109	0.003121	0.108129	0.008145	0.007969	0.009254
.71	0.166981	0.265902	0.121818	0.085439	0.087591	0.270436	0.133215	0.222285	0.272168
325	0.529555	0.985920	0.393336	0.295285	0.298665	0.717752	0.493591	0.726051	0.949988
L02	0.051059	0.095348	0.032909	0.025070	0.024955	0.066999	0.038868	0.075878	0.080670
948	0.256119	0.377572	0.200626	0.153246	0.155812	0.310727	0.238330	0.387288	0.512748
588	1.028338	0.031405	0.019319	0.015001	0.015280	0.028068	0.023244	0.059172	0.049440
968	0.010892	1.838460	0.002969	0.003218	0.002173	0.039579	0.011571	0.005601	0.005895
073	0.002359	0.002949	1.001861	0.001437	0.001465	0.002678	0.002246	0.003666	0.004865
L01	0.000115	0.000144	0.000091	1.000070	0.000071	0.000131	0.000109	0.000179	0.000237
576	0.000761	0.001002	0.000597	0.000468	1.000485	0.000880	0.000738	0.001176	0.001558
147	0.018720	0.080497	0.006555	0.005217	0.005130	1.087994	0.010929	0.011637	0.014379
595	0.055977	0.071536	0.034892	0.027193	0.027546	0.060583	1.041448	0.169539	0.084513
553	0.275512	0.358620	0.212790	0.168058	0.170876	0.308380	0.253295	1.407797	0.506391
049	1.116350	1.395745	0.880585	0.680255	0.693313	1.267552	1.062903	1.735191	2.302546
353	4.985082	5.965264	2.975183	2.507772	2.531637	4.401621	3.389818	4.956099	4.941624
531	0.996956	1.247859	0.785220	0.606932	0.618529	1.131339	-0.052577	0.653472	

rows representing construction and government, and column 16 replaced the zero column representing government. Thus, local consumption, investment and government expenditure have been considered endogenous variables.

As mentioned earlier each element b_{ij}, the elements in Tables 34 and 34, indicates the amount of employment in industry i, producing industry, necessary to sustain a final demand for the product of one worker in industry j, purchasing industry. The differences between the corresponding elements in Models I and II represent the induced effect due to local consumption, investment and government expenditure.

The elements of the B matrixes are the indicators which have been used to estimate and evaluate the impact of any projected change on the economic system of Muskingum County. This is the subject presented in the following discussion.

SOME FEATURES OF THE ECONOMY IN MUSKINGUM COUNTY

The results of the input-output analysis along with the other data revealed by the economic base study show some features of the economy in the county in 1963 which can be used and interpreted in various ways. Table 36 shows the direct, indirect and total effect on the local economy due to a change in final demand for both Model I and II. The industries are shown by order of direct effect for Model I.

Columns (1) and (4) in the table shows the direct effect of each industry on the total economy in the county, in Model I and II respectively, that is the direct employment required in the economy to

TABLE 36

DIRECT, INDIRECT AND TOTAL IMPACT OF A CHANGE IN FINAL DEMAND ON THE ECONOMY OF MUSKINGUM COUNTY

	Model I			Model II			
	Direct (Σaij) (1)	Total (Σbij) (2)	Indirect (3)	Direct (Σaij) (4)	Total (Σbij) (5)	Indirect (6)	Induced (7)
Food Manufg.	0.9890	2.5403	0.5513	0.9999	4.9851	2.9852	0.9970
Lumber Manfg.	0.9025	2.8915	0.9890	0.9999	5.9653	3.9654	1.2479
Agr. Livestock	0.5012	1.6935	0.1923	0.7548	4.1414	2.3866	0.9998
Other Nondurable	0.4913	1.6338	0.1425	0.7933	4.4016	2.6083	1.1313
Agr. Forestry	0.4905	1.6879	0.1974	0.8388	4 6099	2.7711	1.1974
Finance...	0.2856	1.3682	0.0826	0.7783	4.5382	2.7599	1.2942
Agr. Others	0.2169	1.2980	0.0811	0.5832	3.6361	2.0529	0.9571
Mining	0.1930	1.2362	0.0432	0.6114	3.8177	2.2063	1.0601
Transportation...	0.1227	1.1428	0.0201	0.5699	3.6397	2.0698	1.0194
Services	0.1000	1.1196	0.0196	0.4961	3.2864	1.7903	0.8775
Construction	0.0687	1.0847	0.0160	0.4881	3.3898	1.9017	--
Stone Manfg.	0.0546	1.0617	0.0071	0.4133	2.9752	1.5619	0.7852
Wholesale & Retail	0.0510	1.0642	0.0132	0.5582	3.6974	2.1392	1.0826
Government	0.0492	1.0000	--	0.8373	4.9561	3.1188	0.6535
Other Durable	0.0215	1.0253	0.0038	0.3101	2.5078	1.1977	0.6069
Elec. Machinery	0.0189	1.0214	0.0025	0.3145	2.5316	1.2171	0.6185

Source: (1) and (4), Table 33, Summation oi first 14 rows in each column in Model I and the first 17 rows in Model II.
(2) and (5) Multiplier, Column summation, Table 34 in Model I and Table 35 in II.
(3) and (6) Subtract Total - Direct - 1.
(7) Table 35.

create one job in each industry which is the column summation of the input-output coefficients of the industries included in the endogenous section of the model. Columns (2) and (5) shows the total effect of changing the final demand and thus the total reaction of the system to fit with the new situation, due to the change, which is known as the multiplier. Columns (3) and (6) shows the indirect effect which is the induced effect after the first iteration of the multiplier; thus, it equals the total effect minus the direct effect, the first iteration, minus one unit which is the original change. Column (7) shows the induced effect due to consumption, investment, and government expenditure and it is a part of the indirect effect of Model II.

The table shows that the industry that has high direct effect tends to have higher multiplier and thus indirect effect. This is logical since in this case the industry depends on the local activities to a larger extent and thus any change in it will affect the local system more than in the case where the industry imports most of its inputs as with the industries at the bottom of the table.

Notwithstanding the importance of the multiplier with its components, direct and indirect effects, the importance of an industry cannot be judged by the size of the multiplier alone. The relative size of the industry, its total employment, and the classification of the industry as basic or service, the size of its export, complement the effect of the multiplier.

Table 37 shows the industries in two groups, non-manufacturing and manufacturing, each in order of total employment. Also, the table shows percentage of export and the rank of the multipliers.

TABLE 37

TOTAL EMPLOYMENT, EXPORT AND MULTIPLIER
IN MUSKINGUM COUNTY, 1963

	Total Employment	Export % of Output	Export Rank	Multiplier I Value	Multiplier I Rank
Non-Manufacture					
Wholesale & Retail	5,407	12.71	9	1.0642	9
Services	2,988	20.05	7	1.1196	7
Government	2,543	0.75	10	1.0000	10
Trans., Comm., & Util.	1,871	20.95	6	1.1428	6
Agr. Others	1,125	16.89	8	1.2980	4
Construction	1,057	56.10	1	1.0847	8
Agr. Livestock	1,021	24.88	4	1.6935	1
Finance	705	24.68	5	1.3682	3
Mining	314	51.66	2	1.2362	5
Agr. Forestry	16	33.00	3	1.6879	2
Manufacture					
Stone	3,220	99.31	3	1.0617	4
Elec. Machinery	2,165	99.67	2	1.0214	6
Other Durable	1,776	99.77	1	1.0253	5
Food	787	70.59	5	2.5403	2
Other Nondurable	666	78.82	4	1.6338	3
Lumber	68	--	6	2.8915	1

Source: Tables 28 and 34.

The table shows different characters for each group of industries. In the nonmanufacturing group, the service industries occupy the top in order of total employment with wholesale and retail trade first followed by services, government, and transportation, communication and utilities. At the same time they export low percentage of their activities and have low multiplier values. On the other hand other industries such as agriculture, construction and mining employ fewer people, export higher percentage of their activities and have higher multipliers. In contrast the durable manufacturing industries employ large number of workers, export almost all their product and have the lowest

multiplier values. On the other hand, nondurable manufacturing industries such as food processing, paper products, and others employ fewer people, export less than the former but larger than nonmanufacturing and have the highest multiplier effects.

This shows that durable manufacturing constitutes a large portion of the economic base of the county by generating more income inflow through export but has low effect on the local economy, low multiplier. At the same time food processing and other nondurable manufacturing besides being basic industries are fundamental in generating more effect on the local economy. Considering the average weekly earnings of workers in the different industries, this sheds more light on the importance of these industries, Table 38. It shows that food processing ranks second after other durable manufacturing which includes machinery and primary metals and is followed by lumber, other nondurable manufacture and electric machinery. For the nonmanufacture industries only trade and services have lower average.

Table 38 also shows a comparison between the multipliers estimated for Muskingum County in this study and multipliers estimated for Columbus Metropolitan Area in Ohio. The estimates of Model II are comparable to that of the Cclumbus study since both used an internal closed system in which consumption is considered an endogenous variable.

As expected, lumber and food manufacturing are higher in the county since more agricultural supplies are available locally. By the same reasoning agriculture and mining are lower in the county because more supplies needed for these industries, e.g., machinery, are im-

ported while they are supplied locally in the Columbus area. This also explains the lower estimates for services and trade industries which reflect the fact that the Columbus area is a larger and more complete trading center.

TABLE 38

MULTIPLIERS FOR MUSKINGUM COUNTY AND COLUMBUS METROPOLITAN AREA

	Muskingum County Model I	Muskingum County Model II	Columbus Metropolitan Area (1)	Average Weekly Earning, 1965 (2)
Lumber and Wood Prod.	2.8915	5.9653	2.7668	$ 98.95
Food Processing	2.5403	4.9851	2.1627	104.97
Other Nondurable	1.6338	4.4016	2.6609*	94.21*
Agriculture	1.4877*	3.8820*	4.2668	N.A.
Finance	1.3682	4.5382	3.1055	101.54
Mining	1.2362	3.8177	4.2425	102.78
Trans. & Comm.	1.1428	3.6398	3.4069*	124.45
Services	1.1196	3.2864	4.2425*	56.46
Construction	1.0848	3.3898	3.0183	126.31
Wholesale & Retail	1.0642	3.6975	4.0572	72.55
Stone Manfg.	1.0617	2.9752	2.7386	96.96
Other Durable	1.0253	2.5078	2.8518*	105.12*
Elec. Machinery	1.0214	2.5316	2.5949	93.77
Government	1.0000	4.9561	4.3238	N.A.
Households	--	4.9416	3.5075	N.A.

*Weighted average for individual components.

Source: (1) Comparable to Model II, The Columbus Area Economy, op. cit., Tabe 5.5, p. 91.
(2) For Muskingum County, Ohio Bureau of Unemployment Compensation, Table RS 203.2-60, 7/29/66.

APPLICATION OF THE INPUT-OUTPUT RESULTS

The results of the input-output analysis have been used in the following presentation to show how different patterns of growth can affect the local economy of Muskingum County. However, in regard to the limitations imposed on this study, the results which are presented here must be regarded as approximate and indicative of the general nature of the interrelationships among the industries in the county.

For simplicity the 16 industries presented in Tables 34 and 35 have been grouped into 4 groups, agriculture, agricultural manufacturing, manufacturing, and nonmanufacturing. A weighted average using total employment in each industry as the weight has been used to aggregate total impact coefficients of the components in each of the four groups.[9] Table 39 shows the aggregated coefficients. For each group the first row represents the coefficient of Model I while the second row represents Model II in which consumption and government were included. Thus, while the figures in Model I reflect the interindustry interactions only, the coefficients in Model II add the impact of local consumption and government expenditures on the economy. This explains the higher values of Model II.

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[9]For a discussion on grouping the industries see: Dorfman, Samuelson and Solow, P., p. 240-245.

TABLE 39

AGGREGATION OF TOTAL IMPACT COEFFICIENTS

		Agr.	Agr. Manfg.	Manfg.	Non-Manfg.	Government*	Consumption*
Agriculture	I	1.3969	1.3079	0.0049	0.0144		
	II	1.4678	1.3815	0.0576	0.0883	0.1427	0.1470
Agr. Manfg.	I	0.0029	1.0772	0.0038	0.0032		
	II	0.0299	1.1053	0.0239	0.0313	0.0648	0.0553
Manfg.	I	0.0039	0.0165	1.0077	0.0037		
	II	0.0139	0.0269	1.0152	0.0143	0.0167	0.0210
Non-Manfg.	I	0.0840	0.1668	0.0746	1.0917		
	II	1.0051	1.1285	0.7558	2.0607	1.5890	1.9093
Government*	I						
	II	0.2682	0.2821	0.1992	0.2725	1.4078	0.5064
Labor*	I						
	II	1.0970	1.1386	0.8163	1.1469	1.7352	2.3025
Multiplier	I	1.4877	2.5682	1.0910	1.1130		
	II	3.8820	5.0631	2.8678	3.6139	4.9561	4.9416

*Not included in Model I.

Source: Tables 34 and 35.

Effects of A Given Absolute Number Change in Final Demand

The solution of the input-output model as presented previously in this chapter is in the form:

$$X_i = b_{i1} Y_1 + b_{i2} Y_2 + \ldots + b_{in} Y_n$$

where X_i = total output of the producing industry i

b_{ij} = total impact coefficients of purchasing industry j on producing industry i.

Y_j = final demand for output of producing industries.

Substituting given values of Y_j in this equation gives total output of each producing industry which satisfies that set of final demand. Consequently if a given change in any of the Y's is substituted in the equation, X_i in this case presents the change required in that particular industry to meet the given change. On this basis, the changes required by an increase of 100 jobs in the final demand, as given in 1963, have been calculated and presented in Table 40. The upper part of the table is calculated according to Model I and the lower part represents Model II. The effect of this change is in general higher in Model II than in Model I because it reflects the induced effect of consumption expenditure on the economy. However, a word of caution is due here since the results of the two models are not comparable due to the different proportions of local consumption component in different industry groups. Hence the induced effect of consumption varies from one industry to another.

The additional change in agriculture, agricultural manufacture, and manufacture induces more jobs in nonmanufacture than the latter has on the formers. This is because of the nature of the nonmanufacturing as service industries. In addition, the change in agricultural manufacture induces the highest change in the total economy. It induces a 1.00% change in total employment while agriculture ranks second and induces a 0.58% change followed by nonmanufacture with 0.43% and manufacture with 0.42%. The same ranks hold true in Model II with higher values. This shows that a change in final demand for agricultural processed products affects the local economy in the county more than a similar change in the final demand for other locally produced goods

TABLE 40

THE IMPACT OF AN ADDITIONAL 100 JOBS CHANGE
IN FINAL DEMAND FOR EACH INDUSTRY GROUP

	1963		Change in Employment Due to 100 Job Change in Final Demand of:						
	Total Employment	Final Demand	Agr.	Agr. Manfg.	Manfg.	Non-Manfg.	Government	Consumption	Total Change
Model I									
Agriculture	2162	643.44	139.69 (6.46)	130.79 (6.05)	0.49 (0.02)	1.44 (0.07)			272.41 (12.60)
Agriculture Manufacturing	855	783.00	0.29 (0.03)	107.72 (12.60)	0.38 (0.04)	0.32 (0.04)			108.71 (12.71)
Manufacturing	7827	7722.04	0.39 (0.00)	1.65 (0.02)	100.77 (1.29)	0.37 (0.00)			103.18 (1.32)
Non-Manufacturing	12342	10713.00	8.40 (0.07)	16.68 (0.14)	7.46 (0.06)	109.17 (0.89)			141.71 (1.15)
Total	25729		148.77	256.84	109.10	111.30			626.01
% of Total Employment			(0.58)	(1.00)	(0.42)	(0.43)			(2.43)

TABLE 40--Continued

	1963		Change in Employment Due to 100 Job Change in Final Demand of:						
	Total Employment	Final Demand	Agr.	Agr. Manfg.	Manfg.	Non-Manfg.	Government	Consumption	Total Change
Model II									
Agriculture	2162	449.28	146.78 (6.79)	138.15 (6.39)	5.76 (0.27)	8.83 (0.41)	14.27 (0.66)	14.70 (0.68)	328.49 (15.19)
Agr. Manfg.	855	555.50	2.99 (0.35)	110.53 (12.93)	2.39 (0.28)	3.13 (0.37)	6.48 (0.76)	5.53 (0.65)	131.05 (15.33)
Manufacturing	7827	7184.53	1.39 (0.02)	2.69 (0.03)	101.52 (1.30)	1.43 (0.02)	1.67 (0.02)	2.10 (0.03)	110.80 (1.42)
Non-Manfg.	12342	2692.00	100.51 (0.81)	112.85 (0.91)	75.58 (0.61)	206.07 (1.67)	158.90 (1.29)	190.93 (1.55)	844.84 (6.85)
Government	2543	19.00	26.82 (1.05)	28.21 (1.11)	19.92 (0.78)	27.25 (1.07)	140.78 (5.54)	50.64 (1.99)	293.62 (11.55)
Labor	27736	2007.00*	109.70 (0.40)	113.86 (0.41)	81.63 (0.29)	114.69 (0.41)	173.52 (0.63)	230.25 (0.83)	823.65 (2.97)
Total Change	25729		388.20	506.31	286.78	361.39	495.61	494.16	2532.45
% of Total Employment			(1.51)	(1.97)	(1.11)	(1.40)	(1.93)	(1.92)	(9.84)

*7.8% of total employment.

and services followed by demand for agricultural products and last is the demand for manufacturing products. This can be shown also by considering the effect of agricultural industries on nonagricultural industries and vice-versa. The change in demand for the former induces 27 jobs in nonagriculture industries in addition to 178 jobs within itself while the same change in nonagricultural industries induces only 3 jobs in agricultre besides 18 jobs within itself.

Table 40 also shows a hypothetical example related to creation of jobs outside the county, hence increasing commuting from the county. In this case, workers work outside the county but live and consume within the county. A change of 100 jobs in final demand for labor, 2007 which is 7.8% of labor force work outside the county--1960 Census of Population, represents job opportunities for those commuters outside the county. Such change would induce 14.7 jobs in local agriculture, 5.5 in local agricultural manufacturing, 2 in manufacturing and 190.9 in nonmanufacturing. Such effect is reflected largely in the nonmanufacturing industries again because of the services rendered by this category.

Effects of A Proportionate Percentage Change in Final Demand

The changes required in the local economy of the county due to a change of 10% in the final demand for each industry group are shown in Table 41. The calculation here is the same as in the previous section with the substitution of a 10% of the final demand in each industry instead of the given 100 units. Thus, the change in final demand differs from one industry to another depending on the

TABLE 41

THE IMPACT OF A 10% PROPORTIONATE CHANGE
IN FINAL DEMAND FOR EACH INDUSTRY GROUP

	1963		Change in Employment Due to 10% Change in Final Demand of:						
	Total Employment	Final Demand	Agr.	Agr. Manfg.	Manfg.	Non-Manfg.	Government	Consumption	Total Change
				Model I					
Agriculture	2162	643.44	89.88 (4.16)	102.40 (4.74)	3.75 (0.17)	15.42 (0.71)			211.45 (9.78)
Agriculture Manufacturing	855	783.00	0.18 (0.02)	84.34 (9.86)	2.95 (0.35)	3.38 (0.40)			90.85 (10.63)
Manufacturing	7827	7722.04	0.25 (0.00)	1.29 (0.01)	778.13 (9.94)	4.01 (0.05)			783.68 (10.01)
Non-Manufacturing	12342	10713.00	5.41 (0.04)	13.06 (0.11)	57.63 (0.47)	1169.57 (9.48)			1245.67 (10.09)
Total Change			95.72	201.09	842.46	1192.38			2331.65
% of Total Employment			(0.37)	(0.78)	(327)	(4.63)			(9.06)

TABLE 41--Continued

	1963		Change in Employment Due to 10% Change in Final Demand of:						
	Total Employment	Final Demand	Agr.	Agr. Manfg.	Manfg.	Non-Manfg.	Government	Consumption	Total Change
				Model II					
Agriculture	2162	449.28	65.94 (3.05)	76.75 (3.55)	41.36 (1.91)	23.76 (1.10)	0.27 (0.01)	29.50 (1.36)	237.58 (10.99)
Agr. Manfg.	855	555.50	1.34 (0.16)	61.40 (7.18)	17.16 (2.01)	8.42 (0.98)	0.12 (0.01)	11.11 (1.30)	99.55 (11.64)
Manufacturing	7827	7184.53	0.63 (0.01)	1.50 (0.02)	729.34 (9.32)	3.85 (0.05)	0.03 (0.00)	4.22 (0.05)	739.57 (9.45)
Non-Manfg.	12342	2692.00	45.16 (0.37)	62.69 (0.51)	542.99 (4.40)	554.73 (4.49)	3.02 (0.02)	383.20 (3.10)	1591.79 (12.90)
Government	2543	19.00	12.05 (0.47)	15.67 (0.62)	143.10 (5.63)	73.36 (2.88)	2.67 (0.10)	101.63 (4.00)	348.48 (13.70)
Labor	27736	2007.00*	49.29 (0.18)	63.25 (0.23)	586.45 (2.11)	308.73 (1.11)	3.30 (0.01)	462.12 (1.67)	1473.14 (5.31)
Total Change			174.41	281.26	2060.40	972.85	9.41	991.78	4490.11
% of Total Employment			(0.68)	(1.09)	(8.01)	(3.78)	(0.04)	(3.85)	(17.45)

*7.8% of total employment.

size of its final demand. Therefore, looking into each model, the industries are not comparable because of the differences in the size of final demand in each group, i.e., a small multiplier effect in one industry would be offset by the large proportionate change in its final demand, e.g., a 10% change in final demand for manufacturing equals 772 units while in agricultural manufacturing it is only 78 units. Therefore, the results shown in Table 41 must be interpreted for each industry separately.

The Use of the Two Models

Model I treats consumption as an exogenous variable within final demand. Thus, the estimated coefficients actually underestimate the impact of the change in final demand on the local economy simply because any such change affects households income as explained by the Keynesian consumption function and thus it is not constant as assumed by the model. However, the model is useful in measuring the impact on the interstructural system of the producing industries and estimating parameters for its economic interdependence.

Model II, on the other hand, has the advantage of including consumption in the endogenous system and thus evaluates the induced effect, due to consumption, on the local economy. However, in this case the assumption of constant input-output coefficient in relation to household and consumption and considering the human behavior in the same manner as other industries is seriously questionable.

However, the use of the two models is very beneficial for studying the structure of the economy in order to gain a better understanding for solving its problems.

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

The Appalachian Region of Ohio as a part of the Appalachian Region of the Eastern United States suffers from lack of job opportunities, out migration, low level of education and low productivity of its resources which is reflected in lower incomes and a lower level of living to the people of the region. Consequently the region is lagging behind the rest of the state and the nation in its economic growth. To diagnose the causes of these problems and gain a better understanding of alternative solutions to the problems, research is required and needed in the region.

This study was conducted to investigate the economic structure of a selected community within the region and to estimate the interaction between the different sections of that economy. This should lead to a better understanding of the operation of the economy and thus provide an idea about the effect any stimulated change in the economy would have on its growth.

To pursue the objectives of this study a time series analysis has been conducted on data for a six-county area which includes Muskingum, Coshocton, Guernsey, Noble, Morgan and Perry Counties. Using a multiple linear regression analysis a functional relationship has been determined to estimate the contribution of output of agriculture, manu-

facturing and nonmanufacturing activities to total income in each county. These estimates in turn have been used to estimate productivity of each activity in relation to income generation in each county. The results of this analysis show that Muskingum County had positive productivity indicators for the three studied activities, with agriculture at the top. Agriculture had negative indicators in Coshocton and Guernsey while manufacture had negative indicators in Perry, Morgan and Noble Counties, Table 4, page 34.

Muskingum County was selected as a study area to determine its economic structure. The economic base approach has been used as a technique in pursuit of this objective. The basic idea of this approach is that the portion of each economic activity that serves the external market, i.e., exports, is considered a basic activity which generates income inflow to the community and thus stimulates more activities in the economy, i.e., the service activities.

The economic activities in the county have been grouped in 10 industry divisions according to the Standard Industrial Classification. Employment in each industry in the year 1963, which is considered the base year for this study, is allocated between the different demand sectors based on the allocation of sales of each industry. The results of this allocation, Table 28, page 79, show that manufacturing is the main employer in the county and provides 34% of total employment, also it represents the biggest part in the basic sector since it exports 95% of its products. Other industries in order of the percentage exported from their production are construction, mining, finance, wholesale trade, transportation, agriculture, services, retail

trade, and government. In order of number of employees the industries are manufacturing, retail trade, services, government, agriculture, transportation, wholesale trade, construction, finance and mining, almost the opposite order of the proportion of export. The results also show that agriculture provides local industries with 70% of its activities followed by mining, transportation and finance while manufacturing provides only 2% to that sector.

To estimate the interaction among the different sections of the economy in the selected county an input-output model has been used. The county input-output flow table has been derived, useing 1963 data, from the U.S. table which was developed by the U.S. Department of Commerce to reflect the activity of the U.S. economy in 1958. Using this derived table, Table 32, page 101, and the given final demand as revealed by the economic base study, two models have been studied. In the first model consumption is considered an ultimate demand and thus is included in the final demand as an exogenous variable along with export to estimate the interindustry interactions. Model II represents an internally closed system by considering consumption within the endogenous system, and thus export is the only exogenous variable and the only mover of the economy to estimate the induced effect due to consumption and the impact of changes in the economic base, exports, on the economy of the county. The solutions of the two models give estimates for the interactions between the different sections in the economy and thus estimate multipliers effect for changes in the final demand of each industry division in the economy, Tables 34 and 35, pages 109 and 110. These estimates show that the industry which has

high direct effect on the local economy, i.e., purchases more inputs locally, tends to have higher multiplier and thus indirect effect, since any change in its output requires more locally produced inputs and thus affects the local economy more than any change in an industry that imports a larger part of its inputs. The results also show that although durable manufacturing constitutes a large portion of the economic base of the county by generating more income inflow through export it has low multiplier effect on the economy, e.g., 1.06 in stone, glass and clay industry and 1.02 in electric machinery, machinery and primary metals industries, which reflects the fact that these industries import their major inputs, Table 37, page 114. At the same time food processing, lumber processing and other nondurable manufacturing, besides being basic industries are fundamental in generating more impact on the local economy through their multipliers effect, i. e., 2.54, 2.89 and 1.63 respectively. On the other hand the industries in the service activities category such as wholesale and retail trade, services, government and transportation, communication and utilities, not only export very little of their activities but also have low multipliers and thus the change in final demand for their services does not affect the local economy very much.

When the estimated coefficients are grouped into four industry groups, Table 39, page 118, agricultural manufacturing shows the highest impact multiplier, on the local economy followed by agriculture, nonmanufacture, then manufacturing industries. In addition, comparing the effect a change of 100 unit in final demand for each industry group has on other industry groups, Table 40, page 120 and 121, the

results show that the change in agriculture, agricultural manufacturing, and manufacturing induces more change in nonmanufacturing than the change in the latter has on the formers. Also, it shows that the change in final demand for agricultural processed products affects the local economy more than a similar change in the final demand for other locally produced goods and services, followed by the demand for agricultural products, and least is the demand for manufacturing products. Presenting the results in another form, it is shown that the change in final demand for agriculture and related industries affects non-agricultural industries far more than the change in the latter affects agricultural industries.

Conclusions

The conclusions of this study reflect an approximation of the general nature of the economy in the study area, bearing in mind the limitations imposed on the data and models used throughout the analysis. The conclusions are:

1. Muskingum County represents a promising area for potential future growth. It has an advantageous position both geographically and economically. The time series analysis shows that during the period 1950-64 all the economic activities in the county had positive productivity which was not the case for the other studied counties.

2. Agriculture industry is the most productive activity in relation to income generation in the county. It has the highest productivity indicator among all activities in the county and within agriculture in the surrounding counties. Also, this industry supplies the local in-

dustries sector in the county with 70% of its output and has a high multiplier effect which ranks fourth among 14 industry groups. It is worth noting that livestock and dairy products represent a major part in total sales of the industry which indicates their importance as suppliers for other local industries substituting for imports and thus generating more income locally through interindustries transactions.

3. Manufacturing is by far the leading employer of Muskingum County workers, with one out of three workers in this industry. It represents a major part in the county's basic sector and thus earns a major part of income inflow for the community.

However, when viewed in terms of its effect on the local economy two observations are worth noting: (a) that the industries which are agriculturally oriented have the highest multiplier effects on the local economy while other industries have the lowest effects; (b) that 88% of employment in manufacture is engaged in the production of durable goods. This leads to the conclusion that the county has unbalanced collection of durable and nondurable industries and that the industries which provide a major part of job opportunities in the county, durable industries, import the major part of their supplies and thus have low local interindustries transactions and hence low multiplier effect due to the large leakage of their revenues from the county. Therefore, those industries must be encouraged and stimulated to stay in the county, otherwise the economy would be seriously affected by a loss of sizable job opportunities. At the same time more nondurable industries and the so-called light industries must be stimulated to locate new plants in the county.

4. The industries which constitute the major part of the service activity sector in the county, trade, services, government, and transportation, communication and utilities, dominate the list in terms of employment, export the least of their activities, have low multiplier effects and are affected by changes in final demand for products of other industries more than they affect other industries. This reflects the logic of the economic base thought. These service activities have large man-hour content and are stimulated and supported by the activities in the basic sector. Therefore, economic growth cannot be originated through these activities alone because their size is due mostly to the size of the local economy.

5. Taking into consideration only each industry's effect in generating local transactions (the size of its multiplier), the industry's ability in generating income inflow to the community (the size of its exports), and the average wage rate, (excluding agriculture), any development program for Muskingum County should consider emphasizing the expansion of the following industries in order; food processing, livestock and dairy products in agriculture, other agricultural products, other nondurable and light manufacturing industries, lumber and wood manufacturing, and forestry products, and to a lesser extent stone and clay products and mining.

Implications

The findings of this study shed some light on the mechanism within which the economy of Muskingum County operates. The analysis shows that agriculture and agricultural manufacturing are the most pro-

ductive and effective industries in generating income through stimulating more local interindustry transactions although, these industries are declining in the area which shows an improper trend in the use of the resources available in the county. Therefore, for economic growth to accelerate in the county changes inevitably should take place throughout the community such as:

1. Understanding on both sides, community leaders and the general public. Without their awareness of the need for change and dedication to face its challenges, economic growth is unattainable.

2. Cooperation between all interested parties in the county, public and private, to undertake a comprehensive program for economic development with determined goals within a framework that makes better use of the resources available in the area.

In addition, the public and private sectors must complement the actions of each other to make the county a better place for work, business and living in pursuit for future growth. Improvement in public services, education and training system, land use, etc., would enhance economic activities in the county. Such actions are very important and needed to facilitate the operation of the existing industries and to attract new industries to locate their plants in the area.

Finally, to keep the county's economic base, which stimulate and support the rest of the economy, in continuous health and progress, the existing durable industries must be encouraged at least to stay in the county if not to increase their activities since they provide a major part of employment and a loss of one of these industries would greatly and seriously affect the local economy. Besides, a special

effort must be made to attract industries which are related to agriculture, food and lumber processing, and other nondurable and light industries. This would enhance the local economic activities two-fold: (1) through their high multiplier effect in generating more local transactions, and (2) through supplying inputs to other durable industries substituting for imports for the latter which would result in generating more local transactions and consequently more economic activities.

APPENDIX A

PRODUCTIVITY ANALYSIS FOR AN ALTERNATE AREA

A time series analysis similar to the one which has been conducted on the study area of this research and presented in Chapter II has been applied to an alternate area comprises six counties in the southern part of the Appalachian Region of Ohio. These counties are Adams, Brown, Highland, Ross, Pike, and Scioto. The analysis here is based on the same theoretical framework discussed in Chapter II and thus the model used is the same.* Therefore, only the results of the analysis are presented here with a comparison between this area--referred to as alternate area--and the study area.

The primary features which promote the alternate area for potential growth, in the writer's opinion, are the following:

1. Highway 23 crosses the area from north to south passing through Ross, Pike, and Scioto Counties. Also the proposed Appalachian Highway will cross the area from east to west passing through Pike, Scioto, Adams, and Brown Counties. This means that almost all the chosen counties will be served with a good network of highways which will facilitate transportation and communication in the area.

2. Ohio River is the boundary for all of Scioto, Adams, and Brown Counties which is a real advantage for these counties and the area as a whole.

3. The inconvenience resulting from coal strip mining does not exist in the area as in other sections of the Appalachian Region. This lessens the problems and obstacles for development in the area.

4. The location of the area nearby and to the south of Columbus with which the area is connected by highway 23 and to the east of Cincinnati with which the area is connected by Ohio River and will be through the proposed Appalachian highway mentioned above. This location gives the area the advantage of using the facilities of these two metropolitan areas.

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*For a detailed discussion of the theoretical framework and the model, please refer to Chapter II of this study.

5. The area has a combination of diverse resources, Table 42, which includes agricultural areas in Brown, Highland, Ross, Adams, and to some extent, Pike County, industrial centers especially in Ross and Scioto Counties, and large urban centers in Ross, Scioto and Highland Counties. This combination appears to be of primary importance for growth of the area.

TABLE 42

SELECTED INDICATORS FOR ECONOMIC ACTIVITIES
IN THE ALTERNATE AREA

County		Total Population	Labor Force	Constant $ of 1957-59 Value of Farm Pro. Sold (000$)	Value Added By Manfg. (000$)	Trade Sales & Services Receipts (000$)
Adams	1950	20,499	6,965	6,777	1,189	15,410
	1955	20,800	6,864	6,932	1,500	21,310
	1960	19,982	6,369	6,683	1,748	19,689
	1964	19,543	6,000	6,399	2,182	21,762
Brown	1950	22,221	7,903	9,024	2,061	27,926
	1955	23,072	8,191	8,684	2,875	32,499
	1960	25,178	8,724	8,316	4,002	34,602
	1964	26,494	7,200	9,049	3,681	35,097
Highland	1950	28,188	10,447	12,273	7,283	41,034
	1955	29,402	10,952	12,896	8,643	51,011
	1960	29,716	11,155	11,484	9,397	59,034
	1964	30,197	10,300	11,990	11,980	60,846
Ross	1950	54,424	18,683	8,747	19,553	66,398
	1955	58,445	19,579	10,773	34,185	93,607
	1960	61,215	20,379	10,065	47,487	82,157
	1964	63,980	20,400	8,380	61,932	97,099
Pike	1950	14,607	4,208	2,818	162	8,813
	1955	15,306	4,439	2,744	243	30,546
	1960	19,380	5,526	3,254	309	20,579
	1964	21,126	4,925	2,985	386	21,861
Scioto	1950	82,910	28,863	4,029	47,787	139,251
	1955	84,340	28,676	4,066	49,185	177,993
	1960	84,216	27,496	3,773	58,224	146,968
	1964	83,419	23,800	3,739	66,792	134,814

Table 43 shows that during the period 1950-1964 only Adams County was losing population, Pike County was growing rapidly, while the others were growing slower than the average for the state. Meanwhile, four out of the six counties were losing their labor force. The table also shows that agriculture was declining in four counties while manufacture was increasing rapidly in all the counties especially in Ross and Pike Counties.

TABLE 43

PERCENTAGE CHANGE IN SELECTED INDICATORS IN THE ALTERNATE AREA BETWEEN 1950-1964

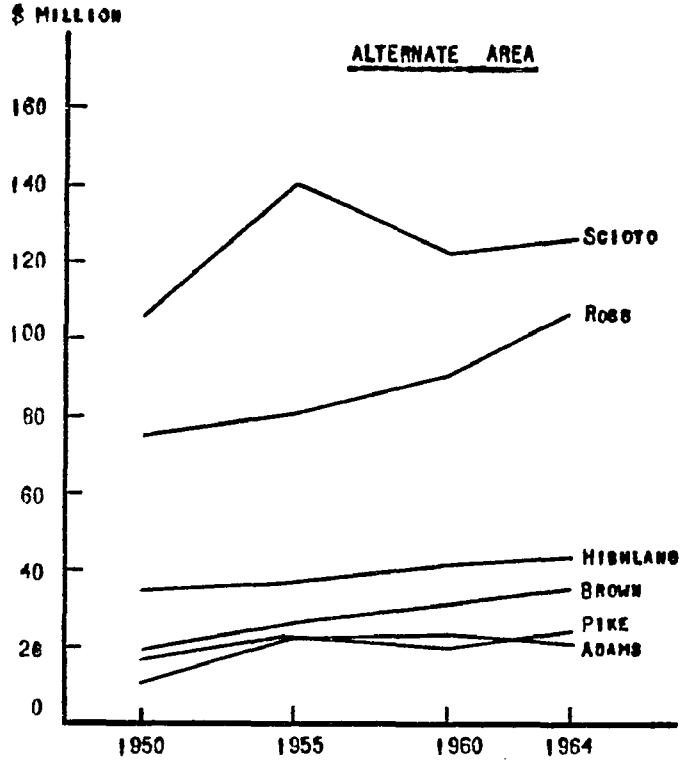
County	Total Population	Labor Force	Agri-culture	Manfg.	Non-Manfg.
Adams	- 4.66	- 13.85	- 5.58	83.52	41.21
Brown	19.22	- 8.89	0.27	78.60	25.67
Highland	7.12	- 1.40	- 2.30	64.49	48.28
Ross	17.55	9.19	- 4.19	216.73	46.23
Pike	44.62	17.03	5.92	138.27	148.05
Scioto	0.61	- 17.54	- 7.19	39.77	- 3.19

The alternate area has been divided into three locations,

(1) Adams, Brown and Highland
(2) Ross and Pike
(3) Scioto

using the same criteria used in the study area, page 22. Figures 8 and 9 show the change pattern in total and per capita income over the period 1950-1964 in each county in both the study area and the alternate area. Figure 10 shows the percentage distribution of employment in the major industries in 1960 in each county in the two areas.

FIGURE 8
TOTAL EFFECTIVE BUYING INCOME
(CONSTANT DOLLAR 1957 - 59)



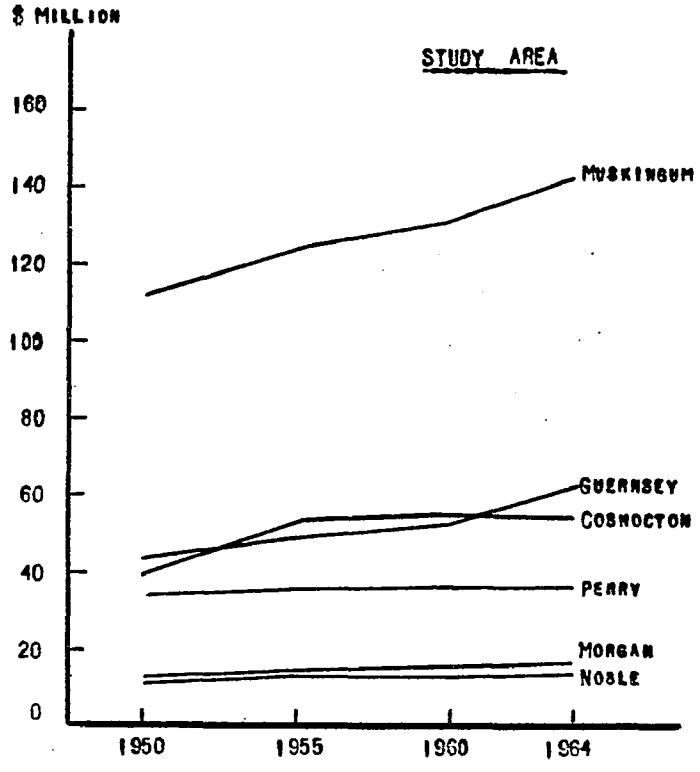
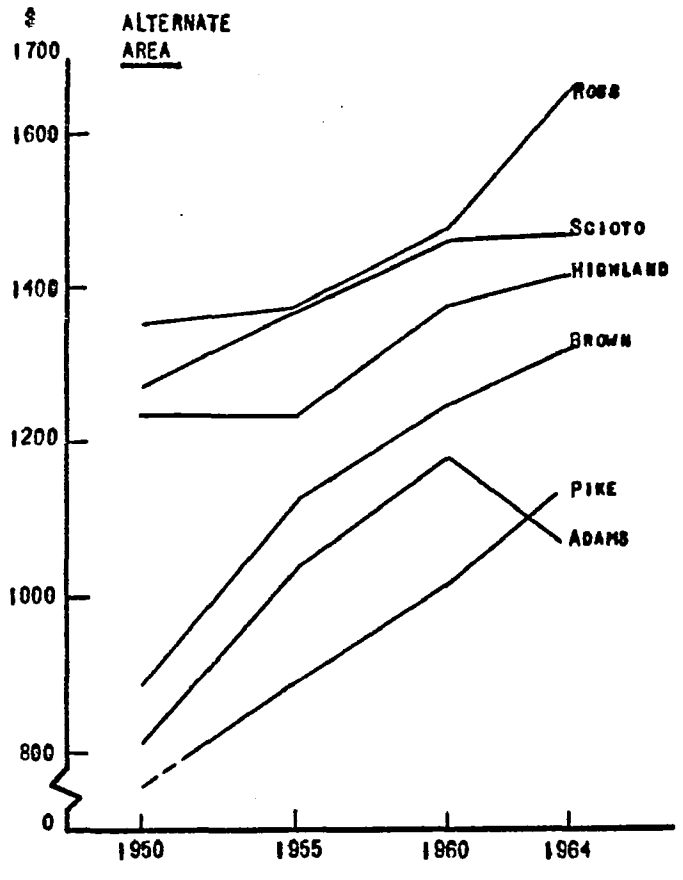


FIGURE 9
PER CAPITA EFFECTIVE BUYING INCOME
(CONSTANT DOLLAR 1957 - 59)



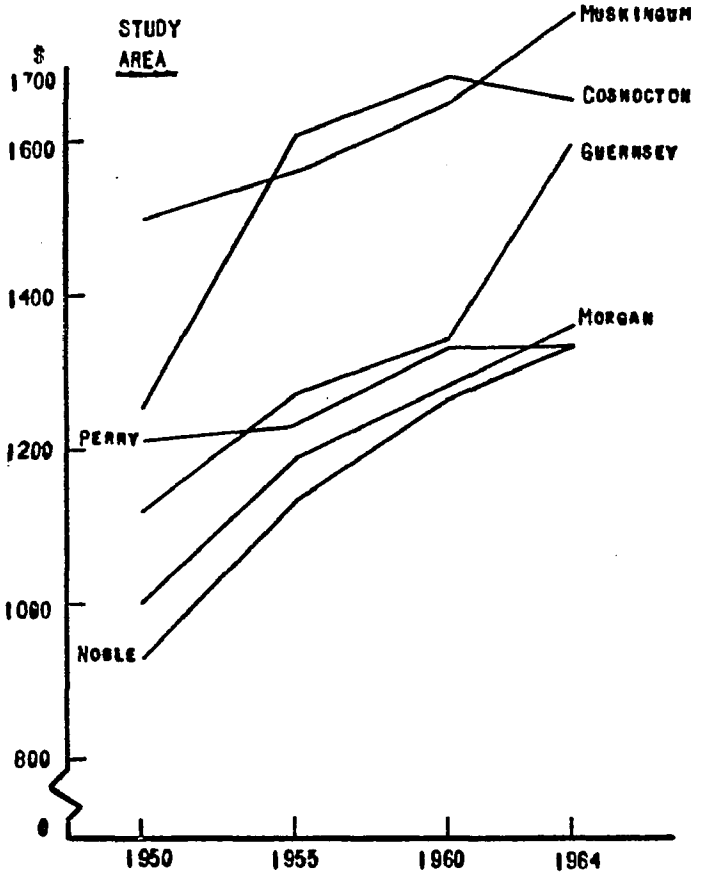
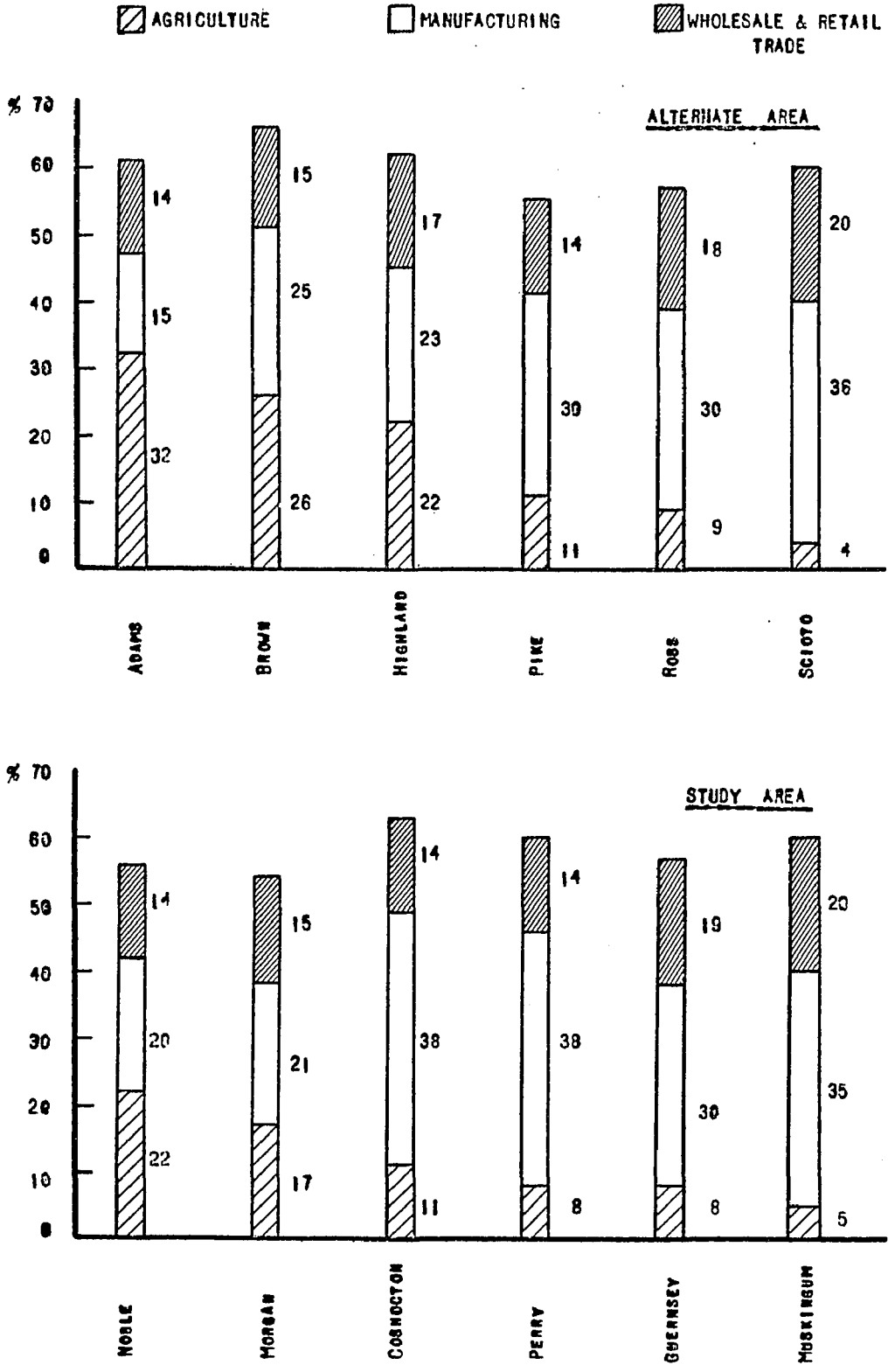


FIGURE 10
PERCENTAGE OF CIVILIAN LABOR FORCE EMPLOYED
IN MAJOR INDUSTRIES IN 1960



Empirical Results in the Alternate Area

The parameters of the functional relationship, which explains income generation in terms of output of the major economic activities in the area, have been estimated by multiple linear regression as:

$$\begin{aligned}\log Y = {} & (-0.5536 + 3.0922\ D_1 + 2.7569\ D_2) + \\ & (\ 0.4062 - 0.3735\ D_1 - 0.5101\ D_2) \log X_1 + \\ & (\ 0.3182 - 0.0797\ D_1 - 0.1214\ D_2) \log X_2 + \\ & (\ 0.4999 - 0.2983\ D_1 - 0.0478\ D_2) \log X_3 + 0.0171\ X_4\end{aligned}$$

Therefore, the linear functional relationship in each location in this alternate area has been determined as:

$$\begin{aligned}\text{location (1) } \log Y = {} & 2.5386 + 0.0327 \log X_1 + 0.2385 \log X_2 + \\ & 0.2016 \log X_3 + 0.0171\ X_4. \\ \text{location (2) } \log Y = {} & 2.2033 - 0.1039 \log X_1 + 0.1968 \log X_2 + \\ & 0.4521 \log X_3 + 0.0171\ X_4. \\ \text{location (3) } \log Y = {} & -6.4027 + 1.2898 \log X_1 + 0.5193 \log X_2 + \\ & 0.8460 \log X_3 + 0.0171\ X_4.\end{aligned}$$

These estimated coefficients have been used to estimate indicators for productivity of the different economic activities in relation to income generation in each county, Table 44. For each county the first row represents agriculture, the second for manufacture and third for nonmanufacture.

Interpretation of the Results

The coefficients of the functional relationship and productivity in the alternate area show some differences from the study area.

1. Manufacture in the alternate area is more productive than it is in the study area. It has positive coefficients in all the counties and has higher values also.

2. Agriculture in the alternate area is less productive than it is in the study area.

This shows that although the two areas are within one region and characterized by the same general features and problems, they have different combinations of resources, which are allocated in different ways. Consequently, the two areas have different systems of economic activities and different productivities for their resources.

TABLE 44

PRODUCTIVITY INDICATORS IN EACH COUNTY
IN THE ALTERNATE AREA

County	Calculated V $	Actual $\bar{Y}$ $	Value of $\bar{X}_i$	b_i	Productivity Indicator
Adams	20,990	21,005	6,698	0.0327	0.04
			1,655	0.2385	3.02
			19,543	0.2016	0.22
Brown	27,380	28,032	8,768	0.0327	0.10
			3,155	0.2385	2.07
			32,531	0.2016	0.17
Highland	39,540	39,182	12,161	0.0327	0.11
			9,326	0.2385	1.01
			52,981	0.2016	0.15
Ross	89,170	88,733	9,491	- 0.1039	- 0.98
			40,289	0.1968	0.44
			84,815	0.4521	0.48
Pike	19,840	19,624	2,950	- 0.1039	- 0.70
			275	0.1968	0.31
			20,450	0.4521	0.44
Scioto	124,900	124,344	3,902	1.2898	3.78
			55,497	0.5193	1.17
			149,757	0.8460	0.71

APPENDIX B

Survey No._____

Firm Identification_____

Date_____ CONFIDENTIAL

Interviewer_____

Ohio Agricultural Research and Development Center
The Ohio State University
Department of Agricultural Economics and Rural Sociology
Columbus, Ohio 43210
July 1, 1967

BUSINESS QUESTIONNAIRE

1. Firm name _____

2. Location _____

3. Type of business:
   a. Manufacturing _____
   b. Contract construction _____
   c. Transportation and utilities _____
   d. Trades: _____
      Wholesale _____
      Retail _____
   e. Finance, insurance, and real estate _____
   f. Services _____
   g. Government _____
      Local _____
      State _____
      Federal _____

4. Headquarters _____

5. Type of ownership:
   a. Proprietorship _____
   b. Partnership _____
   c. Corporation _____
      Single unit _____
      Chain _____

6. What is the number of your firm's employees?
   a. Full time employees _____
   b. Part time employees (please specify) _____

7. What is the percentage distribution of your firm's total sales during the past year between the following:

   a. Federal government agencies _____
   b. Others in Coshocton, Geurnsey, Noble, Morgan and Perry Counties (exclude a) _____
   c. Others in rest of State of Ohio (exclude a and b) _____
   d. Others in rest of U.S. (exclude a, b and c) _____
   e. Foreign countries _____
   f. Directly to consumers in Muskingum County _____
   g. State and local government agencies in Muskingum County _____
   h. Local firms in Muskingum County _____

8. From the amount indicated in 7f what is the percentage distribution between:

   a. Residents in Muskingum County _____
   b. Non-residents in Muskingum County _____

9. From the amount indicated in 7h what is the percentage distribution between:

   a. Agricultural firms _____
   b. Mining firms _____
   c. Construction firms _____
   d. Wholesale and retail firms _____
   e. Finance, insurance and real estate firms _____
   f. Transportation firms _____
   g. Communication and public utilities firms _____
   h. Services firms _____
   i. Manufacture firms _____

10. From the amount indicated in 9i what is the percentage distribution between:

   a. Food and kindred products firms _____
   b. Stone, clay, and glass products firms _____
   c. Machinery, except electrical, firms _____
   d. Electrical machinery firms _____
   e. Primary metal firms _____

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