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The Structure of the Texas Economy: Input-output Analysis - Volume 1

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The Structure of the Texas Economy

by Herbert W. Grubb, Ph. D.

Volume I



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The results, interpretations, and explanations are the responsibility of the author. This report is intended as an analysis of the Texas economy. It is presented to serve as a tool which provides information about the Texas economy and which can be used to assist in evaluation of economic effects of alternative public policies and programs. The report does not set forth policies nor express views or positions held by public officials either at the state or national level.

PREFACE

Professor Wassily Leontief of Harvard University published the first input-output analysis of the U. S. economy in 1936. As opposed to other analytic tools used by economists which emphasize understanding of economic phenomena through economic variables, such as employment, income, the interest rate, the price level, gross product, value added, and investment, Leontief's input-output techniques dealt with the problem of understanding the structure of specialized functioning economies, and the ways in which the individual parts influence each other. The input-output technique permits the analyst to classify and organize transactions data about the economy into mathematical statements which represent the trading among the individual sectors of the economy. The models systematically display each sector's sales and purchases and quantitatively measure outputs and inputs of each sector for the time period chosen. Solution of the system of equations provides quantitative estimates of interindustry relationships.

Since Leontief's first input-output publication in 1936, input-output models of the U. S. economy have been published by the Bureau of Labor Statistics of the U. S. Department of Labor and by the Office of Business Economics of the U. S. Department of Commerce. A number of other national input-output models have been prepared, including models for Japan, The United Kingdom, France, Sweden, The Netherlands, Russia, and Israel. In recent years, input-output models of state economies within the United States have been published. Notable examples are those for West Virginia, Kansas, Washington, Arizona, Nebraska, North Carolina, New Mexico and Mississippi. Other recent studies of regions and parts of states include the Lower Colorado Region, parts of California, Pennsylvania, Oklahoma and Texas.

Governments and industries alike have found the information provided by input-output models to be useful in planning future activities and assessing the economic impacts of selected investments and policies. Industries such as Western Electric, Celanese Corporation, and United States Steel Corporation have used input-output analyses to assist in the planning of procurement of input materials, intraindustry management of diverse but interrelated departments and the estimation of expected direct and indirect consumption of products produced both by direct customers as well as the customers of their respective customers. Notable uses of input-output models by governmental agencies are the evaluations of economic impacts of public facility construction, defense spending, and water project construction.

In 1968, the Population and Economics Task Force of the Planning Agency Council for Texas initiated an extensive interindustry study of the structure of the Texas economy. Funding was obtained through a U. S. Department of Housing and Urban Development 701 Comprehensive Planning Grant with one-third state and two-thirds federal monies. Project administration, leadership, and direction were placed in the Division of Planning Coordination of the Office of the Governor.

The major aim of the program was the estimation of input-output models of regional economies within Texas and of the Texas statewide economy for 1967. The procedures emphasized estimation of input-output models from a sample of primary data. Secondary data were required for the purpose of calculating a part of the input-output model parameters, including the individual sector or industry output totals. The study year 1967 was chosen since 1967 was the most recent year for which complete censuses of manufacturing, business, transportation, and mineral industries were available for Texas.

Nine Texas universities were invited by the Governor to participate in the project. For study purposes, Texas was divided into nine regions and the Governor's Office initiated a series of contracts with each of the nine participating universities (later reduced to eight) for the collection of data from a sample of manufacturing and business establishments of a specific region and the estimation of the regional input-output model. Each contract provided for a project staff and a project director at each participating university. The contractual arrangement further provided for uniform coordination of regional projects to the extent that definitions and standard questionnaires, data processing procedures, and data classification procedures, as determined through the leadership of the statewide project director's office, would be followed in the conduct of each respective regional study.

The state project director's office established the sampling procedure and drew the sample of establishments to be interviewed in each region. The state project director's office also issued general guidelines, special reports prepared by individual consultants, and conducted a part of the secondary and primary data processing. Regional project directors participated in the formulation of research guidelines through periodic project directors' meetings and in "special reports" to the state director's office. The regional project staffs conducted the surveys, prepared the survey data for computer data processing, and transmitted copies of the survey data to the state director's office. The survey data from the nine individual regions were combined and used in the estimation of the state input-output model. In addition, each regional project staff analyzed the data and estimated the input-output model for its particular region.

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The first part of the report is devoted to a general survey of the situation in the country. It is followed by a detailed account of the work done during the year. The report concludes with a summary of the results and a list of the publications issued during the year.

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A STRUCTURAL ANALYSIS OF THE TEXAS ECONOMY

USING INPUT-OUTPUT MODELS

INTRODUCTION

From 1950 to 1970 Texas has had significant population and income growth. Population increased from 7.7 million in 1950 to 11.2 million in 1970 and grew at an average annual rate of 1.5 percent during the 1960's. From 1950 to 1970, total personal income increased from \$10.4 billion to \$39.5 billion. During this period, per capita income increased from \$1,349 to \$3,515. The annual rate of increase in Texas per capita income has followed the U.S. trend fairly closely and Texas per capita income has remained at approximately 90 percent of the national per capita income during the 1950-1970 period. Texas population increased from 5.05 percent of the national total in 1950 to 5.46 percent in 1970, and shifted from 59.8 percent living in urbanized areas in 1950 to 79.6 percent living in urbanized areas in 1970. As the Texas population has increased in size and shifted into urbanized areas, both the private and public sectors of the economy have increased in size and complexity. Resource and service scarcities have been encountered and a wide range of social and economic problems has arisen as the Texas economy and population have grown.

In recent years, Texas state agencies and regional councils of government have begun comprehensive planning efforts for the purpose of dealing with present and future problems of natural resource shortages, employment, unemployment, the economy, and the organization and management of the myriad of services now produced by federal, state, and local governments. Major Texas planning efforts include outdoor recreation, law enforcement and criminal justice, water supply, waste water treatment, air pollution control, solid waste disposal, transportation, communications, electronic data processing, health, industrial expansion, coastal resources management, and education. State government's planning programs are proceeding concurrently with federal government planning and regulatory policy making.

In addition to identifying problems, specifying objectives, considering alternatives, and formulating plans, much of the planning effort requires economic evaluation of the benefits and costs of implementing alternative plans. Some planning requires evaluation of the potential economic impacts of alternative public policies and programs before such policies and programs are implemented.

Objectives

The purpose of this study is to provide a model of the Texas economy. It is anticipated that such a model will be used as a tool to serve planning functions of state agencies and regional councils of government within Texas. The specific

objectives are as follows:

1. Calculate an input-output model of the Texas economy
 - a. Estimate interindustry transactions
 - b. Estimate direct input requirements of each producing industry from other industries of the economy
 - c. Solve the system of equations and estimate interdependence among the sectors of the economy
2. Analyze and interpret interdependence among sectors of the Texas economy

The research procedure uses input-output conventions and definitions established in previous national input-output models. Major reliance is placed upon primary transactions data from a representative sample of Texas establishments. Secondary data from the various censuses conducted by the U.S. government are used to complement survey data collected from specific economic sectors. In addition, statistical data from the files of state agencies and other published research are used.

The analyses and interpretation parts of the study are aimed at the estimation of quantitative measures of economic interdependence, illustration of the potential uses and applications of these interdependency estimates, and illustrations of the methods whereby technical resource input data such as labor, water, minerals and perhaps other resources can be combined with economic structural relationships for the purpose of gaining systematic and more complete estimates of direct and indirect resource requirements to meet the changing demands of Texas consumers for products and services produced by the Texas economy. The objectives of this study are to produce an economic model that can be used as a planning tool. The model yields information that is directly usable by public officials and planners alike. The planning problems and needs for information to be used in planning by the public sector of the Texas economy are discussed below. The type of information required by planners includes a general understanding of the (1) functions of the economy, (2) organization of the economy, (3) elements of public planning, and (4) nature and kind of economic analyses required.

Functions of an Economy

The major functions of an economy include the determination of the kinds and quantities of products and services to be produced, the organization of production, the distribution of production to consumers, and maintenance and growth of the economy. Under a market system of economic organization, individuals and corporations make their respective assessments of consumer wants and desires, arrange for resources, select techniques of production, perform or employ managerial services and participate in the economy by producing goods and services for sale. Individual establishments specialize in the production of those products and services

which appear to offer the "best" opportunity for successfully accomplishing management's objectives.

The production processes are complex and many require a large number of different kinds of production inputs ranging from services of labor, transportation, finance, and utilities to specific quantities of raw materials -- chemicals, steel, fiber, paint, and packaging material. The production of inputs used in manufacturing and business activities is specialized and is a part of the overall economic process. To put it another way, the path from natural resources or raw materials to finished products involves many different and oftentimes specialized processes or stages of manufacturing. Each different stage requires, in addition to raw materials, services such as transportation, trade services which are added on as mark-ups if the materials pass through the trades or "middlemen" sectors, utilities, advertising, legal and other professional services.

The products of each intermediate production stage are sold to manufacturers of the local economy for use in their respective production processes, exported to manufacturers in other economies, or both. Finished goods are sold to the consumer group of the economic sectors which includes local households, government, exports, and capital formation.

The procurement of production inputs, like the sale of products, may involve trading with establishments located in other regions. Individual manufacturing and business establishments may find it necessary or advantageous to import part or all of the materials and services used in the production process although it is not likely that 100 percent of both materials and services will be imported. The willingness and physical ability to import inputs permits a wider range of economic activities in many regions than would be the case otherwise, since all the necessary inputs are not available for certain kinds of production in many regions. For example, iron ore is not found in Houston, Texas. Thus, the metals industries can not manufacture steel in Houston without importing iron ore. Likewise, according to present information about crude oil reserves, petroleum refining cannot be done in Austin or Dallas unless crude oil is imported.

The ultimate purpose of economic activity is to produce goods and services that are saleable to consumers. The consumers, or households, represent the human resources of an economy and participate in the economy by supplying the management and labor skills required in production. For these services, households receive salary, wage, property, and dividend payments. Households use these incomes to purchase goods and services produced. The willingness of consumers to purchase and the prices at which purchases are made are the market indicators on which production decisions are based. Markets operate to express and transfer information from consumers to producers who then assess the potential profitability of alternative products, select a product mix, engage resources, and proceed with production. The overall success of manufacturing and business enterprise depends highly upon

management's ability to select the proper marketable mix of products to produce, since production is costly and, in most cases, production is done without sales agreements beforehand. Use of costly resources in the production of unmarketable products or products which can only be sold after costly storage and at reduced prices would be expected to result in economic losses to the producers. If society values such products in the marketplace below the cost of production, then producers experience economic losses and proceed to shift some resources to other uses or perhaps cease resource use altogether. The production of unusable goods results in social losses to an economy since the resources could have been used to produce goods desired by consumers.

Society indicates its preference for products by purchasing those offered for sale and by offering higher prices as the quantity available dwindles. Higher prices to producers results in larger returns to resources, attracts new producers and stimulates existing producers to expand production of products thus affected. In this way the demands of the society of consumers are translated into demands for resources. Producers register the resource demands to resource owners through the prices they are willing to pay for the resources, given production technology and prices and quantities of available complementary and substitutive resources. Resource owners make sales and thereby allocate available supplies to the various purchasers in accordance with profit motives, return on investment, or other objectives they hold. Resource owners who employ their resources in production themselves will be stimulated to make similar adjustments for the purpose of re-allocating resources from lower to higher paying uses. Thus, the resources of society are allocated or rationed among many competing uses, through the trading of consumers and producers in economic sectors and geographic regions.

The public sectors produce what has been termed "social goods." The list of social goods includes public education, transportation facilities, water supply facilities, waste collection and disposal, law enforcement, police protection, correction, national defense, public health, regulation of private industries, research, food and drug inspection and testing as a part of the administration of pure food and drug legislation, institutional care of patients of certain illnesses, various other public welfare functions, and governmental administration and legislation. The production of social goods requires resources including management, labor and capital. Government enterprises are financed in a variety of ways including revenues from the sale of products and services, and taxes and fees collected from the private sectors and individual taxpayers.

The products and services produced by government are distributed to the society of consumers in a variety of ways, including specific charges for shares of products or resources received from specific projects. In the case of public facilities and public education, distribution is free to individuals subject to the condition that the individual is qualified to participate in or use the facilities

when and as such facilities are available. The price mechanism is not used to ration and distribute these types of public goods. In the case of public goods, distribution is usually made to the extent of the supply available on a first come-first served basis to those deemed to be qualified and in need of such services.

The rationale for producing public goods usually is based on either or both the principles that the nature of the activity does not lend itself well to private enterprise or is not "profitable" because products or services are too widespread and indefinite to be easily organized and traded in the marketplace, or that the action is desirable or necessary for the general or overall good and, in that respect, the most efficient or at least costly manner of production is by government.

Regional Economies -- An Overview

The system described above is the market system of economic organization and operation and is governed by the familiar laws of supply and demand subject to certain institutional and legal constraints. Given the market considerations, the location of resources, market outlets, transportation facilities for production inputs and products, labor supply, availability of services, community and environmental amenities, preferences of management, and perhaps other factors such as stability of general prices and wages, knowledge, competition, and information exchange, production capital has been located. A collection of individual establishments operating in a more or less homogeneous environment and under the same laws, rules, and regulations, such as the collection of establishments located in Texas is recognized as an economy.

In many respects, the Texas economy is a regional economy within the larger United States national economy. Among the distinguishing characteristics of the Texas economy are unique institutional arrangements, such as state laws which govern business activity, tax rates, terms of trade between buyer and seller, contractual arrangements, labor employment terms, and natural resources which influence the types of productive enterprise that can be done. Among the latter factors are climate, land resource quantity and quality, mineral deposits, sea and forest resources, and attitudes, culture, education level, and goals of the people, whether implicit or explicit.

The Texas economy has unique characteristics which distinguish it both in a market and a non-market way from other state economies. Furthermore, there are significant diversities within the state. To deal with many of the present economic and social problems, it is necessary to view and analyze individual areas and regions of the state separately. For this purpose, the Texas economy has been divided into regions having homogeneous resources, regions having concentra-

tions of economic activity and regions that are isolated from other regions (Figure 1).^{1/} For example, the Texas High Plains is a region which has homogeneous land resources that distinguish it from other parts of the state and which have, by virtue of location and quality, influenced the type of economic activity within the High Plains boundaries. There are other examples of homogeneous economic regions within Texas such as South Texas, Central Texas, and East Texas.

The Dallas-Fort Worth area is an example of a regional economy that is largely composed of manufacturing, finance, and other services. The area can be viewed as a regional economy that produces both finished and partially finished goods for export to other regions, sales to local area processors, and sales of finished goods and services to local area consumers. In addition, the regional producers and consumers purchase or import goods and services produced in other regions. To the extent that the collection of managements successfully analyzes and evaluates production costs in the different regions, transportation costs between regions and institutional factors which affect costs and returns, and to the extent that individual business establishments accordingly specialize and trade among themselves, regional economies specialize in production of the products for which the respective regions have a comparative advantage. Through the process of specialization and trade, the economic welfare of participants is enhanced.

The El Paso area can be viewed as an economy which has some of the same features as the Dallas-Fort Worth economy such as specialization in business, services, and manufacturing with agriculture in the neighboring rural areas. One major feature of the El Paso economy which distinguishes it as a regional economy within Texas is its relatively isolated location from other major centers of economic activity within the state. In addition, the El Paso economy has unique cultural and social features which may influence the nature of economic activity such as its proximity to the major Mexican city of Juarez. For these and other reasons, including natural resource supply problems, it is useful for many public and private planning purposes to view the El Paso area and its environs as a regional economy within Texas. In this regard, specific regional analyses are required if a more complete understanding of an individual region's social and economic problems and potential solutions of such problems is to be achieved.

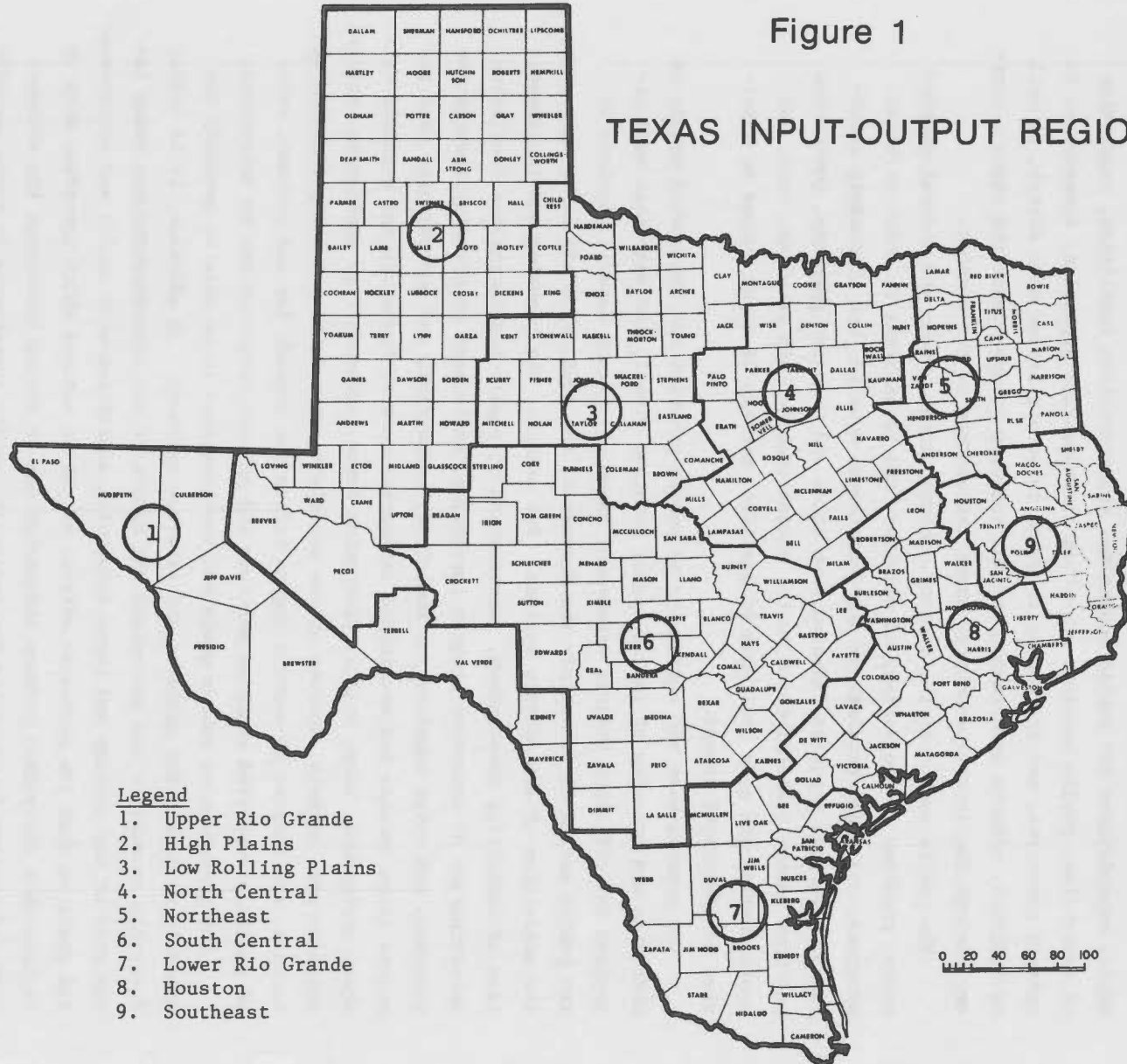
Planning -- The Public Sector Viewpoint

Government represents a major part of demand for goods and services produced

^{1/} The map of Figure 1 shows nine regions of Texas. Analogous studies were done for each region as a part of the Texas Input-Output Project described in the preface of this report.

Figure 1

TEXAS INPUT-OUTPUT REGIONS



Legend

- 1. Upper Rio Grande
- 2. High Plains
- 3. Low Rolling Plains
- 4. North Central
- 5. Northeast
- 6. South Central
- 7. Lower Rio Grande
- 8. Houston
- 9. Southeast

0 20 40 60 80 100
MILES

by the Texas economy and, at the same time, employs a significant amount of labor and professional talent.^{2/} The production of "social goods and services" and government demand for goods and services produced by the private sectors interfaces with and impacts upon the various private sectors of the economy. For example, expenditures for public education, transportation facilities, regulation of industries, public housing, promotion of industrial expansion, investments in natural resources, and the manner in which taxes are levied have direct, as well as indirect, effects upon industries and industry groups within the state's economy through the interdependencies among the sectors of the economy.

The public sector of the economy, through local, state and federal governments, produces a wide variety of services, and is an arena in which policies, programs, rules and regulations are formulated, debated, and ultimately established. Through programs financed from taxes and transfer payments, government performs income redistribution to the extent that certain services, cash, and goods-in-kind are made available to qualified members of lower income or otherwise disadvantaged groups.

The present size and complexity of public programs and the upward trends in both size and quantity of public sector programs clearly indicate that well organized and efficient program management based on current data is required if the public sector is to satisfy the demands of the population and is to mesh with the activities of the private sectors. For example, the planning and implementation of industrial development, construction of public transportation facilities, determination of education program curriculum, employment opportunity information programs, and water supplies for municipal, industrial, and agricultural uses requires large amounts and meaningful interpretations of technical and economic data about employment, labor skills, production costs, revenues from production, natural resource use, markets, sources of raw materials, sources of partially finished materials, and sources of service inputs before the demands for and economic value of publicly supported supplied services and natural resources can be determined.

The producers of public goods and services need to be able to quantify the schedule of demand for products and services produced. In addition, it is highly desirable to measure and understand the nature of the interdependencies among industries of the economy and those industrial activities with social and environmental goals so that the pervasive effects of public actions which interface with or impinge upon individual private industries can be traced throughout the economy. Such information is necessary for evaluating public investments to serve specific regions and sectors of the economy.

^{2/} In 1967, government spending in Texas was \$14 billion; personal income for the same year was slightly over \$29 billion. 1967 Census of Governments, Vol. 4, No. 5, U. S. Department of Commerce, Bureau of the Census, September 1969.

The public sector planning process involves a series of actions aimed ultimately at alleviation of pressing difficulties of society. The planning process includes (1) problem identification and statement, (2) listing of objectives to be accomplished, (3) specification of alternatives to be considered and evaluated, (4) selection of analytic techniques and specification of planning methods and procedures to be used, (5) specification of data sources and data items required, (6) data collection, (7) data processing, (8) data analysis, (9) interpretation of results, (10) statement of conclusions, including alternative plans for consideration, (11) analysis of alternatives in terms of potential for achieving objectives, (12) implementation of selected plans, and (13) evaluation of plans implemented. If implemented plans fail to achieve the desired results, then modification should be made in light of the previous planning and implementation experience and new data. Likely the entire planning process will have to be repeated until felt difficulties have been alleviated to the desired extent, or until other felt difficulties become more important and require a reallocation of public resources.

Selecting a Model

One of the purposes of the present study is to provide data and interpretations of significant relationships about the Texas economy. The study is intended to be a tool whereby public officials and especially public sector planners and administrators can obtain quantitative approximations of the economic effects of public sector investments and operating programs.

A study of this nature could be made at three different levels: (1) intra-establishment, (2) inter-establishment, and (3) interindustry. Analysis on the first level deals with the individual business firm and is the kind of analysis familiar to most individuals. This type of emphasis is often used to guide investments by the private sector, measure profitability of individual business establishments, supply operating data to management and, in summary form, communicate the establishments' financial conditions to the public. Although this type of analysis is of interest to public planners, it is not the type best suited to serve public planning efforts. More aggregated and comprehensive economic analyses are needed.

The latter two levels of analyses mentioned above deal with larger units of the economy than the intra-establishment level. Inter-establishment analysis pertains to groups of establishments within an industry or sector of the economy. This level of information is useful to some public planning functions. It fails, however, to provide comparable information about the entire economy.

Interindustry analyses provide a wider range and different type of information about an economy than the previously mentioned levels of analyses. A better guide for adjusting resource use to improve efficiency and for making policy rec-

ommendations concerning public investments in natural resources and services -- generating programs of an area is a comprehensive economic model that will give systematic expression of production input requirements at the industry level. Such a model should show how production-consumption relations influence resource allocation in the economy represented and should explicitly relate the population's consumption to the producing sectors so that the effects of population growth or decline can be estimated in quantitative terms and better estimates of resources required to serve the population can be made.

An appropriate model for such a study is the input-output technique introduced by W. W. Leontief of Harvard University in 1931.^{3/} The input-output technique consists of four parts: (1) specification of equations of the model, (2) collection of data which represents the economic system, (3) estimation of coefficients using appropriate statistical techniques, and (4) solutions, in quantitative terms, of the specified equations.

^{3/} Leontief, W. W., "Quantitative Input-Output Relations in the Economic System of the United States," *The Review of Economics and Statistics*, XVIII August 1936, 105-125.

FRAMEWORK OF THE TEXAS INPUT-OUTPUT MODEL

Input-Output Model -- Sectors and Transactions Table

The foundation of an input-output model is a transactions table that shows the dollar value of the goods and services traded (bought and sold) by each sector of the economy. An economic sector is the collection of establishments which produces the same kind of products or quite similar products. The Standard Industrial Classification system (SIC codes),^{4/} in use at the national level, is used to classify establishments. Establishments with multiproduct lines of production are classified according to the major product and the establishment's entire activities are included in the sector into which the major product is placed. For example, an establishment which produces a major product, A, and minor products B and C is classified according to the major product A, and products B and C are included along with the major product among the statistical data of the establishment.

In this study, the one major exception to the sectoring concept stated above has been for the agricultural sectors. These sectors are defined along activity or enterprise lines of economic endeavor as opposed to establishment lines. For example, an individual farm establishment will likely produce more than one crop or have more than one livestock enterprise. Because agricultural data are available crop by crop and livestock enterprise by livestock enterprise, the farming sectors are defined to be individual crop and livestock production activities such as rice, range livestock, feedlot livestock, cotton, vegetables, hay, and so forth.

The input-output table is organized into a rectangular array of rows and columns (Table 1). Each row and its corresponding column represent the transactions of an individual sector. The sales of the sectors are shown along the rows and the purchases of the sectors are shown in the columns. The sum of a row is the total output of the sector represented by that row. The sum of a column is the total inputs of the sector represented.

The sales or outputs of a typical sector may include sales of raw materials to other sectors of the local economy, sales of intermediate goods to other local producing sectors, sales of finished goods to final consumers of the local economy, sales to government, sales to capital formation, and export sales of raw materials, intermediate goods and finished goods to users and consumers outside the local economy. For sectors that produce services instead of goods, the dollar value of sales or services to producing and consuming sectors are tabulated exactly as are the value of sales of goods.

^{4/} Standard Industrial Classification Manual - 1967, Executive Office of the President, Bureau of the Budget, Washington, D.C.

Table 1. Generalized Transactions Table of an Input-Output Model Having n Producing Sectors

Producing Sectors	Purchasing Sectors (Intermediate Flows)						Final Demand	Total Output	
	1	2	...	j	...	n			
1	x_{11}	x_{12}	...	x_{1j}	...	x_{1n}	Y_1	X_1	
2	x_{21}	x_{22}	...	x_{2j}	...	x_{2n}	Y_2	X_2	
.	
.	
.	
i	x_{i1}	x_{i2}	...	x_{ij}	...	x_{in}	Y_i	X_i	
.	
.	
.	
n	x_{n1}	x_{n2}	...	x_{nj}	...	x_{nn}	Y_n	X_n	
P	House-								
F	holds(h)	x_{h1}	x_{h2}	...	x_{hj}	...	x_{hn}	Y_h	X_h
A	Local								
I	Govt. (l)	x_{l1}	x_{l2}	...	x_{lj}	...	x_{ln}	Y_l	X_l
Y	State								
N	Govt. (s)	x_{s1}	x_{s2}	...	x_{sj}	...	x_{sn}	Y_s	X_s
M	Federal								
A	Govt. (f)	x_{f1}	x_{f2}	...	x_{fj}	...	x_{fn}	Y_f	X_f
E	Gross								
L	Sav. (g)	x_{g1}	x_{g2}	...	x_{gj}	...	x_{gn}	Y_g	X_g
N	Depr. (d)	x_{d1}	x_{d2}	...	x_{dj}	...	x_{dn}	.	.
T	Imports (I)	x_{I1}	x_{I2}	...	x_{Ij}	...	x_{In}	Y_I	X_I
S									
Total Input		$\overline{x_1}$	$\overline{x_2}$...	$\overline{x_j}$...	$\overline{x_n}$	\overline{Y}	\overline{X}

The purchases or inputs of a typical sector may include purchases of goods and services from sister sectors of the local economy. Purchase of materials and services from suppliers located outside the economy are considered as imports and are included in the input-output model in the imports sector. The payment of wages and salaries is considered an input from the household sector. Wages and salaries paid to households represent the purchases of labor and management services and result in the incomes used by the population of consumers to purchase finished goods and services produced by the economy.

The payment of taxes to governments is included among the inputs and is tabulated in each respective government row of the table. Such payments are considered to represent the purchase of "public or social goods and services" such as the purchase of the use of public transportation facilities, law and order, regulation of business and commerce, and other governmental activities.

Other rows are set aside in the transactions table to display savings, retained earnings, depreciation, and income set aside to pay a return to capital invested in each respective sector. Thus, all current income of each sector is exhausted and inputs are thereby equated to outputs.

Mathematical Formulation of the Input-Output Model

The variables listed in Table 1 in the general case are as follows. There are n producing sectors of the economy, denoted by X_i , a set of final demand sectors collectively denoted by Y_i , and a set of final payments sectors denoted by $X_h, X_l, X_s, X_f, X_g,$ and X_I . When data are placed in Table 1, the result is a system of expressions which states the dollar value of the transactions among the sectors of the economy as follows:

$$\begin{aligned}
 X_1 &= x_{11} + x_{12} + \dots + x_{1j} + \dots + x_{1n} + Y_1 \\
 X_2 &= x_{21} + x_{22} + \dots + x_{2j} + \dots + x_{2n} + Y_2 \\
 &\cdot \quad \cdot \quad \cdot \quad \quad \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \quad \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \quad \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\
 X_i &= x_{i1} + x_{i2} + \dots + x_{ij} + \dots + x_{in} + Y_i \\
 &\cdot \quad \cdot \quad \cdot \quad \quad \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \quad \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \quad \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\
 X_n &= x_{n1} + x_{n2} + \dots + x_{nj} + \dots + x_{nn} + Y_n
 \end{aligned}
 \tag{1}$$

X_1 is total output of sector one, X_2 is total output of sector two, X_i is total output of sector i , X_n is total output of sector n , x_{11} is the sales of sector one's output to sector one, x_{12} is the sales of sector one's output to sector two, x_{ij} is sales of intermediate goods or services by sector i to producing sector j , and Y_i is sales of sector i to final demand. The sum of sales by sector i to other sectors and final demand, including inventory adjustments and exports, equals total output of sector i .

A sale of output by sector i to sector j is a purchase of input by sector j from sector i . The outputs of sectors i and j are tabulated in rows i and j of the transactions table while at the same time the inputs of each are tabulated in columns i and j respectively.

The information of the transactions table is used to estimate the contributions of each individual sector to the economy. Gross outputs, gross inputs, the distribution of outputs to customer sectors, and the sector of origin of inputs are identified by the entries in the table. The transactions data are also used as the basis for analyses of the interdependency among economic sectors.

In the input-output model, sector j 's total value of output is equated to total cost of production, when production expenses, wages and salaries, taxes, depreciation and undistributed income (sometimes referred to as profits) are all considered as inputs. For analytic purposes it is useful to calculate the input coefficients or input requirements per dollar of output for each sector. The input requirements per dollar of gross output sector-by-sector show the purchases by a typical sector, sector j , from each producing sector i per dollar of output of sector j . For example, sector j purchases the quantity a_{ij} from sector i per dollar of output of sector j (Table 2). Each a_{ij} is an input or expense coefficient which expresses the inputs of sector j which are purchased from sector i per dollar of product or service produced by sector j . From the input coefficients the analyst or planner can gain a quantitative measure of the relative importance of each local economy sector to other sectors of the local economy and can ascertain, in the same way, the proportion of total inputs that are imported by each sector of the economy, the proportion of the total value of product that is paid to each of the local, state and federal governments in taxes and the proportion spent for labor and management. For example, by reading the columns of the input coefficients table, the analyst can see directly the percentage distribution of each sector's inputs from other sectors. The input coefficients show the direct requirements by sector j from sector i in order to produce additional output or conversely show the amount of sector i 's output that would be released or unused by sector j per unit of j 's output if sector j were to reduce or scale down production. The anticipated amount of production change by sector j , either as an increase or decrease, multiplied by the respective input coefficients provides the estimates of total direct effect of a change in sector j 's production upon the

Table 2. Inputs Required by Purchasing Sectors from Producing Sectors per Dollar Value Output of Purchasing Sectors

Producing Sectors	Purchasing Sectors (Intermediate Flows)					
	1	2	...	j	...	n
1	a_{11}	a_{12}	...	a_{1j}	...	a_{1n}
2	a_{21}	a_{22}	...	a_{2j}	...	a_{2n}
.
.
.
i	a_{i1}	a_{i2}	...	a_{ij}	...	a_{in}
.
.
.
n	a_{n1}	a_{n2}	...	a_{nj}	...	a_{nn}
Final Payments	a_{F1}	a_{F2}	...	a_{Fj}	...	a_{Fn}
Total	1.0	1.0	...	1.0	...	1.0

sectors from which sector j purchases inputs. Each sector of the economy, including those operated by government, are thus analyzed.

The direct inputs analyses are of interest and use to public and private sector planners, managers, and administrators alike. The direct inputs table shows at a glance the percentage distribution of each sector's total inputs from among the local economy's sectors, the percentage from imports, the percentage paid to government in the form of taxes, and the percentage paid for wages and salaries. Such information is useful for calculating, at the individual sector level, cost components as a function of output or production, and it shows the relative importance of local sectors as suppliers of inputs to other local sectors and provides parameters for the set of simultaneous equations which represents the economy. A solution of these equations provides useful measures of interdependence among the sectors of the economy. The inputs coefficients are used to

calculate not only the direct effect of sector j's output or production upon sales by sector i, but these same coefficients are used to calculate the total effects upon the local economy by sector j's purchases from sector i. The ultimate objective of such an analysis is to calculate quantitative estimates of the total effect and the intersectoral effects of sector j's production through purchases from sector i, sector i's customers and sector i's customers' customers many times removed. Once these estimates have been made, planners, managers, and administrators can better understand and evaluate, in quantitative terms, the extended or economy-wide effects of changes in policies, programs, markets, and resource supplies which directly affect only one or a few specific industries and economic sectors. For example, changes in defense spending affect the defense producing industries directly and can perhaps be seen readily without input-output analyses, but the extended effects of the defense industry upon other industries and ultimately upon industries who do not deal directly with defense industries but who deal with sectors that do deal with defense sectors cannot be clearly seen until more thorough in-depth analyses have been made. The solution of the input-output equations readily provides such estimates and analyses for each sector of the economy.

A restatement of the transactions equation illustrated in (1) results in a form of the model which permits utilizing the transactions data of Table 1 for the purpose of writing a system of equations that represent the transactions of the economy. Each term, x_{ij} , is replaced by its equivalent value as follows:

$$x_{ij} = a_{ij} X_j \quad (2)$$

where x_{ij} is total purchases by sector j from sector i, a_{ij} is purchases by sector j from sector i per dollar of output of sector j, and X_j is total outputs of sector j. Statement (2) above expresses trading between sectors i and j in terms of rate (a_{ij}) per dollar of total output (input) of sector j and sector j's total output (input).

When the form of equation (2) is substituted into the system shown in expression number (1), the equivalent transactions of each economic sector appear as follows:

$$\begin{aligned}
 X_1 &= a_{11} X_1 + a_{12} X_2 + \dots + a_{1j} X_j + \dots + a_{1n} X_n + Y_1 \\
 X_2 &= a_{21} X_1 + a_{22} X_2 + \dots + a_{2j} X_j + \dots + a_{2n} X_n + Y_2 \\
 &\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
 X_i &= a_{i1} X_1 + a_{i2} X_2 + \dots + a_{ij} X_j + \dots + a_{in} X_n + Y_i \quad (3) \\
 &\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
 &\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
 X_n &= a_{n1} X_1 + a_{n2} X_2 + \dots + a_{nj} X_j + \dots + a_{nn} X_n + Y_n
 \end{aligned}$$

X_1 is total output of sector one, a_{11} is the dollar amount of output of X_1 required by sector one in order for sector one to produce one dollar of output (intrasector usage of output), a_{ij} is the quantity of output of sector i required by sector j per dollar of output of sector j , and X_j is total output of sector j . The properties and theory underlying the system of equations which describe and measure the interindustry relationships of an economy, as stated in general above, have been presented by Leontief and others.^{5/}

When the set of equations expressed in (3) above is solved for outputs (X_i 's) as a function of total sales to final demand (Y_i 's), the result is a set of interindustry coefficients and multipliers which show the "direct plus indirect requirements" of the economy for an individual industry to be able to produce one dollar of product for final demand.^{6/} The solution is expressed this way so that the outputs of individual industries can be related both directly and indirectly to finished goods and services usable by the economy's consumers. From the solution, various kinds of multipliers can be calculated, including final demand and output multipliers. In addition, the analyses can be extended to permit the estimation of the "induced" effects of new income to households upon the individual sectors of the economy. These and other specific analyses are done for the Texas economy in later sections of this report.

^{5/} Leontief, Wassily. The Structure of the American Economy, 1914-1939, New York: Oxford University Press, 1951.
 Chenery, H. B., and Clark P. G. Interindustry Economics, New York: John Wiley and Sons, Inc., 1959, reprint 1967.
 Miernyk, William H. The Elements of Input-Output Analysis, New York: Random House, 1965.

^{6/} The solution is obtained through matrix inversion of $I-A$ where I is the identity matrix and A is the $n \times n$ matrix of "Direct Requirements" coefficients shown in Table 2. A discussion of matrix inversion techniques can be found in W. H. Miernyk, op.cit., 141.

The solution to the set of input-output equations listed in (3) above results in estimates of the "direct plus indirect requirements per dollar of delivery to final demand" or the matrix of interindustry coefficients (Table 3). This matrix shows the aggregated effects of transactions among sectors of the economy and the output multipliers (k_j) for each sector. An individual sector multiplier shows the

Table 3. Direct Plus Indirect Requirements per Dollar of Delivery to Final Demand

Producing Sectors	Purchasing Sectors					
	1	2	...	j	...	n
1	b_{11}	b_{12}	...	b_{1j}	...	b_{1n}
2	b_{21}	b_{22}	...	b_{2j}	...	b_{2n}
.
.
.
i	b_{i1}	b_{i2}	...	b_{ij}	...	b_{in}
.
.
.
n	b_{n1}	b_{n2}	...	b_{nj}	...	b_{nn}
Final Demand Multipliers	k_1	k_2	...	k_j	...	k_n

total value of transactions resulting from a one dollar delivery of final product by that sector to final demand. For example, if sector 10 is "castings and forgings," then k_{10} is the total value of transactions or impacts generated within the economy as sector 10 sells one dollar's worth of its output to final demand. The multipliers are the sums of the b_{ij} 's of each sector. Thus, the individual elements of each column of Table 3 show the individual sector participation in the multiplier. In other words, b_{ij} shows the total of direct and indirect changes in the sales of sector i per dollar sector j sells to final demand. The

solution shows total effects and, in addition, shows the distribution among other sectors of transaction activities of each processing sector of the economy. Herein, the input-output model yields data useful in production and procurement planning of individual business establishments, including the public sectors and those establishments directly and indirectly linked to the public sectors.

The data of Table 3 provide information useful in the analyses of economic impacts of changes in the quantity of final demand placed upon the economy through population and market forces, resources available to the economy, and certain public policies and programs of investment and spending.

The empirical estimates of the solution of the set of input-output equations are expressed in a form which permits the planner to use the results as a basis for projecting future output requirements of each industry. In order to make projections of future output requirements on an industry-by-industry basis, it is necessary, however, to project quantitative estimates of final demand. Since final demand depends upon the size and incomes of the populations of local and export consumers, these types of projections require population, income, and consumption projections. These latter projections are beyond the scope of the present study but the input-output modeling effort of the present has been done in a manner such that projections of final demands in future projects can be linked with input-output models for the purpose of obtaining estimates of the future production requirements of both public and private sectors to meet the "final demands" of future populations. Such analyses and projections can also be extended, through technical resource input coefficients per unit output, to yield estimates of physical quantities of natural resources and labor required to meet future production requirements to satisfy consumer demands for goods and services.

A GENERAL OVERVIEW OF THE TEXAS ECONOMY

This chapter presents population, income, and employment data which serve as background and present an overview of the Texas economy. Factors such as age, sex, income and the geographic location of the population influence the preferences for a particular good or service. Total demand for that good or service will then influence industry decisions including production location and quantity produced. This, in turn, influences production locations and production levels of supporting industries. The input-output model calculated and analyzed in later sections will deal directly with interdependencies among the sectors of the Texas economy.

Population Characteristics of Texas

The population of Texas has increased from 9,579,677 in 1960 to 11,196,730 in 1970,^{7/} reflecting an annual growth rate of approximately 1.5 percent. The 1970 Texas population was 5.51 percent of the total United States population, compared to 5.34 percent in 1960.

The proportion of Texans living in urban areas increased from 41 percent in 1930 to 79.7 percent in 1970 (Table 4). In 1970, over 73 percent of the population resided in Standard Metropolitan Statistical Areas (SMSA's) as compared to 69 percent in 1960 and 55.8 percent in 1950 (Table 5). The combined population of the four largest SMSA's is 46.1 percent of the total state population (Figure 2).

Females have increased from 49.8 percent of the population in 1950 to 51.1 percent in 1970 (Table 6). In the age groups of 18 through 24 years and 65 years and over, females outnumber males (Table 6).

During the period 1950-1970, the age groups, 5 through 17 years, and the group, 65 years and over, have consistently increased as a proportion of the total population whereas the 25-44 years group has consistently decreased (Figure 3).

The median years of school completed by Texans 25 years of age or over has increased from 8.5 years in 1940, to 9.3 years in 1950, and to 10.4 years in 1960.^{8/} A continued increase in educational attainment is indicated since a median educational year of 11.7 had been attained by those Texans between the ages of 14 to 24 years who were no longer enrolled in school.^{9/}

^{7/} U. S. Bureau of the Census, 1970 Census of Population. Advance Report, General Population Characteristics: PC(V2)-45, Texas. U. S. Government Printing Office, Washington, D.C. (February 1971).

^{8/} U. S. Bureau of the Census, U. S. Census of Population: 1960, Volume 1, Characteristics of the Population. Part 45, Texas, U. S. Government Printing Office, Washington, D.C. (1963).

^{9/} Ibid., Table 102.

Table 4. Texas Population by Place of Residence - 1930-1970^{a/}

Year	Total	Rural		Urbanized Area	
		Number	Percent	Number	Percent
1930	5,824,715	3,435,367	58.979	2,389,348	41.021
1940	6,414,824	3,503,435	54.615	2,911,389	45.385
1950	7,711,194	3,098,528	40.182	4,612,666	59.818
1960	9,579,677	2,393,666	24.987	7,186,011	75.013
1970	11,196,730	2,275,784	20.325	8,920,946	79.675

^{a/} U. S. Bureau of the Census, 1940, 1950, 1960 and 1970, U. S. Censuses of Population, Part 45, Texas, U. S. Government Printing Office, Washington, D.C.

Table 5. Total Population of Texas SMSA for Selected Years 1950, 1960, and 1970

SMSA	Total Population			Percent Change 1950 to 1970
	1950 ^{a/}	1960 ^{c/}	1970 ^{e/}	
Abilene	85,517	120,377	113,959	+ 33.3
Amarillo	87,140	149,493	144,396	+ 31.3
Austin	160,980	212,136	295,516	+ 83.6
Beaumont-Port Arthur-Orange	235,650	306,016	315,943	+ 34.1
Brownsville-Harlingen-San Benito	125,170	151,098	140,368	+ 12.1
Bryan-College Station	b/	b/	57,978	-
Corpus Christi	165,471	266,594	284,832	+ 72.1
Dallas	743,501	1,119,410	1,555,950	+109.3
El Paso	194,968	314,070	359,291	+ 84.3
Fort Worth	392,643	573,215	762,086	+ 94.1
Galveston-Texas City	113,066	140,364	169,812	+ 50.2
Houston	806,701	1,418,323	1,985,031	+146.1
Laredo	56,141	64,791	72,859	+ 29.8
Lubbock	101,048	156,271	179,295	+ 77.4
McAllen-Pharr-Edinburg	b/	180,904	181,535	-
Midland	25,785	67,717	65,433	+153.8
Odessa	42,102	90,995	91,805	+118.1
San Angelo	58,929	64,630	71,047	+ 20.6
San Antonio	500,460	716,168	864,014	+ 72.6
Sherman-Denison	b/	73,043	83,225	-
Texarkana	61,966	59,971 ^{d/}	67,813	+ 9.4
Tyler	74,701	86,340	97,096	+ 30.0
Waco	130,194	150,091	147,553	+ 13.3
Wichita Falls	105,309	129,638	127,621	+ 21.2
Total SMSA Percent of State	55.8	69.0	73.5	
Total State	7,711,194	9,579,677	11,196,730	+ 45.2

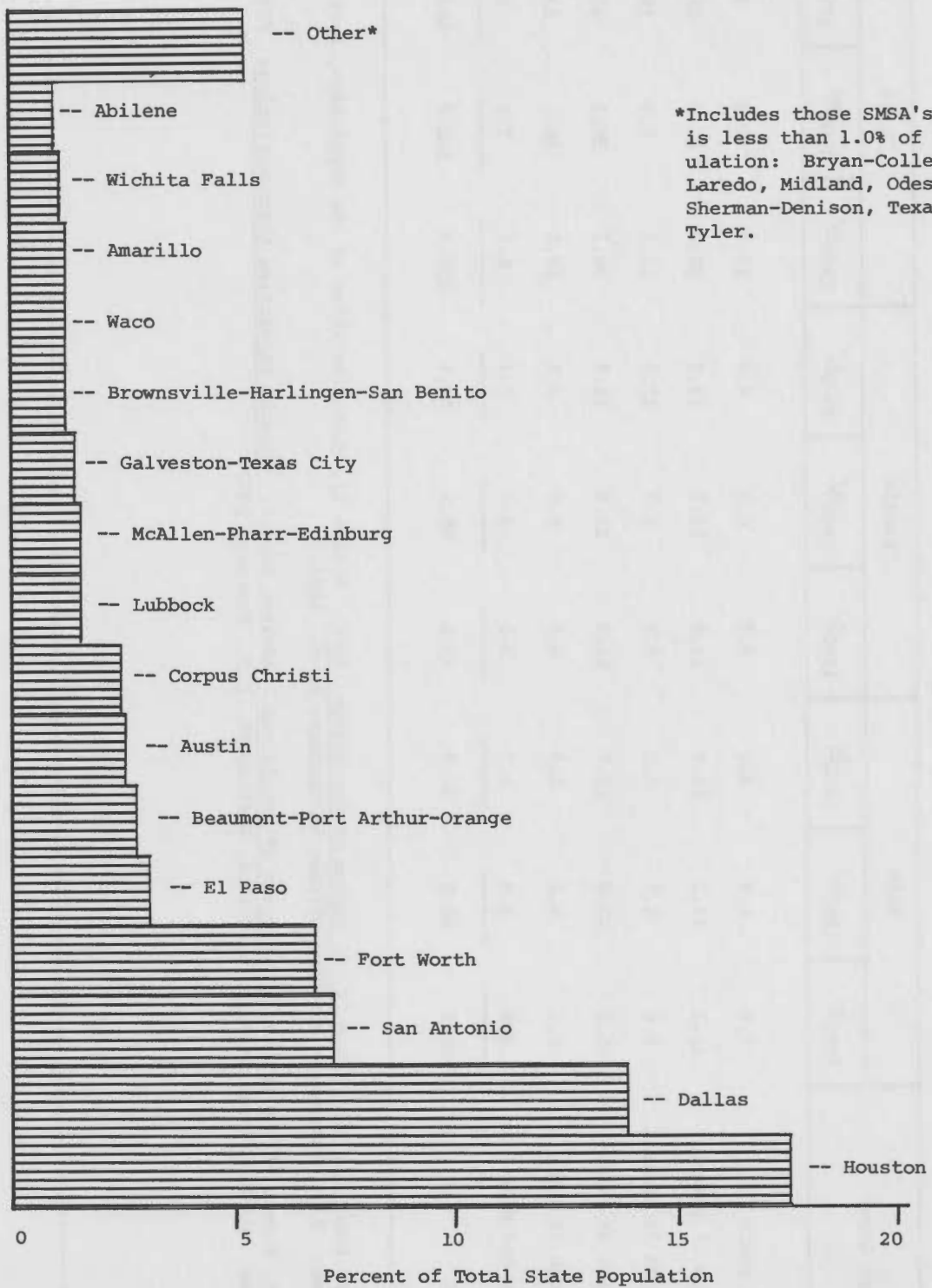
^{a/} U. S. Bureau of the Census, U. S. Census of Population: 1960, Volume 1, Characteristics of the Population. Part 45, Texas. U. S. Government Printing Office, Washington, D.C. 1963.

^{b/} Was not classified as an SMSA that year.

^{c/} 1970 Census of Population, Preliminary Reports, U. S. Department of Commerce, August 1970.

^{d/} Includes only the Bowie County, Texas population figure.

^{e/} 1970 Census of Population, Advance Report, U. S. Department of Commerce, February 1971.



*Includes those SMSA's whose percent is less than 1.0% of the state population: Bryan-College Station, Laredo, Midland, Odessa, San Angelo, Sherman-Denison, Texarkana, and Tyler.

Figure 2. Population in SMSA's as Percent of the Total Texas Population -- 1970

Table 6. Age Groups as a Percent of Texas Population in 1950, 1960, and 1970 - By Sex

Age Group	Male			Female			Total		
	1950 ^{a/}	1960 ^{a/}	1970 ^{b/}	1950 ^{a/}	1960 ^{a/}	1970 ^{b/}	1950 ^{a/}	1960 ^{a/}	1970 ^{b/}
Under 5 years	5.9	6.2	4.5	5.7	6.0	4.4	11.6	12.2	8.9
5 through 17 years	11.2	13.1	13.7	10.8	12.7	13.2	22.0	25.8	26.9
18 through 24 years	5.8	4.7	6.1	5.7	4.7	12.6	11.5	9.4	18.7
25 through 44 years	15.0	12.8	11.7	15.1	13.3	11.3	30.1	26.1	23.0
45 through 64 years	9.1	9.2	9.2	9.0	9.5	4.5	18.1	18.7	13.7
65 years and over	3.2	3.5	3.7	3.5	4.3	5.1	6.7	7.8	8.8
ALL AGES	50.2	49.5	48.9	49.8	50.5	51.1	100.0	100.0	100.0

^{a/} U. S. Bureau of the Census, U. S. Census of Population: 1960. Volume II, Characteristics of the Population, Part 43, Texas. U. S. Government Printing Office, Washington, D. C., 1963.

^{b/} U. S. Bureau of the Census, 1970 Census of Population - Advance Report. General Population Characteristics: PC(V2)-45, Texas. U. S. Government Printing Office, Washington, D.C., February 1971.

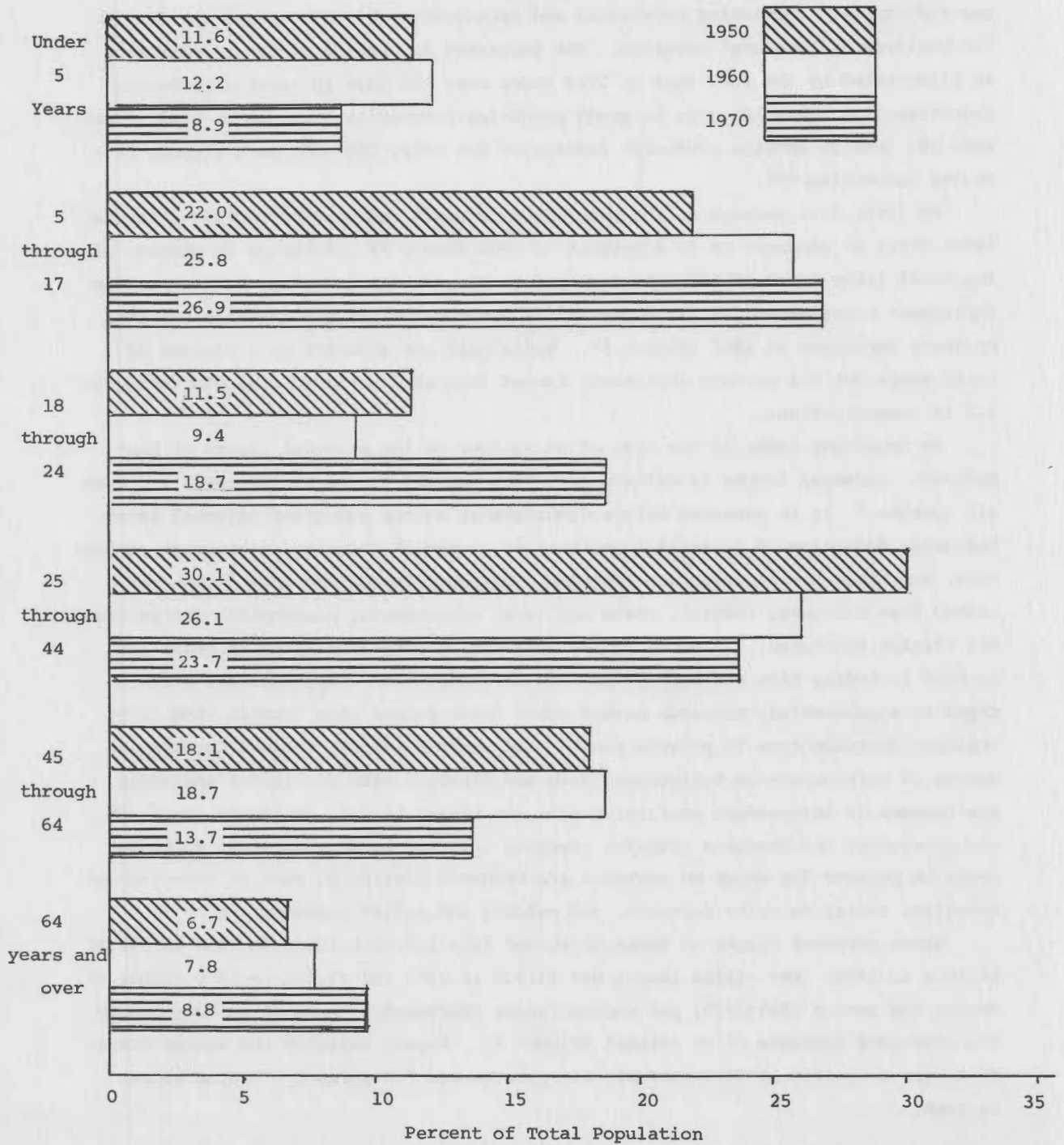


Figure 3. Selected Age Groups as a Percent of the Total Population--Texas, 1950, 1960 and 1970

Income and Occupations of Texas

The civilian labor force averaged 4.1 million during 1968.^{10/} Significant changes in the composition of the labor force occurred as mechanization and technology reduced the number of employees in agriculture, petroleum, and natural gas industries. Increasing population and urbanization have increased the demand for business and personal services. The increased importance of these industries is illustrated by the fact that in 1960 there were 175 jobs in service producing industries for every 100 jobs in goods producing industries, whereas in 1968, there were 192 jobs in service producing industries for every 100 jobs in the goods producing industries.^{11/}

In 1968, 57.6 percent of the population 14 years and over participated in the labor force as compared to 55.4 percent in 1960 (Table 7). Although 26 percent of the total labor force of 1968 was employed in the service industry, service sector employment represented only 17.0 percent of the total wages and salaries received by Texas employees in 1967 (Figure 5). Wages paid per industry as a percent of total wages for all private employment ranged from 19.1 percent in manufacturing to 1.3 in communications.

An important index of the size of an economy is the personal income of that economy. Personal income is defined as: "The current income of persons . . . from all sources." It is measured before deduction of income and other personal taxes, but after deduction of personal contributions to social security, government retirement, and other social insurance programs. Personal income includes income received from business, federal, state and local governments, households, institutions, and foreign countries. Personal income consists of wages and salaries (cash and in-kind including tips and bonuses as well as contractual compensation), various types of supplementary earnings termed other labor income (the largest item being employer contributions to private pension and welfare funds), the net incomes of owners of unincorporated businesses (farm and non-farm with the latter including the incomes of independent professionals), net rental income, dividends, interest, and government and business transfer payments (consisting in general of disbursements to persons for which no services are rendered currently, such as unemployment benefits, social security payments, and welfare and relief payments).^{12/}

Gross personal income in Texas increased from \$10.48 billion in 1950 to \$39.67 billion in 1970. Per capita income was \$1,349 in 1950 and \$3,531 in 1970 (Table 9). During the period 1960-1970, per capita income increased 83 percent as compared to the 1950-1960 increase of 43 percent (Figure 6). Wages, salaries and income transfers were respectively 59.8 percent, 6.6 percent and 7.8 percent of total income in 1969.

^{10/} Texas Employment Outlook to 1975 by Industry and Occupation, Texas Employment Commission, Austin, Texas (July 1971), Page 5.

^{11/} Ibid.

^{12/} Description of Methodology for Estimation of County Income, a staff memorandum of the Office of Business Economics, U. S. Department of Commerce (February 1970), Page 3.

Table 7. Texas Employment by Industry Group - 1960 and 1968^{a/}

Major Group	Average Number of Employees		Average Employment by Industry as a Percent of Total Employment	
	1960	1968	1960	1968
			(Percent)	
Agriculture, Forestry and Fisheries	327,000	294,000	10.0	7.1
Construction	207,700	281,200	6.3	6.8
Mining	123,900	104,800	3.8	2.5
Manufacturing	509,000	735,600	15.5	17.8
Transportation	154,200	162,800	4.7	4.0
Communications	38,900	45,800	1.2	1.1
Public Utilities	64,400	70,600	2.0	1.7
Wholesale	191,200	251,600	5.8	6.1
Retail	598,700	707,000	18.3	17.2
F.I.R.E.	134,800	177,400	4.1	4.3
Services	726,900	1,069,400	22.2	26.0
Public Administration ^{b/}	200,800	221,000	6.1	5.4
Total Average Employment	3,277,500	4,121,200	100.0	100.0

^{a/} Texas Employment Outlook for 1975 by Industries and Occupation, Table A.
Texas Employment Commission, Austin, Texas (July 1971).

^{b/} Includes workers engaged in activities unique to government. Those government workers engaged in activities also conducted by private enterprise such as construction, manufacturing, etc. are not classified as public administration workers.

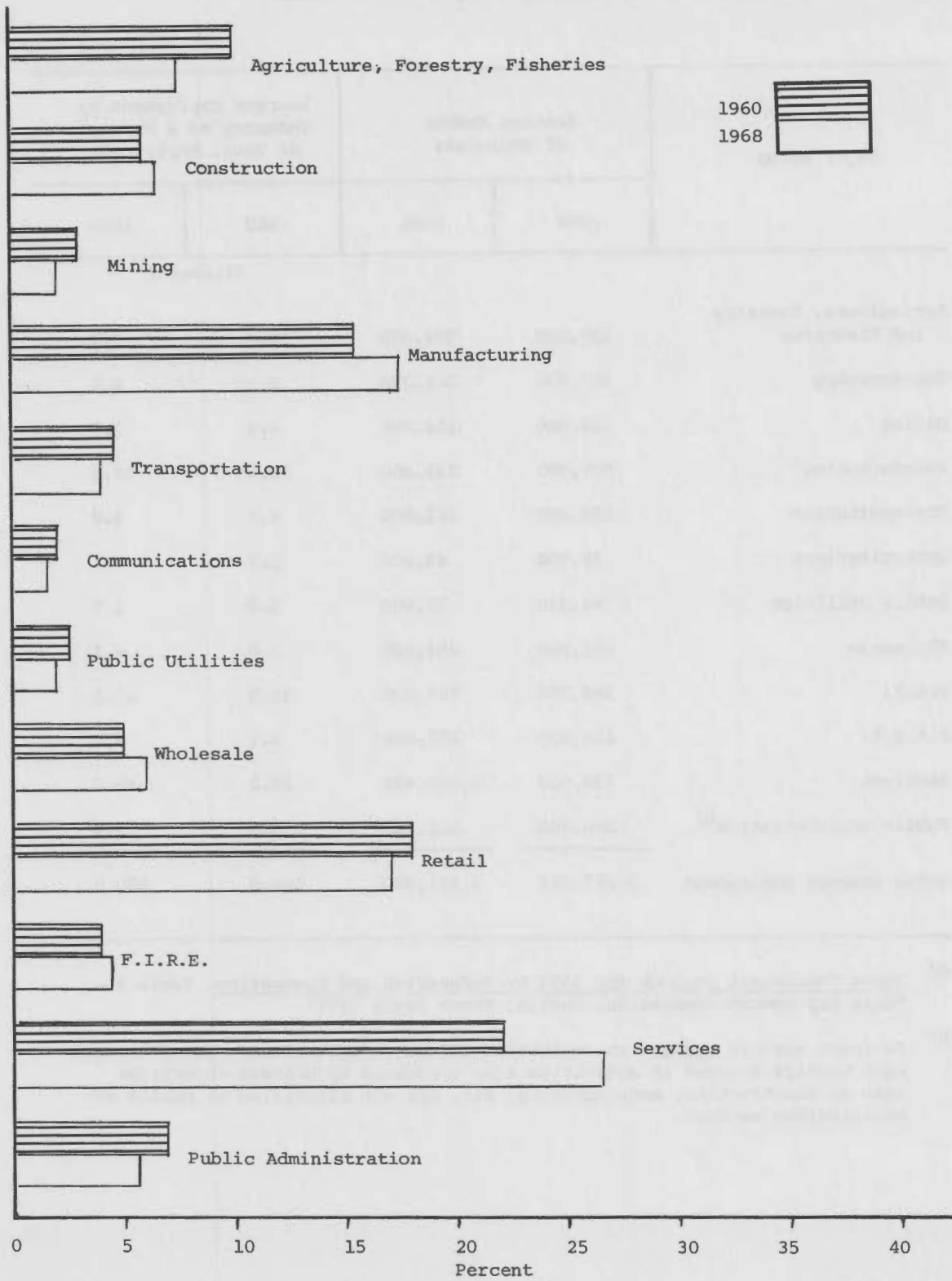


Figure 4. Texas Employment by Industry Group as a Percent of Total State Employment -- 1960 and 1968

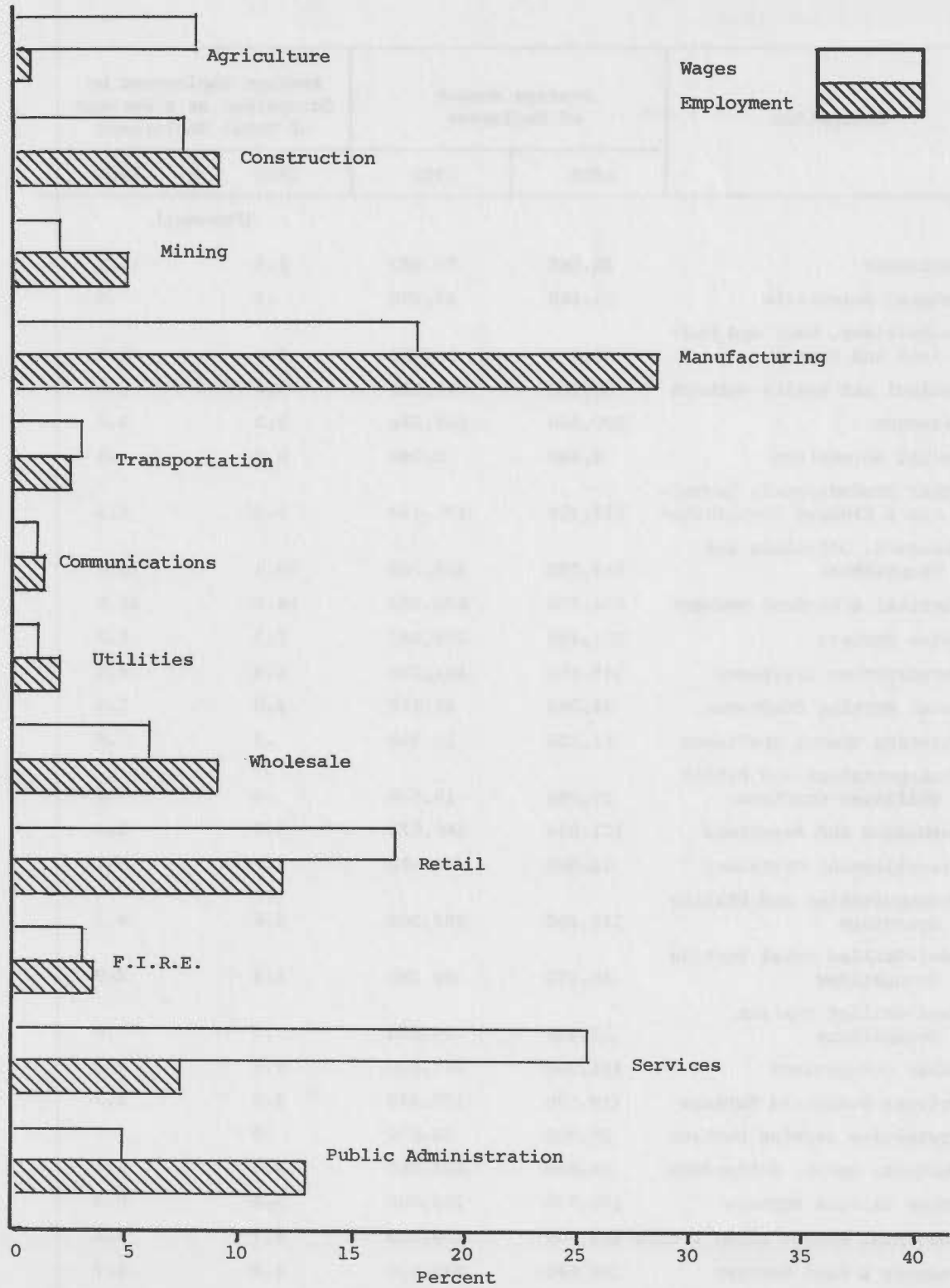


Figure 5. Employment and Wages of Texas Industry Groups as Percents of the Total Employment and Wages -- 1967

Table 8. Employment in Texas by Occupation, 1960 and 1968

Occupation	Average Number of Employees		Average Employment by Occupation as a Percent of Total Employment	
	1960	1968	1960	1968
			(Percent)	
Engineers	41,560	71,480	1.3	1.7
Natural Scientists	11,160	15,290	.3	.4
Technicians, Exc. and Medical and Dental	31,870	52,730	1.0	1.3
Medical and Health Workers	60,280	98,510	1.8	2.4
Teachers	109,620	162,270	3.3	3.9
Social Scientists	1,440	2,090	0.0	.1
Other Professional, Technical & Kindred Occupations	115,350	175,490	3.5	4.3
Managers, Officials and Proprietors	332,500	394,750	10.1	9.6
Clerical & Kindred Workers	464,170	622,070	14.5	15.0
Sales Workers	251,480	278,080	7.7	6.7
Construction Craftsmen	145,450	181,290	4.4	4.4
Metal Working Craftsmen	34,280	48,810	1.0	1.2
Printing Trades Craftsmen	11,120	13,360	.3	.3
Transportation and Public Utilities Craftsmen	20,040	19,570	.6	.5
Mechanics and Repairmen	121,950	168,870	3.7	4.1
Miscellaneous Craftsmen	63,080	74,630	1.9	1.8
Transportation and Utility Operators	149,480	183,560	4.6	4.5
Semi-Skilled Metal Working Occupations	46,470	80,560	1.4	2.0
Semi-Skilled Textile Occupations	15,430	23,800	.5	.6
Other Occupations	311,340	375,600	9.5	9.1
Private Household Workers	129,170	137,240	3.9	3.3
Protective Service Workers	29,900	30,870	.9	.7
Waiters, Cooks, Bartenders	94,460	133,760	2.9	3.2
Other Service Workers	176,730	259,050	5.4	6.3
Laborers, Except Farms & Mine	186,700	209,010	5.7	5.1
Farmers & Farm Workers	269,690	235,610	8.2	5.7
Miscellaneous	52,780	72,850	1.6	1.8
Total	3,277,500	4,121,200	100.0	100.0

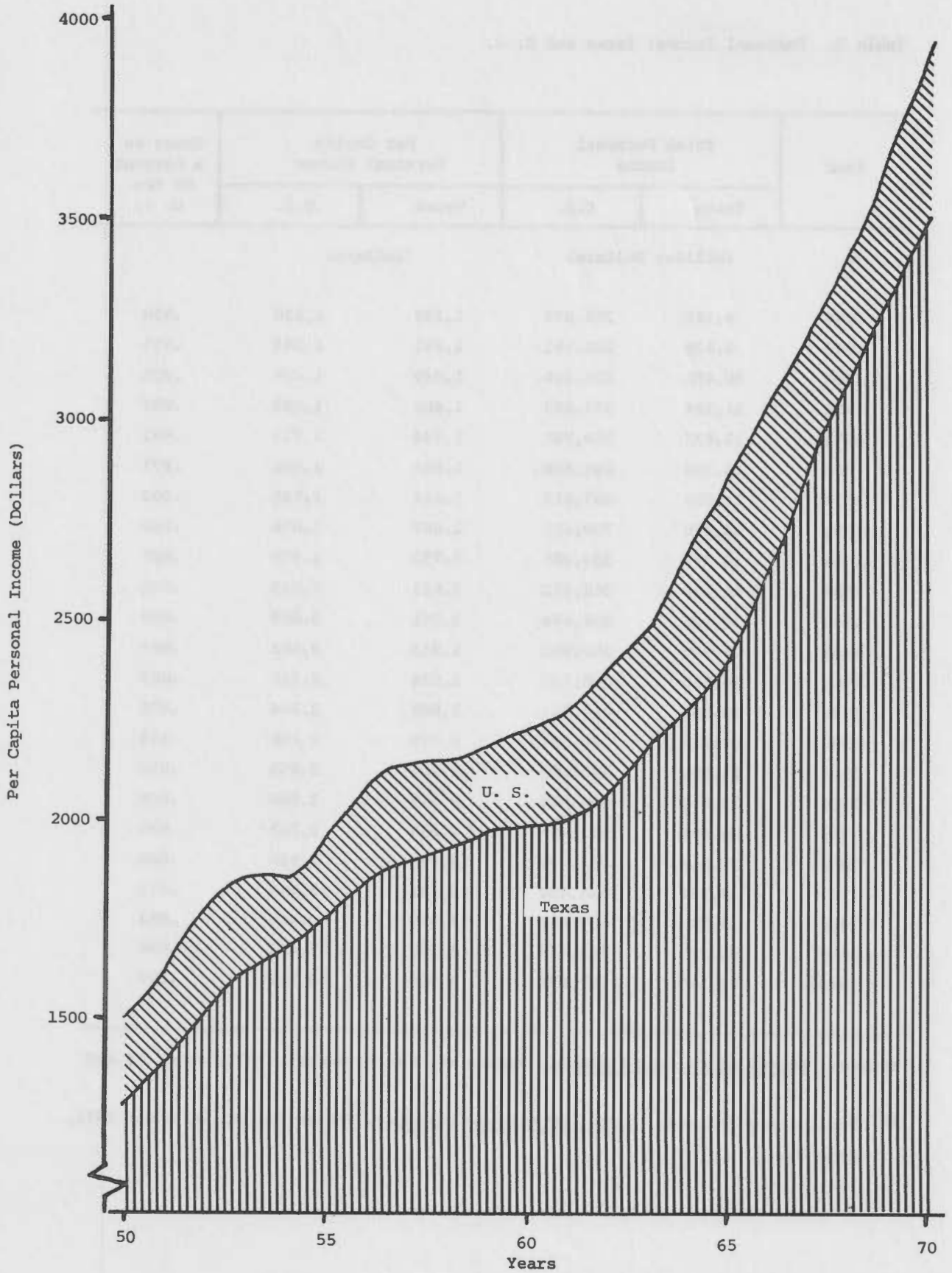


Figure 6. Per Capita Personal Income for Texas and the U. S. -- 1950-1970

Table 9. Personal Income; Texas and U. S.

Year	Total Personal Income		Per Capita Personal Income		Texas as a Percent of the U. S.
	Texas	U.S.	Texas	U.S.	
	(Million Dollars)		(Dollars)		
1948	9,142	208,878	1,199	1,430	.838
1949	9,839	205,791	1,291	1,384	.933
1950	10,486	226,214	1,349	1,496	.902
1951	11,914	253,233	1,469	1,652	.889
1952	12,837	269,767	1,544	1,733	.891
1953	13,196	285,458	1,583	1,804	.877
1954	13,504	287,613	1,611	1,785	.903
1955	14,438	308,265	1,667	1,876	.889
1956	15,472	330,481	1,752	1,975	.887
1957	16,538	348,462	1,823	2,045	.891
1958	17,126	358,474	1,851	2,068	.895
1959	17,995	380,963	1,913	2,161	.885
1960	18,535	398,725	1,924	2,215	.869
1961	19,551	414,411	1,982	2,264	.875
1962	20,518	440,192	2,025	2,368	.855
1963	21,589	463,053	2,102	2,455	.856
1964	23,053	494,913	2,213	2,586	.856
1965	24,895	535,949	2,358	2,765	.853
1966	27,615	583,829	2,580	2,980	.866
1967	29,952	625,490	2,762	3,162	.873
1968	33,247	684,442	3,019	3,425	.881
1969	36,458	744,479	3,259	3,687	.884
1970 ^{a/}	39,525	797,075	3,515	3,910	.899

Source: Survey of Current Business, Volume 48, No. 8, August, 1968, Pages 14 and 15.

^{a/} Preliminary figures: Survey of Current Business, Volume 51, No. 4, April 1971, Page 21.

Table 10. Wages and Salaries; Farm Proprietor Income; Non-Farm Proprietor Income; and Transfer Payments as a Percent of Total Personal Income for Selected Years 1940-1969

Income Source	Year								
	1940	1950	1959	1962	1965	1966	1967	1968	1969
	(Percent)								
Wages and Salaries	56.0	59.8	63.8	64.1	77.7	65.3	65.9	65.8	66.8
Farm Prop. Income	12.2	8.5	5.3	4.8	5.1	4.2	3.0	3.3	3.1
Non-Farm Prop. Income	14.2	12.8	10.5	9.4	8.6	8.1	7.9	7.7	7.4
Transfer Payments	2.9	6.6	6.0	6.6	6.8	7.0	7.5	7.7	7.8

Source: Department of Commerce, Office of Business Economics, Personal Income by Type and Industrial Source - Texas, Washington, D. C.

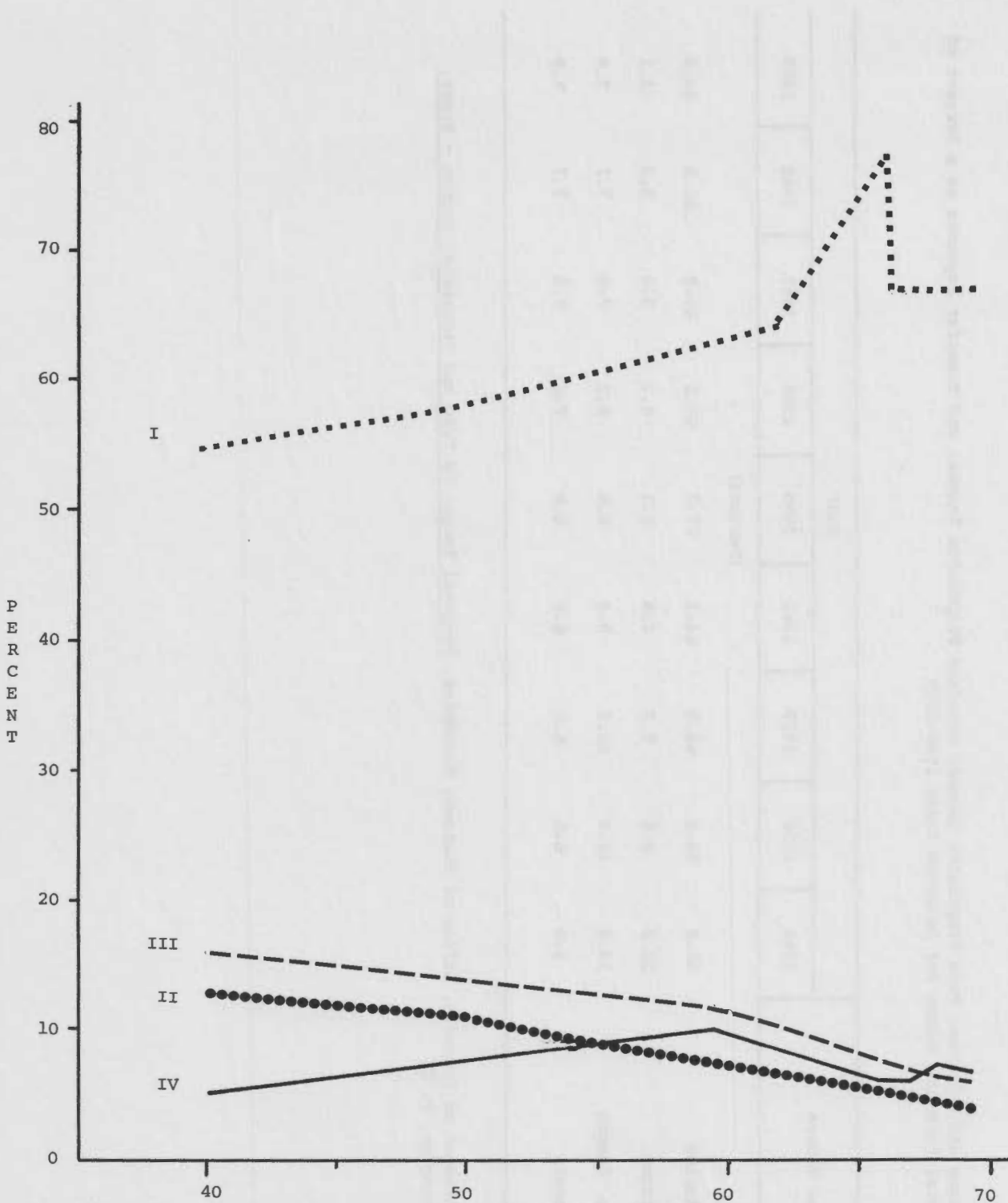


Figure 7. Trends in (I) Wages and Salaries; (II) Farm Proprietor Income; (III) Non-Farm Proprietor Income; and (IV) Transfer Payments Percent Components of Total Personal Income^{a/}

^{a/} Department of Commerce, O.B.E., Personal Incomes by Type and Industrial Source -- Texas, 1929-1969, Washington, D.C., (1971).

Table 11. Personal Earnings by Broad Industrial Sector (Thousands of Dollars)

Industrial Sector Source of Earnings	Year					
	1962	1965	1966	1967	1968	1969
Total Earnings	16,717,768	19,953,875	22,111,079	23,929,223	26,681,556	29,494,043
Farm Earnings	1,237,843	1,251,838	1,367,560	1,104,974	1,319,901	1,347,963
Total Non-Farm Earnings	15,479,925	18,702,037	20,743,519	22,824,249	25,361,655	28,146,080
Government Earnings	2,971,877	3,561,879	4,149,322	4,597,257	5,034,629	5,481,234
Total Federal	1,641,922	1,854,083	2,261,004	2,480,385	2,670,872	2,877,784
Federal Civilian	746,689	906,796	1,046,158	1,151,828	1,267,587	1,357,106
Military	895,233	947,287	1,214,846	1,328,557	1,403,285	1,520,678
State and Local	1,329,955	1,707,796	1,888,318	2,116,872	2,363,757	2,603,450
Private and Non-Farm Earnings	2,508,048	15,140,158	16,594,197	18,226,992	20,327,026	22,664,846
Manufacturing	3,115,230	3,900,170	4,398,926	4,917,177	5,640,230	6,322,213
Mining	907,097	911,116	929,735	943,387	987,362	1,137,759
Contract Construction	992,627	1,281,335	1,446,367	1,614,535	1,741,599	1,978,053
Trans., Comm., Publ. Util.	1,330,924	1,525,422	1,638,910	1,783,832	1,924,118	2,097,694
Wholesale & Retail Trade	3,147,454	3,772,007	4,095,206	4,397,845	4,835,863	5,354,529
Fin., Ins. & Real Estate	852,115	1,059,134	1,139,042	1,249,556	1,423,214	1,547,402
Services	2,116,654	2,627,388	2,877,819	3,251,376	3,700,289	4,145,414
Other	45,947	63,586	68,192	69,284	74,351	81,782

Table 12. Civilian Personal Earnings by Industrial Source as a Percent of Total Civilian Earnings: Texas and U. S. - 1967

Industrial Source	Texas ^{a/}	U. S. ^{b/}
Farms	4.8	3.5
Mining	4.2	1.1
Contract Construction	7.1	6.2
Manufacturing	21.8	30.4
Wholesale and Retail	19.5	17.2
Finance, Insurance and Real Estate	5.5	5.3
Transportation, Public Utilities, and Communications	7.9	7.2
Services	14.4	14.6
Government	14.5	14.2

^{a/} Source: Computed from Table 11.

^{b/} Survey of Current Business, Volume 48, No. 8, August, 1968, Page 21, Tables 63 and 70.

ANALYTIC PROCEDURES AND DATA REQUIREMENTS

Industry Groups of the Texas Economy

The Texas economy is composed of eleven (11) major groups of producing activities, including (1) Agriculture, Forestry and Fisheries, (2) Mining, (3) Construction, (4) Manufacturing, (5) Transportation, (6) Communications, (7) Utilities, (8) Wholesale Trade, (9) Retail Trade, (10) Finance, Insurance and Real Estate, and (11) Services. The Standard Industrial Classification System (SIC) was used to classify individual establishments.^{13/} Each establishment was classified according to its predominant product and was then assigned to an individual sector. Sector definitions were chosen so as to provide detail within the input-output models and to separate, insofar as possible, diverse establishments.

In addition to producing sectors, the Texas Input-Output Model contains final demand and final payments sectors that are distinctly different in concept from the producing or processing sectors represented by the system of equations outlined earlier (Table 1). Transactions among processing sectors are the means whereby raw materials and business services are combined and moved through the economy from stage to successively higher stage until products useful to consumers are ultimately produced. Transactions between processing sectors and final demand sectors are for the purpose of transferring finished goods to ultimate users or transferring raw materials and partially finished goods outside the economy through exports. Final payments are the payments by the producing sectors to households in the form of wages, salaries, rents, interests, and profits, payments to governments in the form of taxes, and payments to establishments outside the economy for imported materials and services. Final payments to households, government, and suppliers of imports are the dollars used to pay for goods and services that move to final demand sectors. The major sector groups are described below.

Agriculture, Forestry and Fisheries

The 17 agricultural, forestry and fisheries sectors of the model represent the farm production of field crops, food grains, cotton, vegetable, citrus, peanuts, treenuts, oilseed crops, range livestock, feedlot livestock, dairy, poultry, forestry and the dollar value of the fish catch landed at Texas ports. In addition, agricultural services such as ginning, harvesting and spraying on a custom basis are included in the agricultural group of sectors. These sectors are composed of individual production activities such as individual crop enterprises and do not follow the predominant product establishment convention adapted and applied to other sectors of the model.

^{13/} Standard Industrial Classification Manual - 1967, Executive Office of the President, Bureau of the Budget, Washington, D.C.

In sectoring the agricultural, forestry, and fisheries activities of the Texas economy, the major dryland and irrigated crops were placed in separate sectors so that specific analyses could be made of the inputs, outputs, and impacts of these different types of agricultural production upon regional and state-wide economies. Range and feedlot livestock were separated into different sectors because the nature of inputs and outputs of these two activities are distinctly different.

Agricultural enterprises such as dairying and poultry production are logical individual sectors with identifiable differences from other activities. It was not practical, from an analytic standpoint, to define sectors for each of the dryland and irrigated speciality crops since total output per crop was low in relation to other sectors and would result in increased rounding errors during computations. Therefore, these crops were grouped into one sector for "all other irrigated crops" and one sector for "all other dryland crops."

The agricultural, forestry, and fisheries sectors include only those activities carried out by farmers, foresters, and commercial fishermen. Output is defined as gross value of product at the "first-handler" point in the marketing process, with the exception of cotton which is valued at the cotton gin after ginning. This procedure is followed with the agricultural sectors since it is conventional for farmers to transport, at farm expense, farm produce to "first-handlers" at central produce collection points. Farmers also pay cotton ginning costs; thus, producer prices (a concept that is explained later) include these additional service costs of producing cotton and making cotton available for sale to the "first-handler."

Agricultural inputs include wages and salaries, fertilizers, seed, herbicides, insecticides, fuel, capital, finance, insurance, real estate, taxes, transportation, utilities, packaging, business services and marketing services.

Mining

In Texas, the mining sectors include crude petroleum production, natural gas and natural gas liquids production, oil and gas exploration, drilling and well servicing, sand and gravel, stone, clay, gypsum, sulphur and a small amount of metal ore production. These activities are grouped into four homogeneous sectors within the Texas Input-Output Model.

Mining is a basic industry from which major Texas exports are ultimately made. The input-output sectors are defined to permit analyses of local economic impacts of changes in export and local demands for energy -- the major Texas mining product. Establishments of the mining industries are classified on the basis of the predominant product; thus, the "establishment convention" of sectoring is applied in data summarization and analyses. Much of the existing metal ore mining is reported and included as a part of the manufacturing sector which uses the respective ores since, in Texas, these activities are vertically integrated in the manu-

facturing processes which use the ores. Mining of metal ores, as such, is not separately handled in accounts of the establishments which do mining and, thus, a separate analysis was not possible.

Since the mining portions of the Texas petroleum industry are major economic activities, there are separate published oil and gas statistical series on production by county. These data were adequate to permit identification of individual sectors of the Texas petroleum industry. Refining is included among the manufacturing sectors and, thus, will be discussed briefly there.

Mining output, in producer's prices, is the value of product at the point of extraction; i.e., ready to be transported to refinery, smelter, or other processor. Under the procedures of the project, the mining establishment pays costs of exploration, drilling or other production costs. The next processor pays raw product price plus transportation and other charges required to move mining output from the site of extraction into the manufacturing process where value is added and materials are changed either in form, time, or place utility.

Mining inputs include wages, salaries, capital, royalties, leases, exploration, business services, interest or capital, insurance and taxes.

Construction

In the Texas Input-Output Model, construction is separated into five separate sectors. These sectors represent residential, commercial and institutional, industrial, facility, and maintenance and repair "value of work put in place" respectively. The value of work of the "special trades" or services establishments which provide services on a subcontract basis to major "new construction" projects and maintenance and repair services to existing structures are included as a part of the respective sectors for which the work is done. These latter sectors provide a wide range of services, including foundation work, masonry, carpentry, electrical, heating, air conditioning, plumbing, glass, steel erection, metal work, roofing, repair and demolition.

Sectoring of construction establishments was done so as to provide separate analyses of inputs required to produce residential housing, business and office housing, factory or plant housing, and facilities in the various regions of Texas. In addition, these analyses within the input-output model provide estimates of local economy impacts of changes in demand for construction outputs and information useful in important public and private policies and programs of finance for housing and spending for facilities.

The output of construction sectors is considered to be new capital that is usually sold directly to the capital formation sector of final demand. For purposes of analyses, construction output is defined as dollar value of work put in place during the study period. Inputs include building materials, equipment usage, business services, wages and salaries, engineering and architectural services, finance, and transportation of materials.

Manufacturing

The Texas Input-Output Model has 88 manufacturing sectors. These include establishments classified by SIC code 1900 through 3999. In general, establishments having different two-digit SIC codes appear in different sectors. Further stratification was carried out within two-digit SIC's so that, in some cases, establishments with different three and four-digit SIC codes appear in different sectors.

The manufacturing sectors include production activities by ordnance and accessories, food and kindred products, textile and apparel products, lumber and wood products, furniture and fixtures, paper, printing, publishing, chemicals, petroleum, rubber and plastics, leather, stone, clay, glass, concrete, primary and fabricated metals, machinery, equipment, instruments, photographic and optical goods, watches, clocks, and miscellaneous manufactured goods. Manufacturing establishments such as food processors and petroleum refineries receive raw materials, transform these materials into more highly usable states and sell the resulting outputs either to other manufacturers, in the case of partially finished goods, or to consumers (final demand) in the case of finished goods.

For both the producers and users of intermediate goods, the input-output analysis of economic structure is particularly helpful in understanding markets for outputs and inputs. The producer of intermediate products usually does not deal directly with final demand sectors of the economy since his output is not in a form usable by final consumers. Thus, these manufacturing sectors must anticipate and forecast demands for their products through the analyses of product demands of their customers' customers several times removed. Input-output models are especially useful for this type of analysis. The models show the requirements for intermediate products and business services (discussed in detail later) sector-by-sector for a given level of output of an individual sector. From input-output models, producers of intermediate products such as chemicals, steel, lumber, paper, and textiles can gain information useful in short run decisions pertaining to level of production, raw materials required, and labor force to hire, and information required for longer run decisions about investments in new plant and equipment. The input-output model interindustry coefficients relate final demand to business and public sector services in an identical way to that of the relationship between final demand, intermediate goods, and raw materials.

The output of the manufacturing sectors is defined as the dollar value of production in terms of producer's prices (f.o.b. the factory). Inputs of manufacturing sectors include materials purchased from other local sectors, wages and salaries, transportation of inputs, business services, taxes, imported materials and services and perhaps withdrawals from production materials and finished goods inventories.

Transportation

Separate sectors were included for rail, motor, water, pipeline, and air transportation establishments engaged in the movement and storage of freight and trans-

port of persons. Freight forwarding services were separated into individual sectors so that these services could be treated explicitly in the analysis. Transportation produced by privately owned and operated automobiles and airplanes was not included in the producing sectors. This latter type of transportation was considered to be a part of consumption by households and was included among household expenditures in final demand sectors.

Transportation and storage services are in general demand by the producing sectors of the economy. Transportation services are essential to a highly specialized and geographically dispersed economy such as the Texas economy. Without these services, including storage and preservation facilities, such as refrigeration, much of present production could not be moved to consumers.

The input-output model of the Texas economy provides information useful in transportation planning since the model shows the value of transportation services purchased by the producing industries. Exports and imports among regions are particularly important factors in transportation requirements of the economy. The costs of transportation as reflected through inputs directly by transportation establishments and indirectly through public investments in facilities, roads, and airports are of significance with respect to local economic impact of transportation activities and are of major interest to economic development and long range public investments. Roads for tourism and recreation travel are among the current transportation planning problems.

The output of the transportation sectors is measured in terms of the dollar value received by transportation establishments for services rendered. In the analyses of the Texas Input-Output Study, the purchaser of goods pays transportation services; thus, these sectors sell services to users of products and to households and government.

Transportation sector inputs include wages, salaries, business services, insurance, capital, finance, utilities, taxes and fuel.

Communications

The communications sectors of the Texas Input-Output Model include telephone and telegraph, radio and television and "other" communications services. Establishments engaged in providing these services were grouped into three separate sectors to obtain homogeneity within sectors and to keep, insofar as possible, differences between sectors. Printing and publishing establishments were included in the manufacturing group as individual printing and publishing sectors.

Part of the distinction between communication sectors is the type of inputs used in production and a part is obviously the resulting outputs. "Voice type" communications facilities use different kinds of capital and have a different type of service input; i.e., voice oriented services and personnel. Telephone and telegraph services are highly capital oriented and are provided for the direct

sale of services to households, government, and business for person-to-person communication and are, thus, distinguished from mass media communications.

Mass media communications are significant in the sale of goods and services through communications of advertising services which inform consumers about products and services. In addition, mass media communications services are used widely in entertainment and recreation associated with advertising. These sectors are included explicitly in the input-output model for the purpose of gaining information about the interrelationships between these and other sectors of the Texas economy.

For purposes of analyses, the outputs of communications are defined as the incomes received by communications establishments for services rendered. In the case of telephone and telegraph establishments, income is from rental of equipment to households, governments, and businesses. In the case of radio and television, income is largely from the sale of advertising time and the production and transmission of advertising messages (commercials) along with broadcast entertainment. Inputs include capital, wages and salaries, talent, business services, energy, insurance, finance, taxes, and real estate.

Utilities

Establishments which produce electricity, distribute natural gas or provide water and sanitary services are classified and grouped into three separate homogeneous sectors. Water and sewer systems are largely publicly owned and, thus, the services rendered are productions of the public sectors. These activities were included among the processing sectors of the economy, however, rather than in the final demand sectors along with government, since these are service producing as opposed to governmental functions per se.

Electric and gas utilities in Texas are owned primarily by the private sector. The exceptions are rural electric cooperatives, and a small number of municipal electric systems and municipal gas distribution systems. The outputs of publicly owned utilities appeared to be too small to justify or permit a separation between private and public sectors for the electric and gas utilities. Thus, all electric establishments are included in the electric utilities sector, and natural gas transmission and distributing establishments are included in the natural gas utilities sector.

The outputs of utilities sectors include the sale of energy or energy services, and water and waste disposal services to households, government, industry and business establishments. Total value of outputs of utility establishments are the sum of receipts for these services.

Inputs of utilities sectors include fuels, labor, business services, capital, taxes, wages and salaries, utility services, finance, insurance and real estate services.

Wholesale and Retail Trade

Establishments engaged in the well known wholesale and retail trades were classified and grouped into 18 separate sectors. There are seven wholesale trade sectors and 11 retail trade sectors. Restaurants are included among the retail trades sectors even though these establishments operate as if they were manufacturers; i.e., the food purchased is changed from raw materials to finished meals and priced accordingly, instead of being marked-up as is done by other retail sectors.

The trades or "margins" industries as they are sometimes called, provide services to the economy both in the marketing of finished goods to consumers and in the procurement and marketing of inputs used by the processing sectors. The major factor considered in the classification and sectoring of establishments engaged in the trades is the type of products handled which to a large degree determines the type of inputs used and is, therefore, a major basis for differences among sectors. For example, those establishments engaged in handling food require refrigeration and preservation facilities, whereas establishments engaged in clothing sales do not. Both types require transportation services but food handlers require regular, perhaps daily, transportation whereas clothing requires less frequent transportation.

The trades establishments, to a large extent, perform the functions of moving manufactured goods through the markets and, in the process, reflect the desires and demands of consumers back to producers. Among the major points of interest are the export-import flows of material and the conditions and reasons underlying exports and imports of the state's economy. Policies such as local industrialization, natural resources investment and development, and provision of transportation facilities depend upon a better understanding of the export-import goods flows. Thus, there is a need to collect and analyze data from the various specialized trading establishments where these export and import exchanges occur.

The trade sectors' output is in the form of services rendered in the production of time, place, and convenience utility to producers and consumers. The trade establishments purchase goods for resale in a market for which advanced commitments have not been explicitly made by purchasers. The original value of the product is marked-up by a ratio or percentage of the purchase price to permit recovery of expenses incurred both for the original goods, plus cost of moving, handling, storing, merchandising, brokerage, labor, business services, insurance, finance, capital, return on investment, and management. The quantity sold depends upon price at retail and "sales" are often held at lowered prices to move merchandise which did not sell at original prices asked.

For purposes of input-output analyses, output of the trades sectors is the gross value of the "margins" collected on goods handled. The value of the merchandise sold is not included in the outputs or the inputs of the trades sectors

in accordance with the "producer price" concept discussed later in this report. Inputs are the expenses of handling and include transportation, warehousing, business services, salaries and wages, capital, finance, insurance and real estate, and taxes paid to government. Taxes collected for government, such as sales and excise taxes, are not trade inputs. These taxes are added-on at the "cash register," and are paid by the purchaser to government. The trades sector collect these taxes and pass them on to government.

Finance, Insurance, and Real Estate

The Finance, Insurance, and Real Estate (FIRE) establishments are grouped into three homogeneous sectors. Banking and credit agencies are included in one sector; insurance establishments, including insurance agents and carriers, are included in the insurance sector; and the third sector includes security and commodity brokers, dealers, exchanges and services, real estate, and holding and investment companies.

Finance establishments provide services in the form of banking, transmission of funds, investments and investment counseling, estate management, and credit for a variety of investment and purchasing activities of households, government, and businesses. Users of finance establishments make payments for services rendered in the form of interest payments for use of borrowed funds. Finance institutions or establishments also receive rents, fees, profits, and returns on owned properties, bonds and securities. The nature of finance output is in the form of services and through the widespread use of these services, the finance sector outputs are commonplace inputs of practically every other sector of the economy.

Inputs of the finance sectors include wages, salaries, interests, capital, business services, insurance, real estate, taxes, utilities, and communications.

Insurance establishments provide services to the producing and consuming sectors of the economy in the form of widespread risk assumption and finance. Purchasers of insurance services make payments in the form of insurance premiums for risk transfer and interest payments for borrowed funds analogous to interest paid to other finance establishments for borrowed funds. A part of the process of risk assumption includes investment of premium income; thus, the insurance sector is also a member of the larger finance group of sectors.

The inputs of the insurance sector include wages, salaries and commissions, real estate rental, business services, insurance losses, taxes, capital and communications.

"All other FIRE" includes services performed by real estate establishments and brokers of commodities and securities. The outputs of the real estate part of this sector are in the form of rental of real estate, including farmland, rental of office, commercial space, and housing, plus real estate marketing services. The outputs for commodities and securities brokers are in the form of

services rendered in the purchase and sale of contracts and certificates. The sellers and purchasers pay brokerage fees for these services.

The inputs of real estate establishments include wages and salaries, business services, licenses and fees, finance, insurance, travel, utilities, taxes, and capital investments in roads and "improvements."

The inputs of brokers include wages and salaries, fees and licenses, travel, professional analyses, business services, capital, utilities, communications, insurance, and taxes.

Services

In the Texas Input-Output Model, establishments engaged in producing services are grouped into 25 homogeneous sectors. This type of business enterprise includes legal services, lodging services, barber and beauty services, research, employment, amusement, recreation, rental, repair, health and medical, education, engineering, architecture, accounting, auditing, and bookkeeping services. The activities represented in these service sectors utilize a large amount of professional skills and training in relation to other inputs, with the exception, in some cases, of highly specialized capital equipment, as in the case of medical and research activities. The outputs of the service sectors are purchased by a large number of other sectors of the local economy and some professional services are exported to other regions in the form of consulting services.

The demand for services by the local economy depends upon the size of the population, incomes of the population, individual preferences, and the size and types of local extractive, manufacturing and other local processing sectors. In a specialized economy, the demand for business and professional services by the basic industries is a major reason for the local multiplier effect. As personal or household sector incomes have increased, there has been an observable similar increase in consumption of recreational, medical, personal, educational, and professional services. Employment in these sectors has increased in relation to employment in other sectors.

Outputs of service sectors are measured, in dollar terms, by the dollar value of payments received for services rendered. These sectors make sales to practically all other processing and consuming sectors; thus, the service sector rows of the input-output transactions matrix have few empty cells.

Inputs of the service sectors include salaries and wages, capital, business services, insurance, real estate, taxes, licenses and fees, utilities, communication, finance, and transportation services.

Final Demand

The final demand sectors receive and use goods and services without further trading or resale of materials as in the case of the processing sector. In an

"open" input-output model, the final demand sectors are households, local government, state government, federal government, capital formation, out-of-state exports, and inventory changes. At the final demand stage of the economy, goods and services are consumed. Sales to final demand sectors are terminal sales of the goods and services produced by the economy. These sectors may, however, sell scrap and salvageable wastes back to the processing sectors for reuse.

In a "closed" input-output model, households are included in the processing sectors and final demand includes only government sectors, capital formation, exports and inventory changes.

Final Payments

The final payments sectors of the economy are the sectors which receive payments from the producing sectors in the form of wages, salaries, profits, rents, interests, and dividends, taxes paid to governments, payments made to establishments located outside the state or region for production materials and services imported, and the accounting for use of existing capital (depreciation allowances) used in production. Except in the case of imports, final payments are the incomes of households and governments.

The part of production costs paid to final payments is included in "value added" or gross state product. Payments made to other sectors for materials represent value of goods at the time and stage of transfer. Presumably, after having combined various materials and services, the resulting products are increased in value and the difference between the sale value and the cost of materials and services from other sectors is the residual from which final payments are made.

Data Requirements and Data Collection Procedures

In reality, the transactions stated earlier in general equation form occur in the market place among a large number of trading entities or establishments. Many individual records are made of these trades, including purchase vouchers, sales receipts, and invoices from which individual establishment financial statements, tax reports, and other summaries and documents are prepared. Periodically, individual establishments are requested to supply summary data about certain items, including employment, wages and salaries paid, costs of materials, total receipts, value added and value of shipments for use in preparing regional, state and national statistics. These data are useful to the general understanding of industry trends but the level of detail is inadequate to permit complete analyses of inter-industry relationships. In fact, very little information can be gained from these "census type" statistics about the "level of finish" of products and the customer destination of sales.

Transactions level detail as opposed to industry summary data are required for the estimation of input-output models. The purpose of this section of the report is to outline the data requirements and present the methods and procedures whereby data were obtained for use in the study.

The Producer Price Concept

In the input-output model, transactions are measured in terms of the dollar values, f.o.b. the shipper, for goods and in terms of the dollar values of gross billings by the suppliers in the case of services. This is known as the "producer price" method of measurement of interindustry trading. Producer prices are used in the input-output model for the purpose of identifying and measuring the direct and indirect linkages among the individual sectors of the economy. Through the producer price approach, an individual purchasing sector is shown to have separately paid the cost of the material obtained from the previous processor, transportation charges to move the material from its origin to the purchaser's destination point, trade margins, brokerage fees, storage costs, and perhaps other costs of obtaining inputs needed in production. In the case of households, costs of obtaining finished goods are separately shown as the cost f.o.b. the shipper from the last-stage processor, transportation charges from the last-stage processor to the retail outlet point, wholesale and retail trade margins or mark-ups, brokerage, insurance, and other charges incurred in the process of moving goods from the last-stage processor to the consumer. The consumer is thus linked directly to the last-stage processor of goods and, in addition, is linked directly to each of the trades and services sectors which participate in the moving and selling of these goods to consumers. The consumer of finished goods is linked to the last-stage processor who is in turn linked, for his inputs, to the immediately preceding processor. In the input-output model, each processing sector is linked directly, by the transactions, to the immediately preceding processing sector. Thus, the producer price measurement method shows that the consumer obtains finished goods such as beef steak, furniture and automobiles from the slaughter plant, the furniture factory and the automobile factory respectively instead of from the grocery store, the retail furniture outlet and the new car dealer respectively. At the same time, for example, the producer price concept shows that the furniture factory buys furniture manufacturing input materials from his suppliers, such as lumber mills f.o.b. the lumber mill; the transportation cost of moving the lumber to the furniture factory is shown as a purchase of transportation by the furniture manufacturing sector from the transportation sector which hauled the lumber.

The consumer pays the transportation and trade margins along with the cost of the basic commodities and receives delivery at the retail outlets, but through the producer price treatment of the data, the consumers' direct dependence upon the manufacturing and service sectors for commodities and services is appropriately

shown. The requirements for transportation and trades services are also indicated in specific terms but the transactions between the trades and the manufacturing sectors for "merchandise to be resold" by the trades sectors are not included. Instead, this transaction is shown as a sale by the manufacturing sector to the consumer. Thus, the trades sectors are included in the model as vital and necessary links but as producers of "trades services" and not as purchasers and sellers of goods.

A major reason for using the producer price concept is the desirability to relate the final consumption sectors (households, exports, governments and capital formation) directly to the local economy producing sectors without artificially counting and recounting the transactions merely associated with "trading." This analytic technique also removes "imported merchandise for resale" from the inputs of the trades sectors and thereby makes the resulting input-output model more flexible as a planning tool pertinent to the Texas economy. If "merchandise purchased for resale" were included in the trades sectors' inputs, changes in consumption due to population or income changes would automatically imply a proportionate change in local and import purchases by the trades sectors. With "merchandise purchased for resale" removed from the trades sectors inputs, and shown as direct sales to final consumers, it is possible to deal individually with the final demands affected by consumption changes and thereby obtain more precise estimates of local economic consequences of such changes. Through the producer price approach, the trades sectors are considered for the production of trades services regardless of the origin of the merchandise which passes through them.

Data Collection Procedures

Data required to calculate the input-output transactions and input coefficients were obtained from secondary sources both in published and unpublished forms and primary sources in the form of individual establishment transactions. Secondary data were obtained from published materials and tabulations of official censuses. Primary data were obtained through interviews of a sample of establishments.

Census and other published data were used in estimating and calculating total outputs (control totals) for individual sectors of the model. Primary data were used in estimating control totals not available elsewhere and in estimating the individual cells of the transactions and input coefficients tables of the input-output model. The study year was 1967, the most recent year for which complete census data were available. All surveys and unpublished data pertain to calendar year 1967 or the fiscal year which most closely represents calendar year 1967.

Secondary Data

Data reported at various levels of detail, in terms of four-, three-, and two-digit Standard Industrial Classification codes for the 1967 Census of Manu-

facturing, Mining, Construction, Wholesale Trade, Retail Trade, Selected Services, and Governments were used in the calculation of control totals for sectors of the regional and state models. All data were summarized by sector, for each region and the state.

Other data documents published by the U. S. Government provided useful industry data. Among those were publications of the U. S. Bureau of Mines, Office of Economic Opportunity, Federal Power Commission, Interstate Commerce Commission, Federal Communications Commission, U. S. Department of Agriculture, and U. S. Department of Commerce. Texas state agency files were the source of Texas state expenditures, tax, mining, transportation, employment, banking, insurance, and credit data.

A major part of the analyses of agricultural sectors was done from secondary data. This approach was possible because various agencies of the U. S. Department of Agriculture, Texas A&M University, The Texas Agricultural Experiment Station, Texas Tech University, and the Texas Department of Agriculture have established and maintained agriculture data files. Current data on production by crop and livestock enterprise by county provided base-year output data. Various published farm management and marketing studies provided the information from which agricultural sector inputs were calculated.

Primary Data

Whereas secondary data were used to calculate total outputs of each sector of the input-output model, the transactions among sectors were estimated from primary data obtained from a sample of establishments of each of the non-agricultural sectors. The list of Texas establishments, classified by four-digit SIC code, in the case of manufacturing establishments, and three-digit SIC code, in the case of all other non-agricultural establishments, was grouped into economic sectors by region (Table 13).^{14/} The list was further stratified into three employment-size groups: establishments with 1-19 employees, establishments with 20-249 employees, and establishments with 250 or more employees. Primary data collection was done through personal interviews and mail surveys of a sample of establishments within each sector. The sampling procedure and sample fractions are explained below.

A random sample, with replacement, was drawn for each of the nine regions from each employment-size strata in the manufacturing, wholesale trade, retail trade, and services sectors, with the exception that 100 percent of the manufacturing and services sectors having 250 or more employees were included in the

^{14/} The list used was the Texas Employment Commission List of establishments that report for unemployment insurance tax purposes. Establishments that employ four or more persons are required to participate in the unemployment insurance program. Others may participate.

Table 13. Sectors and the Four-Digit Standard Industrial Classification Codes (SIC) Contained Within each Sector of the Statewide Input-Output Model^{a/}

Sector Number	Sector Name	SIC's Contained Within Sector
<u>Agriculture, Forestry and Fisheries:</u>		
1	Irrigated cotton	0112
2	Irrigated food grains	0113
3	Irrigated feed grains	0313
4	Other irrigated crops	0119, 0122, and 0123
5	Dryland cotton	0212
6	Dryland food grains	0213
7	Dryland feed grains	0413
8	Other dryland crops	0114, 0141, 0190, and 0219
9	Range livestock production	0139 and 0235
10	Feedlot livestock production	0135 and 0136
11	Dairy	0132
12	Poultry and eggs	0133 and 0134
13	Agricultural supply except farm machinery	5962 and 5969
14	Cotton ginning	0712
15	Agricultural services ^{b/}	0713, 0714, 0715, 0719, 0722, 0723, 0729, 0731, and 0741
16	Primary forestry	0811, 0822, 0823, 0844, 0843, 0851 and 0861 plus stumpage value of timber harvested
17	Fisheries	0912, 0913, 0914, 0919, and 0989
<hr style="border-top: 1px dashed black;"/>		
<u>Mining:</u>		
18	Crude Petroleum	1311
19	Natural gas liquids	1321
20	Oil and gas field services	1381, 1382, and 1389
21	Other mining and quarrying	1011, 1021, 1031, 1051, 1062, 1064, 1069, 1081, 1092, 1093, 1094, 1099, 1411, 1422, 1423, 1429, 1442, 1466, 1452, 1453, 1454, 1455, 1456, 1459, 1476, 1492, 1477, and 1499

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
<u>Construction:</u>		
22	Residential construction	15111, plus subcontractors parts of two-digit SIC 17
23	Commercial, educational, and institutional construction	15112, plus subcontractors parts of two-digit SIC 17
24	Industrial construction	15113, plus subcontractors parts of two-digit SIC 17
25	Facility construction	1611 and 1621
26	Maintenance and Repair	Maintenance and Repair part of two-digit SIC 17

<u>Manufacturing:</u>		
27	Meat products	2011 and 2013
28	Poultry products	2015
29	Dairies	2021, 2022, 2023, 2024, and 2026
30	Grain milling	2041, 2043, 2044, 2045, and 2046
31	Animal feeds	2042
32	Bakery products	2051 and 2052
33	Canned, preserved, pickled, dried and frozen foods	2031, 2032, 2033, 2034, 2035, 2036, 2037, and 2038
34	Other food and kindred products	2061, 2062, 2063, 2071, 2072, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, and 2121
35	Beverages	2082, 2084, 2086, and 2087
36	Textile mill products	2211, 2221, 2231, 2241, 2251, 2253, 2256, 2259, 2261, 2262, 2269, 2271, 2272, 2279, 2281, 2284, 2291, 2293, 2294, 2295, 2297, 2298, and 2299
37	Mens and boys, women and misses and children furnishings	2311, 2321, 2322, 2323, 2327, 2328, 2329, 2331, 2335, 2336, 2337, 2339, 2341, 2342, 2351, 2352, 2361, 2363, and 2369

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
38	Related apparel	2371, 2381, 2384, 2385, 2386, 2387, 2389, 2391, 2392, 2393, 2394, 2395, 2396, 2397, and 2399
39	Logging	2411
40	Lumber mills	2421, 2426, and 2429
41	Millwork and wood products	2431, 2432, 2433, 2441, 2442, 2443, 2445, 2491, and 2499
42	Wood furniture and fixtures	2511, 2512, 2515, 2519, 2521, 2531, 2541, 2591, and 2599
43	Metal furniture and fixtures	2514, 2522, and 2542
44	Paper and paper mills	2611, 2621, 2631, and 2661
45	Paper products except boxes and containers	2641, 2642, 2643, 2645, 2646, 2647, and 2649
46	Boxes and paper containers	2651, 2652, 2653, 2654, and 2655
47	Newspapers	2711
48	Publishing	2721, 2731, and 2741
49	Printing	2732, 2751, 2752, and 2753
50	Manifold business forms	2761
51	Other printing and publishing	2771, 2782, 2789, 2791, 2793, 2794, and 2799
52	Chlorine and alkalies	2812 and 2813
53	Cyclic crudes and intermediates and inorganic pigments	2815
54	Organic chemicals	2818
55	Inorganic chemicals	2819
56	Fibers, plastics	2821, 2823, and 2824
57	Synthetic rubber	2822
58	Drugs	2831, 2833, and 2834
59	Agricultural chemicals	2871, 2872, and 2879

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
60	Soaps, Cleansers and toiletries	2841, 2842, 2843, and 2844
61	Paints and varnishes	2851
62	Other chemicals	2861, 2891, 2892, 2893, 2895, and 2899
63	Petroleum refining	2911
64	Other petroleum products	2951, 2952, 2992, and 2999
65	Tires	3011
66	Fabricated rubber products	3069
67	Plastics products	3079
68	Leather and leather products	3111, 3121, 3131, 3141, 3142, 3151, 3161, 3171, 3172, and 3199
69	Glass	3221, 3229, and 3231
70	Clay	3251, 3253, 3255, 3259, 3261, 3262, and 3269
71	Cut stone and other clay and shell products	3281, 3291, 3292, 3293, 3295, 3296, 3297, 3299, 3274, 3275 and 3201
72	Cement and concrete products	3241, 3271, 3272, and 3273
73	Blast furnaces	3312
74	Primary steel and iron	3313, 3315, 3316, and 3317
75	Foundries	3321, 3322, and 3323
76	Nonferrous primary and secondary smelting	3331, 3332, 3333, 3339, and 3341
77	Aluminum smelting and non-ferrous rolling and drawing	3334, 3352, 3356, and 3357
78	Castings and forgings	3361, 3362, 3369, 3391, 3392, and 3399
79	Fabricated steel	3441
80	Plate work	3443
81	Sheet metal and architectural	3444, 3446, and 3449

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
82	Metal doors	3442
83	Fabricated metal products	3411, 3421, 3423, 3425, and 3429
84	Plumbing	3431, 3432, and 3433
85	Bolts, nuts and screws	3451, 3452, and 3461
86	Electroplating, coating and engraving	3471 and 3479
87	Valves and pipe fittings	3494 and 3498
88	Other fabricated metal	3481, 3491, 3492, 3493, 3496, 3497, and 3499
89	Farm, construction and industrial machinery	3522, 3531, and 3537
90	Materials handling machinery and equipment	3534, 3535, and 3536
91	Mining machinery and equipment	3532 and 3533
92	Engines	3511 and 3519
93	Metal working machinery	3541, 3542, 3544, 3545, and 3548
94	Industrial processing machinery	3551, 3552, 3553, 3554, 3555, and 3559
95	General industrial machinery	3561, 3562, 3564, 3565, 3566, 3567, and 3569
96	Refrigeration machinery	3585
97	Computers, accounting, office and service industry machinery	3571, 3572, 3573, 3576, 3579, 3581, 3582, 3586, 3589, and 3599
98	Electric instruments and apparatus	3611, 3612, 3613, 3621, 3622, 3623, 3624, 3641, 3642, 3643, 3644, and 3629
99	Electric household equipment	3631, 3632, 3633, 3634, 3635, 3636, and 3639
100	Electronic communications equipment	3651, 3652, 3661, 3662, 3671, 3672, 3673, 3674, and 3679

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
101	Other electrical apparatus	3691, 3693, 3694, and 3699
102	Aircraft	3721 and 3728
103	Aircraft engines	3722
104	Other aircraft	3723 and 3729
105	Motor vehicles and parts	3711, 3712, 3713, 3714, and 3715
106	Ship and boat building	3731 and 3732
107	Other transportation equipment	3741, 3742, 3751, 3791, and 3799
108	Scientific instruments	3811
109	Mechanical measuring devices	3821 and 3822
110	Medical instruments	3841, 3842, and 3843
111	Photographic, time and optical instruments	3831, 3851, 3861, and 3871
112	Games and toys	3941, 3942, and 3949
113	Other manufacturing industries	3911, 3913, 3914, 3931, 3951, 3952, 3953, 3955, 3961, 3962, 3963, 3964, 3982, 3983, 3984, 3987, 3991, 3993, 3994, 3995, and 3999

Transportation:

114	Railroad transportation	4011, 4013, 4021, and 4041
115	Intercity rural highway transportation	4131 and 4132
116	Motor freight transportation and local trucking and storage	4212, 4213, 4214, 4222, 4223, 4224, 4225, 4226, and 4231
117	Water transportation	4411, 4421, 4441, 4452, 4453, 4454, 4459, 4463, 4464, and 4469
118	Air transportation	4511, 4521, 4582, and 4583
119	Pipeline transportation	4612, 4613, and 4619

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
120	Local and suburban transportation	4111, 4119, and 4121
121	Other transportation services	4141, 4142, 4151, 4171, 4172, 4712, 4721, 4742, 4782, 4783, 4784, and 4789

<u>Communications:</u>		
122	Telephone and telegraph	4811 and 4821
123	Radio and TV	4832 and 4833
124	Other communications	4899

<u>Utilities:</u>		
125	Gas services	4922, 4923, 4924, and 4925
126	Electric services	4911
127	Water and sanitary services	4941, 4952, 4953, 4959, 4961, and 9302

<u>Wholesale Trade:</u>		
128	Wholesale auto, parts and supplies	5012, 5013, and 5014
129	Wholesale groceries and related products	5041, 5042, 5043, 5044, 5045, 5046, 5047, 5048, and 5049
130	Wholesale farm products and farm product warehousing	4221, 5052, 5053, and 5059
131	Wholesale livestock	5054 and 4731
132	Wholesale machinery, equipment and supplies	5081, 5082, 5083, 5084, 5085, 5086, 5087, and 5088
133	Wholesale petroleum and petroleum products	5092
134	General wholesale	5022, 5028, 5029, 5033, 5034, 5036, 5037, 5039, 5063, 5064, 5065, 5072, 5074, 5077, 5091, 5093, 5094, 5095, 5096, 5097, 5098, and 5099

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
<u>Retail Trade:</u>		
135	Lumber yards	5211
136	Farm equipment dealers	5252
137	Hardware, heating, electrical, paint and wallpaper	5221, 5231, 5241, and 5251
138	Department and variety stores	5311, 5321, 5331, and 5399
139	Food stores	5411, 5421, 5431, 5441, 5451, 5462, and 5499
140	Automotive dealers and repair shops	5511, 5521, 5531, 7531, 7534, 7535, 7538, 7539, 7542, and 7549
141	Gasoline service stations	5541
142	Apparel and accessory stores	5611, 5621, 5631, 5641, 5651, 5661, 5671, 5681, and 5699
143	Furniture, home furnishings and equipment stores	5712, 5713, 5714, 5715, 5719, 5722, 5732, and 5733
144	Eating and drinking places	5812 and 5813
145	Other retail	5341, 5351, 5591, 5592, 5599, 5912, 5921, 5932, 5933, 5942, 5943, 5952, 5953, 5971, 5982, 5983, 5984, 5992, 5994, 5995, 5996, 5997, and 5999

<u>Finance, Insurance and Real Estate:</u>		
146	Banking and credit agencies	6011, 6022, 6023, 6024, 6025, 6026, 6027, 6028, 6032, 6033, 6034, 6042, 6044, 6052, 6053, 6054, 6055, 6056, 6059, 6112, 6113, 6122, 6123, 6124, 6125, 6131, 6142, 6143, 6144, 6145, 6146, 6149, 6152, 6153, 6159, and 6161
147	Insurance carriers	6312, 6313, 6319, 6322, 6323, 6324, 6329, 6332, 6333, 6339, 6351, 6352, 6361, 6399, and 6411

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
148	F.I.R.E. nec	6211, 6221, 6231, 6281, 6512, 6513, 6514, 6515, 6516, 6517, 6518, 6519, 6531, 6541, 6552, 6553, 6561, 6611, 6711, 6722, 6723, 6724, 6725, 6732, 6733, 6792, 6793, 6794, and 6799

Services:

149	Legal services	8111
150	Lodging services	7011, 7021, 7031, 7032, and 7041
151	Personal services	7211, 7212, 7213, 7214, 7215, 7216, 7217, 7218, 7231, 7241, 7251, 7261, 7271, and 7299
152	Advertising	7311, 7312, 7313, and 7319
153	Duplicating and addressing	7331, 7332, and 7339
154	Employment agencies; private	7361
155	Photographic services	7221, 7813, 7814, 7815, 7816, 7817, 7818, 7821, and 7395
156	Research and development	7391 and 8921
157	Other business services	7321, 7341, 7342, 7349, 7351, 7392, 7393, 7394, 7396, 7397, 7398, and 7399
158	Motion picture, amusement and recreation services	7832, 7833, 7911, 7929, 7932, 7933, 7941, 7942, 7943, 7945, 7946, 7947, 7948, and 7949
159	Automobile rental services	7512, 7513, and 7519
160	Automobile parking	7523 and 7525
161	Electrical repair	7622, 7623, and 7629
162	Miscellaneous repair services	7631, 7641, 7692, 7694, and 7699
163	Physicians and dentists services	8011, 8021, 8031, and 8041
164	Hospital and laboratory services	8061, 8071, and 8072

 (Continued)

Table 13 Continued

<u>Sector</u> <u>Number</u>	<u>Sector Name</u>	<u>SIC's Contained Within Sector</u>
165	Other medical services	8092 and 8099
166	Education (public and private)	8211
167	Colleges and universities	8221 and 8222
168	Other educational services	8229, 8231, 8241, and 8242
169	Engineering and architectural services	8911
170	Accounting, auditing and bookkeeping	8931
171	Other professional services	8999
172	Other services	8411, 8421, 8611, 8621, 8631, 8641, 8651, 8661, 8671, 8699, and 8811

Other Manufacturing:

173	Ordnance and ordnance accessories	1911, 1925, 1929, 1931, 1941, 1951, 1961, and 1999
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Other Services:

174	Outdoor recreation
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Final Payments:

175	Scrap
176	Households
177	Property payments
178	Federal government
179	State government
180	Local government
181	Imports
182	Depreciation

(Continued)

Table 13 Continued

Sector Number	Sector Name	SIC's Contained Within Sector
<u>Final Demand:</u>		
177	Federal government defense	9119, 9123, 9128, 9136, 9137 9190, 9710, 9711, 9721, and 9731
178	Federal government non- defense	9108, 9109, 9141, 9144, 9147, 9160, 9161, 9163, 9180, 9182, 9185, 9187, and 9199
179	State government	9241, 9244, 9282, 9285, 9287, 9291, and 9299
180	Local government	9341, 9382, 9385, 9387, 9391, and 9399
181	Exports	
182	New capital investments	
183	Inventory change	

a/ Standard Industrial Classification Manual - 1967, Executive Office of the President/Bureau of the Budget, Washington, D. C.

b/ Livestock auctioning of SIC 0729 is contained in 131 sector.

sample. For the other two employee-size strata the sampling fractions varied as follows. At least one establishment was selected from each manufacturing and service sector strata, two were drawn for manufacturing sectors if the strata population exceeded five, and if the manufacturing strata population exceeded 20, a ten percent proportionate sample was drawn. First and second alternates were selected according to the same criteria. The state sample was the sum of the nine regional samples. The service sector sample selection criteria was analogous to that used in the manufacturing sectors. The sample fraction in the strata having more than 20 establishments was one percent instead of ten percent as was the case in manufacturing.

In wholesale and retail trade sectors the sample was drawn in two stages for each SIC class of trade establishments after the list of trade establishments was adjusted to exclude establishments of four-digit SIC's for which total sales in Texas were less than one-half of one percent of total sales of the sector in which that SIC appeared. The two stage sample procedure for each SIC class of trade establishments was as follows: (1) random selection of three regions from the population of Regions 1, 2, 3, 5, 7 and 9 with Regions 4, 6 and 8 always represented,^{15/} and (2) random selection of sample establishments from each size strata of each SIC from each sample region's list of establishments (if the list did not contain three or more establishments, an alternate region was drawn for that SIC). The sample fractions of each SIC of both the wholesale and the retail trades sectors were 50 percent for the strata having 100 or more employees and two establishments per SIC for establishments having 20-99 employees. In the wholesale trades sectors, one establishment per SIC was selected from the strata having 10-19 employees and in the retail trades sectors one establishment per SIC was drawn from the strata having 6-19 employees. The sample establishment was selected at random and alternate sample units were drawn from the cluster of five establishments created when the randomly selected sample establishment was considered as the central member of the cluster for that particular list; i.e., a five establishment cluster was located by randomly selecting the sample establishment. The alternates were then chosen from the two establishments listed immediately above and below the sample establishment.

In the mining, construction, transportation, communications, utilities, finance, insurance, and real estate sectors, the sample fraction was smaller and the random sampling technique was not used. The sampling procedure was modified in light of the hypothesis that these individual groups of sectors have homogeneous markets and homogeneous inputs. In addition, within these individual groups, in some cases, a

^{15/} See map of Figure 1 for regional boundaries.

few large establishments dominate the sectors, and also, in some cases, there were relatively small numbers of establishments per sector as in the case of natural gas, electric utilities, and communications groups. Published reports, other secondary data, and informed industry representatives provided information and guidance in the selection of a representative sample of these sectors for each of the nine regions of the state.

No surveys were conducted in the final demand and final payments sectors. Data for these sectors were obtained from secondary sources and the responses to questions in surveys of the producing sectors.

Questionnaires were designed and pretested for each identifiable type of sector prior to initiation of surveys. Modifications were made to accommodate differences in terminology and accounting systems among sector groups. The data requested included number of employees, a detailed list of sales and purchases, taxes, inventory changes, and depreciation. During the interviews, accounts of the sample establishments of each sector were classified and recorded according to sector definitions of the input-output model. In addition, region of origin of inputs (purchases) and region of destination of outputs (sales) were requested.

Survey Procedures

Interviews of sample establishments were conducted by the staff of each respective region. Prior to the interviewer call, sample establishments were mailed a one-page letter from the Governor in which the project purposes were outlined and participation was invited. An enclosure briefly explained input-output models and data requirements. Interviewers then called on each sample establishment, made further explanations and secured data from establishments willing to participate. This process was repeated for an alternate establishment when it was not possible to secure an interview from a sample establishment.

Questionnaires were completed in a variety of ways, including complete enumeration of establishment accounts for 1967. Establishment accounts were sampled to reduce the amount of time and work required to secure data from establishments having a large number of accounts. In some cases, the interview teams did the necessary tabulations; in others, establishment personnel provided the data, and in still others, establishment personnel and interviewers worked together to secure the data and complete the questionnaire. Some interviews were completed from annual reports and other materials made available by the sample establishments. A small number of interviews were completed on a person-to-person basis with reliance on percentage estimates of inputs and outputs by type of input supplies and product customers.

Upon interview completion, questionnaires were edited. During the editing process, the classification of individual sales and purchases transactions was completed, reviewed, and corrected when found to be in error. The sum of sales

transactions was compared with the sum of purchases transactions. If these two sums differed, additional information was sought from the sample establishment for the purpose of balancing sales and purchases. Data from other interviews of the same sector were used to assist in identifying "missing" inputs and to estimate dollar values of such inputs when the cost estimates of these values could not be obtained from the sample establishment in question. If perfect balance could not be obtained, it was assumed that as much as 10 percent of reported gross sales could be included among the purchases as payments to capital. Some questionnaires could not be completed within these guidelines and were discarded. An attempt was made to secure an alternate interview for each discarded questionnaire. Following the editing, the acceptable questionnaires were coded for electronic data processing. A standard coding procedure was followed in each region.

Total Outputs

In earlier sections of this report, eleven major groups of sectors of the Texas economy were named and briefly described as to the nature of the contents of outputs and inputs of each. Calculation of the dollar value of each individual sector's total value of outputs is an essential part of the preparation of an input-output model. The purpose of this section is to present a detailed enumeration of the major sources from which data were obtained for the purpose of calculating total outputs (control totals) of the sectors of each major industry and business group.

It is reiterated for emphasis, that total value of outputs of each sector are expressed in the input-output model in terms of prices f.o.b. the shipper for products and in terms of gross billings for services. This is known as the "producer price" concept.

Various national and state agencies collect, organize, and disseminate statistics about gross production of specified industries. No single agency deals with the entire list of economic sectors and, in fact, some important economic activity is not included in either the state or the national statistical series. Thus, it was necessary to assemble the available published and filed statistics, perform standardizing calculations and adjustments and compile the necessary estimates of total outputs per sector.

In most cases, the individual sector total outputs were obtained from secondary sources including publications of the U. S. Bureau of the Census and publications of Texas state agencies. The data sources for each major economic group are listed and discussed briefly below.

Agriculture, Forestry, and Fisheries

Agricultural products were valued at 1967 market prices with government payments to farmers included separately as a part of farm income. In the input-output

model, government payments to farmers were entered commodity by commodity and were included as a part of the outputs of each respective sector. The transaction table shows these payments from the federal government sector to the individual commodity sectors. Thus, government payments to farmers were treated as purchases from the farm sectors even though no actual purchase was made; i.e. commodities were not necessarily delivered to the federal government in exchange for the income payments received by the respective farm sectors.

Estimates of state total outputs of the agriculture (farming) sectors were obtained from Texas Crop and Livestock Reporting Service published statistics of agricultural commodity production in Texas in 1967. The Texas Crop and Livestock Reporting Service obtained and began annual publication of county statistics of commodity production for the 1968 crop year. The 1968 data were used as the basis for calculating total outputs for each of the nine regions for the 1967 study year based on the assumption that production in 1967 followed the same regional distribution observed in 1968.

Agricultural data were also obtained from the 1964 Census of Agriculture and, in some cases, it was necessary to fill data gaps with special computations using production and unit price data from other reports and published studies. Cottonseed tonnage produced in Texas was obtained from U. S. Department of Agriculture data for 1967. Average weight per head of fed cattle was obtained from Raymond A. Dietrich's "The Texas-Oklahoma Cattle Feeding Industry," Texas A&M University Report B-1079, July 1966 to June 1967. Average weight per head of non-fed cattle was obtained from "Texas Livestock Statistics--1968." Cash receipts for the sale of goats in 1967 were obtained from "Cash Receipts from the Sale of Texas Farm Commodities," Bulletin 48. The value of output for catfish farming was obtained from the Texas Agriculture Extension Service. Government payments to farmers, under the conditions of U. S. Government farm price and income programs, were obtained from the Agriculture Stabilization and Conservation Service Reports for 1967.

Estimates of total outputs for the agriculture supply and farm machinery sector were made directly from the 1967 Census of Business--Retail Trade value of sales. The "trade margins" estimated from the survey were applied to census reported gross sales to obtain the appropriate total value of output for this sector (see discussion of the Wholesale and Retail trade sections below).

For the cotton ginning sector, cost per bale and total quantity of cotton ginned were obtained from the U. S. Department of Agriculture's Charges for Ginning Cotton, ERS-2(1969), May 1969 and Summary Report of Texas Cotton and Related Data, Cotton Economic Research, The University of Texas at Austin. The total output or control total is the gross value of billings for cotton ginning services rendered at the cotton gin.

Value of output of the agricultural services sector was estimated by summing the individual crop and livestock sector estimated purchases of custom tillage, spraying and harvesting services. The control total was defined as the gross billings for services rendered at the point at which the service was performed.

Total value of the primary forestry sector output was defined as "stumpage value" of sawlogs, veneer logs, pulpwood, posts, pilings, firewood, and miscellaneous forest products. Stumpage value for forestry was obtained from "The Primary Wood-Using Industries of East Texas -- 1968," publication of the Texas Forest Service.

Fisheries output estimates were expressed in terms of total values of fish catch at the landing point of the catch. These data were obtained from Economic Impact Analysis of Texas Marine Resources and Industries -- Texas A&M University, and from Texas Landings--1967, U. S. Department of the Interior.

Mining

Value of production of crude petroleum, as measured at oil and gas wells, were obtained from the Railroad Commission of Texas, Annual Report of the Oil and Gas Division: 1967. Average price was applied to volume to obtain an estimate of total value of output. Total outputs of natural gas liquids (as a combination of value of liquids produced at other plants, and at cycling plants) were obtained from the Bureau of Mines, Minerals Yearbook, 1967 (Washington, D.C.: U. S. Government Printing Office, 1968) and the Railroad Commission of Texas, Annual Report of the Oil and Gas Division: 1967, Austin, Texas.

Total value of output (gross value of billings at the point of delivery of service) for oil and gas field services was obtained from the U. S. Department of Commerce, Bureau of the Census, 1967 Census of Mineral Industries: Oil and Gas Field Services (U. S. Government Printing Office, Washington, D.C., 1970). In this case, the sector provides the transportation to the point of producing the service and includes this as a part of the inputs.

Total output for the "other mining and quarrying" sector, which includes sulphur, sand and gravel, was estimated from data on tons produced and average price per ton. The sources of the data were the Oil and Gas Division of the Texas Comptroller's Office and the Texas Parks and Wildlife Department.

Construction

Total estimated value of outputs for the construction sectors was obtained from the 1967 Census of Construction; U. S. Department of Commerce. Total output was expressed as the reported Texas gross value of construction put-in-place. Highway and other public facility construction financed from government funds was included in the facility construction sector; government sectors were reduced by an equivalent dollar amount. The cost of transportation of building materials to the construction site was included among the inputs.

Manufacturing

The control totals (total value of output) for the 88 manufacturing sectors (including ordnance) were estimated from the value of shipments as reported in the 1967 Census of Manufacturers--Texas, Department of Commerce, Bureau of the Census. Total value of output was expressed in terms of dollar values f.o.b. the shipper. Some of these sectors are last stage processors of finished goods and some are processors of materials which are moved into other manufacturing activities. Under the producer price concept, the purchaser pays the transportation from the point of shipment to the purchaser's receiving point. In the case of finished goods, the cost of transportation on shipments from the factory is charged to the consumers or the household sector.

Transportation

The transportation sector control totals and transactions were expressed in terms of gross billings for services rendered. Total outputs for the railroad companies, intercity buslines, and motor freight lines were the sums of gross income as reported to the Railroad Commission of Texas in the annual reports of individual establishments. Total value of output of commercial airlines was defined in the same manner as total output for the other transportation sectors. The data were obtained from the Air Transportation Association, Washington, D.C., and included gross receipts received for the transportation of passengers and commodities within and to and from Texas.

Since establishments engaged in producing water transportation services do not regularly report gross revenues, water transportation establishments were surveyed by mail and total output for 1967 was estimated from the sample data.

Pipeline transportation establishments, local and suburban transportation, and other transportation sectors were surveyed by mail and the control totals were estimated from the sample data since no published data were available for these sectors. Pipeline transportation includes the movement of crude oil and other petroleum in liquid form. Natural gas transmission is included in the natural gas utilities sector.

Communications

Total value of output for the telephone and telegraph sector was calculated from the gross receipts statements of Texas revenue as reported to the State Comptroller's Office. Data were also obtained from the Federal Communication Commission's Statistics of Communication Carriers for 1967.

Estimates of total outputs (gross billings) of radio, television, and other communications were made from AM-FM Broadcast Financial Data--1967, Federal Communications Commission, Washington, D.C., February 7, 1969 and T.V. Broadcast Financial Data--1967, Federal Communications Commission, Washington, D.C., December 31, 1968.

Utilities

Natural gas output was measured at its value when sold to the consumer. This is slightly different from the treatment of other sectors and is done because the natural gas transmission establishments of the utilities sectors transport natural gas from the point of production to the point of consumption. Since it was not possible to separate the transportation and the value of the gas, it was necessary to define the control total of natural gas services in terms of the value upon delivery to consumers. Transmission costs were included as a part of the inputs of the natural gas utilities sector.

Data for the natural gas services control total were obtained from the individual establishment annual reports to the Gas Utilities Division of the Railroad Commission of Texas.

Total revenue from sales of electricity were obtained from Edison Electrical Institute's Statistical Yearbook of the Electric Utility Industry for 1967, No. 35, (New York: Edison Electrical Institute, September 1968). The control total for the electric service industry is expressed in the same terms used for the natural gas industry; i.e., the value of electric service is expressed as dollar value delivered to consumers. The problem here is the same as that for natural gas in that electric utility establishments generate and deliver electric service to consumers. In the process, the establishments pay the cost of fuel, the transportation cost of moving fuel from point of production to point of use for electric generation and transmit electric energy to the consumer. Consequently, electric service was valued at the point of consumption.

Water and sanitation data were obtained directly from the expenditures of local governments as reported in the 1967 Census of Governments--Local Governments, Report No. 43, Texas, U. S. Department of Commerce, Bureau of the Census, Table 32, and were expressed as the value of the service delivered to the consumer.

Wholesale Trade

Total value of output of the wholesale trade sectors was defined as the "markup" on merchandise purchased for resale minus transportation cost from the shipping to the receiving point. The wholesale trade sector control totals were calculated from survey and published data as follows: The total gross values of sales for the wholesale trade sectors were obtained from the 1967 Census of Business--Wholesale Trade, Texas, Tables 4, 5, and 6. The individual wholesale trade sector trade margins estimated from the Texas input-output survey data were applied to the total sales to obtain estimates of the control totals.

Retail Trade

The retail trade sector control totals were defined and estimated in the same way as the wholesale trade sectors with the exception of the restaurant sector. The

total gross values of sales by each individual retail trade sector were obtained from the 1967 Census of Business--Retail Trade, Texas, Table 3. The respective retail sector trade margins, estimated from the Texas Input-Output Model survey data, were applied to total retail sales to obtain estimates of individual retail trade sector control totals. The one exception was the "eating and drinking place" sector. For this sector, merchandise purchased was included in the inputs and the outputs were thus expressed in terms of gross receipts for meals and drinks sold.

Finance, Insurance, and Real Estate

The banking and credit sector control total is the sum of total operating revenues of banks and credit agencies. The data were obtained from the "Income Statement and Condition Reports" for 1967 as reported to the Texas Banking Commission for state chartered banks and from Table C. of the Federal Deposit Insurance Corporation's Bank Operating Statistics--1967 for federally chartered banks. Total operating revenues of other credit agencies were obtained from the record files of the Texas Savings and Loan Commission and the Federal Savings and Loan League. Total operating revenues of the Federal Land Bank and Bank of Cooperatives were obtained from a direct mail survey; total operating revenues of firms engaged in other consumer credit in Texas were obtained from the files of financial statements reports to the Texas Consumer Credit Commission. Total operating revenues for business audit institutions and loan correspondants and brokers were estimated from data obtained by mail surveys of this group of establishments.

The control total for insurance sectors was defined as the sum of premiums, interest and dividends of insurance carriers, and insurance agents. Data were obtained from annual financial reports of insurance carriers made to the Texas Insurance Commission. The total premiums collected for fire and casualty type policies were summed from the reports and entered as a part of the control total for the sector. Health and accident insurance was treated the same way. The component attributable to life insurance was estimated as the cost of selling and servicing life insurance policies. Reported life insurance premiums were adjusted (reduced) by the concomitant reported increase in cash value of life insurance so that cash value would not be included in the total outputs of the insurance sectors. Life insurance cash values were considered to be savings of the household sectors.

Establishments engaged in the rental and lease of real estate and commodity and stock brokers were included in the "F.I.R.E. not elsewhere classified" sector. Total value of output of this sector was defined as the gross billings for lease and rental of office space, brokerage fees and rent for the use of real estate. Since there were no published statistics nor financial reports from which to calculate control totals for this sector, the results of a mail survey were used. Estimated establishment means were applied to the total number of establishments to obtain the desired control total estimates.

Services

Total value of outputs for services was defined as the gross billings for services rendered at the point at which the services were delivered. The sources of the data from which service sector control totals were estimated are outlined below.

An average annual income for practicing lawyers was used to estimate the legal sector control total. This information was obtained from a 1966 Economic Survey of Texas Practicing Lawyers made by the Texas Bar Association. The 1966 data were adjusted to 1967 by applying the 1967 general price index.

The following sectors are within the classifications listed by the 1967 Census of Business--Selected Services for Texas: lodging services, personal services, advertising, duplicating and addressing, private employment agencies, photographic services, research and development, business services, motion picture, amusements and recreation services, automobile rental service, automobile parking, automobile repair, and miscellaneous repair services. The total sales for these sectors were obtained from 1967 Census of Business--Selected Services; Texas.

Control totals for physicians and dentists, other medical services, engineering and architectural services, accounting, auditing and bookkeeping, and all other professional services were estimated from income data published for these groups in the 1967 Statistics of Income--Business Income Tax Returns, and from total annual wages paid by the establishments classified in these SIC groups as reported to the Texas Employment Commission.

The control total for hospital and laboratory services was gross-patient-revenue. The data were obtained from an American Hospital Association survey of member hospitals and laboratories for 1967.

The control totals for education sectors were defined as the total funds spent for primary, secondary and higher education during the 1967 school year. The data were obtained from secondary sources, including reports and records of the Texas Education Agency, college, university, and junior college budgets and the Office of the Comptroller of Public Accounts. Expenditures for education were removed from local and state government spending since these activities were included as individual processing sectors in the input-output model.

The elementary and secondary school education control total was the sum of operating expenses, school lunch program expenses, and debt service of public elementary and secondary schools reporting to the Texas Education Agency, plus textbook costs as reported in state government expenditures.

The control total for colleges and universities was obtained from the Texas College Coordinating Board summaries of operating expenses of public junior colleges, colleges and universities plus an imputed private college and university component. The latter was estimated by assuming that cost per student at private educational institutions was equal to that computed for public educational institutions. Cost

per student was applied to 1967 enrollment at private institutions to obtain the desired estimate.

Since budget data for the "other educational services" sector were not available in published or reported form, survey data were used to estimate total outputs by applying sample survey estimates of mean output per establishment to total number of establishments as determined from the Texas Employment Commission list of employers classified in this group.

The control total for the sector entitled "Other Services" which includes charity, church, and non-profit associations and fraternities, was estimated from national data, since no other suitable data were available. It was assumed that Texas per capita spending for these services was equal to national per capita spending as estimated in the 1967 U. S. Input-Output tables for this sector. Per capita spending for "other services" was applied to Texas population estimates for 1967 (10.8 million persons) to obtain the control total estimate.

Outdoor Recreation

The control total for outdoor recreation was defined as the total public funds spent in the operation and administration of outdoor recreation facilities by the Texas Parks and Wildlife Department plus those funds spent by counties, cities, and municipalities for the same purposes. The data used to estimate the control totals were obtained from 1967 reports of the Comptroller of Public Accounts, 1967 city and county audit reports, and the 1967 Census of Governments, U. S. Bureau of the Census, Volume 7, State Report: Texas, Table 32. As with the education sectors, the public expenditures for the outdoor recreation sector were deleted from the state and local government sectors since this sector was included in the processing sectors. It is emphasized that consumer spending for outdoor recreation equipment such as boats, motors, campers, rifles, and other hunting and fishing equipment are not included in the outputs of this sector. The appropriate amounts of these items are included in the outputs (valued f.o.b. the shipper) of the manufacturing sectors which produced them. If the manufacturer was located out-of-state, the items are included f.o.b. the shipper as a part of the imports of Texas households.

Government Sectors

The control totals for the respective local, state and federal government sectors are defined as the total funds spent by each in the delivery of governmental services. Federal government was divided into defense and non-defense sectors. Education, facility construction, and outdoor recreation spending by state and local government were removed and placed in separate processing sectors.

The federal government--defense sector and federal government--non-defense sector control total data were obtained from total federal spending in Texas as reported by the Office of Economic Opportunity in Federal Outlays in Texas for fiscal

years 1967 and 1968. One-half of each reported fiscal year spending was used to approximate calendar year 1967 spending.

The control total for the state government sector was obtained from the total state expenditure as reported in Annual Report of the Comptroller of the State of Texas for fiscal years 1967 and 1968. It was assumed that one-half of state spending for each of fiscal years 1967 and 1968 would, when summed, reasonably approximate calendar year 1967 spending by Texas state government.

The local government control total was obtained from the total revenue and total expenses as reported in the 1967 Census of Government, U. S. Bureau of the Census, Volume 7, State Report: Texas, Table 32.

Households

The household sector total value of output was defined as personal income plus personal contributions for social insurance. Personal income includes wages and salaries, other labor income, proprietor's income, property income, and transfer payments as reported by the U. S. Department of Commerce in the Survey of Current Business, Volume 48, No. 8, August 1968, Page 16.

Capital Formation

The capital formation sector is a unique type of sector. Whereas other sectors of the input-output model are current users of inputs, the capital formation sector is the sector into which the current capital outputs or current sales of the capital producing sectors were recorded. Capital producing sectors such as construction, machinery, and equipment manufacturing sectors sell items which are used by other sectors as long term (more than one year) production inputs or for long term consumption in the case of residential and other types of construction.

In the survey, the sales of outputs of capital producing sectors were classified according to region of destination and sales recorded in the capital formation column were estimated capital sales to Texas investors. Sales of capital items to customers located outside Texas were included in the selling sector's exports. The total of the capital formation column was obtained by summing the survey estimates of capital sales by Texas capital producing sectors. It is emphasized that the capital formation column shows the estimated value of capital purchased by Texas sectors from Texas capital producing sectors. Capital imports by all sectors were estimated from the survey data and entered in the capital formation column, imports row.

Inventory Change

Inventory change for each sector was estimated from the sample survey data for those sectors that were sampled and from secondary data for agricultural sectors. The inventory change column merely displays the inventory change estimate

for each row of the matrix and does not have the same connotation as do the processing sector columns. In cases where inventory change was negative, current sales have been made from inventory; i.e. the output levels show that sales were made but the production expenses did not show that a level of inputs corresponding to outputs had been used. In cases where inventory change was positive, production expenses had been incurred but the resulting outputs had been added to inventory.

Imports

No published data were available with which to calculate imports. The imports row was estimated from survey data for those sectors that were surveyed and from secondary data for the remaining sectors. The 1967 commodity transportation survey of the U. S. Bureau of the Census provided, for selected commodities, tons shipped into Texas from each of the other states of the U. S.

Exports

As was the case with imports, the exports column was estimated from survey data since no suitable published exports data were available. The 1967 commodity transportation survey of the U. S. Bureau of the Census provided some export data in the form of tons of shipments of selected commodities.

INPUT-OUTPUT MODEL ESTIMATION TECHNIQUES

The purpose of this section is to present the methods and procedures whereby the Texas Input-Output Model was estimated. The same procedures were used at the regional level with regional data to estimate the respective regional input-output models. Thus, the state and the regional models were defined and estimated so as to produce models that were comparable from the conceptual and definitional standpoints. The data for some sectors are quite different between the state and regional models. This report does not deal with the regional models. Each individual regional input-output model was estimated separately and a report which presents and explains each is available.

Estimating Total Output of Sectors

In a previous section of this report the concepts, definitions, and data sources were set forth from which sector control totals or total outputs per sector were obtained. For the most part, total outputs for each sector were calculated from secondary data which had been compiled and reported by federal and state governmental agencies. Total value of outputs of each sector for the calendar year 1967 were calculated in terms of producer prices; i.e. f.o.b. the shipper, by summing the reported value of shipments, or value of billings in the case of services of all SIC's (Standard Industrial Classifications) contained within each sector.

The value of output for the irrigated cotton sector was the sum of the reported county values of cotton produced and sold from irrigated acres. The control total for the feedlot livestock sector was the total value of live fat cattle sold from feedlots in Texas in 1967. The control total for the primary forestry sector was the estimated stumpage value of timber, pulpwood, poles, pilings, and miscellaneous wood materials sold from Texas timberland in 1967.

The control total for Sector 18, crude petroleum was the total value of crude oil and natural gas (without liquids) pumped in Texas in 1967. Value was expressed at the well-head. The control total for a typical construction sector -- residential construction -- was the dollar value of residential construction put in place in Texas in 1967. Value of the building site was not included since this is a transfer of land from one owner to another, but the cost of land preparation, foundation work, and other development costs were included in the value of the outputs of residential as well as other types of construction.

The control total for a typical manufacturing sector such as Sector 41, millwork and wood products, was the sum of the value of shipments as reported in the 1967 Census of Manufacturers for the nine four-digit SIC codes (2431, 2432, 2433, 2441, 2442, 2443, 2445, 2491, and 2499) assigned to Sector 41. Control totals for each of the other manufacturing sectors were defined and calculated in the same way.

Control totals for the individual transportation sectors were defined as the sum of billings for transportation services performed by each type of carrier. For example, the rail transportation sector (Sector 114) control total was the sum of Texas billings in 1967 by all rail establishments operating within Texas.

Control totals for communications sectors were defined as gross billings for services performed. In the case of telephone and telegraph, control totals were the sum of revenues collected by Texas establishments that supply telephone and telegraph services minus taxes paid on these services by the purchasers. Control totals for radio and television were defined as the sum of collections for advertising and other income received by the individual establishments of the sector.

Control totals for utilities were defined as the sum of revenues received by utilities establishments for services or products delivered. In the case of electricity, control totals are the gross value of billings by Texas electric generating establishments in 1967. Dollar value was expressed at the point of electric service delivery. In the case of gas services, control totals are the sum of the value of billings for natural gas at the point of delivery. In the case of both electric and gas utilities, the purchase of electric service and natural gas by establishments for the purpose of distribution and resale was deleted from the totals. Thus, the utilities sectors do not contain multiple counting within the sectors. In the case of the electric service sector, the electricity generated and used within the sector could not be estimated from the data available, thus only electricity sold was included in the control totals. The intrasector use of electricity was set at zero.

Control totals for both wholesale and retail trade sectors were defined as the "trade margins" or mark-up on goods purchased and resold. Control totals were estimated individually for each sector by applying the sample survey estimate of the trade margin to the gross sales reported for that sector in the 1967 Census of Wholesale and Retail Trade.

The control totals for finance sectors were calculated by summing the gross revenues received by Texas banking and credit institutions in 1967. The data were obtained from the financial institutions' annual reports and from a mail survey of financial institutions. The control totals for the insurance sectors were obtained by summing from annual reports, the interest, dividends, fire, casualty, health, and accident premiums collected and the ordinary life insurance premiums minus increase in cash value of life policies in 1967 in Texas.

The control total for real estate (Sector 148) was obtained from the sample estimate of gross revenues received by Texas establishments for the use, rental, and lease of urban real estate services such as offices and business space. This sector control total does not include the value of real estate sales since such sales are transfers of real estate capital and are not a part of current production.

Control totals for individual service sectors were defined as the sum of gross billings of establishments of each respective sector. In the case of selected ser-

vices, the necessary data were obtained from the 1967 Census of Selected Services. Special tabulations were made for physicians, dentists, hospital and other medical services. Control totals for education sectors were obtained from records of public spending for education. Estimates were made of expenditures at private educational institutions by applying cost per student for education in the public sector to the enrollment in private sector educational institutions.

Control totals for other public sectors, such as outdoor recreation, were estimated from public agency expenditures in the production of such services. In these cases the value of output was equated to total cost of production of the service.

Estimating Input-Output Tables

In the Texas Input-Output Model, four basic tables were estimated:

- (1) the transactions table,
- (2) the direct requirements table,
- (3) the direct plus indirect requirements table, and
- (4) the direct, indirect and induced requirements table.

The methods whereby empirical estimates of these tables were obtained are described below.

Control totals for each sector were calculated according to the procedures outlined above. Control totals are the dollar value of outputs as defined in Table 1 and are the row sums of the transactions table. That is to say, the transactions along each row of the table must sum to the control total or conversely the total value of output of each sector is distributed along each row to the sector's customers. In Table 1, total outputs are denoted by capital letter X's.

A stratified randomly selected sample of establishments was interviewed for the purpose of securing sales and purchases data in a form suitable for estimating individual sector coefficients that could be applied to the control totals to estimate the transactions of each sector.^{15/} Each establishment interviewed was requested to provide sales and purchases data in the following form. In the case of sales or outputs, the data obtained were (1) total sales net of discounts and rebates for 1967, (2) dollar value of sales in 1967 to each different sector of the Texas economy (Table 4), and (3) the region(s) and dollar values of sales to each region to which sales were made, including regions within Texas and export shipments out-of-state.

In the case of purchases or inputs, the data obtained were (1) total dollar value of operating expenditures in 1967, including materials, services, energy, labor, taxes paid, and depreciation allowances, (2) the dollar value of purchases in

^{15/} The sampling procedure was outlined earlier. The data code form and the sample estimating procedures are found in Cooper, D. W., Grubb, H. W., and Stern, L. H., "Data Processing Procedures and Work Flow Design," Division of Planning Coordination, Office of the Governor, Austin, Texas, March 1972. Sample size for each sector is shown in Appendix B, Table 1.

1967 from each input supplying sector of the Texas economy (Table 4), and (3) the region of location of the supplying sector including out-of-state locations. From this latter information, value of imports of both inputs and finished goods were estimated.

The sample survey sales and purchases data for each sector in which surveys were conducted (all sectors except agriculture, forestry, household and government sectors) were arrayed into separate sales and purchases matrices (Tables 14 and 15). One of the major problems encountered in the survey was the classification of transactions data as to sector and region of origin or destination and the disaggregation of the transactions between trades and non-trades sectors into merchandise purchased for resale and mark-up or trade margins. The manner in which this problem was solved is explained below.

In the survey of manufacturing sectors, it was possible to determine the sector of origin of most of the materials purchased for use in production, but in some cases the records of the establishment interviewed contained only the information that identified the wholesaler or retailer from which materials had been purchased. In like manner, on the sales side of the question, some establishments interviewed had records that permitted direct classification of the ultimate users sectors to which sales had been made, while in other cases, the records showed that sales had been made to trades sectors. Thus, it was necessary to adjust these transactions between trades and non-trades sectors to remove the merchandise purchased for resale from the empirical estimate of the trades sectors' transactions in order to obtain the desired producer price input-output model. The adjustment process is explained below.

Sample establishment purchases were classified during the data coding process into two major groups: (1) purchases from the last stage processor in which case the transaction was recorded in producer prices, and (2) purchases from a trades sector in which case the transaction was recorded in purchasers or delivered prices. Each data field was assigned a code digit that signified the class into which the transaction of that field was to be placed for computation purposes.

A two-stage estimating procedure was used in which computer editing and calculating routines examined the transactions data file field-by-field to determine whether or not sample transactions data had been classified in terms of producer prices or whether certain transactions had been entered as transactions with the trade sectors at delivered prices.^{16/} For those cases in which the data were expressed in producer prices; i.e. reported in dollar values f.o.b. the shipper, the sample data were accepted by the computer routines and entered into the appropriate

^{16/} Cooper, D. W., Grubb, H. W., and Stern, L. H., "Data Processing Procedures and Work Flow Design," Division of Planning Coordination, Office of the Governor, Austin, Texas, March 1972, Pages 39-53.

Table 14. Dollar Value Sales Transactions for n Sample Establishments in Typical Sector t

Sales by Establishments in Sector t ➔

		Purchasing Sectors				Sums	Final Demand	Total Final Demand	Total Sales
		1	2	...	m		1 P		
Sector t	Sample 1	y_{11t}	y_{12t}	...	y_{1mt}	y_{1t}	y_{1ft}	y_{1Ft}	y_{1t}
	Sample 2	y_{21t}	y_{22t}	...	y_{2mt}	y_{2t}	y_{2ft}	y_{2Ft}	y_{2t}
	Establishment .	.	.		.	.	.	.	.
	Establishment .	.	.	y_{ikt}	.	y_{itl}	y_{ift}	y_{iFt}	y_{it}
	Establishment .	.	.		.	.	.	.	.
	Sample n	y_{n1t}	y_{n2t}	...	y_{nmt}	y_{nt}	y_{nft}	y_{nFt}	y_{nt}

where y_{ikt} = Total sales by sample establishment i of sector t to local processing sector k.

y_{itl} = Total sales by sample establishment i of sector t to local processing sectors.

y_{ift} = Total sales by sample establishment i of sector t to final demand sector f.

y_{iFt} = Total sales by sample establishment i of sector t to final demand.

y_{it} = Total sales by sample establishment i of sector t.

Processing sectors include the 174 sectors defined for the Texas Input-Output Model. Final demand sectors include: Households (175), Federal Government-Defense (177), Federal Government - Non-Defense (178), State Government (179), Local Government (180), Exports (181), Capital Formation (182), and Change in Inventory (183).

Table 15. Dollar Value Purchases Transactions for n Sample Establishments in Typical Sector t

		Sector t			
		Sample Establishment Purchases			
		1	2	. . .	n
Input	1	x_{11t}	x_{12t}	. . .	x_{1nt}
Supplying	2	x_{21t}	x_{22t}	. . .	x_{2nt}
Sector	.	.	.	.	.
	.	.	.	x_{kit}	.

	m	x_{m1t}	x_{m2t}	. . .	x_{mnt}
Sums		X_{1t}	X_{2t} . . .	X_{it1} . . .	X_{nt}
Final	1	x_{f1t}	x_{f2t} . . .	x_{fit} . . .	x_{fnt}
Payments	P				
Total Final Payments		X_{F1t}	X_{F2t} . . .	X_{Fit} . . .	X_{Fnt}
Total Purchases		X_{1t}	X_{2t} . . .	X_{it} . . .	X_{nt}

Where x_{kit} = Total purchases by sample establishment i of Sector t from local processing sector k.

X_{it1} = Total purchases by sample establishment i of Sector t from local processing sectors.

x_{fit} = Total purchases (inputs) of sample establishment i of Sector t from final payments Sector f.

X_{Fit} = Total purchases (inputs) of sample establishment i of Sector t from final payments sectors.

X_{it} = Total purchases (inputs) of sample establishment i of Sector t.

Processing sectors include the 175 sectors defined for the Texas Input-Output Model. Final payments sectors include: Households (176), Federal Government (178), State Government (179), Local Government (180), Imports (181), Depreciation (182), and PROP PAY or Residual (177).

cells of the sample estimating procedures. In those cases where the data were classified as having been sold or purchased from a trade sector, it was necessary to remove and reclassify the "merchandise purchased for resale" portion. This adjustment procedure is outlined below.

In the survey of the wholesale and retail trade sectors, data were obtained in sufficient detail to permit estimation of (1) gross trade margins or mark-up on merchandise purchased for resale, (2) the sector of origin of the trade sectors' production inputs (the sector detail of the inputs represented by the gross margins) as well as the proportion of total expenses paid to each sector from which operating inputs were obtained, and (3) the sector of origin and value of purchases of merchandise purchased for resale. The trade margins estimates were applied to wholesale and retail sales reported by the 1967 Census of Business--Wholesale Trade and Retail Trade to obtain the respective trade sector control totals. The sample estimates of inputs by the trade sectors were used to calculate transactions estimates of inputs by the trade sectors analogous to inputs estimates of other processing sectors.

The information secured from the trades sectors surveys regarding the dollar value and sector of origin of merchandise purchased for resale was used in a variety of ways to assist in identifying the sector and region of origin of finished goods as well as manufacturing inputs sold through trades sectors. A set of "merchandise allocating coefficients" was calculated from the survey data for each trades sector. These allocating coefficients estimated the proportion of the dollar value of total expenditures, by trades sectors, that was for trade sectors inputs and the proportion that was for merchandise purchased for resale -- these expenditures were further disaggregated into the proportion that was paid to each sector of the Texas economy for goods purchased for resale and the proportion that was paid for goods imported. The "merchandise allocating" coefficients were then used to estimate the sector of origin of merchandise obtained by non-trade sectors that could only indicate a gross value of purchase from a trade sector. An analogous treatment was given to sales data in those cases where the sample showed that sales of merchandise had been made to a trades sector. The "merchandise allocating" coefficients were entered into the computer edit and calculation routines and when the checking procedures found purchases or sales data classified as having been between trades and non-trades sectors instead of between last-stage processors and ultimate users, the allocating coefficients were applied. The result was an adjustment which left the estimated trade margin in the appropriate cell of the trade sector to which it pertained, while the merchandise value was assigned to the last stage processing sector from which it originated, in the case of purchases of production inputs, and to the ultimate user in the case of sales of outputs.

After adjustments were made to remove merchandise purchased for resale from the transactions of the trades sectors, the individual sample observations of each

sector were pooled and the ratio estimate of each sample cell total to that respective sector sample grand total was calculated (Tables 16 and 17).^{17/} That is to say, the sample purchases data were pooled for each sector and a sample ratio estimate was calculated for each cell of each column of the purchases matrix (Table 16). Likewise, the sample sales data were pooled and a sample ratio estimate was calculated for each row of the sales matrix (Table 17). A set of such coefficients was calculated for each sector of the input-output model. The coefficients for all sectors except agriculture, forestry, education, households, government, and capital formation were calculated from sample survey data. The coefficients for agriculture and forestry were calculated from secondary data -- mainly farm budgets and farm costs and returns as published in reports of the Texas Agriculture Experiment Station and the U. S. Department of Agriculture.^{18/} Gross expenditures for education and government were disaggregated into the proportions paid to each sector by use of audit reports and records of payments for specific types and kinds of materials and services purchased.

In the case of the capital formation sector, heavy reliance was placed upon the sales survey data to estimate sales to Texas buyers of Texas produced capital items. In the case of the household sector, sales data plus data from the most recent U. S. Bureau of Labor Statistics, "Survey of Consumer Expenditures" were used to estimate the household sector purchases of outputs of each producing sector.^{19/} The results of the Wholesale and Retail Trades survey were used to divide the estimated household purchases of the outputs of each sector into the dollar value purchased from Texas producers and the dollar value imported from out-of-state producers.

The sales and purchases coefficients estimated from the sample were used to allocate the sector control totals into two separate transactions tables -- a rows only or sales table and a columns only or purchases table. In each matrix there were some dollar values of sales and purchases that could not be assigned to specific sectors due to incompleteness of classification of the survey data, and neither of these two matrices were balanced. The row and column sums for each respective sector did not sum to the control total for that sector -- a condition necessary for the completion of an input-output model. In the sales matrix, the rows summed to the control totals but the columns did not, whereas in the purchases matrix the columns summed to the control totals but the rows did not. The final step in completion of the model was to reconcile the two separate estimates of the transactions table.

Major reliance was placed upon the data of the purchases matrix to estimate the final transactions matrix since the input data secured by the sample appeared, in the

^{17/} Cochran, W. G., Sampling Techniques, 2nd Edition, New York, John Wiley and Sons, Inc., 1963, Page 29.

^{18/} For specific reference to these data sources, see Appendix B of this report.

^{19/} "Survey of Consumer Expenditures, 1960-61," Bureau of Labor Statistics, U. S. Department of Labor, BLS Report No. 237-91, U. S. Government Printing Office, Washington, D. C., May 1965.

Table 16. Sample Dollar Value Purchases Transactions Totals and Estimated Coefficients for Sector t

Purchases Totals				Ratio			
Small	Medium	Large	Total	Small	Medium	Large	Sector
X_{1St}	X_{1Mt}	X_{1Lt}	X_{1Tt}	a_{1St}	a_{1Mt}	a_{1Lt}	a_{1Tt}
X_{2St}	X_{2Mt}	X_{2Lt}	X_{2Tt}	a_{2St}	a_{2Mt}	a_{2Lt}	a_{2Tt}
.
.
.
X_{kSt}	X_{kMt}	X_{kLt}	X_{kTt}	a_{kSt}	a_{kMt}	a_{kLt}	a_{kTt}
.
.
.
X_{mSt}	X_{mMt}	X_{mLt}	X_{mTt}	a_{mSt}	a_{mMt}	a_{mLt}	a_{mTt}
.
.
.
X_{fSt}	X_{fMt}	X_{fLt}	X_{fTt}	a_{fSt}	a_{fMt}	a_{fLt}	a_{fTt}
X_{St}	X_{Mt}	X_{Lt}	X_{Tt}	1.0	1.0	1.0	1.0

Where X_{kSt} = Total purchases by all Small sample establishments (0-19 employees) in Sector t from Sector k.

X_{kMt} = Total purchases by all Medium sample establishments (20-249 employees) in Sector t from Sector k.

X_{kLt} = Total purchases by all Large sample establishments (250 or more employees) in Sector t from Sector k.

X_{kTt} = Total purchases by all sample establishments in Sector t from Sector k. ($X_{kTt} = X_{kSt} + X_{kMt} + X_{kLt}$)

X_{St} = Total purchases by all Small sample establishments in Sector t.

X_{Mt} = Total purchases by all Medium sample establishments in Sector t.

X_{Lt} = Total purchases by all Large sample establishments in Sector t.

X_{Tt} = Total purchases by all sample establishments in Sector t.

$$a_{kSt} = X_{kSt} \div X_{St}$$

$$a_{kMt} = X_{kMt} \div X_{Mt}$$

$$a_{kLt} = X_{kLt} \div X_{Lt}$$

$$a_{kTt} = X_{kTt} \div X_{Tt}$$

Table 17. Sample Dollar Value Sales Transactions Totals and Estimated Coefficients for Sector t

Sales Totals Dollar Value by Firm Size				Ratio Sales Coefficients			
Small	Medium	Large	Total	Small	Medium	Large	Sector
Y_{1St}	Y_{1Mt}	Y_{1Lt}	Y_{1Tt}	b_{1St}	b_{1Mt}	b_{1Lt}	b_{1Tt}
Y_{2St}	Y_{2Mt}	Y_{2Lt}	Y_{2Tt}	b_{2St}	b_{2Mt}	b_{2Lt}	b_{2Tt}
.
.
.
Y_{kSt}	Y_{kMt}	Y_{kLt}	Y_{kTt}	b_{kSt}	b_{kMt}	b_{kLt}	b_{kTt}
.
.
.
Y_{mSt}	Y_{mMt}	Y_{mLt}	Y_{mTt}	b_{mSt}	b_{mMt}	b_{mLt}	b_{mTt}
.
.
.
Final Demand Y_{fSt}	Y_{fMt}	Y_{fLt}	Y_{fTt}	b_{fSt}	b_{fMt}	b_{fLt}	b_{fTt}
Total Y_{St}	Y_{Mt}	Y_{Lt}	Y_{Tt}	1.0	1.0	1.0	1.0

Where Y_{kSt} = Total sales by all Small sample establishments (0-19 employees) in Sector t to Sector k.

Y_{kMt} = Total sales by all Medium sample establishments (20-249 employees) in Sector t to Sector k.

Y_{kLt} = Total sales by all Large sample establishments (250 or more employees) in Sector t to Sector k.

Y_{kTt} = Total sales by all sample establishments in Sector t to Sector k.
 $(Y_{kTt} = Y_{kSt} + Y_{kMt} + Y_{kLt})$

Y_{St} = Total sales by all Small sample establishments in Sector t.

Y_{Mt} = Total sales by all Medium sample establishments in Sector t.

Y_{Lt} = Total sales by all Large sample establishments in Sector t.

Y_{Tt} = Total sales by all sample establishments in Sector t.

$b_{kSt} = Y_{kSt} \div Y_{St}$

$b_{kMt} = Y_{kMt} \div Y_{Mt}$

$b_{kLt} = Y_{kLt} \div Y_{Lt}$

$b_{kTt} = Y_{kTt} \div Y_{Tt}$

judgement of the interviews, to be relatively more reliable than the sales data. In addition to having more detail per sector, a major portion of the purchases data was tabulated directly from purchases invoices during the interview of each individual establishment. Sales data were obtained in the same manner, but in many instances sales of unfinished or intermediate goods were shown only as having been made to a trades sector and the sample establishment interviewed could not identify the ultimate user sector. Thus, the sales data quality appeared to be lower for input-output model estimation than the counterpart purchases data.

A major difference between the estimated sales and purchases matrices was that the estimated sales matrix had a larger number of empty cells and, in addition, contained some positive estimates for cells that were estimated at zero in the purchases matrix. The purchases matrix was examined carefully sector-by-sector in light of the individual sample elements. The information from the sales matrix was brought to bear for the purpose of completing the allocation of those inputs that could not be allocated from the purchases data. In the purchases matrix, certain individual cells, for which published data were available, were further adjusted to conform with published dollar values. For example, estimates of wages and salaries paid to households by individual sector were compared to total payroll reported for the same sector in the 1967 Census of Manufacturing, Construction, Wholesale Trade, Retail Trade, Selected Services, Government, and Mining Sectors. The input-output model estimates were adjusted where necessary to reconcile differences between reported payroll and estimated payments by sectors to the household sector. In general, only minor adjustments of this type were required since in many cases the estimated and reported payrolls were quite close.

Two other gross but important checks of inputs estimates versus reported dollar values of inputs were performed. In the first of these checks, the cost of materials, as reported in the 1967 Census of Manufacturers, for individual sectors, was compared with the cost of materials estimates derived from the input-output model for the same sectors. In order to perform this check it was necessary to sum the inputs for each sector according to the 1967 Census of Manufacturers definitions of cost of materials. This was a gross check, but it provided useful direction for further refinement of sample data when wide deviations were found between reported and estimated costs of materials. Adjustments were made to bring the estimates into line with the reported value of costs of materials. The same type of comparisons and adjustments were made simultaneously for individual sector value added by manufacture, as reported in the 1967 Census of Manufacturing, and as estimated in the input-output model.

Upon completion of the estimation of the transactions of each cell and the selected internal sector comparison of estimates with reported dollar value, it was necessary to complete the allocations within each row and column so that row and column sums of each sector were simultaneously equated to the control total of the

sector. After all input estimates had been made for each individual sector, including depreciation and taxes paid to local, state, and federal government, the residual income or the difference between the control total and the subtotal of expenses, taxes, and depreciation was assigned to a final payment sector labeled "Prop Pay" (Sector 177 in the transactions table). This sector includes undistributed dividends, payments that were made to out-of-state stockholders and proprietors, and payments made to out-of-state home offices and headquarters for management and other services. Some of this income transferred to out-of-state headquarters was most likely included in the incomes of the parent company for federal income tax purposes. The survey data appeared to exclude a part of federal income tax obligations of branch plants located in Texas. The survey data were not sufficiently detailed to permit a precise estimate as to the ultimate disposition of "Prop Pay."

After the individual cells of each row of the transactions table were estimated, using the columns estimates, the output rows were completed and equated to the control totals by adjusting the exports and household columns cells. The sample estimates were used to make the estimates of transactions among the sectors but when these estimates, in the aggregate, differed from the sector control totals, the necessary adjustments were made to the exports and household columns to equate the estimated sector totals to the independently calculated sector control totals. When adjustments were made to the individual cells of the household column, an offsetting change was made to imports by the household sector. Thus, the original household consumption estimates were not significantly changed but the region of origin of products was shifted slightly from that of the original estimates.

When the household cells had been estimated, any remaining adjustments required within each row were made in the exports column. In most instances, such changes were minor in relation to total exports and for the most part could be considered as rounding of arithmetic.

The direct requirements table was obtained by straightforward calculation of the ratio of each cell in the transactions table to the column total in which the cell is located.^{20/} This table shows the dollar value of outputs of a typical sector i required by typical sector j in order for sector j to produce one dollar of output. The direct requirements coefficients are of significant interest for straightforward use by planners. They are also used for more revealing analyses including calculation of the interindustry relationships within the economy.

The direct-plus-indirect requirements table was obtained through solution of the set comprising the first 175 equations of the Texas Input-Output Model.^{21/} This set is illustrated in equation number 3 of an earlier section of this report entitled "Framework of the Texas Input-Output Model" and in Table 3 of this report.

^{20/} See Table 2 for an illustration of the direct requirements table.

^{21/} Matrix algebra is used to solve the system of equations. For matrix inversion discussion, see Miernyk, W. H., The Elements of Input-Output Analysis. New York, Random House, 1965.

The direct-plus-indirect requirements table considers households to be among the final demand and final payments sector and the results of this table indicate the requirements, sector-by-sector, to produce one dollar of product or service, valued f.o.b. the shipper, for final demand. This concept and the empirical estimates of the direct-plus-indirect requirements are discussed later. This is known as the open input-output model.

When the input-output model is closed, that is, when households are considered to be among the processing as opposed to the final demand and final payments sectors and the first 176 equations of the Texas Input-Output Model are solved, the direct, indirect and induced requirements table is obtained. Whereas the direct-plus-indirect requirements table expresses direct-plus-indirect requirements to deliver one dollar of product or service to final demand, the direct, indirect and induced requirements table considers the additional effects of the household sector's production and consumption as an integral part of the producing functions of the economy. The additional or induced effects of the income paid to households by the other producing sectors is brought into the interindustry matrix and considered to be among the unknowns. This treatment of the model provides information useful in understanding the induced effects upon the local economy insofar as the household sector income and spending actions are concerned. Such information is especially useful in cases where local economy sectors expand or contract employment of the household sector in response to changes in sales of products or services produced.

The direct-plus-indirect and direct-indirect-and-induced requirements tables provide information whereby several types of multipliers pertaining to the economy can be calculated. Among those of interest to planners are final demand multipliers, output multipliers and Type I and Type II income multipliers. Each type was estimated from the Texas Input-Output Model and will be presented and explained in the following sections of this report.

The first part of the document is a letter from the Secretary of the State Department to the Secretary of the War Department. The letter is dated August 1, 1945, and is addressed to the Secretary of the War Department, Washington, D. C. The letter is signed by the Secretary of the State Department, George C. Marshall.

The letter discusses the proposed transfer of the War Relocation Authority (WRA) to the War Relocation Administration (WRA). The letter states that the War Relocation Authority is a government-owned corporation that was established in 1942 to provide for the care and education of Japanese-Americans who were interned in the United States. The letter also states that the War Relocation Authority is currently operating under a charter that was issued by the War Relocation Authority Act of 1942.

The letter proposes that the War Relocation Authority be transferred to the War Relocation Administration, which is a government department that was established in 1945. The letter states that the War Relocation Administration is currently operating under a charter that was issued by the War Relocation Administration Act of 1945. The letter also states that the War Relocation Administration is currently operating under a charter that was issued by the War Relocation Administration Act of 1945.

The letter concludes by stating that the Secretary of the State Department is in favor of the proposed transfer of the War Relocation Authority to the War Relocation Administration. The letter also states that the Secretary of the State Department is in favor of the proposed transfer of the War Relocation Authority to the War Relocation Administration.

INTERPRETATION AND ANALYSES OF THE TEXAS
INPUT-OUTPUT MODEL

Summarized Input-Output Model

The purpose of the following discussion is to present the Texas Input-Output Model, explain and illustrate how to read input-output tables, and illustrate the use of input-output techniques in the analyses of economic impacts of individual sectors upon the entire economy. A summary version of the Texas Input-Output Model is presented in Table 18. This version is expressed at the level of the major sectors of the Texas economy -- Agriculture-Forestry-Fisheries, Mining, Construction, Manufacturing, Transportation, Communications, Utilities, Wholesale Trade, Retail Trade, Finance-Insurance-Real Estate, Education, Services, Households, Government, Imports and Exports, and Savings and Depreciation. The larger, more detailed, 183-sector transactions table is found in Appendix A, Table 1.

Transactions Table

Each of the sectors of the summarized transactions matrix of Table 18 is an aggregation of a subset of the individual sectors of the more detailed 183 sector model of Appendix A. For example, there are 17 individual agricultural, forestry and fisheries sectors, four mining sectors, five construction sectors, 87 manufacturing sectors, eight transportation sectors, three communications sectors, three utilities sectors, seven wholesale trade sectors, 11 retail trade sectors, three finance, insurance, and real estate sectors, 18 service sectors, three medical sectors, three education sectors, one ordnance sector, one outdoor recreation sector, one scrap sector, and seven final payments sectors in the more detailed 183 sector model (Appendix A, Table 1). Further, analyses of these sectors will be presented in a later section of the report. The summarized version is presented here for the purpose of illustrating how to read a transactions table.

In Table 18 the processing sectors are listed in rows and columns one through 13. The final payments sectors are rows 14 through 16 and the final demand sectors are columns 14 through 17. The Transactions Table is used to express the distribution of sales to the customers of each sector, and in an analogous manner to express the distribution of inputs from the input supplying sectors. The sum of each row is the dollar value of total output for the sector represented by that row (the subtotal for final demand sectors is shown in column 18 of the transactions table). The sum of each column is the dollar value of total inputs for the sector represented by that column.

The transactions table is a "snapshot" of the dollar value of outputs, inputs and the trading among the sectors of the economy for the 1967 study year. The extent of interdependence within the Texas economy is measured by the number and relative size of transactions among the processing sectors. Quantitative measures of

Table 18. Transactions Table; Summarized Texas Input-Output Model; 1967
(Millions of Dollars)

		Processing Sectors								
		1	2	3	4	5	6	7	8	9
		AGRICULTURE, FORESTRY, FISHERIES	MINING	CONSTRUCTION	MANUFACTURING	TRANSPORTATION	COMMUNICATIONS	UTILITIES	WHOLESALE TRADE	RETAIL TRADE
Final Payments	Processing Sectors	1	2	3	4	5	6	7	8	9
	1 AGRICULTURE, FORESTRY, FISHERIES	589.176	0	30.330	1380.498	0	0	0	1.308	15.711
	2 MINING	0.126	593.648	78.020	2713.321	7.907	0	957.209	0.888	0.727
	3 CONSTRUCTION	29.105	9.136	22.160	196.762	24.150	0.306	15.270	10.464	6.772
	4 MANUFACTURING	554.899	195.930	1359.270	3726.626	224.219	24.792	65.623	116.724	409.125
	5 TRANSPORTATION	57.289	36.057	132.660	800.563	74.309	2.934	8.842	30.883	26.977
	6 COMMUNICATIONS	7.815	8.971	20.475	85.640	52.781	2.851	8.553	62.914	80.896
	7 UTILITIES	38.742	26.832	11.268	496.394	42.864	9.139	218.204	57.254	95.309
	8 WHOLESALE TRADE	180.169	29.590	14.590	304.690	50.499	1.007	15.337	20.978	62.688
	9 RETAIL TRADE	229.239	15.708	104.023	43.519	15.280	0.405	16.331	39.925	110.691
	10 FINANCE, INSURANCE, REAL ESTATE	114.355	49.712	220.801	211.499	156.996	11.949	31.534	162.788	265.735
	11 EDUCATION	68.005	128.193	28.249	134.751	38.036	31.128	113.697	37.482	57.923
	12 SERVICES	23.635	62.319	142.129	429.305	80.316	29.326	46.513	120.433	247.185
	13 HOUSEHOLDS	1184.114	1697.010	2318.880	4956.328	1067.076	327.981	419.234	2211.370	2952.043
	14 GOVERNMENT	86.054	494.303	259.410	938.554	171.477	175.160	292.711	305.284	343.300
	15 IMPORTS	246.227	619.893	1321.307	6427.722	171.367	106.576	73.214	261.337	764.767
	16 SAVINGS AND DEPRECIATION	252.527	2137.176	173.677	3940.793	571.988	178.748	604.670	814.961	964.804
17 TOTAL INPUTS	3661.471	6046.478	6237.249	26788.945	2549.265	902.302	2886.942	4254.993	6404.653	

Table 18 Continued

Final Demand										
FINANCE, INSURANCE, REAL ESTATE	EDUCATION	SERVICES	HOUSEHOLDS	GOVERNMENT	EXPORTS	CAPITAL FORMATION	INVENTORY CHANGE	TOTAL FINAL DEMAND	TOTAL OUTPUTS	
10	11	12	13	14	15	16	17	18	19	
0	0	0.789	202.591	471.214	1192.500	0	-222.640	1643.665	3661.471	1
0.582	0	0.077	33.359	2.828	1656.323	0	1.463	1693.973	6046.478	2
54.874	9.248	28.398	148.631	46.085	0	5635.688	0	5830.604	6237.249	3
57.987	189.216	327.641	3328.584	2772.436	12222.419	1050.971	220.083	19994.893	26788.945	4
6.554	12.587	55.773	741.759	99.089	468.411	32.578	0	1301.837	2549.265	5
52.415	10.708	71.639	328.416	19.098	62.065	26.865	0	436.644	902.302	6
71.576	40.808	76.061	739.782	57.921	904.788	0	0	1702.491	2886.942	7
18.994	14.288	87.732	1970.002	43.455	834.409	606.565	0	3454.431	4254.993	8
22.217	0.672	47.802	5679.264	15.591	27.007	36.979	0	5758.041	6404.059	9
329.495	62.979	155.444	1826.905	90.112	719.852	0.139	0	2637.008	4408.295	10
106.966	0	46.610	979.810	173.310	0	0	0	1153.120	1944.160	11
242.356	22.726	308.449	3168.350	272.550	431.711	5.200	1.010	3876.821	5631.513	12
2029.495	1401.428	2958.240	1952.833	5266.968	0	0	0	7219.801	30743.000	13
228.445	15.922	252.736	4384.335	466.735	0	0	0	4851.070	8614.406	14
104.462	134.939	588.484	5195.545	2134.700	0	522.632	0	7852.877	18673.172	15
1081.877	28.639	627.438	64.834	0	0	0	0	64.834	11242.132	16
4408.295	1944.160	5631.513	30743.000	11892.092	18519.885	7917.817	-0.084	69072.710	140788.976	17

interdependence are calculated and displayed in tables derived from the transactions table and these will be discussed later.

The households supply the labor and management services and the income received for these services is shown along the household row and is an input of the respective sectors. The household column (column 13) shows the consumption purchases by the households, including imports from outside the state on row 15, column 13.

All inputs and outputs of the transactions table are expressed as annual dollar values f.o.b. the shipping point in 1967. The sales or outputs of each processing industry to the respective local economy and export purchasers are tabulated along the rows of the transactions table. The customer or purchasing sector is listed at the head of each column. For example, the mining sector had total outputs of \$6,046.478 million (row 2, column 19) of which \$2,713.321 million were sales of mining's outputs to Texas manufacturers (row 2, column 4), \$957.209 million (row 2, column 7) were sales to the Texas utilities sector and \$1,656.323 million (row 2, column 15) were sales to markets outside the state. Of mining's sales to manufacturing, 83 percent was sale of crude petroleum to Texas refineries (Appendix A, Table 1). Total outputs of the communications sector were \$902.302 million (row 6, column 19) of which \$20.475 million (row 6, column 3) were sales to construction sectors, \$85.640 million were sales to manufacturing sectors (row 6, column 4), and \$328.416 million were sales to households (row 6, column 13). The outputs of the other sectors are read in the same manner along each respective sector's row.

The manner in which the columns of the transactions table are read is illustrated for the mining sector. The inputs of the mining sector or the costs of mining are shown in column 2. That is to say that the costs of mining have been classified and tabulated according to the sectors from which the production inputs were obtained. For example, the mining sector purchased nothing from agriculture sectors (lease and royalties were paid to the households and savings; rows 13 and 16 of column 2), but the mining sector had purchases from each of the other sectors of the Texas economy and also imported an estimated \$619.893 million of inputs from out-of-state (row 15, column 2). Mining used \$593.648 million of its own outputs as inputs within the mining sector (row 2, column 2), purchased \$135.930 million from manufacturing sectors (row 4, column 2) and paid in the form of wages, salaries, leases and royalties \$1,697.010 million to households (row 13, column 2). Payments to government (row 14) are the total value of taxes, fees, and licenses (\$494.303 million in the case of mining) except that portion of taxes (\$128.193 million) which was allocated to education (Sector 11). As in the case of all sectors, mining's outputs and inputs were equated by assigning the residual income, after expenses, taxes, wages, salaries, leases and royalties, to the savings sector (row 16).

Education was included as a processing sector from which other sectors purchase services on the basis of the assumption that taxpaying establishments as well as individual taxpayers share in the underwriting of programs carried out by government

in proportion to the way government spends tax revenues collected. If the government spends 40 percent of the tax revenues for education, then it is assumed that 40 percent of the taxes paid by each taxpayer are spent for education. Thus, the education sector was entered as a processing sector which sells services to other sectors of the economy. Education's spending, that is, the purchases of such items as materials, services, utilities, and expenditures for teachers' salaries by the education sector are shown in column 12 of the model.

Direct Requirements Table

The direct requirements table is calculated from the transactions table by dividing each cell of each column by the column total (Table 19). The results are tabulated for easy reference in the same manner as that of the transactions table, but only the columns of this table are meaningful. Each column shows one dollar's worth of inputs, while each cell in the column shows the sector of origin of inputs (sector name is read on the row to the left) per dollar's worth of total input. For example, the Agriculture-Forestry-Fisheries sector buys \$0.1515 of inputs from manufacturing per dollar of total inputs (column 1, row 4) and pays \$0.3234 of every dollar of expense to farm households and farm labor for wages, operator income, and the use of natural resources such as land, water, and timber (row 13, column 1).

The proportion of total expenses of each sector that are paid to households for labor and management are shown along the household row (row 13). Likewise, that proportion paid for taxes is shown along the education and government rows (rows 11 and 14). The cost of the capital used during the production period was calculated and is included as depreciation in the savings and depreciation row (row 16). A part of current income was allocated -- depreciation on plant and equipment -- to the recovery of capital used during the production period.

Each column of the direct requirements table shows the estimated initial effect upon the processing sectors of the economy per dollar change in production by the sector represented in the column. That is to say, that when a sector increases outputs, the required total inputs are obtained from input suppliers according to the percentages shown in the column of the direct requirements table which represents the sector. In addition, the coefficients of the direct requirements table are used to express the economy's transactions in a system of equations (Table 2 and Equations 2 and 3). The system of equations can be solved by computers for the purpose of calculating quantitative measures of the interdependence among sectors and calculating different types of multipliers useful in economic impact analyses. The multipliers are valuable tools to assist in understanding the economy-wide impacts upon production, employment, and natural resource use from events such as gaining or losing defense contracts, declining petroleum reserves, declining water supplies, increased or decreased home building by the construction sectors plus other issues pertaining both to individual industries and to the entire economy of the state. The following

Table 19. Direct Requirements Table; Summarized Texas Input-Output Model; 1967

PURCHASES ↓	AGRICULTURE, FORESTRY, FISHERIES MINING CONSTRUCTION MANUFACTURING TRANSPORTATION				
	1	2	3	4	5
1 AGRICULTURE, FORESTRY, FISHERIES	0.16091074	0	0.00486272	0.05153238	0
2 MINING	0.00003441	0.09818079	0.01250872	0.10128510	0.00310168
3 CONSTRUCTION	0.00794899	0.00151096	0.00355285	0.00734490	0.00947332
4 MANUFACTURING	0.15155084	0.02248086	0.21792781	0.13918525	0.08795437
5 TRANSPORTATION	0.01564644	0.00629408	0.02126899	0.02988408	0.02914919
6 COMMUNICATIONS	0.00213439	0.00148367	0.00328270	0.00319684	0.02070440
7 UTILITIES	0.01058099	0.00443762	0.00180657	0.01852981	0.01681426
8 WHOLESALE TRADE	0.04920673	0.00489376	0.00233917	0.01137372	0.01980924
9 RETAIL TRADE	0.06260844	0.00259788	0.01667771	0.00162451	0.00599388
10 FINANCE, INSURANCE, REAL ESTATE	0.03123198	0.00822165	0.03540038	0.00789501	0.06158481
11 EDUCATION	0.01857314	0.02120127	0.00452908	0.00503010	0.01492038
12 SERVICES	0.00645506	0.01030666	0.02278713	0.01602545	0.03150555
13 HOUSEHOLDS	0.32339844	0.28066091	0.37177929	0.18501393	0.41858183
14 GOVERNMENT	0.02350258	0.08175057	0.04159045	0.03503438	0.06726527
15 IMPORTS	0.06724811	0.10252134	0.21184131	0.23993935	0.06722212
16 SAVINGS AND DEPRECIATION	0.06896873	0.35345800	0.02784513	0.14710520	0.14591971
17 TOTAL OUTPUTS	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000

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Item No.	Description	Quantity	Unit	Rate	Amount	Remarks
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Table 20. Direct plus Indirect Requirements Table; Summarized Texas Input-Output Model; 1967

PURCHASES ↓	AGRICULTURE, FORESTRY, FISHERIES MINING CONSTRUCTION MANUFACTURING TRANSPORTATION				
	1	2	3	4	5
1 AGRICULTURE, FORESTRY, FISHERIES	1.20646952	0.00223037	0.02247708	0.07323318	0.00749572
2 MINING	0.03525069	1.11570496	0.04926914	0.14421581	0.02632163
3 CONSTRUCTION	0.01297037	0.00247309	1.00702140	0.01061039	0.01229634
4 MANUFACTURING	0.23394290	0.03593358	0.26986703	1.19086061	0.12022699
5 TRANSPORTATION	0.02859202	0.00886093	0.03174445	0.03968564	1.03536520
6 COMMUNICATIONS	0.00715047	0.00261959	0.00643512	0.00617770	0.02409559
7 UTILITIES	0.02344178	0.00745721	0.01052591	0.02766826	0.02466564
8 WHOLESALE TRADE	0.06442514	0.00673776	0.00851778	0.01959477	0.02392698
9 RETAIL TRADE	0.07898077	0.00355743	0.01998050	0.00812418	0.00842375
10 FINANCE, INSURANCE, REAL ESTATE	0.05372321	0.01285058	0.04698037	0.01980547	0.07493706
11 EDUCATION	0.02876779	0.02492903	0.01015408	0.01329898	0.02107880
12 SERVICES	0.02314736	0.01476315	0.03491971	0.02676001	0.04411150
TOTAL	1.79726291	1.23801769	1.51689257	1.58003501	1.42294520

Table 20 Continued

	COMMUNICATIONS	UTILITIES	WHOLESALE TRADE	RETAIL TRADE	FINANCE, INSURANCE, REAL ESTATE	EDUCATION	SERVICES	
	6	7	8	9	10	11	12	
	0.00254769	0.00326496	0.00295473	0.00829898	0.00201174	0.00751614	0.00521296	1
	0.00972750	0.40572106	0.01145651	0.01749687	0.01188117	0.02367069	0.01625563	2
	0.00140350	0.00756913	0.00383730	0.00297119	0.01448509	0.00664760	0.00684901	3
	0.04116951	0.05192334	0.04113791	0.08611991	0.03084487	0.12155464	0.08073594	4
	0.00549038	0.00866562	0.00967103	0.00825363	0.00410377	0.01130062	0.01411325	5
	1.00443719	0.00535653	0.01655527	0.01495941	0.01446507	0.00720546	0.01518762	6
	0.01376582	1.08726832	0.01770128	0.02071266	0.02186623	0.02686890	0.01908623	7
	0.00290414	0.00973991	1.00689013	0.01287499	0.00677662	0.01016515	0.01868531	8
	0.00130800	0.00826360	0.01067773	1.01933205	0.00682891	0.00189435	0.01038559	9
	0.01804195	0.02136207	0.04537749	0.05041675	1.08605609	0.03913339	0.03566196	10
	0.03652773	0.05299478	0.01229579	0.01337968	0.02895223	1.00396925	0.01229681	11
	0.03745160	0.02704156	0.03590604	0.04802541	0.06603034	0.01868659	1.06422033	12
	1.17477499	1.68917088	1.21406120	1.30284152	1.29430214	1.27861278	1.29869065	

Appendix 10.1

1.1	1.1.1	1.1.1.1	1.1.1.2	1.1.1.3	1.1.1.4	1.1.1.5	1.1.1.6
1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	1.2.1.4	1.2.1.5	1.2.1.6
1.3	1.3.1	1.3.1.1	1.3.1.2	1.3.1.3	1.3.1.4	1.3.1.5	1.3.1.6
1.4	1.4.1	1.4.1.1	1.4.1.2	1.4.1.3	1.4.1.4	1.4.1.5	1.4.1.6
1.5	1.5.1	1.5.1.1	1.5.1.2	1.5.1.3	1.5.1.4	1.5.1.5	1.5.1.6
1.6	1.6.1	1.6.1.1	1.6.1.2	1.6.1.3	1.6.1.4	1.6.1.5	1.6.1.6
1.7	1.7.1	1.7.1.1	1.7.1.2	1.7.1.3	1.7.1.4	1.7.1.5	1.7.1.6
1.8	1.8.1	1.8.1.1	1.8.1.2	1.8.1.3	1.8.1.4	1.8.1.5	1.8.1.6
1.9	1.9.1	1.9.1.1	1.9.1.2	1.9.1.3	1.9.1.4	1.9.1.5	1.9.1.6
1.10	1.10.1	1.10.1.1	1.10.1.2	1.10.1.3	1.10.1.4	1.10.1.5	1.10.1.6

replace declining supplies of natural resources, to guide policymakers in the selection of programs to offset or alleviate unfavorable trends or to enhance desirable trends. New industries might be recruited for the purpose of employing labor and other resources that will be released by declining resources or markets which adversely affect established industries. Some illustrations of economic impact analyses are presented immediately following the discussion of the direct, indirect, and induced table below.

Direct, Indirect, and Induced Requirements Table

In the discussion thus far there has been no attention given to the level of income of the labor, management and capital ownership resource except to mention that payments to households are tabulated along the household row of the transactions table (row 13) and shown as a percent of total inputs on row 13 of the direct requirements table. In the discussion immediately above, it was assumed that the level of income did not depend upon the components of production; i.e. that final demand is determined outside the interindustry transactions and is taken as given. In reality, income depends upon production; a part of final demand is determined within the interindustry framework and thus the level of income is determined within the input-output model.^{22/}

In order to appropriately arrange the model to permit consideration of the dependence of parts of final demand upon the level of income, the model is closed to households; i.e. the household row and column are brought into the system of equations and are treated as a processing sector. The solution of this new set of equations provides the direct, indirect, and induced requirements coefficients (Table 21). The coefficients of Table 19, column 13 show the marginal propensity of households to consume the products of the respective rows in which they are found; i.e. the estimated marginal propensity to consume Texas manufactured goods (row 4, column 13) is \$0.108 per dollar of income, the estimated marginal propensity to consume utilities (row 7, column 13) is 0.002 per dollar of income. Marginal propensities to consume the products of individual sectors of the 183-sector model are shown in column 176 of Appendix A, Table 2.

Inclusion of the household sector among the producing sectors of the model permits an evaluation of the extended effects upon the whole economy, through the household sector, resulting from changes in individual sector payment of wages and salaries to households. Changes in output by one or more producing sectors of the local economy may result in changes (increased or decreased) in payments of wages, salaries, profits, or rents to the household sectors. These changes in household income would be expected to result in changes in household consumption of products

^{22/} Chenery, H. B. and Clark, P. G., Interindustry Economics, New York, John Wiley and Sons, Inc. 1967, Page 63.

Table 21. Direct, Indirect, and Induced Requirements Table; Summarized Texas Input-Output Model; 1967

PURCHASES ↓	AGRICULTURE, FORESTRY, FISHERIES MINING CONSTRUCTION MANUFACTURING TRANSPORTATION				
	1	2	3	4	5
1 AGRICULTURE, FORESTRY, FISHERIES	1.22537641	0.01381689	0.03913482	0.08463068	0.02569174
2 MINING	0.07016532	1.13710134	0.07903034	0.16526314	0.05992353
3 CONSTRUCTION	0.02214800	0.00809733	1.01510726	0.01614288	0.02112891
4 MANUFACTURING	0.40302254	0.13944897	0.41893304	1.29278563	0.28294954
5 TRANSPORTATION	0.06271180	0.02976966	0.06180456	0.06025327	1.06820127
6 COMMUNICATIONS	0.07582966	0.01406657	0.02289225	0.01743794	0.04207247
7 UTILITIES	0.06266197	0.03149213	0.04508049	0.05131108	0.06241122
8 WHOLESALE TRADE	0.13785936	0.05149459	0.07286388	0.06362144	0.09421524
9 RETAIL TRADE	0.27153692	0.12155969	0.18963027	0.12420137	0.19374012
10 FINANCE, INSURANCE, REAL ESTATE	0.14070990	0.06615776	0.12361917	0.07224301	0.15865321
11 EDUCATION	0.07091660	0.05075866	0.04728889	0.03870723	0.06164289
12 SERVICES	0.15385003	0.09486036	0.15007406	0.10555053	0.16989998
13 HOUSEHOLDS	1.00059566	0.61318502	0.88156529	0.60318159	0.96297500
TOTAL	3.64738417	2.37180898	3.14692432	2.69532976	3.20350512

Table 21 Continued

	COMMUNICATIONS	UTILITIES	WHOLESALE TRADE	RETAIL TRADE	FINANCE, INSURANCE, REAL ESTATE	EDUCATION	SERVICES	HOUSEHOLDS	
	6	7	8	9	10	11	12	13	
	0.01647700	0.01478750	0.02213544	0.02648238	0.02071452	0.03308053	0.02548514	0.03183706	1
	0.03545022	0.42699929	0.04687679	0.05107547	0.04641886	0.07087945	0.05369148	0.05879227	2
	0.00816496	0.01316231	0.01314784	0.01179763	0.02356364	0.01905686	0.01668937	0.01545409	3
	0.16573591	0.15496658	0.21266627	0.24872962	0.19809917	0.35017059	0.26202499	0.28471096	4
	0.03062685	0.02945890	0.04428404	0.04106694	0.03785431	0.05743343	0.05069589	0.05745233	5
	1.01819875	0.01674030	0.03550498	0.03292383	0.03294260	0.03246196	0.03352156	0.03145364	6
	0.04266059	1.11117052	0.05748948	0.05843207	0.06066301	0.07989930	0.06113856	0.06604236	7
	0.05671079	0.05424959	1.08098207	0.08311451	0.07902238	0.10891616	0.09699340	0.12298134	8
	0.14317030	0.12561426	0.20602259	1.20451992	0.19730627	0.26225334	0.21684641	0.32424272	9
	0.08212784	0.07437490	0.13362397	0.13407484	1.17210370	0.15674982	0.12893004	0.14647572	10
	0.06758011	0.07868178	0.05505502	0.05391564	0.07064601	1.06095950	0.05748923	0.07097382	11
	0.13374446	0.10669647	0.16810162	0.17372667	0.19532198	0.19541226	1.20436117	0.22008848	12
	0.73717096	0.60979907	1.01508686	0.96230728	0.98979344	1.35292523	1.07284966	1.68488963	13
	2.53781875	2.81670148	3.09097697	3.08216682	3.12444989	3.78019843	3.28241099	3.11539442	

and services produced by other sectors of the local economy and thereby would be expected to have an effect upon the quantities of output that can be sold by these sectors. This additional household effect is known as the induced effect and the coefficients which measure the direct, indirect and induced effects of delivering one dollar of produce or service to final demand are tabulated in Table 21 for the summarized version of the input-output model and in Appendix A, Table 4 for the more detailed version. Each entry of these tables shows purchases from the sector named at the top of the column for each dollar of output sold to final demand. The sum of each column shows the total purchases from all sectors of the local economy, by the sector represented in the column, per dollar of sales to final demand when sales are expressed f.o.b. the shipper. The direct, direct plus indirect, and direct, indirect, and induced effects of changes in final demand are illustrated and explained in Tables 22, 23, 24, and 25 which follow.

For purposes of illustration, it has been hypothesized that the demand for commercial construction has increased by \$100,000 (Table 22). The column labeled "direct output requirements" is obtained by multiplying each cell of column 3 of the direct requirements table presented earlier by \$100,000. The result shows the sectors and amounts paid to each, for the purpose of obtaining the materials and services required to produce the \$100,000 of new construction. For example, \$486 of materials would be purchased directly from the agriculture, forestry and fisheries sector, \$1,251 would be purchased from mining (sand and gravel probably), \$21,793 from manufacturing, \$2,127 from transportation, \$37,178 from households for labor and management, and so on for a total of \$100,000 in spending for construction. These are known as the direct effects of \$100,000 in new construction and represent the additional market for outputs by sectors which sell directly to the construction industry.

When construction buys from other sectors, these sectors in turn make purchases from the entire range of their respective suppliers, each of whom also make purchases from their respective suppliers. One of the important questions is, what is the dollar value of these added or indirect purchases resulting from the initial purchase by the construction sector? For example, \$21,793 in purchases are made directly from the manufacturing sectors in the illustration above. This is the direct effect. The direct plus indirect effect (column 2, Table 22), under the assumption that new household income is not considered for the moment, is \$26,986 or the indirect effect is \$5,193 ($\$26,986 - \$21,793 = \$5,193$). This means that in order to produce the additional outputs to support \$100,000 in new construction, the manufacturing sector must produce \$26,986 of which \$21,793 is sold directly to the construction industry and \$5,193 will be sold as inputs to other sectors whose outputs will have been expanded through their sales to construction.

Each of the entires of the direct and indirect requirements column is interpreted in the same manner as was done for the \$26,986 manufacturing row entry above.

Table 22. Output Required in the Texas Economy for the Texas Construction Industry to Increase Commercial Construction \$100,000 -- 1967

Industry	Output Requirements		
	Direct	Direct & Indirect	Direct, Indirect & Induced
	(\$)	(\$)	(\$)
Agriculture, Forestry, Fisheries	486	2,247	3,913
Mining	1,251	4,826	7,903
Construction	355	100,702	101,510
Manufacturing	21,793	26,986	41,883
Transportation	2,127	3,174	6,180
Communications	328	643	2,289
Utilities	181	1,052	4,508
Wholesale Trade	234	852	7,286
Retail Trade	1,668	1,998	18,963
F.I.R.E. ^{a/}	3,540	4,698	12,362
Education	453	1,015	4,728
Services	2,279	3,492	15,007
Households	37,178	-	88,156
Government	4,159	-	-
Imports	21,184	-	-
Savings & Depreciation	2,784	-	-
TOTAL	100,000	151,689	314,692

^{a/} Finance, Insurance and Real Estate.

Table 23. Output Decreases in the Texas Economy Resulting from a \$100,000 Decrease in Sales to Government by the Texas Manufacturing Industry -- 1967

Industry	Output Decrease		
	Direct	Direct & Indirect	Direct, Indirect & Induced
	(\$)	(\$)	(\$)
Agriculture, Forestry, Fisheries	- 5,153	- 7,323	- 8,463
Mining	- 10,129	- 14,422	- 16,526
Construction	- 734	- 1,061	- 1,614
Manufacturing	- 13,919	-119,086	-129,278
Transportation	- 2,988	- 3,968	- 6,025
Communications	- 320	- 617	- 1,743
Utilities	- 1,853	- 2,766	- 5,131
Wholesale Trade	- 1,137	- 1,959	- 6,362
Retail Trade	- 162	- 812	- 12,420
F.I.R.E. ^{a/}	- 789	- 1,981	- 7,224
Education	- 503	- 1,330	- 3,871
Services	- 1,603	- 2,676	- 10,555
Households	- 18,501	-	- 60,318
Government	- 3,504	-	-
Imports	- 23,994	-	-
Savings & Depreciation	- 14,711	-	-
TOTAL	-100,000	-158,003	-269,533

^{a/} Finance, Insurance, and Real Estate.

Table 24. Output Required in the Texas Economy to Increase the Texas Mining Industry's Exports by \$100,000 -- 1967

Industry	Output Requirements		
	Direct	Direct & Indirect	Direct, Indirect & Induced
	(\$)	(\$)	(\$)
Agriculture, Forestry, Fisheries	-0-	223	1,382
Mining	9,818	111,570	113,710
Construction	151	247	810
Manufacturing	2,248	3,583	13,944
Transportation	629	886	2,976
Communications	148	262	1,407
Utilities	444	746	3,149
Wholesale Trade	489	674	5,149
Retail Trade	260	356	12,156
F.I.R.E. ^{a/}	822	1,285	6,616
Education	2,120	2,493	5,075
Services	1,031	1,476	9,486
Households	28,066	-	61,318
Government	8,175	-	-
Imports	10,252	-	-
Savings & Depreciation	35,347	-	-
TOTAL	100,000	123,802	237,180

^{a/} Finance, Insurance and Real Estate.

Table 25. Output Increases in the Texas Economy Resulting from a \$100,000 Increase in Expenditures for Higher Education by the Federal Government -- 1967

Industry	Output Requirements		
	Direct	Direct & Indirect	Direct, Indirect & Induced
	(\$)	(\$)	(\$)
Agriculture, Forestry, Fisheries	-0-	751	3,308
Mining	-0-	2,367	7,087
Construction	476	665	1,905
Manufacturing	9,733	12,155	35,017
Transportation	647	1,130	5,743
Communications	551	720	3,246
Utilities	2,099	2,686	7,989
Wholesale Trade	735	1,016	10,892
Retail Trade	35	189	26,225
F.I.R.E. ^{a/}	3,239	3,913	15,675
Education	-0-	100,396	106,095
Services	1,169	1,868	19,541
Households	72,084	-	135,292
Government	819	-	-
Imports	6,940	-	-
Savings & Depreciation	1,473	-	-
TOTAL	100,000	127,861	378,019

^{a/} Finance, Insurance and Real Estate.

Both the direct sales to the construction sector and the sales to other sectors who sell to construction (indirect sales to construction) are contained in each entry of this column. For example, in the case of the finance sector, the direct sales of finance services (interest on borrowed funds for the construction period) to the construction sector is shown as \$3,540 in the direct requirements column. In addition, due to new construction purchases from manufacturing and other sectors, the finance sector has new demands for services from these sectors and expands its total sales as a result of the \$100,000 in new construction to \$4,698.

Each entry of the direct and indirect requirements column shows the effect of new construction upon the economy through that particular industry. When the direct and indirect requirements column is summed, the economy-wide effect is estimated. The estimate is \$151,689 of direct plus indirect sales resulting from the initial \$100,000 in new construction expenditures, when the household sector's new spending is ignored. The \$151,689 includes the new construction valued at \$100,000.

The direct, indirect and induced effects are shown in the final column of the table above, and are calculated by multiplying each entry of column 3 in Table 21 (Direct, Indirect and Induced Requirements Table) by \$100,000. The empirical estimates are based on the assumption that the household sector spends new income within the economy, and distributes its spending among the sectors in the same proportions as were estimated for the present Texas Input-Output Model. That is to say, that when the further purchasing effects (induced effects) of the household sector are considered, the gross outputs (sales) of the economy resulting from \$100,000 in new construction is \$314,692 (column 3 above). Within the table, on the manufacturing row, it is shown that manufacturing sectors sell \$21,793 directly to the construction sector. In addition, manufacturers sell \$5,193 to other sectors that sell inputs to the construction sector (direct plus indirect effects). In addition to these sales, manufacturers sell \$14,897 to sectors which sell products to the households. The total sales effect upon the manufacturing sector is \$41,883. That is to say, that the gross incomes of the manufacturing sectors can be expected to increase by \$41,883 as a result of the \$100,000 of new construction. All other entries of the direct, indirect and induced requirements column are interpreted in the same way.

A brief input-output analysis of construction expenditures was presented on the preceding page. The intent of that discussion was to provide illustrations of the manner in which input-output models can be used. Calculations have been made from the same input-output model to express the estimated direct, direct and indirect, and direct, indirect and induced effects of (1) a decrease in sales by Texas manufacturers to government (shown in Table 23), (2) an increase in exports by the Texas mining industry, and (3) an increase in federal government spending for higher education in Texas. The latter two analyses are tabulated in Tables 24 and 25.

Multiplier Analysis

The previous discussion has dealt briefly with the various tables in which input-output data and analyses of direct, indirect and induced production requirements are presented. Input-output models can be further manipulated to obtain multipliers useful to the understanding of the details of how initial economic activity permeates the entire economy. Of particular interest to public policymakers are ways whereby the economy-wide effects of public works programs, defense spending, and public welfare and social program spending can be estimated in sector-by-sector detail. The direct, indirect, and induced requirements table discussed earlier provides this type of information directly and will not be discussed here. Instead, the following discussion shall emphasize the use of input-output models as tools for gaining estimates of the income and output multipliers of production sectors of the economy. Two multipliers of special interest are (1) Type I, and (2) Type II income multipliers. The Type I multiplier shows the direct and indirect changes in household income resulting from an increase of one dollar in output of industries in the processing sectors, assuming that the household sector is not a processing sector. The Type II multiplier takes into account the direct, indirect and induced changes in income resulting from increased output of the producing sectors. The Type II multiplier is derived from the solution to the model when households are included among the processing sectors. Data from both the direct plus indirect requirements table and the direct, indirect and induced requirements table (Tables 20 and 21 of the text for the summarized model, and Appendix A, Tables 3 and 4 for the 183-sector model) are required to compute the direct and indirect income changes (Table 26).^{23/}

The direct household income change per dollar of output is tabulated in column 1 of Table 26 and is the proportion of each sector's total inputs that are paid to households for labor and management services. The more labor intensive a sector is, the higher will be the direct income changes per dollar of production. In the summarized version of the Texas Input-Output Model, education is the most labor intensive sector with a coefficient of 0.72 (Table 26, row 11). This means that 72 percent of expenditures for education are paid to the household sector in the form of salaries and wages for teachers, school administration, and others employed by the education sector.

Wholesale trade and services are the second most labor intensive sectors with 52 percent of total inputs paid to households. Manufacturing and utilities are the least labor intensive with 19 and 14 percent respectively.

The direct income change from new production is only the first round effect. In order for a sector to produce, it must purchase inputs from other sectors. These

^{23/} Miernyk, W. H., The Elements of Input-Output Analysis, New York, Random House, 1965, Pages 42-50.

Table 26. Estimated Multipliers of the Summarized Input-Output Models of the Texas Economy -- 1967^{a/}

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct, Indirect & Induced Income Change	Induced Income Change	Indirect Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Agriculture, Forestry, Fisheries	0.32	0.57	0.25	1.78	1.00	0.43	0.68	3.12	1.49	2.98
2. Mining	0.28	0.34	0.06	1.21	1.61	0.27	0.33	2.18	1.11	2.09
3. Construction	0.37	0.56	0.19	1.51	0.88	0.32	0.51	2.37	1.51	3.10
4. Manufacturing	0.19	0.30	0.11	1.58	0.63	0.33	0.44	3.31	1.33	2.08
5. Transportation	0.42	0.60	0.18	1.43	0.96	0.36	0.54	2.28	1.37	3.00
6. Communications	0.36	0.42	0.06	1.17	0.74	0.32	0.38	2.05	1.17	2.49
7. Utilities	0.14	0.24	0.10	1.71	0.61	0.37	0.47	4.35	1.55	2.53
8. Wholesale Trade	0.52	0.63	0.11	1.21	1.01	0.38	0.49	1.94	1.21	2.86
9. Retail Trade	0.46	0.60	0.14	1.30	0.96	0.36	0.50	2.09	1.28	2.56
10. F.I.R.E. ^{b/}	0.46	0.59	0.13	1.28	0.99	0.40	0.53	2.15	1.19	2.67
11. Education	0.82	0.92	0.20	1.28	1.35	0.43	0.63	1.88	1.27	3.56
12. Services	0.52	0.68	0.16	1.31	1.07	0.39	0.55	2.06	1.22	2.73

^{a/} Industries of this model represent the aggregates of individual sectors of the 183-sector detailed input-output model of the Texas economy.

^{b/} Finance, Insurance, and Real Estate.

1. Column 1 is the household row of Table 19.

2. Column 2 is the sum of each column of Table 20 times the household coefficients of the corresponding column of Table 19.

3. Column 2 minus Column 1.

4. Column 2 divided by Column 1.

5. The household row of Table 21.

6. Column 5 minus Column 2.

7. Column 3 plus Column 6.

8. Column 5 divided by Column 1.

9. The sum of each column of Table 20 divided by the column's element.

10. The sum of each column of Table 21 divided by the column's diagonal element.

outputs of other sectors require labor as well as other inputs. Thus, among other indirect effects of production by an individual sector there are indirect household income effects. These direct and indirect income changes are calculated from the direct plus indirect requirements table and the direct requirements table and are shown in column 2 of Table 26 for the summarized input-output model. For example, production of one dollar of agricultural, forestry and fisheries output for final demand results in \$0.32 of direct income payments to households (Table 26, row 1, column 1) and \$0.25 of indirect household income (Table 26, row 1, column 3). The indirect income resulted from payments to household sectors by those sectors that sell inputs to agriculture, forestry and fisheries and those sectors that sell inputs to sectors that sell inputs to agriculture, forestry and fisheries several times removed.

The ratio of the direct and indirect income change to the direct income change is the Type I multiplier (Table 26, column 4). This multiplier shows the direct and indirect household income changes per dollar of direct payments to households, when the added potential consumption of households that would be possible from this new income is ignored. For example, the Type I multiplier for the agriculture, forestry and fisheries sector was estimated at \$1.78 (Table 26). This means that for each dollar of direct payments by this sector to households, employed by the sector for the purpose of production, an additional \$0.78 will be paid indirectly to households. For example the production and sale of \$10,000 to exports by agriculture, forestry and fisheries would result in direct income to households of \$3,200 ($0.32 \times \$10,000$) but would have a total income effect of \$5,696 ($3,200 \times 1.78$). The indirect income effect was \$2,496 -- the difference between \$5,696 and \$3,200. The reader will note that the direct income effect was calculated from row 1 column 1 of Table 26 which shows that agriculture, forestry, and fisheries pay \$0.32 per dollar of output to households. Thus, the \$10,000 in new sales would require \$3,200 of labor and management from households. In order to obtain the total income effect estimate, the Type I multiplier is applied to the direct income. The same type of calculation can be readily made for each of the other sectors of the model in order to gain information about the income effects of changes in level of production. If markets were lost and production were decreased the income effects would be calculated in the same way except the amounts would be negative or losses instead of gains.

The Type II income multiplier includes the income induced by the household spending of direct and indirect income obtained (or lost) through employment (or unemployment) by the processing sectors. If households receive directly and indirectly \$5,696 due to \$10,000 in production of agriculture, forestry, and fisheries products, this new household income will likely be spent within the economy according to proportions shown in column 13 of Table 20. If this is the case, then sectors which sell to households will increase production to meet these new demands.

The new production will require additional (or what is known as induced employment) and the induced income effects can be estimated by applying the Type II multipliers to the direct income effect. In the case of the agriculture, forestry, and fisheries illustration above, the Type II multiplier is 3.12 (Table 26, row 1, column 8). The direct income effect of \$10,000 in production would be \$3,200, the direct plus indirect effect would be \$5,696 and the direct, indirect, and induced income effect would be \$9,984 ($\$3,200 \times 3.12$). The data of Table 26 can be used to calculate the income effects of changes in the outputs of other sectors. Such calculations will not be made for the summarized model since a more detailed sector-by-sector analysis of the 183-sector model will be presented later.

In Table 26 output multipliers for both the open and the closed input-output models are presented (columns 9 and 10). The closed input-output model considers households to be one of the processing sectors whereas the open model leaves households outside the processing sectors. Final demand multipliers are shown as the column totals of Tables 20 and 21. The output multipliers are the ratios of the respective sector final demand multipliers to the direct plus indirect requirements of each respective sector to deliver one dollar of product to final demand. This latter value is found in the cell in which the sector row and column intersect in the direct plus indirect requirements table for the open model (Table 20) and in the analogous cell of the direct, indirect, and induced requirements table for the closed model (Table 21). The analogous tables for the 183-sector model are in Appendix A, Tables 3 and 4 respectively.

Output multipliers express the economy-wide direct and indirect effects per dollar change in production as opposed to per dollar in sales to final demand. Thus if one wishes to know the economic impacts of a change in total product, some of which is sold to intermediate users he has merely to apply the output multipliers to the contemplated value of output change. For example, the direct, indirect, and induced effect of changing output of the manufacturing sector is \$2.08 per dollar output change (Table 26, row 4, column 10). Individual sector output multipliers for the 183-sector model are presented later.

Texas 183-Sector Input-Output Model

In the preceding section, a summarized or aggregated version of the Texas Input-Output Model was presented for the purpose of illustrating the input-output tables and some types of analyses that can be done through use of input-output models. For some purposes the level of aggregation and analyses presented in the illustration is entirely adequate, but if analysts or planners are interested in and concerned with individual industries of the major groups as presented in the summarized version of the model, the summarized model is not an adequately detailed tool. The purposes of this section of the report are to present information from the more detailed 183-sector model and to expand the analyses to include a sector-by-sector treatment of

major types of inputs, exports and imports as well as to present individual sector multipliers.

Input-Output Tables -- Review and Orientation

In view of the fact that the physical size of a 183-sector input-output table makes display of such a table extremely difficult in printed form, this brief discussion is presented to acquaint the reader with the procedures followed in this report. Tables 1 through 4 are found in Appendix A. Table 1 of Appendix A is the transactions table; Table 2, the direct requirements table; Table 3, the direct plus indirect requirements table; and Table 4 is the direct, indirect, and induced requirements table. The counterpart summarized model tables are text Tables 18, 19, 20, and 21 respectively.

The reader can refer to Table 18 of the text and the associated discussion of Table 18 and see that an individual sector's sales transactions are shown along its row of the transactions table while the sector's purchases transactions are shown in the column assigned to it. Each sector of the model with a few exceptions in the final demand and payments sectors, has a row and a column. Both were assigned the same number in the sector identification numbering system and are found in a symmetric location within the tables.

Tables 18, 19, 20, and 21 of the text can be read relatively easily since the reader can see each table spread before him on two facing pages of the text. Appendix A, Tables 1, 2, 3, and 4 are more difficult to read since none of the tables could be placed in a single field of vision. Instead, it was necessary to print the 183-sector tables in parts and arrange the parts in a series of pages of the appendix. An eight column cross-section of 45 rows is printed on each page. The pages are arranged in a sequence such that all the rows of the tables for each set of eight columns are shown on consecutive pages; i.e. the first four pages of each table show the first eight columns of all 182 rows of the table, the second group of four pages shows columns nine through 16 in their entirety for all 182 rows, the third group of four pages shows columns 17 - 24 and so on until all the columns of each table have been included. Thus the reader can see the inputs transactions in the transactions table for an individual sector by scanning down that sector's column. The column spans four pages. By visualizing the four page groupings in their logical sequence, the reader can follow a row through the entire transactions table and thereby can read the transactions table from the sales or output viewpoint.

Reading the direct, direct plus indirect, and direct, indirect and induced requirements tables (Appendix A, Tables 2, 3, and 4) from the columns viewpoint is the appropriate way to understand these tables. The reader can see the direct, and direct plus indirect requirements for each sector's production by reading down the sector's column. The sector from which the inputs are required is listed on the row at the left edge of each page.

In view of the earlier discussion of the contents and meaning of each of the four principle tables of the summarized input-output model, such a discussion will not be repeated here. Instead, the reader is referred to Tables 18, 19, 20, and 21 and the accompanying text for the main ideas and concepts of input-output tables. The discussion presented there can then be generalized and applied to the 183-sector model shown in Appendix A. In the 183-sector model, the reader can obtain input-output data for individual sectors of the Texas economy.

Gross Value of Output and Sales to Final Demand

Total value of output of each economic sector is one of the measures of interest and usefulness to analysts and planners. In the input-output model, total output is expressed f.o.b. the shipper for products, as the value of trade margins for wholesale and retail trade sectors, and in terms of value delivered for services. The value of output of each sector is shown as the row total for that sector in Appendix A, Table 1. These data are tabulated in Table 27 along with the estimated proportion of total outputs that were sold to the open input-output model final demand sectors; i.e. sales to final demand sectors when households, federal, state, and local government, exports, capital formation and inventory change are included in final demand.

Total value of output is an indication of the significance of a sector to the overall economy although this measure does not fully express the importance of a sector to the economy. For example, a sector may have a comparatively low dollar value of output, when compared to the value of outputs of other sectors and still be vitally important to the economy since it may be a producer of products that are required by other processing sectors. This should be kept in mind as Table 27 and Appendix A, Table 1 are viewed. In Appendix A, Table 1, the disposition of the outputs of each sector can be seen and the dependence of other processing sectors of the local economy upon the outputs of each individual sector can be readily determined by analyzing each row and column of the transactions table.

Due to the large number of interindustry transactions, there will not be a discussion of these on a sector-by-sector basis. However, a rough indication of the interdependence among sectors can be obtained from the percentage of sales of each sector to final demand (Table 27, column 3). If a small proportion of sales are made to final demand, this suggests that sales of goods to other industries are relatively high and thus the sector is a producer of intermediate goods or services used as production inputs by other sectors of the economy. No final conclusions about economic interdependence can be reached from this superficial analysis of sales, since the total value of outputs and distribution of output to other sectors must be considered in the analysis. The solution of the system of equations derived from the transactions table (Appendix A, Tables 3 and 4) provides a better quantitative measure of interdependence among the sectors of the economy than the percentage of sales to final demand coefficients shown in Table 27.

Table 27. Total Value of Output and Sales to Final Demand; Texas Input-Output Model -- Open Version -- 1967^{a/}

Sector Number	Sector Name	Total Value of Output ^{b/}	Sales to Final Demand (Open Model)	
			Dollar Value ^{c/}	Percent of Total Output
(million dollars) (Percent)				
<u>Agriculture, Forestry and Fisheries:</u>				
1.	β Irrigated cotton	361.498	299.324	82.80
2.	β Irrigated food grains	198.944	54.498	27.39
3.	β Irrigated feed grains	256.798	172.970	67.36
4.	β Other irrigated crops	192.035	105.518	54.94
5.	β Dryland cotton	276.679	239.644	86.61
6.	α Dryland food grains	60.240	26.465	43.93
7.	β Dryland feed grains	216.193	90.845	42.02
8.	β Other dryland crops	140.136	61.315	43.75
9.	θ Range livestock production	799.900	399.231	49.91
10.	β Feedlot livestock production	414.698	114.975	27.72
11.	β Dairy	212.190	3.728	1.76
12.	β Poultry and eggs	233.181	69.749	29.91
13.	β Agricultural supply except farm machinery	114.778	-0-	-0-
14.	α Cotton ginning	38.858	-0-	-0-
15.	β Agricultural services	172.061	-0-	-0-
16.	α Primary Forestry	38.342	0.675	1.76
17.	α Fisheries	49.718	4.728	9.51
<u>Mining</u>				
18.	μ Crude petroleum	4,453.742	1,089.778	24.47
19.	θ Natural gas liquids	732.604	433.188	59.13
20.	θ Oil and gas fields services	627.032	144.308	23.01
21.	β Other mining and quarrying	233.100	26.699	11.45
<u>Construction</u>				
22.	Δ Residential construction	1,315.554	1,315.554	100.00
23.	Δ Commercial, educational & institutional construction	1,493.773	1,486.312	99.50
24.	θ Industrial construction	689.705	689.665	99.99
25.	ε Facility construction	2,181.531	2,172.686	99.60
26.	θ Maintenance and repair	556.686	166.797	29.96
<u>Manufacturing</u>				
27.	θ Meat products	836.616	691.199	82.62
28.	β Poultry products	148.709	144.660	97.28
29.	β Dairies	415.913	349.008	83.91
30.	β Grain milling	356.621	291.725	81.80
31.	β Animal feeds	238.087	69.354	29.13

(Continued)

- ω = Gross output more than \$6.0 billion
- μ = Gross output between \$4.0 and \$5.9 billion
- ε = Gross output between \$2.0 and \$3.9 billion
- Δ = Gross output between \$1.0 and \$1.9 billion
- θ = Gross output between \$0.5 and \$0.9 billion
- β = Gross output between \$0.1 and \$0.5 billion
- α = Gross output between zero and \$0.1 billion

Table 27 Continued

Sector Number	Sector Number	Total Value of Output ^{b/}	Sales to Final Demand (Open Model)	
			Dollar Value	Percent of Total Output
			(million dollars)	(percent)
32. β	Bakery products	260.622	229.187	87.94
33. β	Canned, preserved, pickled, dried & frozen foods	319.766	237.453	74.26
34. θ	Other food and kindred prod.	896.801	805.700	89.84
35. β	Beverages	420.466	387.309	92.11
36. β	Textile mill products	125.818	76.899	61.12
37. θ	Mens & boys, women & misses & childrens furnishings	613.904	567.654	92.47
38. α	Related apparel	108.948	101.722	93.37
39. β	Logging	24.501	-0-	-0-
40. β	Lumber mills	103.687	36.232	34.94
41. β	Millwork & wood products	196.118	112.385	57.31
42. β	Wood furniture & fixtures	198.877	168.471	84.71
43. α	Metal furniture & fixtures	34.190	25.804	75.47
44. β	Paper & paper mills	185.297	30.306	16.35
45. β	Paper products except boxes and containers	135.939	50.248	36.96
46. β	Boxes & paper containers	154.067	19.230	12.48
47. β	Newspapers	250.931	100.794	40.17
48. α	Publishing	33.724	11.077	32.85
49. β	Printing	198.827	21.864	10.99
50. α	Manifold business forms	58.639	36.378	62.04
51. α	Other printing & publishing	36.902	7.677	20.80
52. β	Chlorine & alkalies	140.700	54.461	38.71
53. β	Cyclic crudes & intermediates & inorganic pigments	201.500	104.650	51.94
54. Δ	Organic chemicals	1,928.410	1,530.695	79.38
55. β	Inorganic chemicals	317.657	192.921	60.73
56. β	Fibers plastics	324.476	280.772	86.53
57. β	Synthetic rubber	411.460	379.130	92.14
58. α	Drugs	33.189	21.263	64.07
59. β	Agricultural chemicals	166.819	13.157	7.89
60. β	Soaps, cleansers & toiletries	139.776	109.905	78.63
61. β	Paints & varnishes	157.935	115.055	72.85
62. β	Other chemicals	161.319	91.610	56.79
63. ω	Petroleum refining	6,333,422	5,094.650	80.44
64. α	Other Petroleum products	85,869	5.979	6.96
65. β	Tires	114.377	78.429	68.57
66. α	Fabricated rubber products	26.401	5.269	19.96
67. β	Plastics products	140.794	71.188	50.56
68. α	Leather & leather products	43.080	28.171	65.39
69. α	Glass	58.414	12.186	20.86
70. α	Clay	70.797	15.775	22.28
71. β	Cut stone & other clay & shell products	159.277	42.737	26.83

(Continued)

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- β = Gross output between \$0.1 and \$0.5 billion
- α = Gross output between zero and \$0.1 billion

Table 27 Continued

Sector Number	Sector Name	Total Value of Output ^{b/}	Sales to Final Demand (Open Model)	
			Dollar Value ^{c/}	Percent of Total Output
		(million dollars)	(percent)	
72.	β Cement & concrete products	376.082	15.971	4.25
73.	β Blast furnaces	348.539	135.592	38.90
74.	α Primary steel & iron	52.949	7.347	13.88
75.	β Foundries	126.533	72.727	57.48
76.	β Nonferrous primary & secondary smelting	241.593	200.658	83.06
77.	β Aluminum smelting & nonferrous rolling	370.445	157.803	42.60
78.	β Castings & forgings	189.335	93.070	49.16
79.	β Fabricated steel	195.232	65.760	33.68
80.	β Plate work	246.431	209.971	85.21
81.	β Sheet metal & architectural	136.498	15.208	11.14
82.	α Metal Doors	53.559	15.156	28.30
83.	β Fabricated metal products	178.379	53.936	30.24
84.	α Plumbing	35.454	8.071	22.76
85.	α Bolts, nuts & screws	34.394	2.952	8.58
86.	α Electroplating, coating & engraving	41.005	24.234	59.10
87.	β Valves & pipe fittings	252.379	87.275	34.58
88.	α Other fabricated metal	97.776	34.350	35.13
89.	β Farm, construction & industrial machinery	123.926	85.295	68.83
90.	α Materials handling machinery & equipment	32.375	26.862	82.97
91.	θ Mining machinery & equipment	527.257	491.928	93.30
92.	α Engines	24.574	8.971	36.51
93.	α Metal working machinery		37.951	64.15
94.	α Industrial processing mach.	76.702	58.191	75.87
95.	β General industrial mach.	146.693	97.516	66.48
96.	β Refrigeration machinery	280.474	245.946	87.69
97.	β Computers, accounting, office & service industry mach.	142.067	102.873	72.41
98.	β Electric instruments & apparatus	164.440	82.826	50.37
99.	α Electric household equip.	9.759	6.828	69.97
100.	θ Electronic communications equipment	701.203	601.235	85.74
101.	α Other electrical apparatus	48.083	15.517	32.27
102.	Δ Aircraft	1,805.321	1,777.204	98.44
103.	α Aircraft engines	26.800	8.056	30.06
104.	β Other aircraft	151.226	120.067	79.40
105.	θ Motor vehicles & parts	726.265	591.268	81.41
106.	β Ship & boat building	153.684	137.300	89.34
107.	β Other transportation equip.	165.272	148.925	90.11

(Continued)

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Table 27 Continued

Sector Number	Sector Name	Total Value of Output ^{b/}	Sales to Final Demand (Open Model)	
			Dollar Value ^{c/}	Percent of Total Output
		(million dollars)	(percent)	
108.	α Scientific instruments	56.346	45.424	80.62
109.	α Mechanical measuring devices	35.727	22.084	61.81
110.	α Medical instruments	25.447	15.165	59.59
111.	β Photographic, time, & optical instruments	101.739	66.627	65.49
112.	α Games & toys	29.018	26.602	91.67
113.	α Other manufacturing industry	78.470	30.620	39.02
<u>Transportation:</u>				
114.	θ Railroad transportation	517.453	229.852	44.42
115.	α Intercity rural highway transportation	61.787	56.994	92.24
116.	θ Motor freight transportation & local trucking & storage	890.482	458.467	51.48
117.	β Water transportation	340.678	217.411	63.82
118.	β Air transportation	275.512	204.799	74.33
119.	β Pipeline transportation	379.333	74.603	19.67
120.	α Local & suburban transportation	59.305	56.396	95.09
121.	α Other transportation serv.	24.715	3.315	13.41
<u>Communications:</u>				
122.	θ Telephone & telegraph	748.345	371.421	49.63
123.	β Radio & TV	148.123	62.365	42.10
124.	α Other communications	5.834	2.658	45.56
<u>Utilities:</u>				
125.	Δ Gas service	1,618.066	1,094.810	67.66
126.	Δ Electric services	1,039.165	477.708	45.97
127.	β Water & sanitary services	229.711	129.973	56.58
<u>Wholesale Trade:</u>				
128.	θ Wholesale auto, parts & supplies	693.147	643.496	92.84
129.	β Wholesale groceries & related products	390.743	355.128	90.88
130.	β Wholesale farm products & farm product warehousing	170.215	88.357	51.91
131.	α Wholesale livestock	70.361	32.773	46.58
132.	θ Wholesale machinery, equipment & supplies	860.884	701.506	81.49

(Continued)

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Table 27 Continued

Sector Number	Sector Name	Total Value of Output ^{b/}	Sales to Final Demand (Open Model)	
			Dollar Value ^{c/}	Percent of Total Output
		(million dollars)	(Percent)	
133.β	Wholesale petroleum & petroleum products	296.242	208.829	70.49
134.Δ	General wholesale	1,773.401	1,424.342	80.32
<u>Retail Trade:</u>				
135.β	Lumber yards	137.896	51.193	37.12
136.α	Farm equipment dealers	72.852	44.616	61.24
137.α	Hardware, heating, electrical, paint & wallpaper	60.297	50.503	65.93
138.Δ	Department & variety stores	1,255.442	1,254.881	99.96
139.θ	Food stores	779.048	770.735	98.93
140.Δ	Automotive dealers & repair shops	1,307.883	1,108.970	84.79
141.β	Gasoline service stations	396.821	299.483	75.47
142.β	Apparel & accessory stores	338.304	337.985	99.91
143.β	Furniture, home furnishings & equipment stores	250.283	250.157	99.95
144.Δ	Eating & drinking places	1,024.313	955.652	93.30
145.θ	Other retail	666.736	634.666	95.19
<u>Finance, Insurance & Real Estate:</u>				
146.Δ	Banking & credit agencies	1,941.629	1,280.179	65.93
147.Δ	Insurance carriers	1,394.913	911.253	65.33
148.Δ	F.I.R.E. nec.	1,071.753	445.576	41.57
<u>Services:</u>				
149.β	Legal services	251.731	135.593	53.86
150.β	Lodging services	319.437	246.255	77.09
151.θ	Personal services	618.797	579.819	93.70
152.β	Advertising	178.348	8.411	4.72
153.α	Duplicating & addressing	80.581	30.141	37.41
154.α	Employment agencies; private	10.062	5.254	52.22
155.β	Photographic services	103.554	65.056	62.82
156.α	Research & development	38.277	8.796	22.98
157.θ	Other business services	527.416	59.525	11.29
158.β	Motion picture, amusement & recreation services	227.129	194.626	85.69
159.β	Automobile rental services	119.706	45.916	38.36
160.α	Automobile parking	25.466	23.982	94.17
161.α	Electrical repair	77.545	43.348	55.90
162.β	Miscellaneous repair services	191.611	110.376	57.60
163.θ	Physicians & dentist services	608.502	597.926	98.26

(Continued)

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Table 27 Continued

Sector Number	Sector Name	Total Value of Output ^{b/}	Sales to Final Demand (Open Model)	
			Dollar Value ^{c/}	Percent of Total Output (Percent)
164. θ	Hospital & laboratory services	508.705	492.946	96.90
165. β	Other medical services	211.637	211.194	99.79
166. Δ	Education (public & private)	1,412.826	790.358	55.94
167. β	Colleges & universities	463.610	295.472	63.73
168. α	Other educational services	67.724	67.290	99.36
169. β	Engineering & architectural services	260.280	204.430	78.54
170. β	Accounting, auditing & bookkeeping	389.547	151.968	39.01
171. α	Other professional services	51.458	25.267	49.10
172. θ	Other services	700.622	601.066	85.79
<u>Other Manufacturing:</u>				
173. θ	Ordnance & ordnance accessories	750.689	723.192	96.34
<u>Other Services:</u>				
174. α	Outdoor recreation	54.650	34.926	63.91
175. α	Scrap	76.452	-0-	-0-

^{a/} Summarized from data of Appendix A, Table 1.

^{b/} Individual sector control totals.

^{c/} The sum of items in rows 176 through 183.

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The individual sector having the largest value of gross output in Texas in 1967 was the petroleum refining sector (Sector 63) with \$6.3 billion. The sector with the second largest value of output was crude petroleum mining (Sector 18) with \$4.4 billion. Only one other sector, Sector 25, had outputs exceeding \$2.0 billion. Facility construction, which includes highway construction had gross value of output slightly under 2.2 billion (Table 27).

Of the total 175 producing sectors of the model (excluding households), 14 sectors had gross outputs that ranged in value from \$1.0 to \$2.0 billion. These were residential construction (Sector 22), commercial educational and institutional construction (Sector 23), organic chemicals (Sector 54), aircraft manufacture (Sector 102), natural gas utilities (Sector 125), electric utilities (Sector 126), general wholesale (Sector 134), department and variety stores (Sector 138), automotive dealer and repair shops (Sector 140), eating and drinking places (Sector 144), banking and credit agencies (Sector 146), insurance carriers (Sector 147), real estate (Sector 148), and elementary and secondary education (Sector 166). Twenty-four sectors had outputs in the \$0.5 to \$1.0 billion range, 85 sectors had gross outputs in the \$100 thousand to \$0.5 billion range and 49 sectors had gross outputs less than \$100 thousand (Table 27).

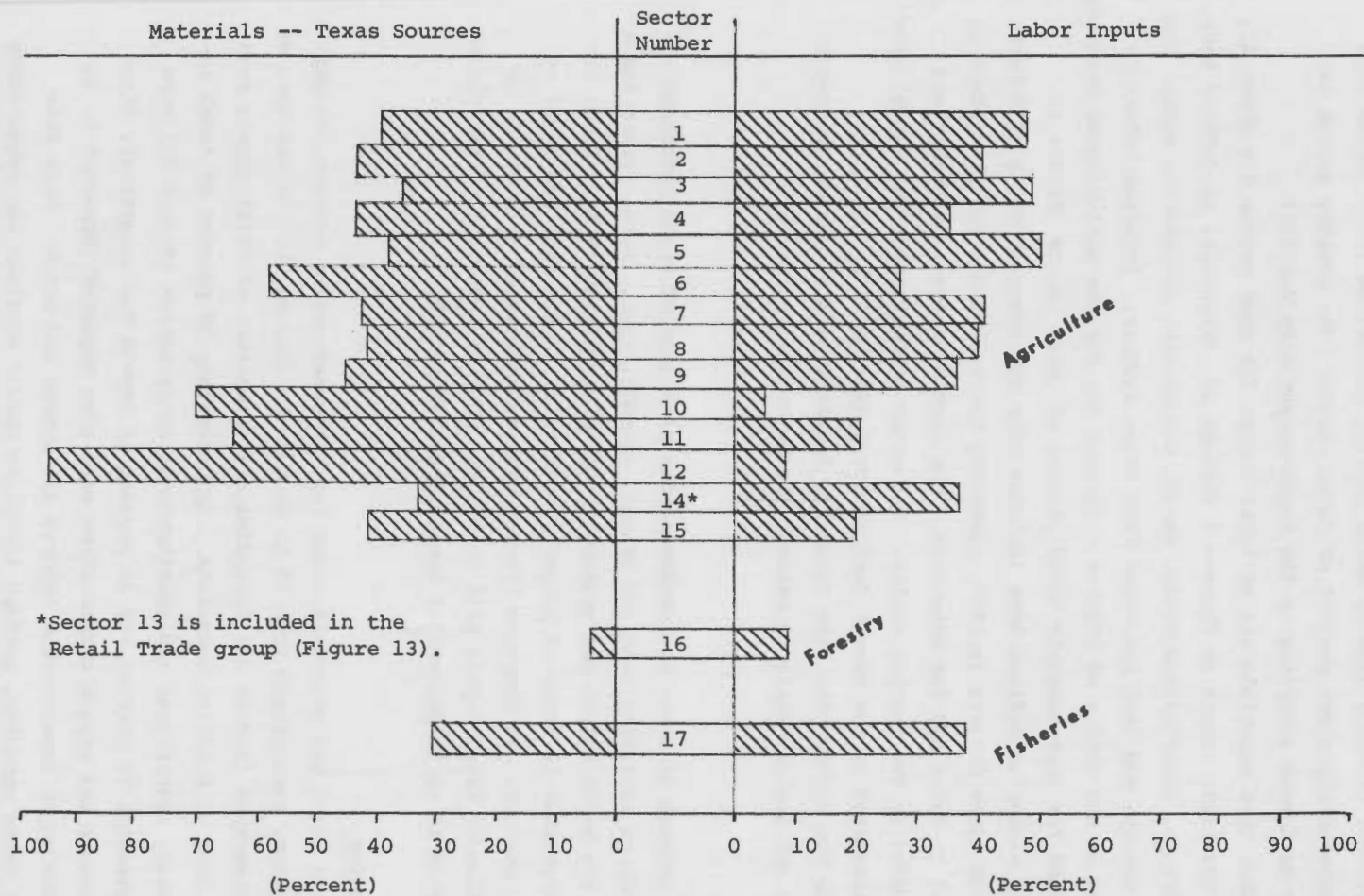
Materials and Labor Inputs

The transactions data of the input-output model have been summarized and presented in graphic form in Figures 8 through 14 for the purpose of showing the proportion of total inputs that is materials cost and the proportion that is labor cost. Other groupings such as proportion of inputs paid to government in the form of taxes and the proportion of inputs that are for business and other services could be depicted in an analogous manner but were not since each sector's inputs are tabulated both in dollar values and percentages of total for each input originating sector in Appendix A, Tables 1 and 2 respectively. Materials and labor were chosen in order to give the reader a quick graphic view of these inputs, on a sector-by-sector basis, as a percent of total inputs.

Of particular importance is the degree of labor intensity of each sector. The higher the proportion of total inputs paid to households for labor and management services, the more labor intensive is that sector. In Figures 8 through 14, labor intensity is demonstrated by the length of the bars. The longer the bar, the higher the proportion labor is of total inputs. The sector name corresponding to each sector number is found in Table 27 and in Appendix A, Tables 1, 2, 3, and 4.

Agriculture, Forestry and Fisheries Sectors

In the agricultural crops groups of sectors (1-8), labor ranges from 28 percent of total inputs for dryland food grains to 51 percent for dryland cotton. In general, livestock sectors are less labor intensive than crops sectors. Labor ranges



*Sector 13 is included in the Retail Trade group (Figure 13).

Figure 8. Materials and Labor as Percent of Total Inputs of each Agriculture, Forestry and Fisheries Sector -- 1967.

from approximately four percent of total inputs for feedlot livestock to 36 percent of total inputs for range livestock. Dairy farm labor inputs were estimated at approximately 20 percent of total inputs, while poultry production labor inputs were estimated at approximately eight percent of total inputs. The poultry sector had negative returns or losses according to the input-output data for 1967.

The proportion that materials are of total inputs for each sector are shown directly opposite the labor inputs in Figures 8 through 14. Materials, as defined here, include raw materials, semifinished goods, parts, components, containers, scrap, supplies, electric energy, and fuel purchased from Texas sectors. Imported materials were not included in the charts of Figures 8 through 14. For the agricultural sectors, materials accounted for approximately 40-50 percent of total inputs (Figure 8).

The forestry sector as defined here includes only the stumpage value of forest products sold from Texas forests in 1967, producing the relatively low percentage of total inputs paid to labor and for materials. The cost of harvesting timber and pulpwood is included in the logging sector. The major proportion of the forest sector inputs was allocated to the forest land resource (Sector 177).

According to the survey data, the fisheries industry paid 37 percent of total inputs for labor and approximately 31 percent for materials (Figure 8).

Mining Sectors

The mining sectors of Texas are predominantly producers of crude petroleum although other products including sand and gravel, sulphur, stone, salt, gypsum and a minor amount of the heavy metals are produced. Petroleum mining is less labor intensive than agriculture in terms of proportion of total inputs paid for labor -- approximately 30 percent. It compares closely with manufacturing (Figure 10) in terms of proportion of total inputs paid to labor. Cost of materials of the mining sectors ranges from 10 to 30 percent of total inputs (Figure 9).

Construction Sectors

The estimated labor and materials costs for the construction sectors, as percent of total inputs, each ranged from 30 to 40 percent (Figure 9). In the case of residential construction (Sector 22) approximately 30 percent of total inputs were imported in the form of building materials. Approximately 18 percent of total inputs for commercial, educational and institutional construction (Sector 23) were imported. Six percent, 22 percent and 21 percent of inputs for industrial, facility, and maintenance and repair construction were also imported (Appendix A, Table 2). Among the major construction imports are lumber and brick. With this ready market for these products, perhaps investors should consider the possibility of increasing the production of either or both of these building materials within Texas.

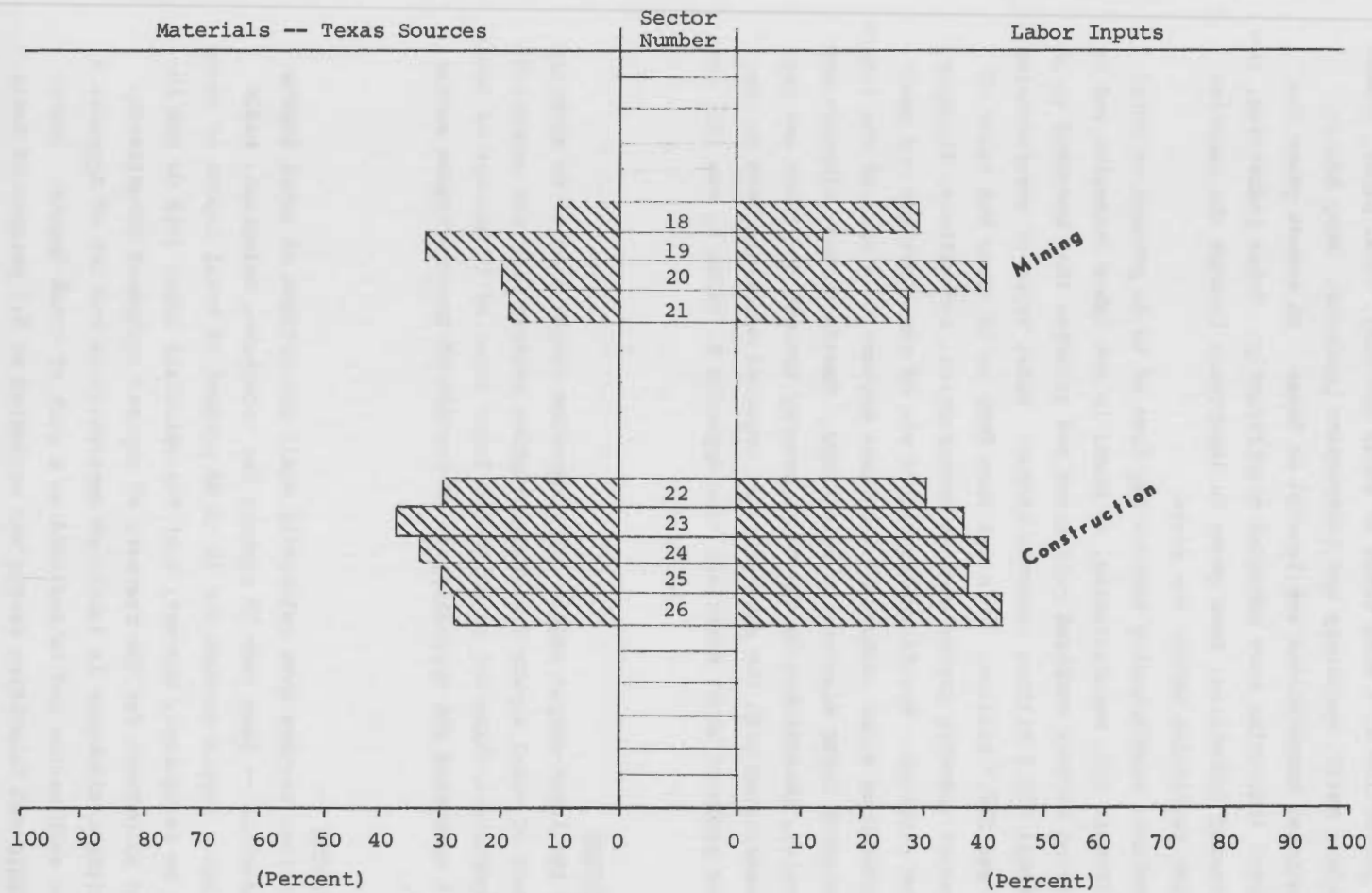


Figure 9. Materials and Labor as Percent of Total Inputs of each Mining and Construction Sector -- 1967.

Manufacturing Sectors

The manufacturing sectors (Sectors 27 through 113 and 173) of the Texas economy engage in the production of a wide range of food, clothing, wood, paper, chemical, plastic, leather, metal, machinery and instruments products. Many branch plants of major national corporations are located in Texas. In recent years the chemicals and apparel industries have expanded significantly. Other industries, including food processing industries, have grown in importance through the location of new manufacturing facilities within the state.

Generally speaking, manufacturing sectors pay from 10 to 40 percent of total inputs for labor (Figure 10). Manufacturing, as such, is not labor intensive and in 1967 all manufacturing sectors combined paid wages and salaries that amounted to 16 percent of Texas total \$30.7 billion personal income. Total value of manufacturing shipments in 1967 was \$26.7 billion. This was from four to 12 times the value of outputs of other major industry groups such as construction, agriculture, transportation, trades, and services. Manufacturing sector use of raw materials and semi-finished goods produced by other sectors of the Texas economy is a part of the inter-industry interdependence being measured in this study. Manufacturing, although not highly labor intensive, contributes to the Texas economy through the labor and services employment associated with the processing of imported materials used in conjunction with Texas produced input materials (see Appendix A, Table 2, row 181, columns 27-113).

Transportation Sectors

According to the input-output model, labor expenses ranged from 40 to slightly less than 60 percent of total inputs for transportation sectors with the exception of pipeline transportation which had an estimated labor input of 17 percent of total inputs. Materials accounted for approximately 20 percent of transportation sector inputs (Figure 11).

Communications Sectors

The communications sectors have relatively small proportions of total inputs in the form of materials -- less than 10 percent for telephone, telegraph, radio and television. Labor inputs account for 35 to 40 percent of total inputs of these sectors. It must be recognized, however, that the materials input data do not include depreciation allowances for the recovery of capital equipment investments. The annual depreciation allowance is tabulated separately on row 183 of Appendix A, Tables 1 and 2 for each sector and is included as a part of total inputs. Depreciation for the radio and television sector was estimated at 5.7 percent of total inputs, 15 percent for miscellaneous communications, and 14 percent for the telephone sector. It is also significant that a high proportion of total inputs of the communications sectors are paid to government in the form of taxes. The estimate

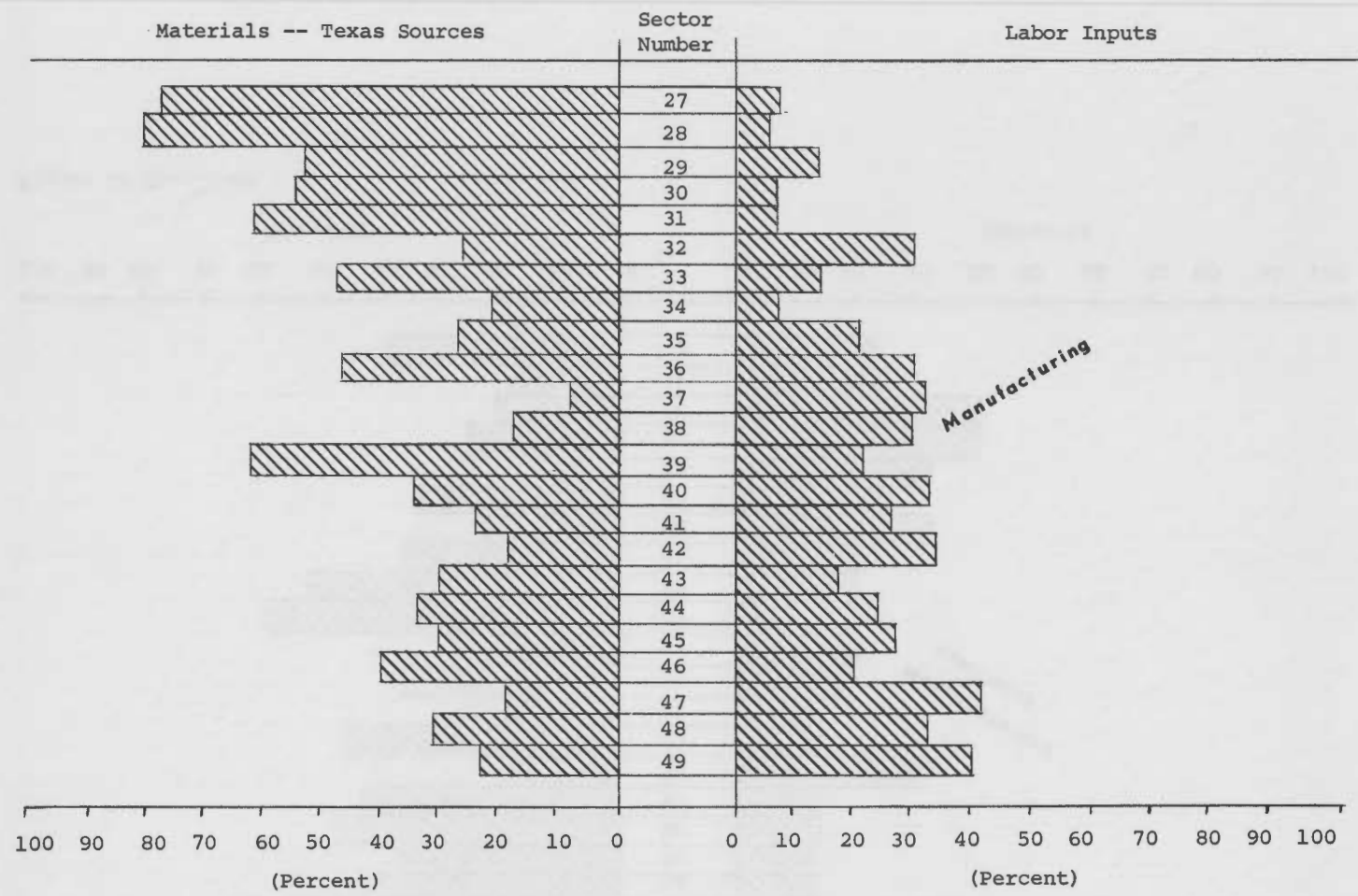


Figure 10. Materials and Labor as Percent of Total Inputs of each Manufacturing Sector -- 1967.

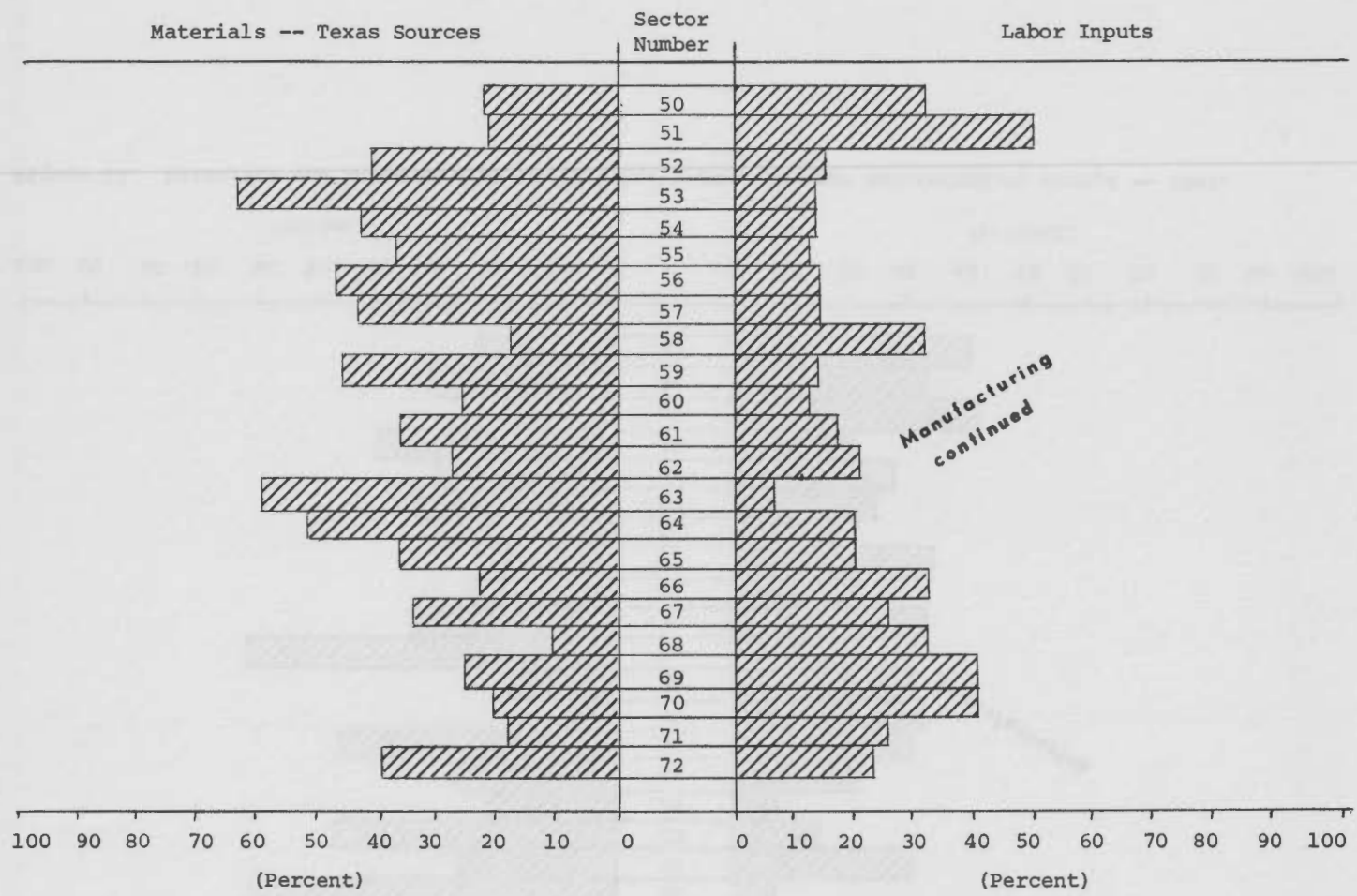


Figure 10 Continued

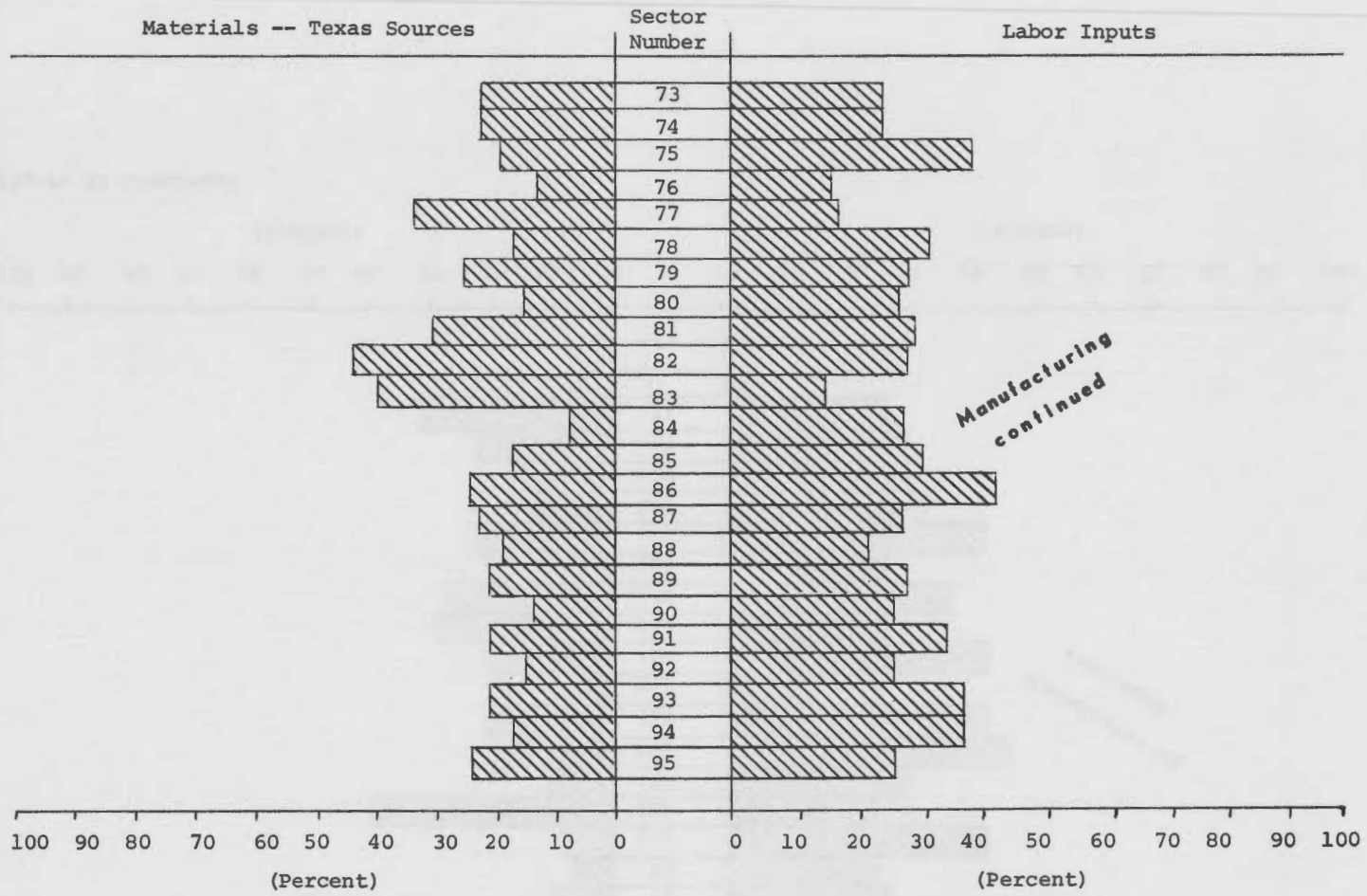


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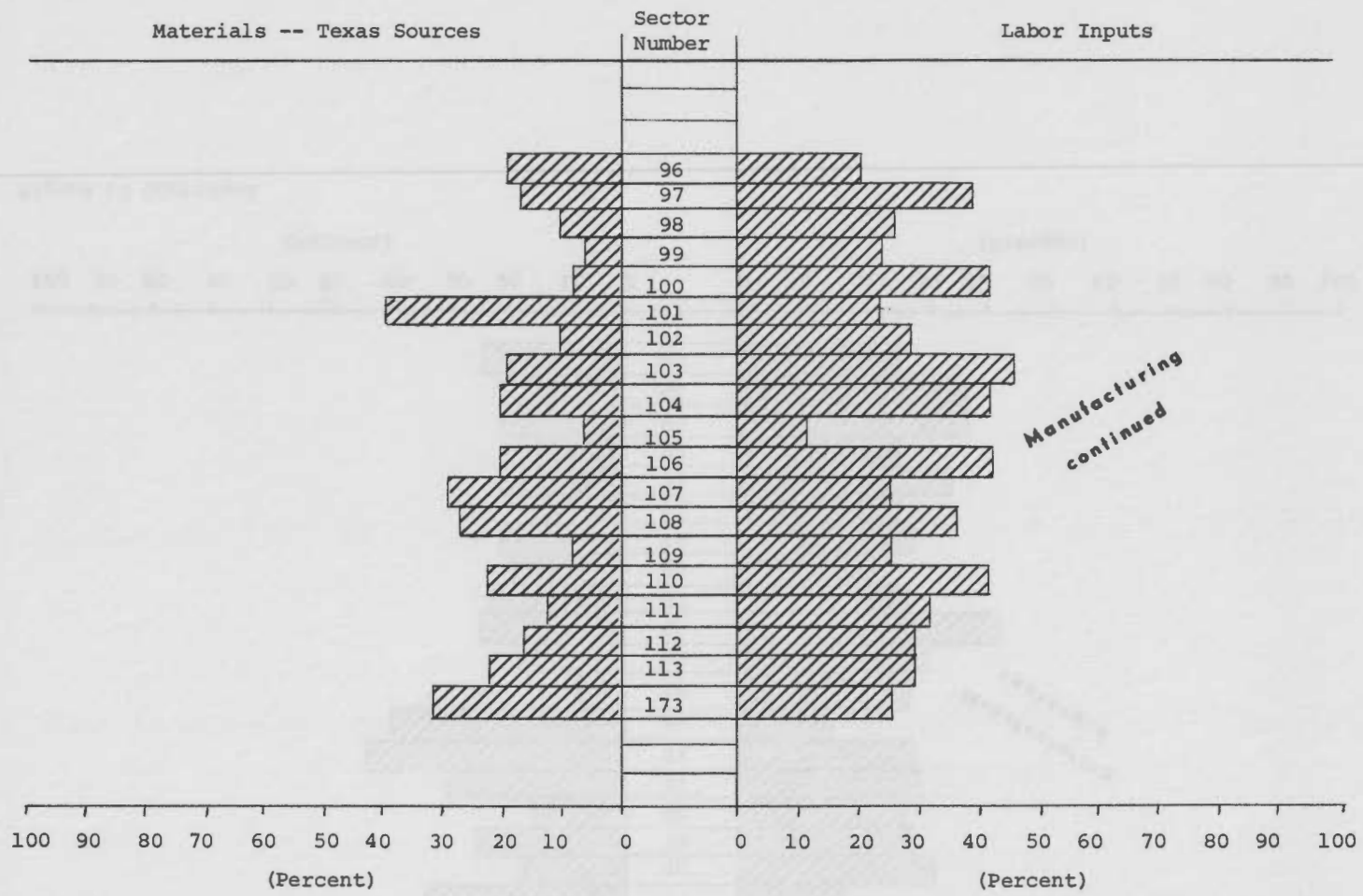


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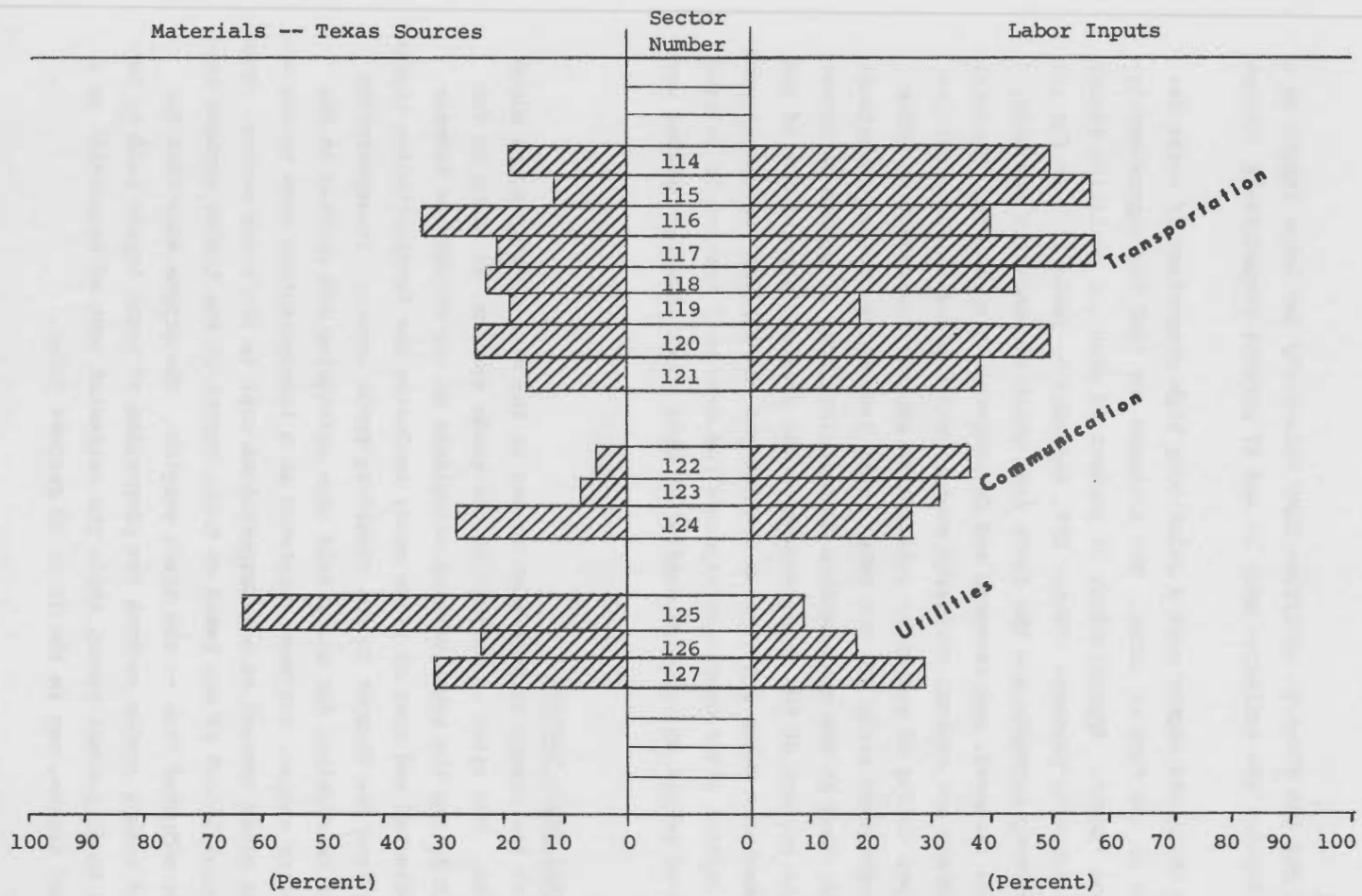


Figure 11. Materials and Labor as Percent of Total Inputs of each Transportation, Communications, and Utilities Sector -- 1967.

in 1967 was approximately 20 percent for telephone and telegraph and 13.5 percent for radio and television.

Utilities Sectors

Both natural gas and electric utilities have relatively low labor inputs as a percent of total inputs; the estimates were 10 and 17 percent respectively (Figure 11).

The electric utilities sector pays a relatively high proportion of total inputs to government in the form of taxes. The estimate for 1967 was approximately 16 percent of total inputs. Approximately 25 percent of electric utilities inputs were estimated as property payments (Sector 177, Appendix A, Table 2). As for all other sectors, property payments are the funds from which stockholders are paid, new investments are financed, and research and development is sponsored. The utilities sectors of Texas are capital intensive sectors which means that capital investment is high per dollar of output in relation to capital investment in other sectors. The input-output study did not obtain data from which capital investment could be estimated; thus it was not possible to calculate rate of return on investment for any of the sectors of the Texas economy. The property payment row of the input-output transactions table provides an estimate of the residual income (income remaining to pay capital after operating expenses had been met) that could be used to calculate rate of return to invested capital if data about invested capital were available.

Wholesale and Retail Trade Sectors

The outputs of the trades sectors were valued at the mark-up or margins added to merchandise sold. The value of outputs of the trade sectors, as shown in the tables of Appendix A, are the gross margins calculated as the difference between gross revenues collected and cost of goods sold, including the transportation charges to move the goods from the shipper to the receiving trade sector. Transportation costs from shipper to receiver for goods sold were calculated and shifted to the transportation sector output, but were tabulated as a transportation cost to the ultimate user of the goods instead of a transportation cost to the trade sector. Thus, the graphs of Figures 12 and 13 are based on total inputs of the trades sectors commensurate with the adjusted data -- the trade margins. The graphs show that for both wholesale and retail trades sectors the proportion of total inputs paid to labor was in the 30 to 60 percent range, while the estimated cost of materials, as a proportion of total inputs, was in the 10 to 20 percent range.

Finance, Insurance, and Real Estate Sectors

Outputs of the finance sector are the value of gross billings for services rendered and include interest received on loans outstanding. The value of output for

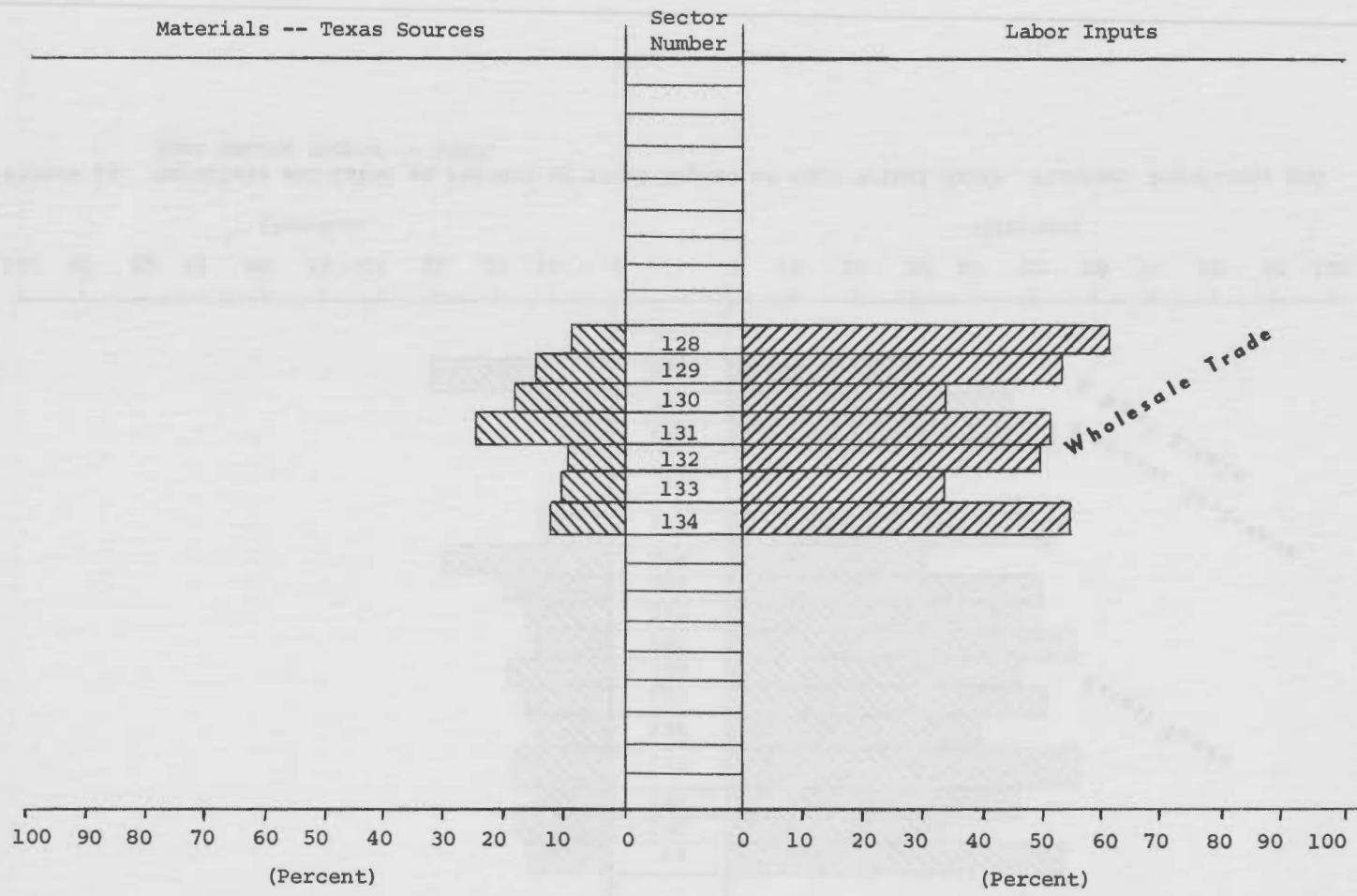


Figure 12. Materials and Labor as Percent of Total Inputs of each Wholesale Trade Sector -- 1967.

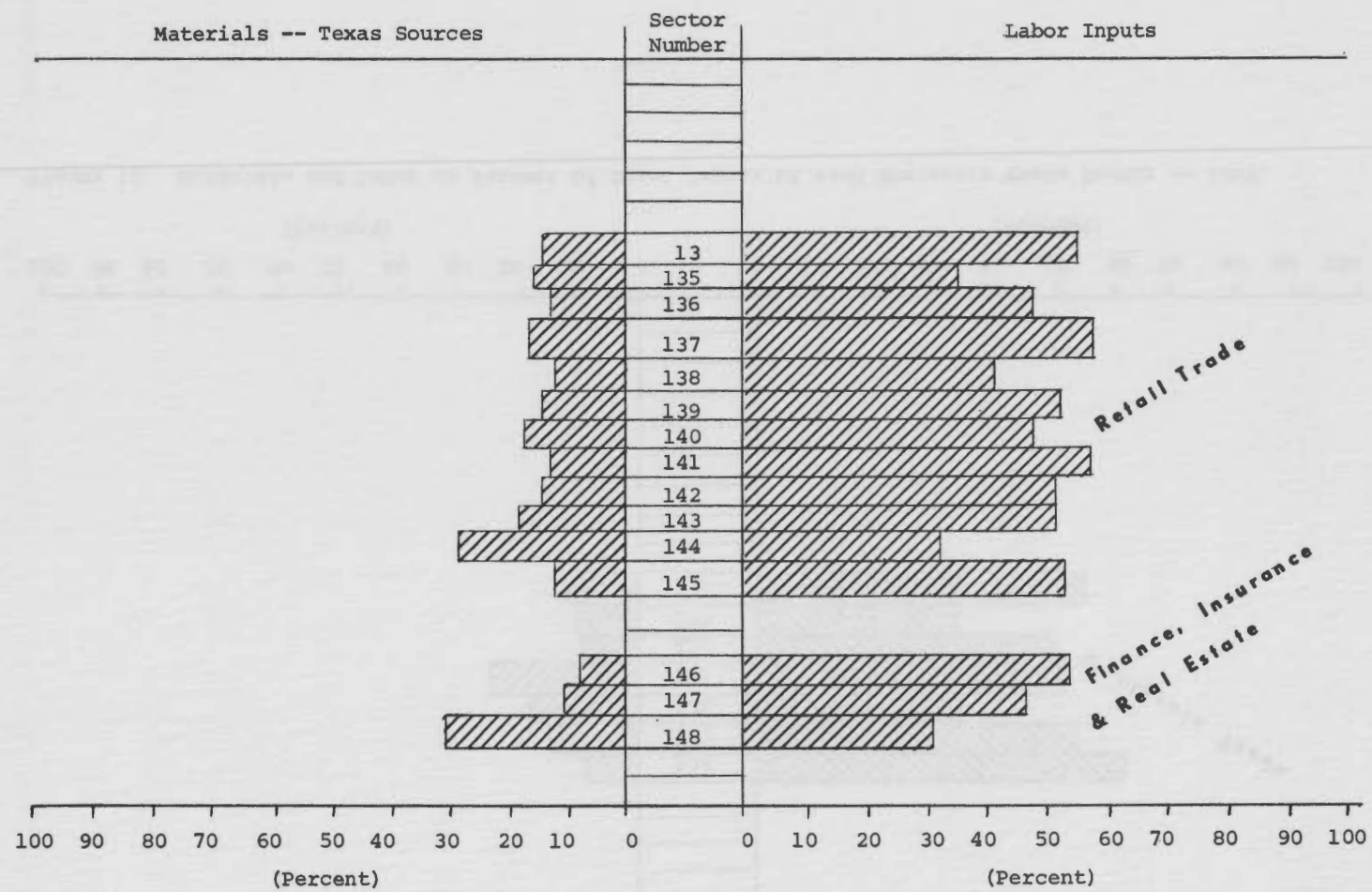


Figure 13. Materials and Labor as Percent of Total Inputs of each Retail Trade, Finance, Insurance, and Real Estate Sector -- 1967.

the insurance sector was calculated as the premiums received for fire, casualty, and health policies in force plus premiums collected minus case value increases for life insurance policies in force. Output of the real estate sector was defined as the estimated gross billings for lease and rental of real estate. As can be seen from Figure 13, the proportion of total inputs paid for labor in finance and insurance sectors is high compared to the proportion paid for materials (45-55 percent for labor in insurance and finance as compared to approximately 10 percent for materials). Labor and materials each account for approximately 30 percent of total inputs in the real estate sector (Sector 148).

Services Sectors

Value of output of the service type sectors (professional as well as repair and personal services) is defined as gross billings for services rendered. The proportion of total inputs of the service sectors that were paid for labor ranged from approximately 30 to 60 percent (Figure 14). In general, the service sectors had the highest proportion of total inputs allocated to labor of all major sector groupings. The proportion of inputs paid for materials was in the 10 to 20 percent range (Figure 14).

Export-Import Analysis

Two major points of interest about a regional economy center around the markets for outputs of both raw materials and finished goods and the source of production inputs. Since regional economies, such as the Texas economy, tend to specialize in the production of those goods for which a comparative advantage exists, it is advantageous to trade with other regions both for production inputs as well as for some finished goods which can be secured at a lower cost than if they were produced locally. The input-output model contains both an imports row and an exports column (Appendix A, Table 1, row 181 and column 181). Each sector's estimated dollar value of imports is tabulated in row 181 and estimated dollar value of exports is tabulated in column 181.

The estimated proportion of each sector's output that was sold to markets outside Texas (exports from the Texas economy) is graphed in Figures 15 through 20. Likewise, the estimated proportion of total dollar value of each sector's inputs (inputs = outputs) that was imported into the state is graphed, in the same figures, on the bar to the left of exports. In this way, the reader can quickly gain a view of each sector's exports and imports as a proportion of gross inputs and outputs. In addition, the graphs permit a direct comparison of the percent of imports with the percent of exports on the column base of 100 percent of inputs and outputs.

It is emphasized that exports and imports are valued f.o.b. the shipper just as all other transactions of the input-output model are valued. The exports are made in the form of the outputs of the respective exporting sectors and, thus, if

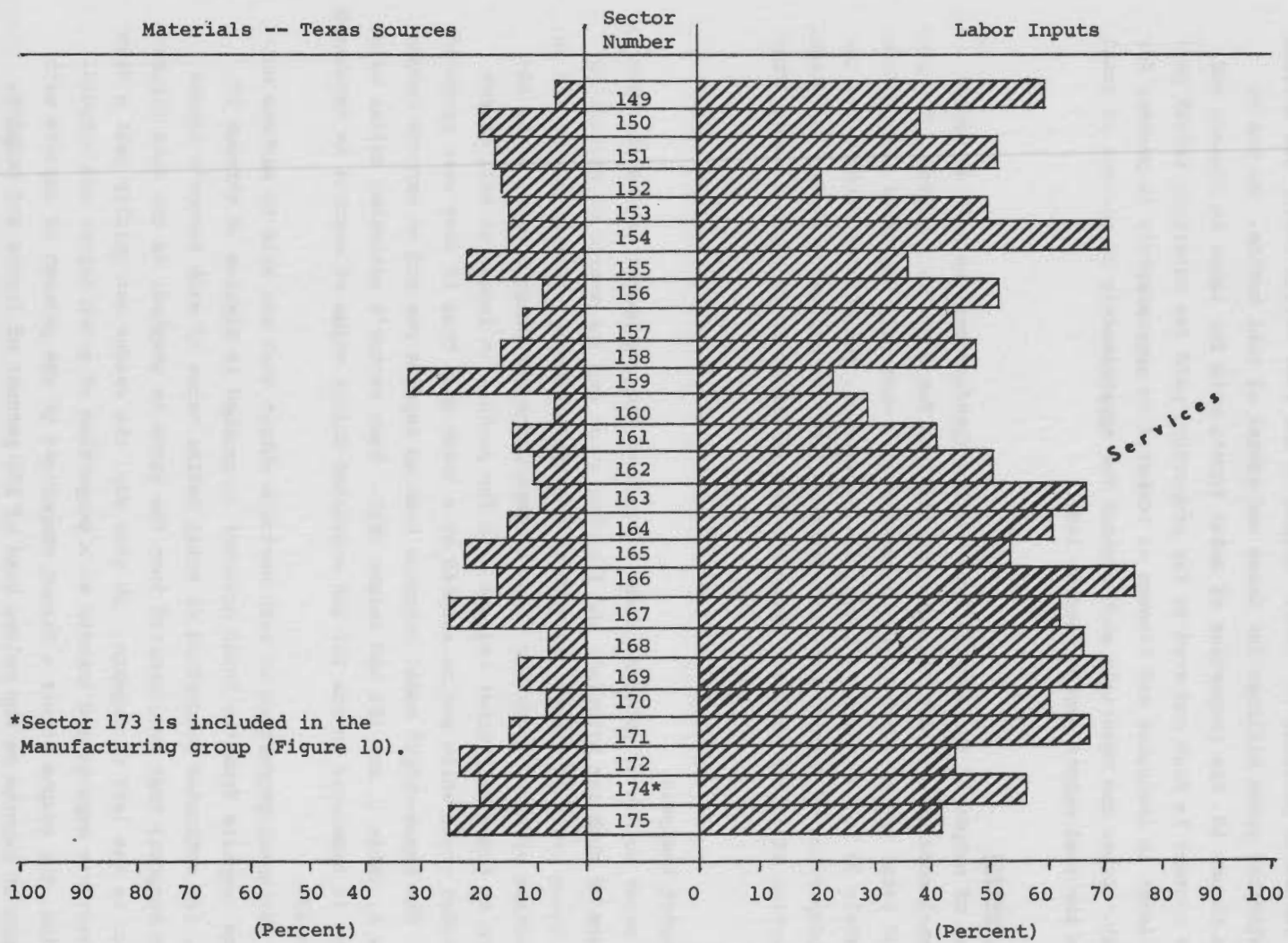


Figure 14. Materials and Labor as Percent of Total Inputs of each Service Sector -- 1967.

a sector is producing raw materials and exported a part of its output, it may be assumed that the sector is exporting raw materials, or if the sector is producing partially finished goods, then any exports would be assumed to be in the form of partially finished goods. In some instances, the exports data may indicate industries or sectors which might be expanded within the state's economy to do further processing and thereby increase employment within the state. A brief discussion of the sector groups is presented below.

Agriculture, Forestry, and Fisheries

The agricultural sectors which exported a high proportion of total outputs were cotton (Sectors 1 and 5), feed grains (Sectors 3 and 7), and range livestock (Sector 9) (see Figure 15). Feedlot livestock (Sector 10) was a significant importer. The inputs of Sector 10 are largely feeder cattle, while the exports of Sector 10 in 1967 were fat cattle for slaughter. Due to the fact that the meat packing industry has increased significantly in Texas since 1967, the exports of slaughter cattle have likely decreased in recent years. This is one illustration of a case in which raw materials -- fat cattle -- for meat packing industry has attracted the meat packing industry to expand within Texas. With the recent growth in the feedlot livestock sector, this sector now uses much more locally produced feedgrains and feeder cattle thus reducing the exports of these two sectors.

The primary forestry sector (Sector 16) is defined and included in the input-output model as stumpage value of product. The major proportion of forestry outputs are sold to the Texas logging and paper sectors (Sectors 39 and 40). Hence, imports and exports of this sector are zero. As is shown later, however, other sectors do import forest materials and products.

The Texas fisheries industry produces primarily soft shelled fish. The major product is shrimp. According to the 1967 input-output survey, no fishery products landed at Texas ports were exported from Texas (Figure 15).

Mining

The mining sectors of the Texas economy export both crude petroleum and natural gas liquids in significant proportions of total output (Figure 16). Slightly more than 20 percent of crude petroleum and approximately 55 percent of natural gas liquids, (Sectors 18 and 19) imported approximately six and 16 percent of inputs respectively. These imports were largely raw materials of the same type as those produced in Texas. The origin of these imports in 1967 was neighboring states.

Sector 20, oil and gas field services, had estimated imports of approximately 25 percent of inputs and exports of approximately 22 percent (Figure 16). Texas is a leading producer of oil and gas field services in the larger southwest region. Some of the imports of the sector are in the form of highly specialized equipment services and materials for use in the production of exploration, drilling, and well services.

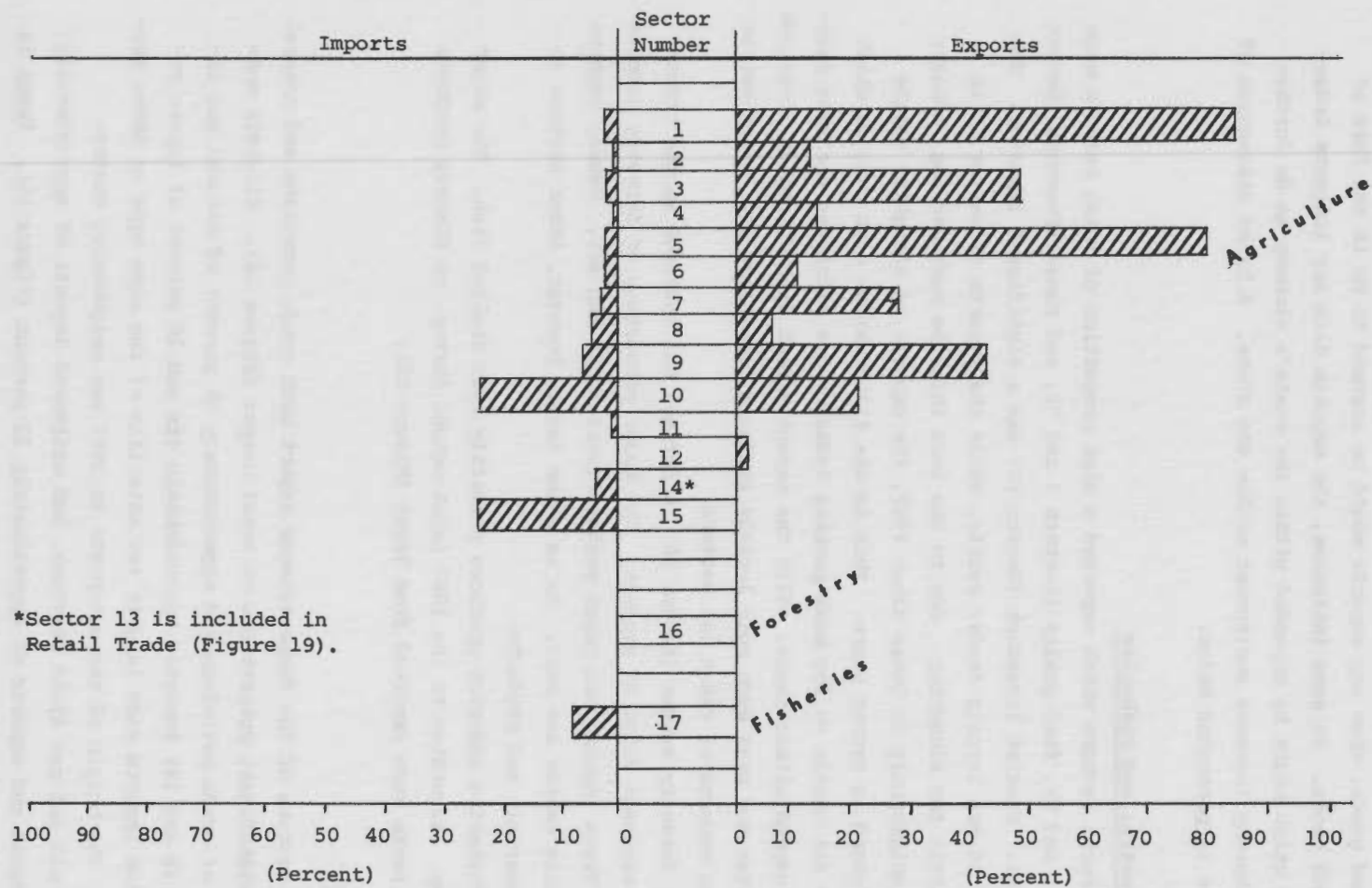


Figure 15. Imports and Exports as Proportion of Total Outputs of each Agriculture, Forestry, and Fisheries Sector -- 1967.

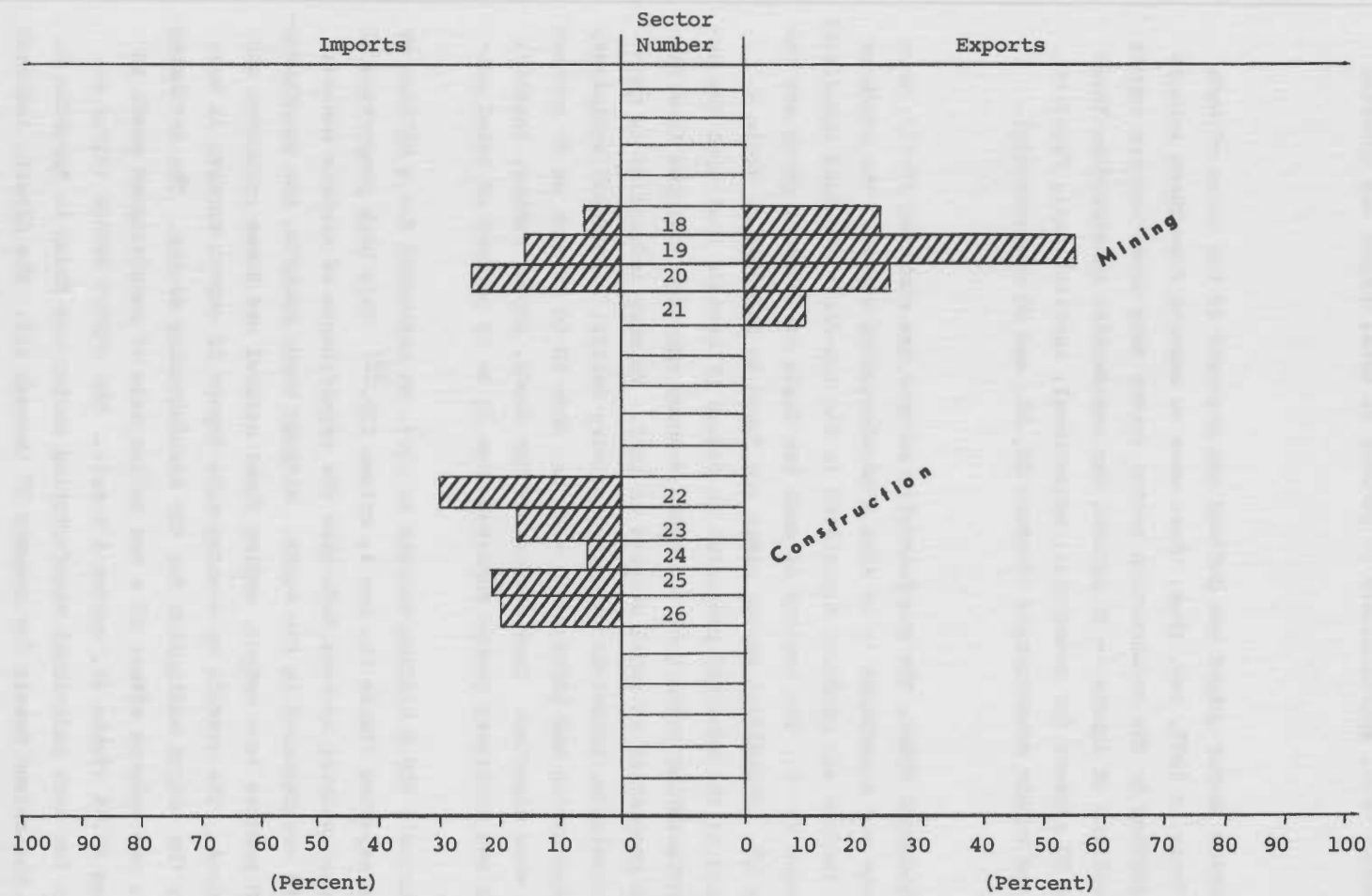


Figure 16. Imports and Exports as Proportion of Total Outputs of each Mining and Construction Sector -- 1967.

The remaining mining sector, Sector 21 (other mining and quarrying) produces sand and gravel and stone. These materials are primarily used in construction. According to the survey data, approximately 10 percent of total output was exported in 1967.

Construction

The construction sector output was defined and measured as the value of work put in place in Texas in 1967, and, thus, there were no exports from these sectors (Figure 16). According to the construction sector survey data these sectors import significant proportions of inputs -- 30 percent for residential construction (Sector 22) and 18 to 20 percent for commercial, educational, institutional, facility, and maintenance and repair construction (Sectors 23, 25, and 26 respectively).

Manufacturing

In the input-output model, the manufacturing sectors are numbered 27-113; Sector 173 -- ordnance and accessories -- is also a manufacturing sector. The products of these sectors include all products classified in the two-digit standard industrial classification codes 19-39. The sectors of each two digit SIC product group are indicated on Figure 17. Individual sector names are found in Appendix A, Table 1.

An examination of the material presented in Figure 17 reveals that with few exceptions, the manufacturing sectors of the Texas economy exported (shipped from Texas) a significant proportion of total outputs in 1967. In such industries as textiles, apparel, chemicals, petroleum refining, primary metals, electrical equipment, and in some transportation and instruments sectors, from 50 to as much as 90 percent of total outputs were exported. Many sectors in the foods, paper, rubber, leather, fabricated metals and machinery groups exported from 10 to 40 percent of total outputs (Figure 17).

Of manufacturing's \$26.8 billion outputs in 1967, an estimated \$12.2 billion or 45.5 percent were exported (Table 18, row 4, column 15).^{24/} This high proportion of exports by the manufacturing sectors indicates the significance of markets outside Texas for products manufactured in the state. Without these markets, the manufacturing sectors would produce less output, employ fewer natural and human resources and engage less services. The overall or economy-wide impact of export markets is measured directly by the output multiplier for the manufacturing sector. The estimated direct, indirect, and induced effect of a one dollar sale of manufactured goods to export markets was \$2.69 (Table 21, column 4 total). The export demand (final demand) multipliers for each individual manufacturing sector are found in Appendix A, Table 4, and are the column totals for columns 27 through 113. The direct, indirect

^{24/} Individual sector estimated exports are tabulated in Appendix A, Table 1, column 181, rows 27-113.

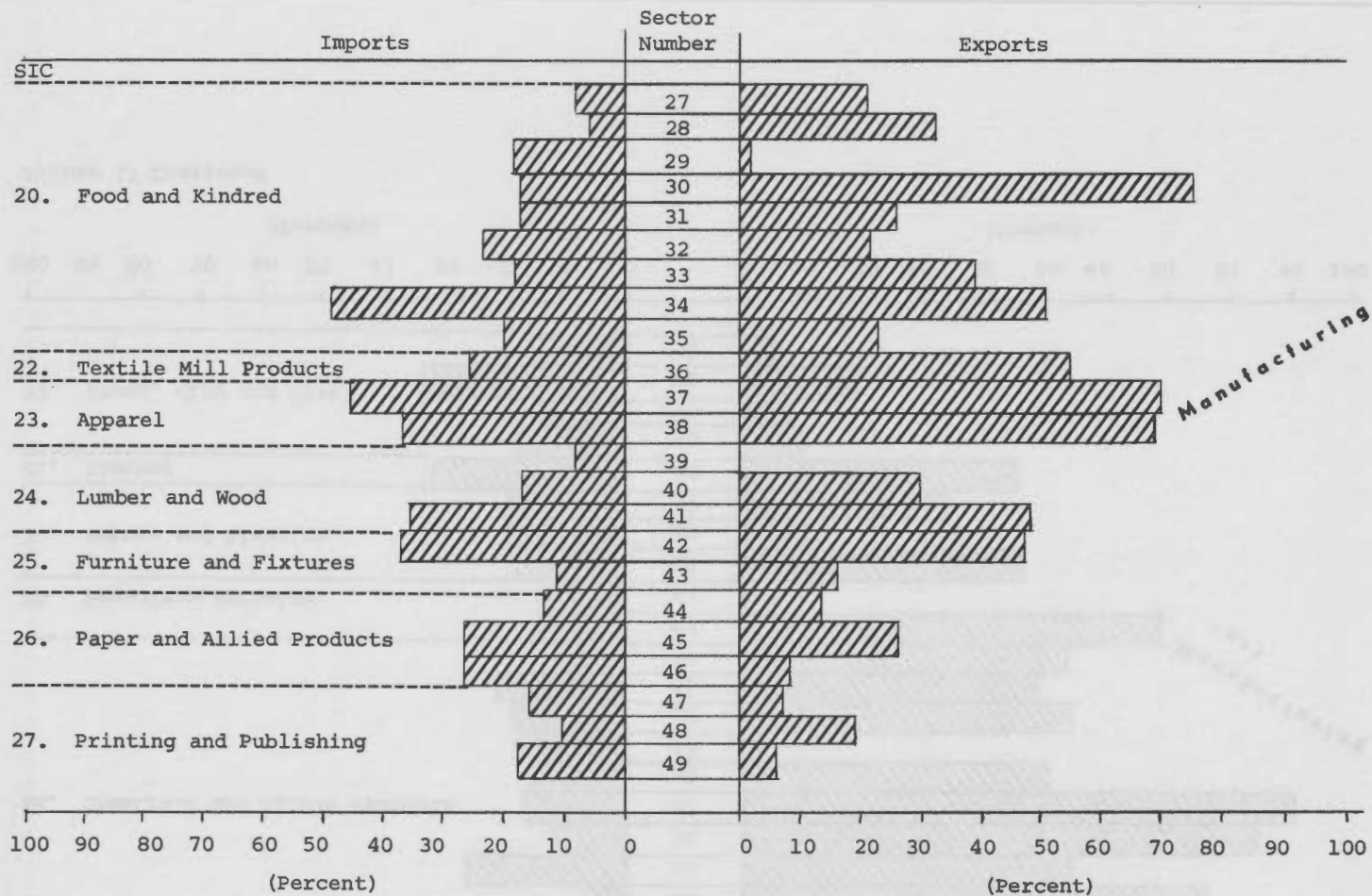


Figure 17. Imports and Exports as Proportion of Total Outputs of each Manufacturing Sector -- 1967.

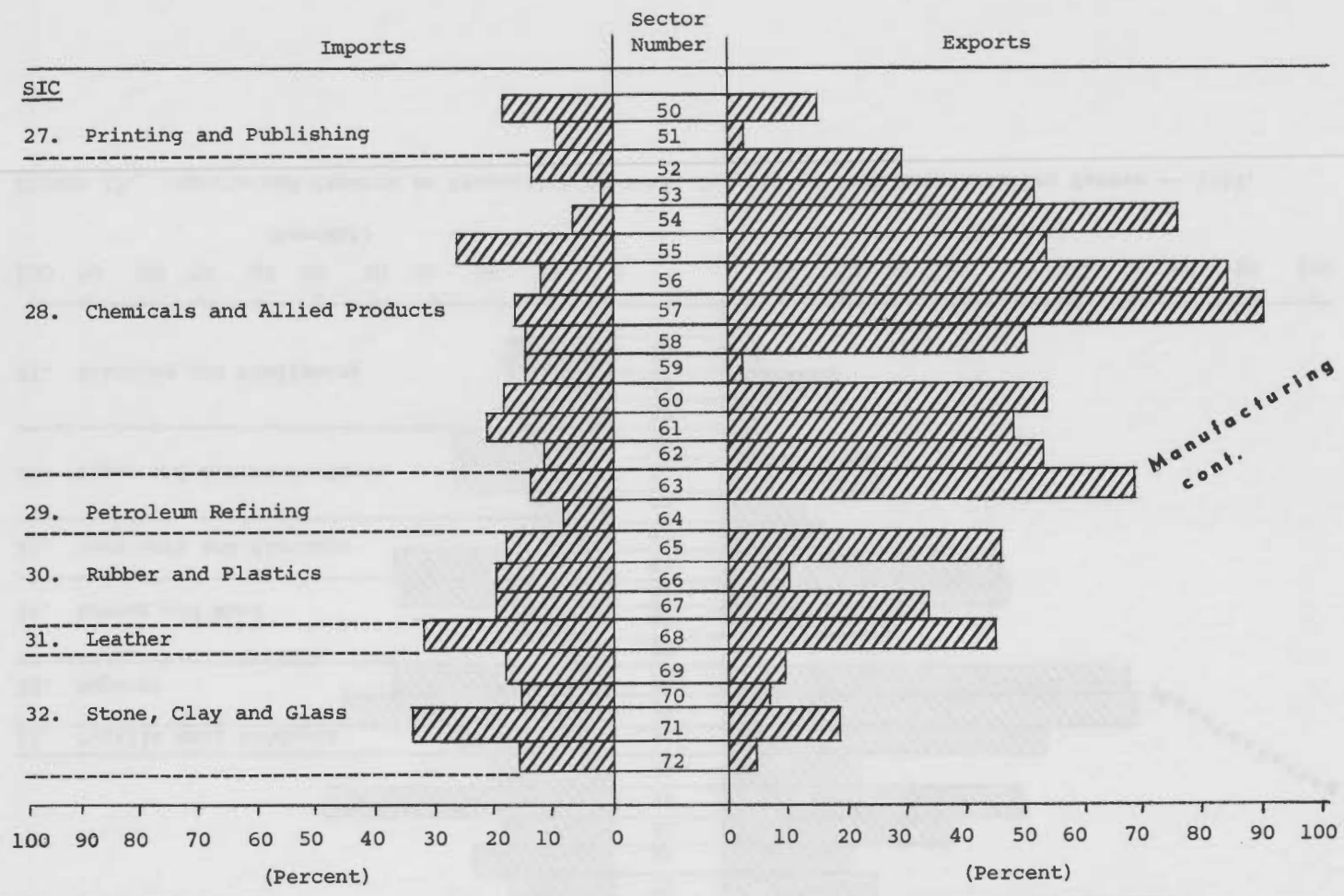


Figure 17 Continued

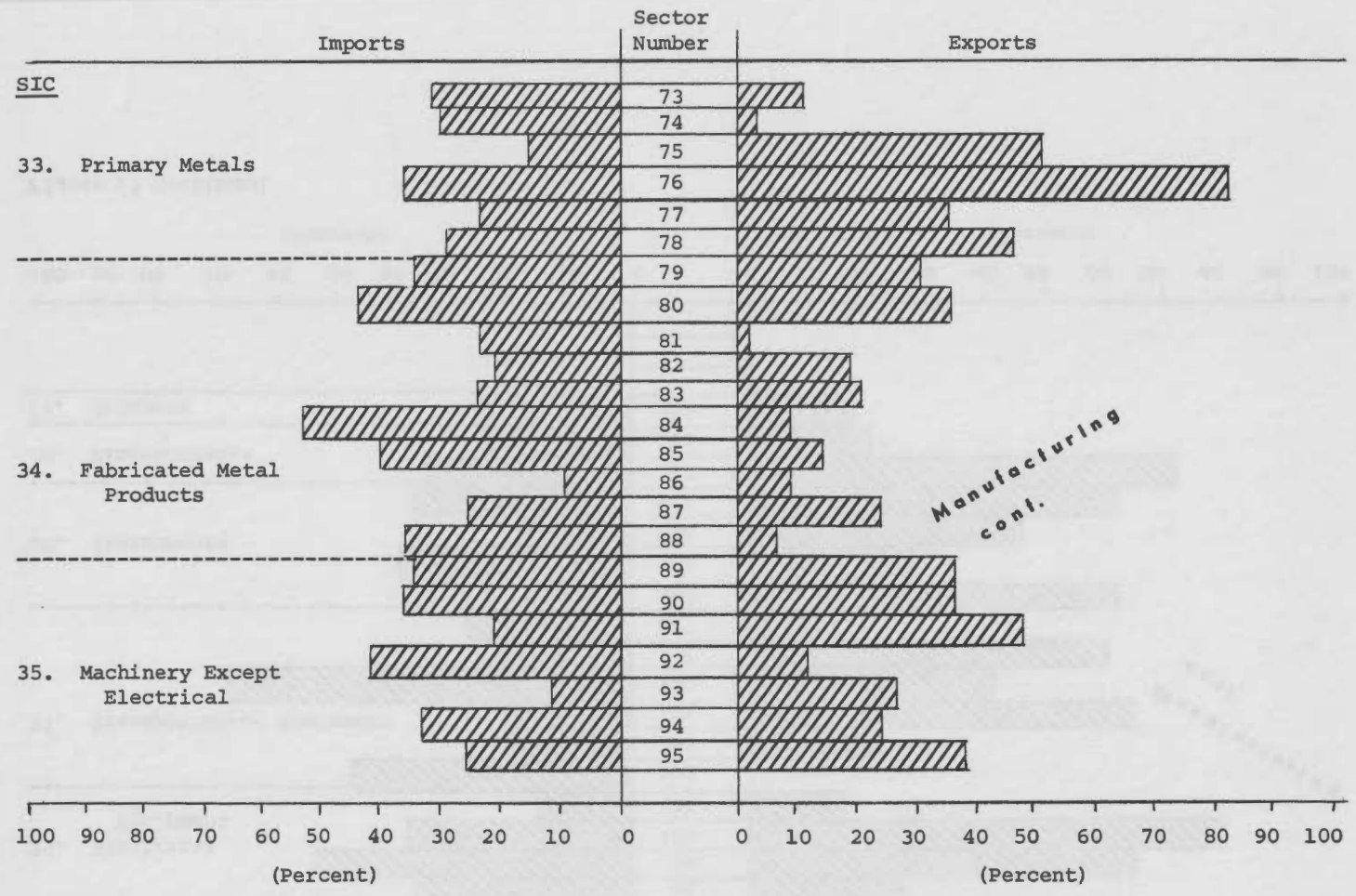


Figure 17 Continued

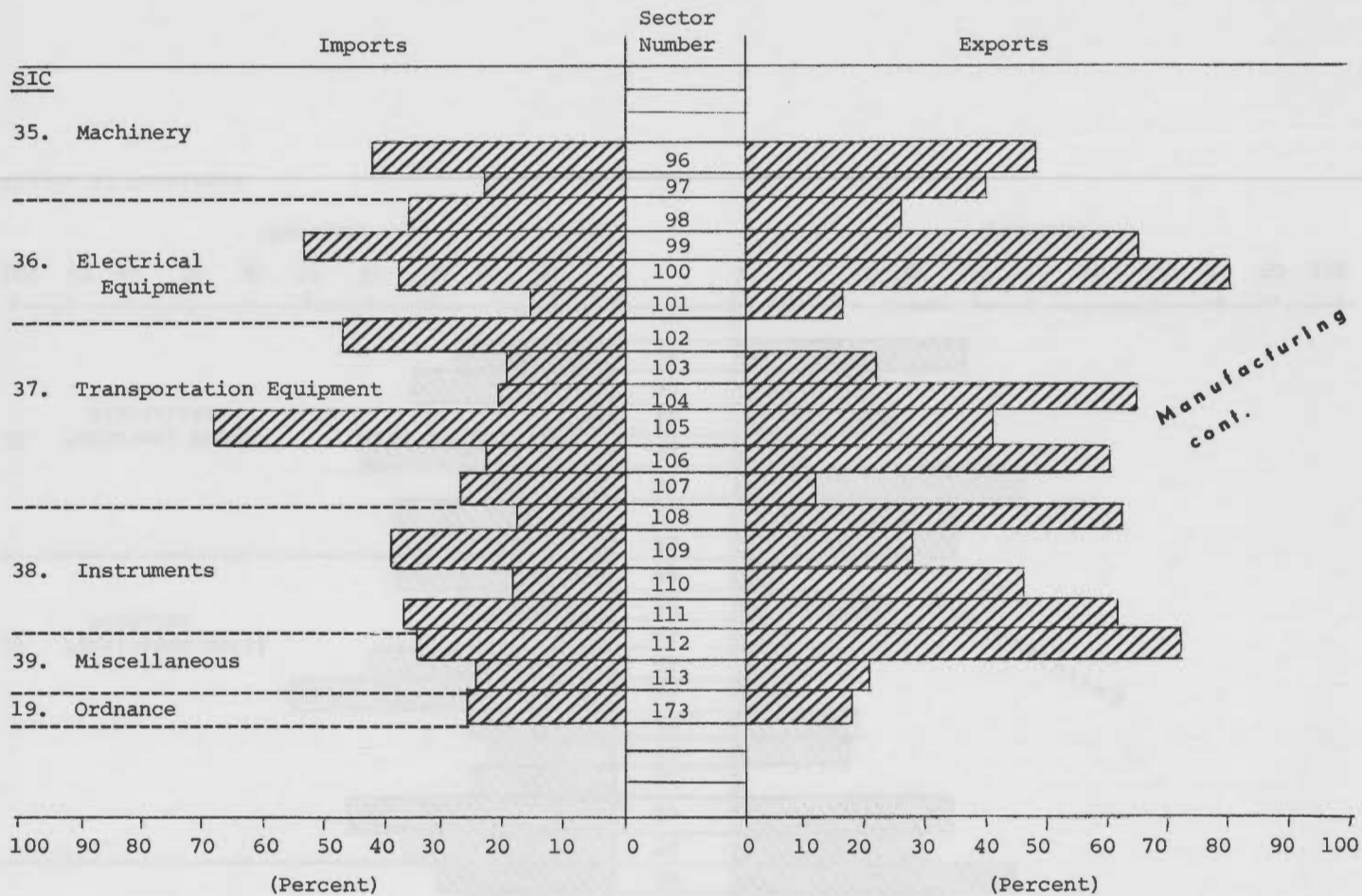


Figure 17 Continued

and induced effects upon the Texas economy due to a change (increase or decrease) in export sales of an individual sector can be calculated by applying the multipliers to the estimated dollar value of the change when the latter is valued f.o.b. the shipper. For example, the multiplier for Sector 27, meat products, is 4.07. For each dollar of sales to exports by the meat products sector, there is a \$4.07 direct, indirect and induced effect upon the entire Texas economy. The sectors to which the \$4.07 would be paid and the amounts paid to each are shown in Appendix A, Table 4, column 27. Similar calculations of the impacts of exports of other sectors can be made by applying the appropriate multipliers found in Appendix A, Table 4. The calculation procedures were illustrated earlier in Tables 22, 23, 24, and 25 and in the discussion pertaining to those tables.

The manufacturing sectors were major importers of inputs in 1967 (Figure 17). According to the estimates, individual sector imports ranged from 10 to 50 percent of total inputs. For the entire group of manufacturing sectors, imports were estimated at \$6.4 billion or 24 percent of total inputs (Tables 18 and 19). Estimated manufacturing sector imports at \$6.4 billion was 52 percent of estimated manufacturing sector exports. As in the case of exported raw materials and partially finished goods, imported manufacturing inputs may be products that could be produced within Texas when the markets become large enough to permit efficient production units to locate within Texas. However, it will be necessary to conduct in-depth analyses of the imports data. The imports row of the input-output model is an aggregation of total dollar value of imported inputs and is useful only as a guide and for perspective with respect to the total value of imports of each producing sector. More detailed imports analyses of the data will be done as a separate activity. Space requirements of such an analysis do not permit its inclusion here.

Transportation

In order to obtain meaningful results from analyses of the transportation sectors, the following background and concepts are presented. The transportation industry is unique, from the input-output modeling standpoint, in that the activities of the industry are not confined to specific locations; i.e. revenues and costs are incurred at different geographic locations, some of which are outside Texas. Thus the available data must be modified and adjusted to obtain consistency with that of other sectors and to accurately reflect the transportation sectors of the Texas economy.

The transportation industry of both the nation and the state is regulated with respect to routes over which individual establishments can operate and with respect to rates charged for services rendered. Both national and state regulatory agencies administer policies and regulations within which the Texas transportation sectors operate. Data pertaining to the level of output and cost of operating transportation establishments are reported to the regulatory agencies. In Texas, data are filed

with the Texas Railroad Commission for truck, rail, and pipeline transportation. In most cases, the data pertain to the Texas portion of interstate hauling; i.e., costs for interstate shipments are prorated on a ton mile basis and allocated to the states through which shipments were made. In other cases, the reporting establishments are intrastate carriers and, thus, the reported data pertain only to Texas.

The transportation sector's outputs were valued at the dollar value of income received for transportation services rendered within Texas. Transportation sales were assigned to the purchaser of goods transported. Thus, transportation sector exports are the estimated dollar value of transportation services performed by Texas establishments to move goods sold to out-of-state buyers from the Texas shipping point to Texas borders. The estimated proportions of total output that were exported ranged from zero for intercity rural highway and local and suburban (Sectors 115 and 120 respectively) to a high of 58 percent for water transportation (Sector 117). The proportions of output exported by rail, motor trucks, air, pipeline, and other transportation services were estimated at 25, 5, 12, 20 and 4 respectively (Figure 18). Transportation sector imports of inputs were relatively low. The estimated proportions were in the 5 to 10 percent range (Figure 18).

Communications

The two major communications sectors are telephone and telegraph and radio and television. Total outputs of each were valued at the dollar value of billings for services rendered. In the case of telephone and telegraph, only the Texas billings were included, and, thus, this sector is shown as having no exports (Figure 18). This sector had estimated imports of approximately 10 percent of total inputs.

The radio and television sector sells services, in the form of broadcast advertising, to a wide variety of customers. Some of these are located outside Texas, and, thus the estimated exports of approximately 41 percent of total outputs (Figure 18, Sector 123). This sector had an estimated 18 percent of total inputs that were imported. Imports include the payments to national networks for broadcast materials as well as payments for talent and materials used in the production of services.

Utilities

Output of the utilities sectors were valued at the dollar value of billings for natural gas sales, in the case of the natural gas transmission sector, and at the dollar value of electric and water and sanitation service billings for these sectors. The latter two, electric and water and sanitation services (Sectors 126 and 127) sell only to Texas customers, and thus, these two sectors have no exports. The natural gas transmission sector (Sector 125) purchases natural gas from the petroleum mining sector and transports the gas by pipeline to markets. According to the estimates, in 1967 approximately 56 percent of the gross value of outputs of this sector were exported (Figure 18). Imports of inputs by the utilities sectors were relatively low -- less than five percent (Figure 18).

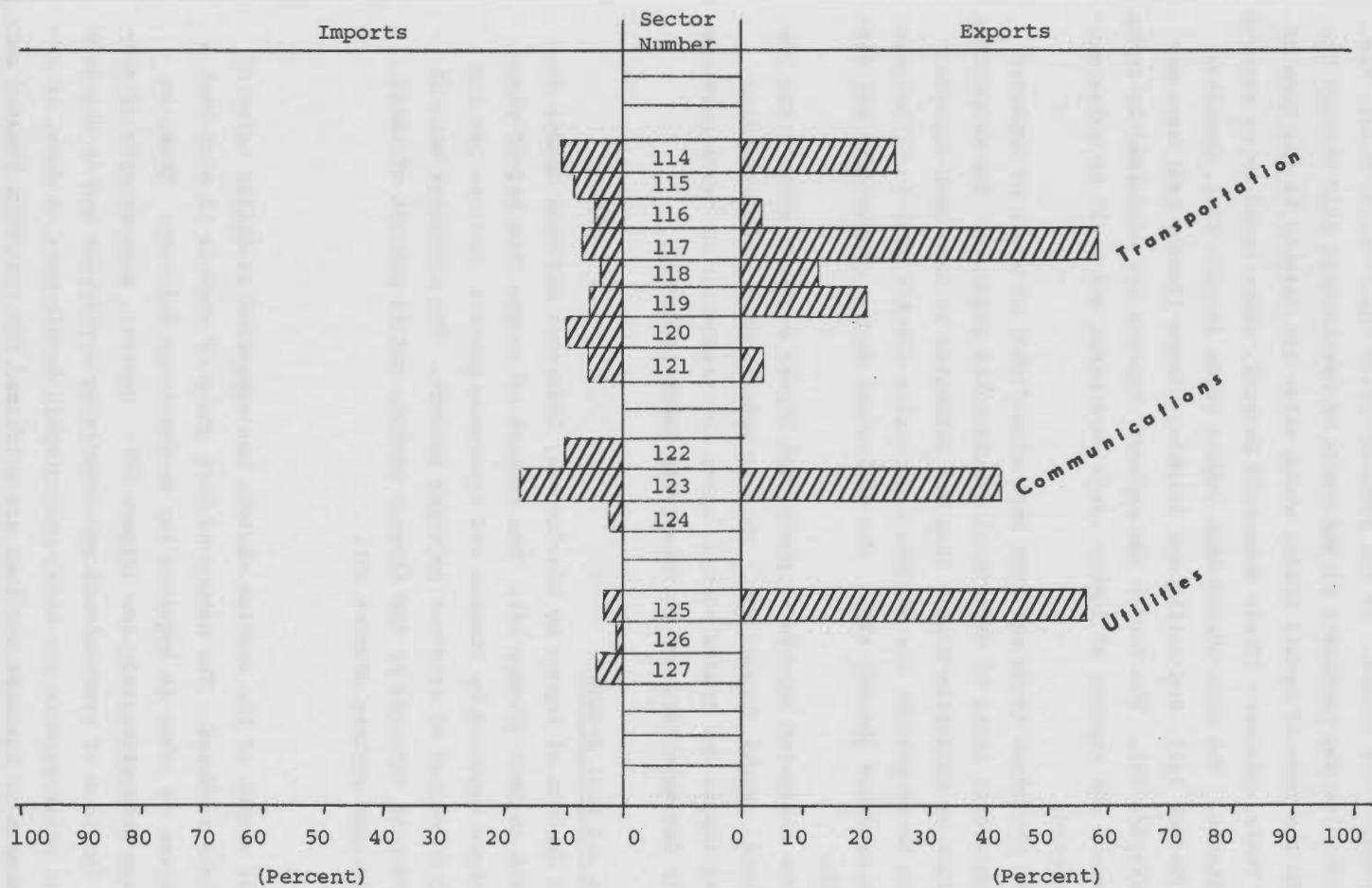


Figure 18. Imports and Exports as Proportion of Total Outputs of each Transportation, Communications, and Utilities Sectors -- 1967.

Wholesale and Retail Trade

The trade sectors value of outputs are the dollar value of margins or mark-up on merchandise purchased for resale. In the producer-price input-output model, the trade margins are sold to the purchaser of the goods on merchandise sold through the trades sectors. In the case of retail trade, where sales are largely in the form of finished goods to Texas consumers (Texas Household Sector), there would be no exports of retail trade outputs. The data showed that lumber yards (Sector 135), gasoline service stations (Sector 141), and eating and drinking places (Sector 144) were exporting services (Figure 19). The latter two sectors' exports are explained in terms of sales to tourists. The exports of lumber yards were minor and would be sales margins on lumber exported.

The exports of wholesale trade services were significant as would be expected in view of the significant level of exports of manufactured products. The proportion of total value output of wholesale trades that was estimated to have been exported in 1967 ranged from three percent for wholesale groceries (Sector 129) to 51 percent for wholesale farm products (Sector 130). The individual sector proportions are displayed in Figure 19.

In general, the estimated imports of production inputs by trade sectors was low in proportion to total inputs (Figure 19). This is consistent with expectations about the source of inputs for trades sectors since the production of trade services involves relatively few materials and is relatively labor intensive.

Finance, Insurance and Real Estate

The estimated imports of inputs by the finance, insurance and real estate sectors were negligible in 1967 (Figure 19). The receipt of income from out-of-state customers for services rendered by finance and insurance sectors (Sectors 146 and 147) is considered an export of services by these sectors. The estimates were 15 percent of total outputs exported by the finance sectors and 30 percent of total outputs by the insurance sectors (Figure 19).

Services

Gross value of output of the service sectors was expressed as dollar value of billings for services rendered. The nature of this group of sectors is such that a relatively high degree of labor is required for on-the-scene delivery. Thus, in general, exports are proportionately low (Figure 20). However, some exports of services are done in the form of professional and consulting activities and in the form of contract work in which repairs are made, photographic development is done, or activity such as research or business services are performed for customers located outside Texas. In general, the proportion of total output of services that are exported is in the three to five percent range; however, a few sectors exported as much as 20 percent (photographic services and automobile rental). The service industries do

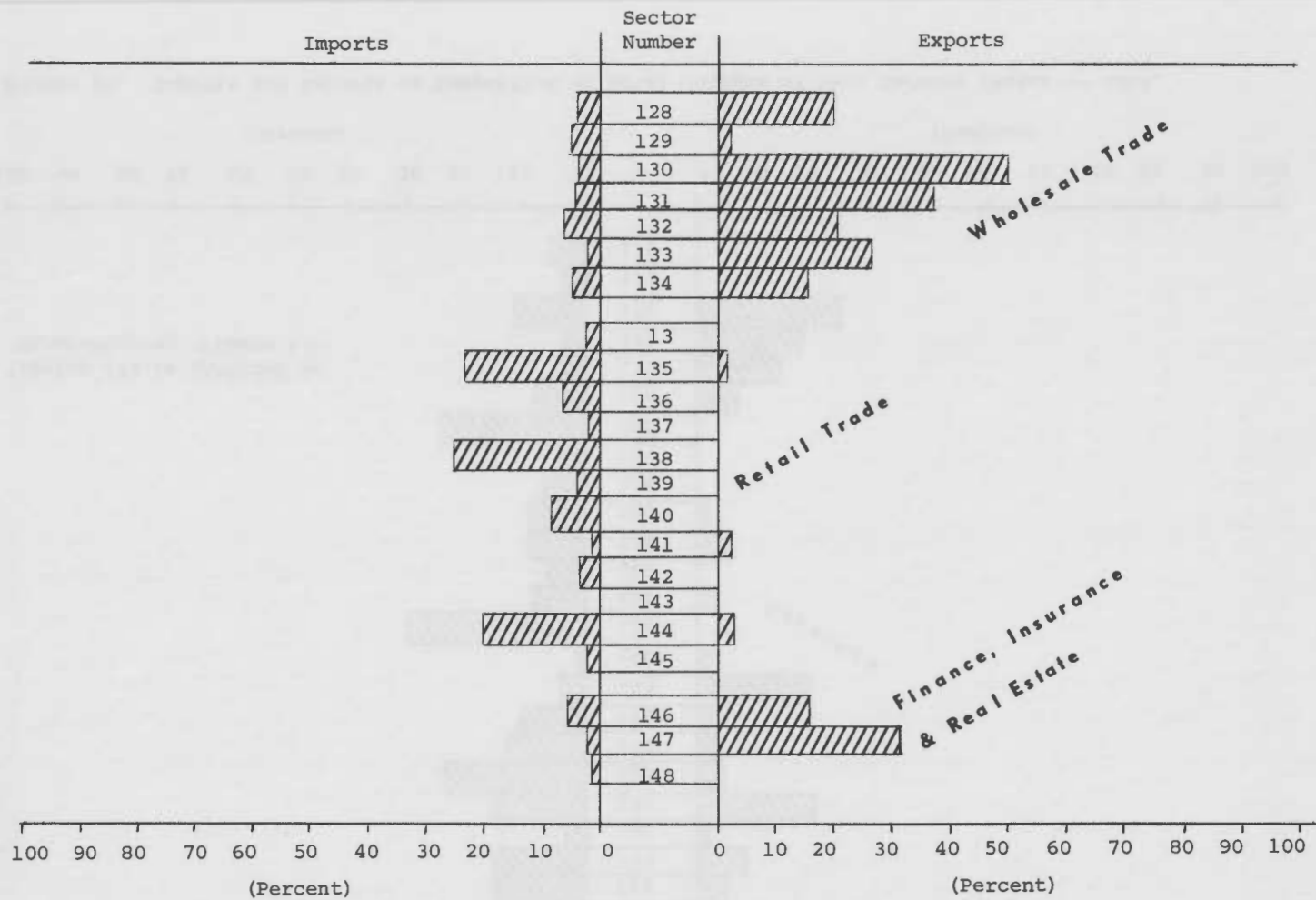
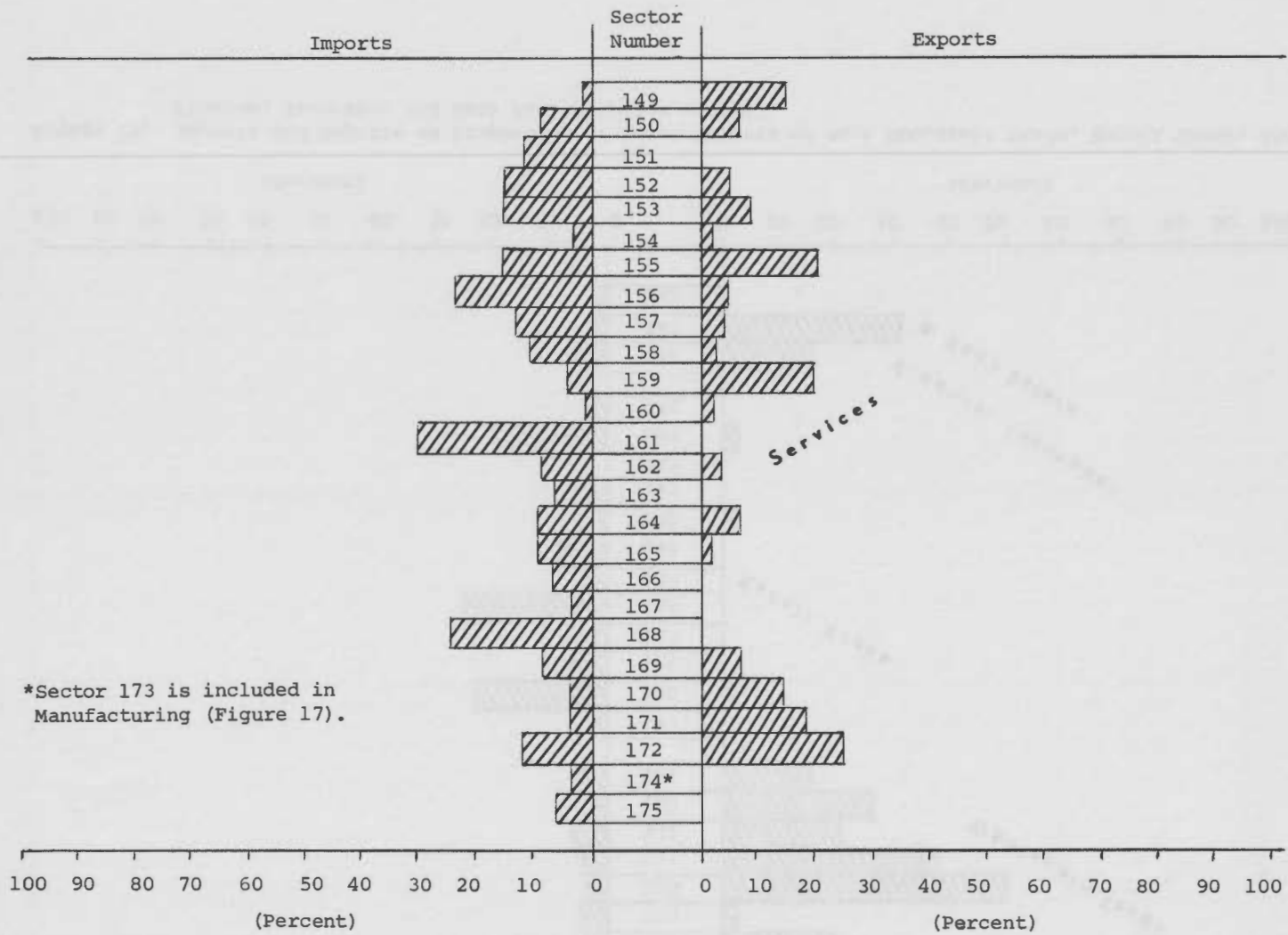


Figure 19. Imports and Exports as Proportion of Total Outputs of each Wholesale Trade, Retail Trade, and Finance, Insurance and Real Estate Sector -- 1967.



*Sector 173 is included in Manufacturing (Figure 17).

Figure 20. Imports and Exports as Proportion of Total Outputs of each Service Sector -- 1967.

not import large proportions of total inputs but activities such as electrical repair (Sector 161), research and development (Sector 156), and education services (Sector 168) imported more than 20 percent of total inputs.

Multiplier Analysis

The concepts of the income, final demand, and output multipliers were stated earlier in the discussion of the materials presented in Table 26. The Type I income multiplier for a sector of the economy is an estimate of the total (direct plus indirect) income paid to the household sector of the economy, per dollar of direct income paid by the sector to households, when households are considered to be a part of final demand. The Type II income multiplier for a sector is an estimate of the total (direct, indirect, and induced) income paid to the household sector, per dollar of direct income paid by the sector to households, when households are considered to be a part of the processing sectors. Household spending of new income received is included in the analysis for the purpose of calculating the induced effects upon the economy of new household income, under the assumption that households will spend new income in the same proportions among sectors as was estimated for previous income levels.

In the earlier discussion, the analyses were at the major industry level for illustrative purposes. Analyses at the major industry levels are extremely aggregated analyses and are not adequate for most planning applications. Individual sector multipliers provide analysts and planners with information applicable to more specific problems and problem areas such as the effects upon the economy of wages lost due to market or resource problems of specific industries (Table 28).

The materials of Table 28 show a number of items of interest to planners. For example, column one shows the estimated direct income paid to households by each sector per dollar of total inputs (inputs = outputs). This is an approximation of salaries and wages per dollar of output of each sector. The individual sector coefficients can be used to calculate estimates of household income changes that might be expected to occur if the sector's output were to change. These same coefficients can be used to calculate household income resulting from a given level of production by any of the sectors of the economy. For example, \$100,000 of residential construction (Sector 22) would be expected to result in \$31,290 of direct income payments to the household sectors ($0.3129 \times \$100,000 = \$31,290$), whereas an additional output of \$100,000 by the meat products sector (Sector 27) would be expected to result in \$9,610 of direct income payments to the household sectors ($0.0961 \times 100,000 = \$9,610$). By further examination of column one, Table 28, the reader can gain an impression as to which of the sectors pay the largest proportion of total inputs to households. Given estimates of future demand for products of each sector, these coefficients can be used to guide the selection of industries

Table 28. Summary of the Estimated Individual Sector Multipliers of the Open and Closed Input-Output Models of the Texas Economy -- 1967.

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Irrigated cotton	0.4832	0.6832	0.2000	1.4139	1.1545	0.4713	0.6713	2.3893	1.6291	3.7598
2. Irrigated food grains	0.3980	0.6191	0.2211	1.5555	1.0462	0.4271	0.6482	2.6286	1.6667	3.5501
3. Irrigated feed grains	0.4871	0.6650	0.1779	1.3652	1.1237	0.4587	0.6366	2.3069	1.5728	3.6410
4. Other irrigated crops	0.3450	0.5826	0.2376	1.6887	0.9844	0.4018	0.6394	2.8533	1.6471	3.3956
5. Dryland cotton	0.5099	0.7038	0.1939	1.3803	1.1892	0.4854	0.6793	2.3322	1.5983	3.7872
6. Dryland food grains	0.2729	0.5606	0.2877	2.0542	0.9473	0.3867	0.6744	3.4712	1.7945	3.4026
7. Dryland feed grains	0.4136	0.6192	0.2056	1.4971	1.0463	0.4271	0.6327	2.5297	1.6798	3.6187
8. Other dryland crops	0.4025	0.6237	0.2212	1.5496	1.0539	0.4302	0.6514	2.6184	1.6131	3.5411
9. Range livestock products	0.3605	0.6040	0.2435	1.6755	1.0206	0.4166	0.6601	2.8311	1.6984	3.5503
10. Feedlot livestock products	0.0354	0.4466	0.4112	12.6158	0.7547	0.3081	0.7193	21.3192	2.1484	3.5330
11. Dairy	0.2077	0.5533	0.3456	2.6639	0.9349	0.3816	0.7272	4.5012	2.0843	3.7888
12. Poultry and eggs	0.0794	0.5707	0.4913	7.1877	0.9644	0.3937	0.8850	12.1461	2.4111	3.9457
13. Agricultural supply except farm machinery	0.5523	0.6416	0.0893	1.1617	1.0842	0.4426	0.5319	1.9631	1.2369	3.2497
14. Cotton ginning	0.3661	0.5568	0.1907	1.5209	0.9408	0.3840	0.5747	2.5698	1.5184	3.2695
15. Agricultural services	0.1965	0.4244	0.2279	2.1598	0.7172	0.2928	0.5207	3.6499	1.8783	3.1728
16. Forestry	0.0862	0.2091	0.1229	2.4258	0.3533	0.1442	0.2671	4.0986	1.2350	1.8924
17. Fisheries	0.3748	0.5320	0.1572	1.4194	0.8989	0.3669	0.5241	2.3983	1.4303	3.0850
18. Crude petroleum	0.2868	0.3900	0.1032	1.3598	0.6590	0.2690	0.3722	2.2978	1.2183	2.4132
19. Natural gas liquids	0.1427	0.3058	0.1631	2.1430	0.5167	0.2109	0.3740	3.6209	1.4797	2.4381
20. Oil and gas services	0.3996	0.5193	0.1197	1.2995	0.8775	0.3582	0.4779	2.1959	1.2403	2.7828
21. Other mining & quarrying	0.2769	0.3869	0.1100	1.3973	0.6538	0.2669	0.3769	2.3611	1.3049	2.5184
22. Residential construction	0.3129	0.4635	0.1506	1.4813	0.7832	0.3197	0.4703	2.5030	1.4325	2.8903
23. Commercial, educational and institutional construction	0.3662	0.5388	0.1726	1.4713	0.9105	0.3717	0.5443	2.4863	1.5631	3.2562
24. Industrial construction	0.4137	0.6150	0.2013	1.4866	1.0392	0.4242	0.6255	2.5120	1.5855	3.5199
25. Facility construction	0.3824	0.5207	0.1383	1.3617	0.8798	0.3591	0.4974	2.3007	1.4634	3.1009

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
26. Maintenance and repair	0.4322	0.5668	0.1346	1.3114	0.9577	0.3909	0.5255	2.2159	1.4338	3.1862
27. Meat products	0.0961	0.5005	0.4044	5.2081	0.8457	0.3452	0.7496	8.8002	2.4708	3.9675
28. Poultry products	0.0649	0.5123	0.4474	7.8937	0.8657	0.3534	0.8008	13.3390	3.0876	4.6661
29. Dairies	0.1377	0.4249	0.2872	3.0857	0.7179	0.2930	0.5802	5.2135	2.0650	3.3710
30. Grain milling	0.0830	0.4220	0.3390	5.0843	0.7131	0.2911	0.6301	8.5916	1.9628	3.2862
31. Animal feeds	0.0840	0.4523	0.3683	5.3845	0.7643	0.3120	0.6803	9.0988	2.0422	3.4423
32. Bakery products	0.2887	0.4098	0.1211	1.4195	0.6925	0.2827	0.4038	2.3987	1.4546	2.7262
33. Canned, preserved, pickled, dried & frozen foods	0.1389	0.3838	0.2449	2.7631	0.6486	0.2648	0.5097	4.6695	1.7564	2.9532
34. Other food and kindred products	0.0988	0.2239	0.1251	2.2662	0.3783	0.1544	0.2795	3.8289	1.3547	2.0455
35. Beverages	0.1948	0.3283	0.1335	1.6853	0.5548	0.2265	0.3600	2.8480	1.3709	2.3397
36. Textile mill products	0.2887	0.4640	0.1753	1.6072	0.7841	0.3201	0.4954	2.7160	1.3937	2.7928
37. Mens, boys, womens and misses furnishings	0.3085	0.3601	0.0516	1.1673	0.6085	0.2484	0.3000	1.9724	1.1389	2.2628
38. Related apparel	0.3007	0.3876	0.0869	1.2890	0.6550	0.2674	0.3543	2.1783	1.2583	2.4678
39. Logging	0.2111	0.3872	0.1761	1.8342	0.6543	0.2671	0.4432	3.0995	1.8133	3.0274
40. Lumber mills	0.3186	0.4629	0.1443	1.4529	0.7822	0.3193	0.4636	2.4551	1.4806	2.8884
41. Millwork & wood products	0.2567	0.3761	0.1194	1.4651	0.6355	0.2594	0.3788	2.4757	1.3478	2.5098
42. Wood furniture & fixtures	0.3281	0.4141	0.0860	1.2621	0.6997	0.2856	0.3716	2.1326	1.2759	2.5754
43. Metal furniture & fixtures	0.1706	0.3142	0.1436	1.8417	0.5309	0.2167	0.3603	3.1120	1.4930	2.4809
44. Paper and paper mills	0.2407	0.4038	0.1631	1.6776	0.6824	0.2786	0.4417	2.8351	1.5701	2.8279
45. Paper products except boxes and containers	0.2592	0.3971	0.1379	1.5320	0.6710	0.2739	0.4118	2.5887	1.4753	2.7186
46. Boxes & paper containers	0.2037	0.3806	0.1769	1.8684	0.6432	0.2626	0.4395	3.1576	1.6011	2.7637
47. Newspapers	0.3958	0.5301	0.1343	1.3393	0.8957	0.3656	0.4999	2.2630	1.3886	3.0352
48. Publishing	0.3198	0.5516	0.2318	1.7248	0.9321	0.3805	0.6123	2.9146	1.5192	3.1479

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
49. Printing	0.3873	0.5130	0.1257	1.3246	0.8669	0.3539	0.4796	2.2383	1.3516	2.9066
50. Manifold business forms	0.3066	0.4291	0.1225	1.3995	0.7251	0.2960	0.4185	2.3650	1.3662	2.7143
51. Other printing & publishing	0.4802	0.6030	0.1228	1.2557	1.0189	0.4159	0.5387	2.1218	1.2883	3.0938
52. Chlorine & alkalis	0.1377	0.3059	0.1682	2.2215	0.5169	0.2110	0.3792	3.7538	1.6269	2.5417
53. Cyclic crudes & intermediates & inorganic pigments	0.1306	0.3717	0.2411	2.8461	0.6281	0.2564	0.4975	4.8093	2.1855	3.3534
54. Organic chemicals	0.1274	0.3061	0.1787	2.4027	0.5172	0.2111	0.3898	4.0597	1.7259	2.6766
55. Inorganic chemicals	0.1231	0.2889	0.1658	2.3469	0.4882	0.1993	0.3651	3.9659	1.5285	2,4179
56. Fibers & plastics	0.1313	0.3042	0.1729	2.3168	0.5140	0.2098	0.3827	3.9147	1.8090	2.7648
57. Synthetic rubber	0.1332	0.2893	0.1561	2.1719	0.4889	0.1996	0.3557	3.6704	1.8037	2.7134
58. Drugs	0.3084	0.4270	0.1186	1.3846	0.7215	0.2945	0.4131	2.3395	1.3686	2.7083
59. Agricultural chemicals	0.1265	0.2913	0.1648	2.3028	0.4923	0.2010	0.3658	3.8917	1.7046	2.6042
60. Soaps, cleansers, and toiletries	0.1115	0.2191	0.1076	1.9650	0.3702	0.1511	0.2587	3.3202	1.4191	2.1027
61. Paints and varnishes	0.1635	0.3074	0.1439	1.8801	0.5194	0.2120	0.3559	3.1768	1.6890	2.6476
62. Other chemicals	0.1902	0.2930	0.1028	1.5405	0.4951	0.2021	0.3049	2.6030	1.4951	2.4148
63. Petroleum refining	0.0624	0.3106	0.2482	4.9776	0.5249	0.2143	0.4625	8.4119	1.7211	2.5924
64. Other petroleum products	0.1859	0.3974	0.2115	2.1377	0.6715	0.2741	0.4856	3.6122	1.8839	3.0984
65. Tires	0.1945	0.3188	0.1243	1.6391	0.5387	0.2199	0.3442	2.7697	1.6503	2.6517
66. Fabricated rubber products	0.3668	0.4687	0.1019	1.2778	0.7920	0.3233	0.4252	2.1592	1.3729	2.8464
67. Plastics products	0.2454	0.3887	0.1433	1.5839	0.6569	0.2682	0.4115	2.6769	1.5821	2.7907
68. Leather & leather products	0.3251	0.3949	0.0698	1.2147	0.6672	0.2723	0.3421	2.0523	1.2053	2.4270
69. Glass	0.3961	0.5313	0.1352	1.3413	0.8978	0.3665	0.5017	2.2666	1.4131	3.0713
70. Clay	0.4038	0.5385	0.1347	1.3336	0.9099	0.3714	0.5016	2.2533	1.3909	3.0746
71. Cut stone and other clay and shell products	0.2539	0.3553	0.1014	1.3994	0.6004	0.2451	0.3465	2.3647	1.2674	2.3781
72. Cement & concrete products	0.2152	0.4009	0.1857	1.8629	0.6775	0.2766	0.4623	3.1482	1.4683	2.6355

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
73. Blast furnaces	0.2483	0.3662	0.1179	1.4748	0.6188	0.2526	0.3705	2.4921	1.3234	2.4627
74. Primary steel and iron	0.2523	0.3486	0.0963	1.3817	0.5891	0.2405	0.3368	2.3349	1.3021	2.3979
75. Foundries	0.3921	0.5365	0.1444	1.3683	0.9065	0.3700	0.5144	2.3119	1.3630	3.0284
76. Nonferrous primary and secondary smelting	0.1629	0.3137	0.1508	1.9257	0.5301	0.2164	0.3672	3.2541	1.3663	2.3160
77. Aluminum smelting and non- ferrous rolling and drawing	0.1719	0.3018	0.1299	1.7557	0.5100	0.2082	0.3381	2.9668	1.2828	2.0855
78. Casting and forgings	0.3200	0.4120	0.0920	1.2875	0.6962	0.2842	0.3762	2.1756	1.2311	2.5091
79. Fabricated steel	0.2755	0.4085	0.1330	1.4828	0.6903	0.2818	0.4148	2.5056	1.2294	2.3652
80. Plate work	0.2725	0.3499	0.0774	1.2840	0.5912	0.2413	0.3187	2.1695	1.1924	2.2855
81. Sheet metal and architectural	0.2900	0.4348	0.1448	1.4993	0.7347	0.2999	0.4447	2.5334	1.3735	2.6709
82. Metal doors	0.2755	0.4561	0.1806	1.6555	0.7707	0.3146	0.4952	2.7975	1.6473	3.0708
83. Fabricated metal products	0.1537	0.3258	0.1721	2.1197	0.5505	0.2247	0.3968	3.5817	1.5716	2.5892
84. Plumbing	0.2786	0.3224	0.0438	1.1572	0.5447	0.2223	0.2661	1.9551	1.1165	2.1301
85. Bolts, nuts and screws	0.3189	0.4113	0.0924	1.2897	0.6950	0.2837	0.3761	2.1794	1.2582	2.5487
86. Electroplating, coating and engraving	0.3838	0.4872	0.1034	1.2694	0.8233	0.3361	0.4395	2.1451	1.3406	2.8383
87. Valves and pipe fittings	0.2851	0.3988	0.1137	1.3988	0.6738	0.2750	0.3887	2.3634	1.3177	2.5584
88. Other fabricated metal	0.2171	0.3217	0.1046	1.4818	0.5436	0.2219	0.3265	2.5039	1.2877	2.2872
89. Farm, construction and industrial machinery	0.2787	0.3793	0.1006	1.3610	0.6409	0.2616	0.3622	2.2996	1.3015	2.4938
90. Materials handling machines and equipment	0.2719	0.3380	0.0661	1.2431	0.5711	0.2331	0.2992	2.1004	1.1834	2.2461
91. Mining machinery & equipment	0.3525	0.4585	0.1060	1.3007	0.7748	0.3163	0.4223	2.1980	1.2945	2.7190
92. Engines	0.2720	0.3864	0.1144	1.4206	0.6530	0.2666	0.3810	2.4007	1.2884	2.5037
93. Metal working machinery	0.3832	0.4973	0.1141	1.2978	0.8403	0.3430	0.4571	2.1928	1.3286	2.8912

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Open Model	Closed Model
94. Industrial processing machinery	0.3802	0.4713	0.0911	1.2396	0.7963	0.3250	0.4161	2.0944	1.2530	2.7214
95. General industrial machinery	0.2621	0.3696	0.1075	1.4101	0.6245	0.2549	0.3624	2.3827	1.3245	2.4835
96. Refrigeration machinery	0.1996	0.2979	0.0983	1.4925	0.5034	0.2055	0.3038	2.5220	1.2961	2.2320
97. Computers, accounting, office & service industry	0.3903	0.4827	0.0924	1.2367	0.8157	0.3330	0.4254	2.0899	1.2358	2.7326
98. Electric instruments and apparatus	0.2590	0.3129	0.0539	1.2081	0.5288	0.2159	0.2698	2.0417	1.1679	2.1508
99. Electric household equipment	0.2355	0.3023	0.0668	1.2837	0.5107	0.2084	0.2752	2.1686	1.1495	2.1001
100. Electrical communications equipment	0.4208	0.4629	0.0421	1.1000	0.7822	0.3193	0.3614	1.8588	1.1109	2.5542
101. Other electrical apparatus	0.2266	0.3935	0.1669	1.7365	0.6649	0.2714	0.4383	2.9342	1.5900	2.8033
102. Aircraft	0.2936	0.3476	0.0540	1.1839	0.5874	0.2398	0.2938	2.0007	1.1286	2.2074
103. Aircraft engines	0.4599	0.5684	0.1085	1.2359	0.9605	0.3921	0.5006	2.0885	1.2534	3.0081
104. Other aircraft	0.4149	0.5184	0.1035	1.2495	0.8760	0.3576	0.4611	2.1114	1.2863	2.9117
105. Motor vehicles and parts	0.1060	0.1408	0.0348	1.3283	0.2379	0.0971	0.1319	2.2443	1.0941	1.5304
106. Ship & boat building	0.4212	0.5258	0.1046	1.2483	0.8884	0.3626	0.4672	2.1092	1.2898	2.9345
107. Other transportation equipment	0.2523	0.3911	0.1388	1.5501	0.6609	0.2698	0.4086	2.6195	1.3676	2.5511
108. Scientific instruments	0.3674	0.4838	0.1164	1.3168	0.8175	0.3337	0.4501	2.2251	1.4164	2.9358
109. Mechanical measuring devices	0.2557	0.3266	0.0709	1.2773	0.5519	0.2253	0.2962	2.1584	1.1815	2.1964
110. Medical instruments	0.4153	0.5155	0.1002	1.2413	0.8711	0.3556	0.4558	2.0975	1.3333	2.9536
111. Photographic, time and optical instruments	0.3167	0.3783	0.1616	1.1945	0.6393	0.2610	0.3226	2.0186	1.1592	2.3330
112. Games and toys	0.3042	0.3923	0.0881	1.2896	0.6629	0.2706	0.3587	2.1792	1.2550	2.4845
113. Other manufacturing industries	0.3004	0.4219	0.1215	1.4045	0.7130	0.2911	0.4126	2.3735	1.3578	2.6770

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
114. Railroad transportation	0.4947	0.6043	0.1096	1.2215	1.0212	0.4169	0.5265	2.0643	1.2726	3.0861
115. Intercity rural highway transportation	0.5659	0.6563	0.0904	1.1597	1.1090	0.4527	0.5431	1.9597	1.2286	3.2860
116. Motor freight transpor- tation and local trucking and storage	0.4003	0.6010	0.2007	1.5014	1.0156	0.4146	0.6153	2.5371	1.5224	3.3028
117. Water transportation	0.5680	0.7009	0.1329	1.2340	1.1844	0.4835	0.6164	2.0852	1.3294	3.5007
118. Air transportation	0.4412	0.5820	0.1408	1.3191	0.9835	0.4015	0.5423	2.2291	1.3903	3.1820
119. Pipeline transportation	0.1746	0.2826	0.1080	1.6186	0.4776	0.1950	0.3030	2.7354	1.3166	2.2033
120. Local and suburban trans- portation	0.4861	0.6183	0.1322	1.2720	1.0447	0.4264	0.5586	2.1491	1.4678	3.4057
121. Other transportation services	0.3843	0.5648	0.1805	1.4697	0.9543	0.3895	0.5700	2.4832	1.4060	3.1812
122. Telephone and telegraph	0.3728	0.4343	0.0615	1.1650	0.7339	0.2996	0.3611	1.9686	1.1391	2.4734
123. Radio and T.V.	0.3208	0.4509	0.1301	1.4055	0.7620	0.3111	0.4412	2.3753	1.3343	2.7436
124. Other communications	0.2564	0.4153	0.1589	1.6197	0.7018	0.2865	0.4454	2.7371	1.3632	2.6234
125. Gas services	0.1037	0.4001	0.2964	3.8582	0.6761	0.2760	0.5724	6.5198	1.8413	3.0604
126. Electrical services	0.1755	0.3119	0.1364	1.7772	0.5271	0.2152	0.3516	3.0034	1.4494	2.3994
127. Water & sanitary services	0.3005	0.4766	0.1761	1.5860	0.8054	0.3288	0.5049	2.6802	1.4166	2.7793
128. Wholesale auto parts and supplies	0.5956	0.6622	0.0666	1.1118	1.1190	0.4568	0.5234	1.8788	1.1623	3.1877
129. Wholesale groceries and related products	0.5255	0.6145	0.0890	1.1694	1.0384	0.4239	0.5129	1.9760	1.2536	3.1464
130. Wholesale farm products and farm product warehousing	0.3263	0.4565	0.1302	1.3990	0.7714	0.3149	0.4451	2.3641	1.3087	2.7261
131. Wholesale livestock	0.5125	0.6740	0.1615	1.3151	1.1389	0.4649	0.6264	2.2222	1.4068	3.4909

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
132. Wholesale machinery, equip- ment and supplies	0.4982	0.5730	0.0748	1.1501	0.9683	0.3953	0.4701	1.9436	1.1825	2.9740
133. Wholesale petroleum and petroleum products	0.3320	0.4213	0.0893	1.2690	0.7119	0.2906	0.3799	2.1443	1.2464	2.5629
134. General wholesale	0.5494	0.6278	0.0784	1.1427	1.0609	0.4331	0.5115	1.9310	1.2096	3.0584
135. Lumber yards	0.3568	0.4430	0.0862	1.2416	0.7486	0.3056	0.3918	2.0981	1.2063	2.5918
136. Farm equipment dealers	0.4890	0.5687	0.0797	1.1630	0.9609	0.3922	0.4719	1.9650	1.2142	2.9989
137. Hardware, heating, elec- trical, paint & wallpaper	0.5832	0.7049	0.1217	1.2087	1.1912	0.4863	0.6080	2.0425	1.3068	3.5161
138. Department & variety stores	0.4091	0.4944	0.0853	1.2085	0.8354	0.3410	0.4263	2.0420	1.2233	2.6868
139. Food stores	0.5238	0.6321	0.1083	1.2068	1.0681	0.4360	0.5443	2.0391	1.2799	3.1822
140. Automotive dealers and repair shops	0.4773	0.5822	0.1049	1.2198	0.9838	0.4016	0.5065	2.0612	1.1768	2.7861
141. Gasoline service stations	0.5724	0.6600	0.0876	1.1530	1.1152	0.4552	0.5428	1.9483	1.2292	3.2651
142. Apparel & accessory stores	0.5147	0.6233	0.1086	1.2110	1.0533	0.4300	0.5386	2.0464	1.2776	3.2011
143. Furniture, home furnishings and equipment stores	0.5176	0.6743	0.1567	1.3027	1.1394	0.4651	0.6218	2.2013	1.3827	3.4723
144. Eating & drinking places	0.3334	0.5127	0.1793	1.5378	0.8663	0.3536	0.5329	2.5984	1.6057	3.1312
145. Other retail	0.5257	0.6311	0.1054	1.2005	1.0664	0.4353	0.5407	2.0285	1.2585	3.1709
146. Banking & credit agencies	0.5357	0.6125	0.0768	1.1434	1.0349	0.4224	0.4992	1.9319	1.1405	2.8955
147. Insurance carriers	0.4682	0.5836	0.1154	1.2465	0.9861	0.4025	0.5179	2.1062	1.2627	3.0298
148. F.I.R.E. nec	0.3293	0.5774	0.2481	1.7534	0.9757	0.3983	0.6464	2.9630	1.5233	3.2284
149. Legal services	0.6134	0.6801	0.0667	1.1087	1.1493	0.4692	0.5359	1.8737	1.1412	3.2605
150. Lodging services	0.3966	0.5476	0.1510	1.3807	0.9253	0.3777	0.5287	2.3331	1.3869	3.0820
151. Personal services	0.5315	0.6432	0.1117	1.2102	1.0869	0.4437	0.5554	2.0450	1.2833	3.2170
152. Advertising	0.2232	0.5105	0.2873	2.2872	0.8627	0.3522	0.6395	3.8651	1.5977	3.1302
153. Duplicating & addressing	0.5062	0.6046	0.0984	1.1944	1.0216	0.4170	0.5154	2.0182	1.2289	3.1093

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
154. Employment agencies (private)	0.7189	0.8298	0.1109	1.1543	1.4022	0.5724	0.6833	1.9505	1.2632	3.8693
155. Photographic services	0.3693	0.5235	0.1542	1.4175	0.8846	0.3611	0.5153	2.3953	1.3560	2.9485
156. Research & development	0.5342	0.6248	0.0906	1.1696	1.0558	0.4310	0.5216	1.9764	1.2418	3.2067
157. Other business services	0.4535	0.5439	0.0904	1.1993	0.9190	0.3751	0.4655	2.0265	1.2375	2.9116
158. Motion picture, amusement and recreation services	0.4907	0.6145	0.1238	1.2523	1.0384	0.4239	0.5477	2.1162	1.2881	3.1662
159. Automobile rental services	0.2375	0.3760	0.1385	1.5832	0.6355	0.2595	0.3980	2.6758	1.5023	2.6817
160. Automobile parking	0.2982	0.4311	0.1329	1.4457	0.7284	0.2973	0.4302	2.4427	1.2488	2.6031
161. Electrical repair	0.4225	0.5145	0.0920	1.2178	0.8693	0.3548	0.4468	2.0575	1.2250	2.8326
162. Miscellaneous repair services	0.4919	0.5506	0.0587	1.1193	0.9304	0.3798	0.4385	1.8914	1.1487	2.8668
163. Physicians & dentists services	0.6753	0.7703	0.0950	1.1407	1.3016	0.5313	0.6263	1.9274	1.2121	3.5417
164. Hospital and laboratory services	0.6175	0.6996	0.0821	1.1330	1.1821	0.4825	0.5646	1.9143	1.2248	3.3521
165. Other medical services	0.5511	0.6892	0.1381	1.2506	1.1646	0.4754	0.6135	2.1132	1.3763	3.5164
166. Education (Public & private)	0.7557	0.8268	0.0711	1.0941	1.3971	0.5703	0.6414	1.8487	1.2778	3.7341
167. Colleges & universities	0.6248	0.7095	0.0847	1.1356	1.1989	0.4894	0.5741	1.9189	1.2450	3.4328
168. Other educational services	0.6513	0.6853	0.0340	1.0522	1.1580	0.4727	0.5067	1.7780	1.0771	3.2246
169. Engineering & architectural services	0.7127	0.7916	0.0789	1.1107	1.3377	0.5461	0.6250	1.8769	1.1888	3.6574
170. Accounting, auditing and bookkeeping	0.6224	0.6846	0.0622	1.0999	1.1569	0.4723	0.5345	1.8588	1.1400	3.2517
171. Other professional services	0.6817	0.7793	0.0976	1.1432	1.3168	0.5375	0.6351	1.9316	1.2385	3.6847
172. Other services	0.4566	0.6155	0.1589	1.3480	1.0401	0.4246	0.5835	2.2779	1.3889	3.2309
173. Ordnance & ordnance accessories	0.2570	0.4246	0.1676	1.6521	0.7175	0.2929	0.4605	2.7918	1.4511	2.7376

(Continued)

Table 28 Continued

Sector Name	Direct Income Change	Direct & Indirect Income Change	Indirect Income Change	Type I Multi- plier	Direct Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type II Multi- plier	Output Multipliers	
									Open Model	Closed Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
174. Outdoor recreation	0.5674	0.6523	0.0849	1.1496	1.1023	0.4500	0.5349	1.9427	1.2626	3.3094
175. Scrap	0.4237	0.5732	0.1495	1.3528	0.9686	0.3954	0.5449	2.2861	1.3826	3.1852

Footnotes numbers correspond to column numbers

1. Household row of the direct requirements table (Appendix A, Table 2).
2. The sum of each column in the direct and indirect requirements table (Appendix A, Table 3) multiplied by the household entry in the corresponding column of the direct requirements table (Appendix A, Table 2).
3. The direct and indirect income change (column 2) less the direct income change (column 1).
4. The direct and indirect income change (column 2) divided by the direct income change (column 1).
5. Household row of the direct, indirect, and induced requirements table (Appendix A, Table 3).
6. Direct, indirect, and induced income change (column 5) less the direct and indirect income change (column 2).
7. Indirect income change (column 3) plus the induced income change (column 6).
8. Direct, indirect, and induced income change (column 5) divided by the direct income change (column 1).
9. The sum of each column in the direct and indirect requirements table (Appendix A, Table 3), divided by that column's diagonal element.
10. The sum of each column in the direct, indirect, and induced requirements table (Appendix A, Table 4) divided by that column's diagonal element.

that will have the greatest direct effects upon household income in cases of industrial development needed to provide jobs for the state's labor force.

The general information as to the quantity of direct income payments made by each sector of the economy to the household sector can be obtained from the transactions table of the Texas Input-Output Model (Appendix A, Table 1, row 176).

Due to interdependence among the sectors of the economy, there is an indirect household income change in addition to the direct change that occurs as the result of an individual sector's change in production. The indirect effect is brought about as each sector's suppliers change their respective purchases of household supplied inputs (labor and management) when there are changes (increases or decreases) in their respective outputs. The individual sector indirect income changes are shown in column 3 of Table 28. The Type I income multiplier is the ratio of direct and indirect income to direct income and is the household income payments by all sectors of the economy per dollar of direct income payments of each individual sector (Table 28, column 4). For example, the production of one dollar of boxes and paper containers (Sector 46) results in \$0.2037 of payments of income to the household sector by the box and paper container sector (Table 28, row 46, column 1). An additional \$0.1769 is paid to the household sector by all other sectors of the economy (Table 28, row 46, column 3). This indirect income payment of \$0.1769 represents income received by households due to the household inputs required to produce the goods and services purchased for use directly in the manufacture of one dollar of boxes and paper containers by Sector 46, and indirectly in the goods and services used by the sectors which manufacture the inputs used by the sectors which supply the input suppliers of the boxes and paper container manufacturing sector.

The Type I income multiplier is the ratio of the direct plus indirect income change to the direct income change, when household spending of additional income is not considered. The Type I income multiplier for a sector expresses the total or economywide income payment to the household sector per dollar of direct income paid to the household sector by the sector. For example, the Type I multiplier for Sector 46, boxes and paper containers is 1.86 (Table 28, row 46, column 4). This means that for each dollar of wages and salaries paid directly to the household sector by Sector 46, there will be an additional \$0.86 paid to the household sectors through the indirect route described in the paragraph immediately above.

The size of the Type I income multiplier depends upon two factors -- the degree or amount of interdependence among the sectors as expressed by the total direct and indirect income change, and the direct income change. The larger the former is in relation to the latter, the larger the Type I income multiplier is. Estimates of the Type I multiplier for Texas sectors ranged from lows of approximately 1.10 to 1.24 for many of the services and trades sectors to a high of 12.61 for feedlot livestock production (Table 28, column 4). Approximately 28 percent of the input-output model sectors had Type I multipliers in the 1.10 to 1.24 range, 38 percent in the 1.25 to 1.49 range, 19 percent in the 1.50 to 1.99 range and 3 percent

greater than 5.00 (Figure 21). The livestock sectors of agriculture and the food processing and petroleum refining sectors of the manufacturing group had higher Type I income multipliers than other manufacturing, trades, and service sectors (Table 28, Sectors 10-12, 27-34, and 63).

The Type II income multiplier is analogous to the Type I multiplier. It is calculated from the closed input-output model (model with households included among the processing sectors). It expresses the direct, indirect, and induced income paid to households per dollar of direct income paid to households. The induced component is a result of inclusion of the spending by households of new income received as a result of increased production by one of the processing sectors (Table 28, column 6). Type II income multipliers are greater than Type I income multipliers due to the added household consumption resulting from new income. For example, the Type I multiplier for Sector 46 (boxes and paper cartons) was 1.86. The Type II multiplier for Sector 46 was 3.16 (Table 28, row 46, column 8). The difference is due to the \$0.26 of induced income resulting from the household sector's spending of both the direct and indirect household income received as a result of Sector 46 payments of direct income to households as a part of production costs. The induced income changes and Type II income multiplier for each sector are shown in columns 6 and 8 of Table 28 respectively. The distribution of the number of sectors in each of five size classes of Type II multipliers is shown in Figure 22. Of the 175 sectors in the model, 15 percent were in the 1.50 to 1.99 range, 49 percent were in the 2.00 to 2.49 range, 17 percent were in the 2.50 to 2.99 range, 14 percent were in the 3.00 to 4.99 range and five percent of the sectors had Type II multipliers that exceeded 5.00 (Figure 22). These estimates illustrate the extent of interdependence among sectors and emphasize the potential effects of household income upon the economy. This information is especially useful in public policy and program planning to encourage and stimulate employment of labor. The information is also useful in the evaluation of public spending to stimulate employment or to increase incomes of selected disadvantaged groups. The multipliers assist in identifying the industries through which the largest effects can be obtained. Thus, the recruitment and expansion of these industries within the state's economy would be desirable if markets for the products are available.

Whereas the Type I and Type II income multipliers relate total household income to direct household sector payments by a producing sector, the output multiplier for a sector expresses the gross value of products and services required of the Texas economy per dollar of output of the sector, f.o.b. the shipper to final demand, whereas output multipliers express the direct and indirect requirements per dollar of total sales f.o.b. the shipper.

In many cases the planner will find output multipliers to be more useful since the data concerning sales to final demand may not be as readily available as the data pertaining to total outputs or contemplated total outputs. Output multipliers are also of interest for industries or sectors which produce and supply partially

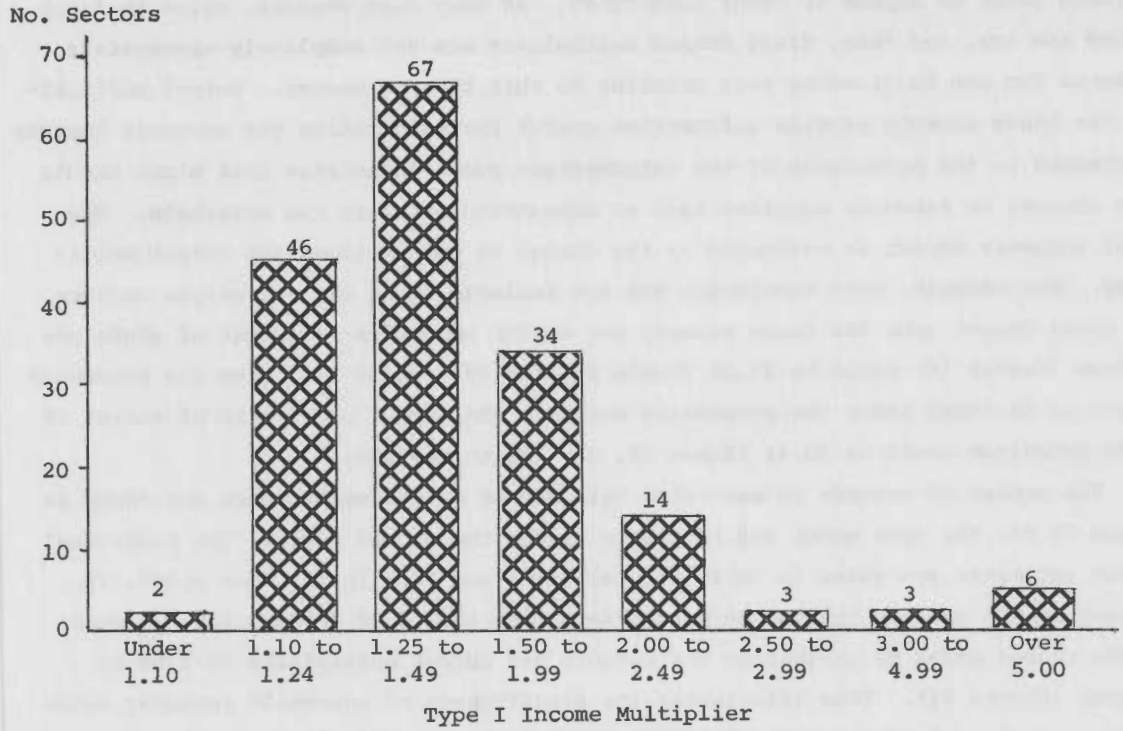


Figure 21. Number of Sectors by Size Class of Type I Income Multiplier -- Texas Input-Output Mode; 1967.

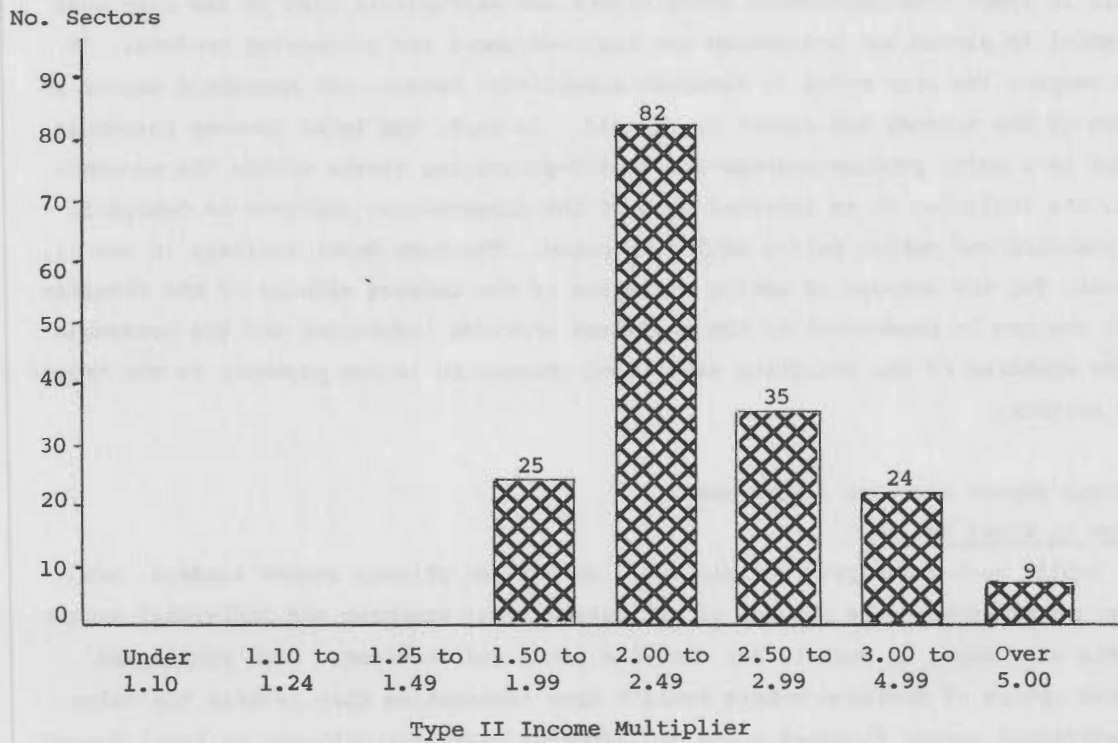


Figure 22. Number of Sectors by Size Class of Type II Income Multipliers -- Texas Input-Output Model; 1967.

finished goods as inputs to other industries. In many such sectors, sales to final demand are low, and thus, final demand multipliers are not completely appropriate measures for use in planning work relating to this type of sector. Output multipliers for these sectors provide information useful for calculating the economic impacts of changes in the production of the intermediate goods industries that might result from changes in resource supplies such as exhaustion of basic raw materials. The total economic impact is estimated as the change in output times the output multiplier. For example, when households are not included among the processing sectors, the total impact upon the Texas economy per dollar reduction in output of crude petroleum (Sector 18) would be \$1.18 (Table 28, row 18, column 9). When the household sector is included among the processing sectors, the impact per dollar of output of crude petroleum would be \$2.41 (Table 28, row 18, column 10).

The number of sectors in each size category of output multipliers are shown in Figure 23 for the open model and in Figure 24 for the closed model. The individual sector estimates are shown in Table 28, columns 9 and 10. In the open model, 95 percent of the sectors had output multipliers less than 2.00 (Figure 23), whereas in the closed model 99 percent of the sectors had output multipliers of 2.00 or greater (Figure 24). This illustrates the significance of household spending within the economy and more importantly demonstrates the overall effects of leakage from the economy. The payments of wages and salaries to households by each sector, when analyzed in the open input-output model, are analogous to leakages from the economy such as payments to establishments outside the economy for imported materials. The result is lower interdependence coefficients and multipliers than is the case when the model is closed and households are included among the processing sectors. In this respect the open model is somewhat unrealistic because the household sector is a part of the economy and cannot be ignored. In fact, the local economy household sector is a major produce-and-service-demand-generating sector within the economy. Thus, its inclusion as an integral part of the input-output analyses is desirable for planning and public policy making purposes. The open model analysis is useful, however, for the purpose of making estimates of the induced effects of the simultaneous changes in production by the goods and services industries and the household sector spending of the resulting associated changes in income payments to the household sectors.

Economic Impact Analyses Illustrated

Change in Final Demand

Public sector analysts and planners, as well as private sector leaders, are often concerned with the problem of estimating total economic and individual sector effects of changes in markets for finished goods and services. Both public and private groups of decision makers benefit from information that relates the value of individual sector finished goods and services ready for delivery to final demand

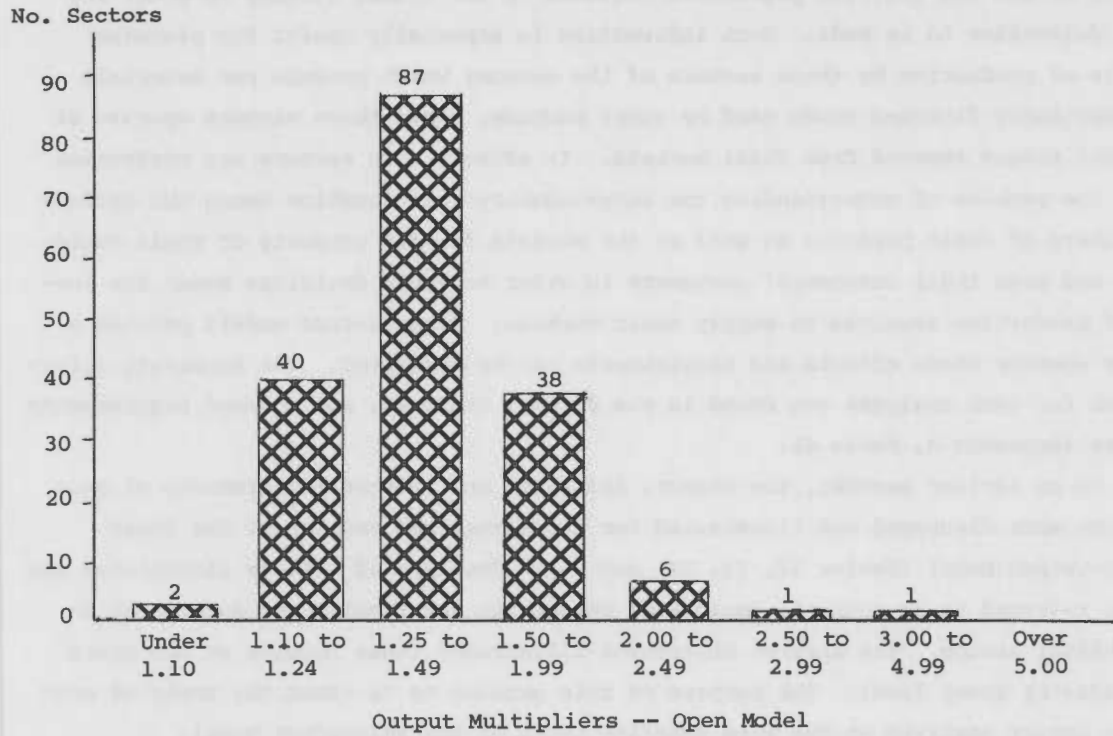


Figure 23. Number of Sectors by Size Class of Open Model Output Multipliers -- Texas Input-Output Model; 1967.

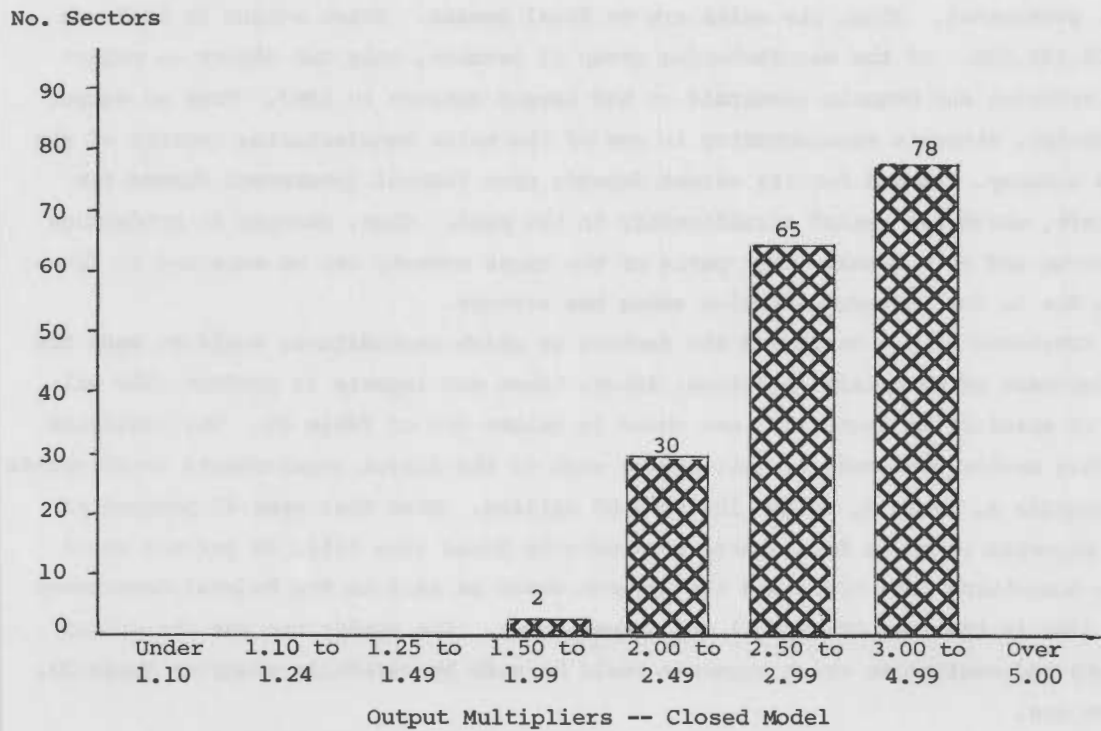


Figure 24. Number of Sectors by Size Class of Closed Model Output Multipliers -- Texas Input-Output Model; 1967.

to the direct and indirect production required of the entire economy in order for such deliveries to be made. Such information is especially useful for planning levels of production by those sectors of the economy which produce raw materials and partially finished goods used by other sectors, since these sectors operate at several stages removed from final markets. In effect, such sectors are confronted with the problem of understanding the interindustry relationships among the different users of their products as well as the markets for the products of their customers and even their customers' customers in order to reach decisions about the level of production required to supply their markets. Input-output models provide a means whereby these effects and requirements can be estimated. The necessary information for such analyses are found in the direct, indirect, and induced requirements tables (Appendix A, Table 4).

In an earlier section, the direct, indirect, and induced requirements of production were discussed and illustrated for the summarized version of the Texas Input-Output Model (Tables 22, 23, 24, and 25). The type of effects illustrated are often referred to as economic impacts of changes in the level of production of an individual sector. The earlier discussion illustrated these impacts at the gross or industry group level. The purpose of this section is to treat the topic of economic impact analysis at the more detailed level of the 183-sector model.

In order to illustrate the input-output model technique of economic impact analysis, the effects of a change in the aircraft manufacturing sector (Sector 102) will be presented below. This sector, in Texas, produces military aircraft for the U. S. government. Thus, its sales are to final demand. Total output in 1967 was \$1,805,321,000. Of the manufacturing group of sectors, only two others -- petroleum refining and organic chemicals -- had larger outputs in 1967. From an output standpoint, aircraft manufacturing is one of the major manufacturing sectors of the Texas economy. Demand for its output depends upon federal government demand for aircraft, which has varied significantly in the past. Thus, changes in production may occur and as a result other parts of the Texas economy can be expected to fluctuate due to the interdependencies among the sectors.

Estimated direct costs and the sectors to which expenditures would be made for the purchase of materials, services, labor, taxes and imports to produce \$100 million of aircraft by Sector 102 are shown in column one of Table 29. The estimates for this sector were made by multiplying each of the direct requirements coefficients of Appendix A, Table 2, column 102 by \$100 million. Note that over 46 percent of such payments would be for imports from outside Texas (row 181), 29 percent would be to households (row 176), and six percent would be paid to the Federal Government (row 178) in the form of payroll and income taxes. The reader can see the dollar amounts and sectors to which payments would be made by carefully studying Table 29, column one.

Table 29. Economic Impacts of \$100 Million Increase in Demand for Aircraft by the Federal Government -- 1967

Sector	Direct Effects ^{a/}	Direct plus Indirect Effects ^{b/}	Direct, Indirect and Induced Effects ^{c/}
(Dollars)			
1. Irrigated cotton	0	1,988	43,235
2. Irrigated food grains	0	729	38,263
3. Irrigated feed grains	0	1,154	80,945
4. Other irrigated crops	0	2,043	234,631
5. Dryland cotton	0	634	26,970
6. Dryland food grains	0	226	14,752
7. Dryland feed grains	0	1,754	111,847
8. Other dryland crops	0	1,455	136,292
9. Range livestock production	0	8,531	561,902
10. Feedlot livestock production	0	6,946	437,207
11. Dairy	0	10,126	370,600
12. Poultry and eggs	0	605	311,420
13. Agricultural supply except farm machinery	0	972	90,927
14. Cotton ginning	0	161	4,287
15. Agricultural services ^{b/}	0	1,252	98,705
16. Forestry	0	6,213	23,819
17. Fisheries	0	2,486	54,541
18. Crude petroleum	0	162,490	1,167,708
19. Natural gas liquids	4,542	17,655	125,654
20. Oil and gas field services	0	17,429	123,581
21. Other mining and quarrying	7,201	16,957	40,960
22. Residential construction	0	0	0
23. Commercial, educational and institutional construction	0	68	143
24. Industrial construction	0	0	0
25. Facility construction	0	568	1,198
26. Maintenance and repair	406,631	456,388	962,237
27. Meat products	0	19,398	1,219,249
28. Poultry products	0	396	179,090
29. Dairies	0	22,425	737,606
30. Grain milling	0	1,714	86,403
31. Animal feeds	0	2,358	230,356

(Continued)

Table 29 Continued

Sector	Direct Effects ^{a/}	Direct plus Indirect Effects ^{b/}	Direct Indirect and Induced Effects ^{c/}
		(Dollars)	
32. Bakery products	0	10,852	383,488
33. Canned, preserved, pickled, dried and frozen foods	0	17,756	321,832
34. Other food and kindred products	1,828	4,275	745,172
35. Beverages	942	2,446	603,347
36. Textile mill products	6,425	13,249	47,580
37. Mens, boys, women and misses and childrens furnishings	1,163	3,026	308,007
38. Related apparel	0	839	54,195
39. Logging	0	4,781	20,519
40. Lumber mills	0	13,343	46,027
41. Millwork and wood products	15,510	36,540	106,676
42. Wood furniture and fixtures	2,216	11,204	86,033
43. Metal furniture and fixtures	3,213	5,559	25,430
44. Paper and paper mills	0	36,433	167,635
45. Paper products except boxes and containers	0	14,652	103,379
46. Boxes and paper containers	0	13,460	124,081
47. Newspapers	12,020	20,735	430,437
48. Publishing	346,974	383,028	405,641
49. Printing	73,062	166,645	389,468
50. Mainfold business forms	38,885	44,579	75,692
51. Other printing and publishing	12,463	36,048	83,154
52. Cholrine and alkalies	0	21,559	64,699
53. Cyclic crudes and intermediates and inorganic pigments	166	8,515	25,297
54. Organic chemicals	3,268	35,843	130,452
55. Inorganic chemicals	609	9,240	106,366
56. Fibers, plastics	55	28,100	44,540
57. Synthetic rubber	1,163	5,570	20,921
58. Drugs	0	255	25,109
59. Agricultural chemicals	0	1,303	96,873
60. Soaps, cleansers and toiletries	13,959	17,309	90,091
61. Paints and varnishes	24,539	42,927	122,357

(Continued)

Table 29 Continued

Sector	Direct Effects ^{a/}	Direct plus Indirect Effects ^{b/}	Direct, Indirect and Induced Effects ^{c/}
(Dollars)			
62. Other chemicals	57,441	69,485	89,550
63. Petroleum refining	176,534	310,391	1,911,451
64. Other petroleum products	43,649	51,092	67,235
65. Tires	2,991	7,442	61,869
66. Fabricated rubber products	20,107	38,675	51,538
67. Plastic products	38,054	73,384	111,001
68. Leather & leather products	14,346	16,629	32,561
69. Glass	111	4,179	58,392
70. Clay	0	6,257	33,431
71. Cut stone and other clay and shell products	6,536	18,446	64,249
72. Cement and concrete products	0	20,419	52,758
73. Blast furnaces	3,434	27,173	53,211
74. Primary steel and iron	0	15,957	26,600
75. Foundries	2,160	15,374	39,993
76. Nonferrous primary and secondary smelting	499	66,456	73,971
77. Aluminum smelting and non- ferrous rolling and drawing	669,410	831,950	892,181
78. Castings and forgings	98,487	329,442	351,558
79. Fabricated steel	45,311	56,850	64,688
80. Plate work	69,849	75,892	80,546
81. Sheet metal and architectural	7,976	19,711	49,852
82. Metal doors	554	1,108	14,490
83. Fabricated metal products	20,052	35,171	129,393
84. Plumbing	1,108	7,201	21,029
85. Bolts, nuts and screws	41,322	50,219	64,401
86. Electroplating, coating and engraving	56,832	66,539	70,263
87. Valves and pipe fittings	166	9,984	29,486
88. Other fabricated metal	38,165	54,547	75,890
89. Farm, construction and indus- trial machinery	0	3,270	20,581
90. Materials handling machinery and equipment	0	1,122	2,839

(Continued)

Table 29 Continued

Sector	Direct Effects ^{a/}	Direct plus Indirect Effects ^{b/}	Direct, Indirect and Induced Effects ^{c/}
(Dollars)			
91. Mining machinery and equipment	2,271	4,541	10,620
92. Engines	0	2,021	6,257
93. Metal working machinery	57,164	78,448	86,388
94. Industrial processing machinery	46,972	50,558	62,276
95. General industrial machinery	18,833	22,221	26,560
96. Refrigeration machinery	104,912	108,783	129,206
97. Computers, accounting, office and service industry machinery	294,352	329,552	337,809
98. Electric instrument and apparatus	206,778	226,305	254,563
99. Electrical household equipment	0	236	3,157
100. Electronic communications equipment	1,484,777	1,522,770	1,548,824
101. Other electrical apparatus	310,803	345,452	360,110
102. Aircraft	1,335,940	101,356,656	101,361,715
103. Aircraft engines	0	20	493
104. Other aircraft	1,437,528	1,462,785	1,464,649
105. Motor vehicles and parts	16,507	36,378	673,481
106. Ship and boat building	0	669	28,223
107. Other transportation equipment	0	1,569	92,750
108. Scientific instruments	5,484	16,060	23,880
109. Mechanical measuring devices	21,492	22,621	23,785
110. Medical instruments	17,061	18,249	36,992
111. Photographic, time and optical instruments	27,253	40,628	64,162
112. Games and toys	0	258	11,300
113. Other manufacturing industries	127,235	135,952	203,063
114. Railroad transportation	120,256	186,043	440,680
115. Intercity rural highway transportation	55	1,658	113,324
116. Motor freight transportation and local trucking and storage	152,106	230,809	1,225,157
117. Water transportation	0	9,339	79,110
118. Air transportation	162,187	178,615	522,498
119. Pipeline transportation	0	17,458	97,587

(Continued)

Table 29 Continued

Sector	Direct Effects ^{a/}	Direct plus Indirect Effects ^{b/}	Direct, Indirect and Induced Effects ^{c/}
(Dollars)			
120. Local and suburban transportation	55	186	113,140
121. Other transportation services	18,612	24,981	46,446
122. Telephone and telegraph	61,263	140,473	1,131,489
123. Radio and TV	0	12,103	140,227
124. Other communications	2,049	2,603	8,885
125. Gas services	5,041	81,101	775,728
126. Electric services	85,525	202,663	1,545,090
127. Water and sanitary services	7,478	22,824	348,123
128. Wholesale auto, parts & supplies	3,379	15,987	941,549
129. Wholesale groceries and re- lated products	0	1,061	716,644
130. Wholesale farm products and farm product warehousing	0	1,446	95,268
131. Wholesale livestock	0	528	45,459
132. Wholesale machinery, equipment and supplies	416,214	444,949	629,396
133. Wholesale petroleum and petroleum products	52,456	64,625	297,848
134. General wholesale	387,023	472,243	2,669,139
135. Lumber yards	4,764	12,652	115,401
136. Farm equipment dealers	277	465	83,447
137. Hardware, heating, electrical, paint and wallpaper	3,933	4,534	104,701
138. Department and variety stores	2,271	2,349	2,400,886
139. Food stores	0	373	1,485,029
140. Automotive dealers and repair shops	609	15,053	2,323,624
141. Gasoline service stations	0	14,480	627,433
142. Apparel and accessory stores	0	170	645,311
143. Furniture, home furnishings, and equipment stores	111	173	467,723
144. Eating and drinking places	111	15,418	1,877,309
145. Other retail	21,160	25,738	1,265,504
146. Banking and credit agencies	225,112	301,174	2,795,870
147. Insurance carriers	107,128	187,441	1,393,834

(Continued)

Table 29 Continued

Sector	Direct Effects ^{a/}	Direct plus Indirect Effects ^{b/}	Direct, Indirect and Induced Effects ^{c/}
(Dollars)			
148. F.I.R.E. nec	0	69,485	1,491,648
149. Legal services	0	27,592	304,585
150. Lodging services	0	17,216	500,609
151. Personal services	5,428	12,735	1,165,671
152. Advertising	66,526	131,142	312,485
153. Duplicating and addressing	16,728	34,780	140,358
154. Employment agencies; private	388	1,506	13,692
155. Photographic services	67,633	85,240	208,431
156. Research and development	14,457	16,451	20,528
157. Other business services	95,994	169,858	605,186
158. Motion picture, amusement and recreation services	0	2,407	420,186
159. Automobile rental services	15,399	29,240	119,754
160. Automobile parking	0	170	47,136
161. Electrical repair	1,606	3,311	131,752
162. Miscellaneous repair services	14,014	37,348	309,365
163. Physicians and dentists services	0	1,127	1,152,304
164. Hospital and laboratory services	0	464	912,719
165. Other medical services	0	12	397,647
166. Education (public and private)	636,341	720,625	2,265,559
167. Colleges and universities	187,280	208,417	812,815
168. Other educational services	0	61	129,072
169. Engineering and architectural services	81,094	89,545	119,254
170. Accounting, auditing, and bookkeeping	2,880	32,639	464,401
171. Other professional services	0	20,803	72,944
172. Other services	82,035	98,452	994,523
173. Ordnance and accessories	665	699	9,432
174. Outdoor recreation	23,874	26,189	106,133
175. Scrap	0	21,101	27,629
176. Households	29,363,642	--	58,747,025
177. Property payment	5,888,814	--	--

(Continued)

Table 29 Continued

Sector	Direct Effects ^{a/}	Direct plus Indirect Effects ^{b/}	Direct, Indirect and Induced Effects ^{c/}
(Dollars)			
178. Federal government	6,109,052	--	--
179. State government	236,191	--	--
180. Local government	317,007	--	--
181. Imports	46,573,379	--	--
182. Depreciation	453,105	--	--
TOTAL	100,000,000	114,392,531	223,745,997

*Sector No. 102; Appendix A, Tables 2, 3, and 4.

^{a/} Appendix A, Table 2, Column 102; each cell multiplied by \$100 million.

^{b/} Appendix A, Table 3, Column 102; each cell multiplied by \$100 million.

^{c/} Appendix A, Table 4, Column 102; each cell multiplied by \$100 million.

The direct expenditure for materials and services to produce aircraft necessitate that the sectors to which orders are placed increase their respective outputs. This, of course, requires that these sectors purchase additional inputs from their suppliers. The inputs requirements of each of these sectors are also shown in Appendix A, Table 2, in each respective sector's column. The direct plus indirect requirements, excluding the induced effects of new household income, are shown in Table 29, column 2. The total effect of the initial \$100 million is estimated at \$114.4 million (Table 29, column 2 total). This is not especially large and is due to the large leakage in the form of imports and the fact that the \$29.3 million in new household income is also treated as a leakage in the direct plus indirect requirements analysis.

The indirect requirements of the economy resulting from the production of \$100 million of new aircraft are obtained by calculating the difference between the dollar values in columns two and one of Table 29. Aircraft manufacture (Sector 102) requires no direct inputs from the agricultural sectors, but according to the input-output model, sectors from which aircraft manufacture purchases do require such inputs. For example, the indirect requirements from the irrigated cotton producing sector (Sector 1) are estimated at \$1,988 (Table 29, row 1, column 2) to produce aircraft valued at \$100 million. Likewise, aircraft production uses zero crude petroleum directly but, according to the input-output model, the indirect requirements would be \$162,490 for the \$100 million of aircraft production (Table 29, row 18, column 2).

Manufacture of \$100 million of output by Sector 102 requires \$6,425 of direct inputs from the textile mill sector (Table 29, row 36, column 1). Direct plus indirect requirements of textile mill outputs were estimated at \$13,249 which means that \$100 million of aircraft manufacture has an indirect textile mill requirement of \$6,824 ($\$13,249 - \$6,425$) (Table 29, row 36, columns 1 and 2). The indirect requirement is due to the textile input requirements of sectors that supply inputs to the aircraft manufacturing sector directly as well as by sectors which supply inputs to the latter group of sectors. The indirect requirements of other sectors of the economy for the production of \$100 million of aircraft are interpreted in the same way.

When the input-output model is closed; i.e. households are included as one of the processing sectors, the induced effects of household spending of additional income can be estimated. The estimates of the direct, indirect, and induced effects of \$100 million increase in aircraft output are \$223.7 million (Table 29, column 3). The individual sector components of the total effects are shown within Table 29. For example, the initial \$100 million of aircraft manufacture spending yielded approximately \$29.4 million in direct payments of salaries, wages, and dividends to households. The indirect and induced requirements for production by other sectors of the economy results in estimated total payments to households of \$58.7 million (Table 29

row 176, column 3). The induced effects of this level of payments to households upon the textile mill products sector was estimated at \$34,331 (\$47,580 - \$13,249) (Table 29, row 36, column 3). The \$34,331 of textile mill induced outputs would be used as inputs to other sectors which produce and sell finished goods to households. The markets for these sector's outputs would have been expanded by the gross amount of \$34,331 on the basis of household incomes resulting from a \$100 million increased production of aircraft. The induced effects of this increased household income upon gross markets of other sectors is interpreted in an analogous manner and can be observed for the aircraft manufacturing sector example in Table 29, column 3. The coefficients whereby similar analyses of the direct, indirect, and induced effects of changes in production of each sector of the economy are presented in Appendix A, Tables 2, 3, and 4. The analyst or planner can apply estimates of changes in sales to final demand directly to the coefficients and calculate the total economy and individual sector effects for each sector of interest.

Change in Output

In the previous discussion, the input-output model was used to analyze the economic impacts of a change in final demand for a typical manufacturing sector of the economy. Since many sectors sell only a part of outputs to final demand and in some rather important cases, practically no sales are made to final demand sectors, the analyses based on final demand multipliers do not provide information usable by planners. In these cases, output multipliers derived from the final demand multipliers are the appropriate types of multipliers whereby the economy-wide effects of changes in outputs resulting either from changes in demand for intermediate products and services or changes in basic resources used by such industries can be analyzed.

Output multipliers are calculated directly from the direct and indirect requirements and the direct, indirect, and induced requirements tables (Appendix A, Tables 3 and 4) by dividing each cell of each respective column by the value in the diagonal or row-column intersection cell. The division -- the value in the diagonal cell of the direct plus indirect requirements table -- in the calculation for each respective sector contains one dollar of output. Under the assumptions of input-output analyses, each sector produces homogeneous outputs, therefore sales to intermediate demand and final demand are of the same kinds of outputs. Thus, when the calculation stated above is made, the result is a new multiplier which is expressed in terms of requirements per dollar of output as opposed to requirements per dollar of sales to final demand.

Output multipliers were calculated for each sector of the Texas Input-Output Model (Table 28). A detailed illustration of the computation of the sector-by-sector direct, indirect, and induced requirements for two sectors of the model (irrigated feed grains and aircraft manufacture) are shown in Table 30. According to

Table 30. A Comparison of Final Demand and Output Multipliers for Irrigated Feed Grains and Aircraft Manufacturing -- Texas
 Closed Input-Output Model; 1967^{a/}

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
1. Irrigated cotton	0.00088103	0.00087214	0.00043235	0.00042654
2. Irrigated food grains	0.00080310	0.00079499	0.00038263	0.00037749
3. Irrigated feed grains	1.01020105	1.00000000	0.00080945	0.00079858
4. Other irrigated crops	0.00460387	0.00455738	0.00234631	0.00231479
5. Dryland cotton	0.00053843	0.00053299	0.00026970	0.00026608
6. Dryland food grains	0.00033261	0.00032925	0.00014752	0.00014554
7. Dryland feed grains	0.00269638	0.00266915	0.00111847	0.00110344
8. Other dryland crops	0.00266985	0.00264289	0.00136292	0.00134461
9. Range livestock production	0.01086191	0.01075223	0.00561902	0.00554353
10. Feedlot livestock production	0.00845827	0.00837286	0.00437207	0.00431334
11. Dairy	0.00722557	0.00715261	0.00370600	0.00365621
12. Poultry and eggs	0.01323125	0.01309764	0.00311420	0.00307237
13. Agricultural supply except farm machinery	0.02611246	0.02584878	0.00090927	0.00089706
14. Cotton ginning	0.00008670	0.00008582	0.00004287	0.00004229
15. Agricultural services	0.03758032	0.03720083	0.00098705	0.00097379
16. Forestry	0.00047044	0.00046569	0.00023819	0.00023499
17. Fisheries	0.00107586	0.00106499	0.00054541	0.00053809
18. Crude petroleum	0.05805206	0.05746584	0.01167708	0.01152020
19. Natural gas liquids	0.00407483	0.00403368	0.00125654	0.00123966

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
20. Oil and gas fields	0.00614310	0.00608107	0.00123581	0.00121920
21. Other mining and quarrying	0.00390188	0.00386247	0.00040960	0.00040410
22. Residential construction	0	0	0	0
23. Commercial, educational and institutional construction	0.00000273	0.00000270	0.00000143	0.00000141
24. Industrial construction	0	0	0	0
25. Facility construction	0.00002293	0.00002269	0.00001198	0.00001182
26. Maintenance and repair	0.01841409	0.01822814	0.00962237	0.00949310
27. Meat products	0.02358919	0.02335098	0.01219249	0.01202870
28. Poultry products	0.00343781	0.00340309	0.00179090	0.00176684
29. Dairies	0.01441135	0.01426583	0.00737606	0.00727696
30. Grain milling	0.00180543	0.00178720	0.00086403	0.00085242
31. Animal feeds	0.00697934	0.00690886	0.00230356	0.00227262
32. Bakery products	0.00748151	0.00740596	0.00383488	0.00378336
33. Canned, preserved, pickled, dried, and frozen foods	0.00638898	0.00632446	0.00321832	0.00317508
34. Other food and kindred products	0.01431338	0.01416884	0.00745172	0.00735161
35. Beverages	0.01163676	0.01151925	0.00603347	0.00595242
36. Textile mill products	0.00079353	0.00078551	0.00047580	0.00046941
37. Mens, boys, women and misses and childrens furnishings	0.00588561	0.00582617	0.00308007	0.00303869

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
38. Related apparel	0.00104030	0.00102980	0.00054195	0.00053467
39. Logging	0.00040568	0.00040159	0.00020519	0.00020243
40. Lumber mills	0.00090209	0.00089298	0.00046027	0.00045409
41. Millwork and wood products	0.00219923	0.00217703	0.00106676	0.00105242
42. Wood furniture and fixtures	0.00163706	0.00162052	0.00086033	0.00084878
43. Metal furniture and fixtures	0.00039970	0.00039567	0.00025430	0.00025088
44. Paper and paper mills	0.00335646	0.00332257	0.00167635	0.00165383
45. Paper products except boxes and containers	0.00315703	0.00312515	0.00103379	0.00101991
46. Boxes and paper containers	0.00286935	0.00284037	0.00124081	0.00122414
47. Newspapers	0.00871220	0.00862423	0.00430437	0.00424654
48. Publishing	0.00055262	0.00054704	0.00405641	0.00400191
49. Printing	0.00509472	0.00504328	0.00389468	0.00384235
50. Manifold business forms	0.00074996	0.00074239	0.00075692	0.00074675
51. Other printing and publishing	0.00111096	0.00109974	0.00083154	0.00082037
52. Chlorine and alkalies	0.00565481	0.00559771	0.00064699	0.00063829
53. Cyclic crudes and intermediates and inorganic pigments	0.00086901	0.00086023	0.00025297	0.00024957
54. Organic chemicals	0.00460858	0.00456205	0.00130452	0.00128699
55. Inorganic chemicals	0.01993428	0.01973299	0.00106366	0.00104937
56. Fibers, plastics	0.00062497	0.00061866	0.00044540	0.00043942

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
57. Synthetic rubber	0.00079719	0.00078914	0.00020921	0.00020640
58. Drugs	0.00048698	0.00048206	0.00025109	0.00024772
59. Agricultural chemicals	0.06832068	0.06763078	0.00096873	0.00095572
60. Soaps, cleansers, and toiletries	0.00168452	0.00166751	0.00090091	0.00088880
61. Paints and varnishes	0.00181095	0.00179267	0.00122357	0.00120713
62. Other chemicals	0.00080734	0.00079919	0.00089550	0.00088347
63. Petroleum refining	0.10134722	0.10032381	0.01911451	0.01885772
64. Other petroleum products	0.00049631	0.00049130	0.00067235	0.00066332
65. Tires	0.00299004	0.00295984	0.00061869	0.00061038
66. Fabricated rubber products	0.00032624	0.00032295	0.00051538	0.00050846
67. Plastic products	0.00223898	0.00221637	0.00111001	0.00109510
68. Leather and leather products	0.00033354	0.00033018	0.00032561	0.00032124
69. Glass	0.00111711	0.00110583	0.00058392	0.00057607
70. Clay	0.00064779	0.00064125	0.00033431	0.00032981
71. Cut stone and other clay and shell products	0.00130570	0.00129252	0.00064249	0.00063386
72. Cement and concrete products	0.00102867	0.00101829	0.00052758	0.00052049
73. Blast furnaces	0.00119110	0.00117908	0.00053211	0.00052496
74. Primary steel and iron	0.00068587	0.00067894	0.00026600	0.00026243
75. Foundries	0.00078642	0.00077848	0.00039993	0.00039456

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
76. Nonferrous primary and secondary smelting	0.00031291	0.00030976	0.00073971	0.00072978
77. Aluminum smelting and nonferrous rolling and drawing	0.00173668	0.00171915	0.00892181	0.00880195
78. Castings and forgings	0.00102358	0.00101324	0.00351558	0.00346835
79. Fabricated steel	0.00047219	0.00046742	0.00064688	0.00063819
80. Plate work	0.00037135	0.00036760	0.00080546	0.00079464
81. Sheet metal and architectural	0.00067888	0.00067203	0.00049852	0.00049182
82. Metal doors	0.00027340	0.00027064	0.00014490	0.00014295
83. Fabricated metal products	0.00241764	0.00239323	0.00129393	0.00127654
84. Plumbing	0.00037192	0.00036816	0.00021029	0.00020747
85. Bolts, nuts, screws	0.00066385	0.00065715	0.00064401	0.00063536
86. Electroplating, coating and engraving	0.00012635	0.00012507	0.00070263	0.00069319
87. Valves and pipe fittings	0.00158432	0.00156832	0.00029486	0.00029090
88. Other fabricated metal	0.00104068	0.00103017	0.00075890	0.00074871
89. Farm, construction and industrial machinery	0.01220129	0.01207808	0.00020581	0.00020304
90. Materials handling machinery and equipment	0.00007102	0.00007030	0.00002839	0.00002801
91. Mining machinery and equipment	0.00030318	0.00030012	0.00010620	0.00010477
92. Engines	0.00018722	0.00018533	0.00006257	0.00006173
93. Metal working machinery	0.00024753	0.00024503	0.00086388	0.00085228
94. Industrial processing machinery	0.00038116	0.00037731	0.00062276	0.00061439

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
95. General industrial machinery	0.00028142	0.00027858	0.00026560	0.00026203
96. Refrigeration machinery	0.00045191	0.00044735	0.00129206	0.00127471
97. Computers, accounting, office and service industry machinery	0.00033990	0.00033646	0.00337809	0.00333271
98. Electric instrument and apparatus	0.00091454	0.00090530	0.00254563	0.00251143
99. Electrical household equipment	0.00006609	0.00006542	0.00003157	0.00003114
100. Electronic communications equipment	0.00070088	0.00069380	0.01548824	0.01528017
101. Other electrical apparatus	0.00095744	0.00094778	0.00360110	0.00355272
102. Aircraft	0.00010615	0.00010508	1.01361715	1.00000000
103. Aircraft engines	0.00010486	0.00010380	0.00000493	0.00000486
104. Other aircraft	0.00005094	0.00005043	0.01464649	0.01444972
105. Motor vehicle and parts	0.02190124	0.02168008	0.00673481	0.00664433
106. Ship and boat building	0.00063207	0.00062569	0.00028223	0.00027844
107. Other transportation equipment	0.00179217	0.00177407	0.00092750	0.00091504
108. Scientific instruments	0.00017295	0.00017120	0.00023880	0.00023559
109. Mechanical measuring devices	0.00004959	0.00004909	0.00023785	0.00023465
110. Medical instruments	0.00040178	0.00039772	0.00036992	0.00036495
111. Photographic, time and optical instruments	0.00049516	0.00049016	0.00064162	0.00063300
112. Games and toys	0.00021550	0.00021332	0.00011300	0.00011148
113. Other manufacturing industries	0.00192420	0.00190477	0.00203063	0.00200335

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
	114. Railroad transportation	0.01331777	0.01318329	0.00440680	0.00434759
115. Intercity rural highway transportation	0.00219154	0.00216941	0.00113324	0.00111801
116. Motor freight transportation and local trucking and storage	0.02669466	0.02642510	0.01225157	0.01208698
117. Water transportation	0.00444536	0.00440047	0.00079110	0.00078047
118. Air transportation	0.00721543	0.00714257	0.00522498	0.00515479
119. Pipeline transportation	0.00518011	0.00512780	0.00097587	0.00096276
120. Local and suburban transportation	0.00216428	0.00214243	0.00113140	0.00111620
121. Other transportation services	0.00067916	0.00067231	0.00046446	0.00045822
122. Telephone and telegraph	0.02387858	0.02363746	0.01131489	0.01116289
123. Radio and TV	0.00320187	0.00316954	0.00140227	0.00138343
124. Other communications	0.00012390	0.00012264	0.00008885	0.00008766
125. Gas services	0.03443218	0.03408448	0.00775728	0.00765306
126. Electric services	0.03878203	0.03839041	0.01545090	0.01524333
127. Water and sanitary services	0.00696666	0.00689631	0.00348123	0.00343446
128. Wholesale auto, parts and supplies	0.02047226	0.02026553	0.00941549	0.00928900
129. Wholesale groceries and related products	0.01372267	0.01358410	0.00716644	0.00707016
130. Wholesale farm products and farm product warehousing	0.00461555	0.00456894	0.00095268	0.00093989
131. Wholesale livestock	0.00088963	0.00088064	0.00045459	0.00044848

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
132. Wholesale machinery, equipment and supplies	0.00483851	0.00478965	0.00629396	0.00620940
133. Wholesale petroleum and petroleum products	0.02011867	0.01991551	0.00297848	0.00293846
134. General wholesale	0.05528279	0.05472454	0.02669139	0.02633281
135. Lumber yards	0.00249544	0.00247024	0.00115401	0.00113851
136. Farm equipment dealers	0.02081731	0.02060710	0.00083447	0.00082326
137. Hardware, heating, electrical, paint and wallpaper	0.00418426	0.00414201	0.00104701	0.00103294
138. Department and variety stores	0.04587970	0.04541640	0.02400886	0.02368632
139. Food stores	0.02841683	0.02812987	0.01485029	0.01465079
140. Automotive dealers and repair shops	0.05826460	0.05767624	0.02323624	0.02292408
141. Gasoline service stations	0.03112545	0.03081114	0.00627433	0.00619004
142. Apparel and accessory stores	0.01235129	0.01222657	0.00645311	0.00636642
143. Furniture, home furnishings and equipment stores	0.00894337	0.00885306	0.00467723	0.00461439
144. Eating and drinking places	0.03599494	0.03563146	0.01877309	0.01852089
145. Other retail	0.02387319	0.02363212	0.01265504	0.01248503
146. Banking and credit agencies	0.07005836	0.06935091	0.02795870	0.02758310
147. Insurance carriers	0.02960691	0.02930794	0.01393834	0.01375109
148. F.I.R.E. nec	0.03163684	0.03131737	0.01491648	0.01471609
149. Legal services	0.00607141	0.00601010	0.00304585	0.00300494

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
150. Lodging services	0.00981963	0.00972047	0.00500609	0.00493883
151. Personal services	0.02230493	0.02207970	0.01165671	0.01150011
152. Advertising	0.00473853	0.00469068	0.00312485	0.00308287
153. Duplicating and addressing	0.00234444	0.00232077	0.00140358	0.00138473
154. Employment agencies; private	0.00025389	0.00025132	0.00013692	0.00013508
155. Photographic services	0.00257486	0.00254886	0.00208431	0.00205631
156. Research and development	0.00013614	0.00013477	0.00020528	0.00020252
157. Other business services	0.01324954	0.01311575	0.00605186	0.00597056
158. Motion picture, amusement and recreation services	0.00801167	0.00793076	0.00420186	0.00414541
159. Automobile rental services	0.00219575	0.00217358	0.00119754	0.00118145
160. Automobile parking	0.00090695	0.00089779	0.00047136	0.00046503
161. Electrical repair	0.01111706	0.01100480	0.00131752	0.00129982
162. Miscellaneous repair services	0.00688109	0.00681160	0.00309365	0.00305209
163. Physicians and dentists services	0.02205070	0.02182803	0.01152304	0.01136824
164. Hospital and laboratory services	0.01746568	0.01728932	0.00912719	0.00900457
165. Other medical services	0.00760608	0.00752928	0.00397647	0.00392305
166. Education (public and private)	0.05310872	0.05257242	0.02265559	0.02235123
167. Colleges and universities	0.01296413	0.01283322	0.00812815	0.00801895
168. Other educational services	0.00247008	0.00244514	0.00129072	0.00127338

(Continued)

Table 30 Continued

Sector Name	Irrigated Feed Grains Multiplier		Aircraft Manufacturing Multiplier	
	Final Demand ^{b/}	Output ^{c/}	Final Demand ^{d/}	Output ^{e/}
169. Engineering and architectural services	0.00085318	0.00084457	0.00119254	0.00117652
170. Accounting, auditing and bookkeeping	0.01005941	0.00995783	0.00464401	0.00458162
171. Other professional services	0.00118790	0.00117590	0.00072944	0.00071965
172. Other services	0.01768527	0.01750668	0.00994523	0.00981162
173. Ordnance and accessories	0.00016703	0.00016535	0.00009432	0.00009305
174. Outdoor recreation	0.00167865	0.00166170	0.00106133	0.00104707
175. Scrap	0.00020935	0.00020723	0.00027629	0.00027258
176. Households	1.12370351	1.11235631	0.58747025	0.57957805
Total	3.67814689	3.64100481	2.23745997	2.20740144

^{a/} Calculated from data of Appendix A, Table 4, Sectors 3 and 102 respectively.

^{b/} Appendix A, Table 4, Column 3.

^{c/} Appendix A, Table 4, Column 3 divided by value on Row 3.

^{d/} Appendix A, Table 4, Column 102.

^{e/} Appendix A, Table 4, Column 102 divided by value on row 102.

the estimates of the input-output model the direct, indirect, and induced requirements per dollar of irrigated feed grains sales to final demand was \$3.67, whereas the direct, indirect, and induced requirements per dollar of output was \$3.64 (Table 30, columns one and two respectively). Direct, indirect and induced requirements per dollar of aircraft sales to final demand were estimated at \$2.24 while direct, indirect, and induced requirements per dollar of aircraft output were estimated at \$2.21 (Table 30, columns three and four). The direct, indirect, and induced requirements of each individual sector from both the final demand and output viewpoints are shown in Table 30. A sector-by-sector comparison can be made for the purpose of gaining an appreciation of the difference between final demand and output multipliers.

Various local market, export market, and public policy factors can affect the level of purchases or spending for finished goods and services produced by any one or several of the individual sectors of the Texas economy. The input-output model is a useful tool through which the total economy-wide output and income effects of changes in demand for products and services can be estimated. For example, the estimated total change in output resulting from a \$1.0 million change in export demand for meat products was \$4.06 million (Table 31, row 27). Such a change would result in an estimated change in incomes paid to households for \$0.85 million (Table 31, row 27). The output and income effects of a \$1.0 million change in final demand (export, government and capital demand) for each of the sectors of the Texas economy are shown in Table 31.

Through use of the estimates shown in Table 31, planners and public policy makers can select those programs and actions for implementation which have the most beneficial effects upon total output and income. For example, if unemployment is high and incomes are down as a result, government spending can be channeled so as to purchase commodities or stimulate exports of products of those sectors which have the highest income effects and thereby alleviate the effects of unemployment and the expected decline in consumer spending associated therewith. In the case of economic development, agencies can use these indicators to select those sectors for further expansion which have the highest direct and indirect impacts upon production and income.

Table 31. Estimated Change in Each Sector's Output and Change in Household Income Paid by Each Sector as a Result of a One Million Dollar Change in Final Demand for Each Sector's Output -- Texas; 1967

Sector	Change in Output ^{a/}	Change in Income ^{b/}
1. Irrigated cotton	3.79	1.15
2. Irrigated food grains	3.67	1.05
3. Irrigated feed grains	3.67	1.12
4. Other irrigated crops	3.54	0.98
5. Dryland cotton	3.82	1.19
6. Dryland food grains	3.73	0.95
7. Dryland feed grains	3.63	1.05
8. Other dryland crops	3.59	1.05
9. Range livestock production	3.61	1.02
10. Feedlot livestock production	3.55	0.76
11. Dairy	3.84	0.93
12. Poultry and eggs	4.58	0.96
13. Agricultural supply except farm machinery	3.26	1.08
14. Cotton ginning	3.27	0.94
15. Agricultural services ^{b/}	3.27	0.72
16. Primary forestry	1.89	0.35
17. Fisheries	3.12	0.90
18. Crude petroleum	2.45	0.66
19. Natural gas	2.44	0.52
20. Oil and gas field services	2.94	0.88
21. Other mining and quarrying	2.52	0.65
22. Residential construction	2.89	0.78
23. Commercial, educational and institutional construction	3.26	0.91
24. Industrial construction	3.52	1.04
25. Facility construction	3.10	0.87
26. Maintenance and repair	3.22	0.96
27. Meat products	4.06	0.85
28. Poultry products	4.73	0.87
29. Dairies	3.40	0.72
30. Grain milling	3.29	0.71
31. Animal feeds	3.48	0.76

(Continued)

Table 31 Continued

Sector	Change in Output ^{a/}	Change in Income ^{b/}
32. Bakery products	2.75	0.69
33. Canned, preserved, pickled, dried and frozen foods	2.95	0.65
34. Other food and kindred products	2.06	0.38
35. Beverages	2.47	0.55
36. Textile mill products	2.91	0.78
37. Men and boys, women and misses and childrens furnishings	2.27	0.61
38. Related apparel	2.49	0.65
39. Logging	3.03	0.65
40. Lumber mills	2.98	0.78
41. Millwork and wood products	2.55	0.63
42. Wood furniture and fixtures	2.58	0.70
43. Metal furniture and fixtures	2.48	0.53
44. Paper and paper mills	2.85	0.68
45. Paper products except boxes and containers	2.73	0.67
46. Boxes and paper containers	2.84	0.64
47. Newspapers	3.06	0.90
48. Publishing	3.35	0.93
49. Printing	3.01	0.87
50. Manifold business forms	2.72	0.73
51. Other printing and publishing	3.25	1.02
52. Chlorine and alkalies	2.67	0.52
53. Cyclic crudes and intermediates and inorganic pigments	3.36	0.63
54. Organic chemicals	2.71	0.52
55. Inorganic chemicals	2.47	0.49
56. Fibers, plastics	2.77	0.51
57. Synthetic rubber	2.71	0.49
58. Drugs	2.71	0.72
59. Agricultural chemicals	2.65	0.49
60. Soaps, cleansers and toiletries	2.12	0.37
61. Paints and varnishes	2.67	0.52
62. Other chemicals	2.42	0.50
63. Petroleum refining	2.83	0.52

(Continued)

Table 31 Continued

Sector	Change in Output <u>a/</u>	Change in Income <u>b/</u>
64. Other petroleum products	3.19	0.67
65. Tires	2.65	0.54
66. Fabricated rubber products	2.84	0.79
67. Plastics products	2.82	0.66
68. Leather and leather products	2.47	0.67
69. Glass	3.09	0.90
70. Clay	3.09	0.91
71. Cut stone and other clay and shell products	2.39	0.60
72. Cement and concrete products	2.85	0.68
73. Blast furnaces	2.49	0.62
74. Primary steel and iron	2.40	0.59
75. Foundries	3.07	0.91
76. Nonferrous primary and secondary smelting	2.41	0.53
77. Aluminum smelting and nonferrous rolling	2.47	0.51
78. Castings and forgings	2.54	0.70
79. Fabricated steel	2.68	0.69
80. Plate work	2.30	0.59
81. Sheet metal and architectural	2.81	0.73
82. Metal doors	3.09	0.77
83. Fabricated metal products	2.60	0.55
84. Plumbing	2.13	0.54
85. Bolts, nuts and screws	2.55	0.69
86. Electroplating, coating and engraving	2.90	0.82
87. Vales and pipe fittings	2.58	0.67
88. Other fabricated metal	2.31	0.54
89. Farm, construction and indus- trial machinery	2.49	0.64
90. Materials handling machinery and equipment	2.25	0.57
91. Mining machinery and equipment	2.75	0.77
92. Engines	2.50	0.65
93. Metal working machinery	2.89	0.84
94. Industrial processing machinery	2.75	0.80

(Continued)

Table 31 Continued

	Sector	Change in Output ^{a/}	Change in Income ^{b/}
95.	General industrial machinery	2.49	0.62
96.	Refrigeration machinery	2.23	0.50
97.	Computers, accounting, office and service industry machinery	2.77	0.82
98.	Electric instruments and apparatus	2.15	0.53
99.	Electric household equipment	2.10	0.51
100.	Electronic communications equipment	2.57	0.78
101.	Other electrical apparatus	2.86	0.66
102.	Aircraft	2.24	0.58
103.	Aircraft engines	3.06	0.96
104.	Other aircraft	2.92	0.88
105.	Motor vehicles and parts	1.54	0.24
106.	Ship and boat building	2.95	0.89
107.	Other transportation equipment	2.64	0.66
108.	Scientific instruments	2.94	0.82
109.	Mechanical measuring devices	2.22	0.55
110.	Medical instruments	2.96	0.87
111.	Photographic, time and optical instruments	2.36	0.64
112.	Games and toys	2.49	0.66
113.	Other manufacturing industries	2.69	0.71
114.	Railroad transportation	3.23	1.02
115.	Intercity rural highway transpor- tation	3.29	1.11
116.	Motor freight transportation and local trucking storage	3.45	1.02
117.	Water transportation	3.55	1.18
118.	Air transportation	3.24	0.98
119.	Pipeline transportation	2.21	0.48
120.	Local and suburban transportation	3.41	1.04
121.	Other transportation services	3.18	0.95
122.	Telephone and telegraph	2.51	0.73
123.	Radio and TV	2.75	0.76
124.	Other communications	2.72	0.70
125.	Gas services	3.12	0.68

(Continued)

Table 31 Continued

Sector	Change in Output <u>a/</u>	Change in Income <u>b/</u>
126. Electric services	2.43	0.53
127. Water and sanitary services	3.04	0.81
128. Wholesale auto, parts and supplies	3.25	1.12
129. Wholesale groceries and related products	3.19	1.04
130. Wholesale farm products and farm product warehousing	2.76	0.77
131. Wholesale livestock	3.55	1.14
132. Wholesale machinery, equipment and supplies	2.99	0.97
133. Wholesale petroleum and petroleum products	2.57	0.71
134. General wholesale	3.19	1.06
135. Lumber yards	2.60	0.75
136. Farm equipment dealers	3.00	0.96
137. Hardware, heating, electrical, paint and wallpaper	3.52	1.19
138. Department and variety stores	2.78	0.84
139. Food stores	3.27	1.07
140. Automotive dealers and repair shops	3.09	0.98
141. Gasoline service stations	3.30	1.12
142. Apparel and accessory stores	3.24	1.05
143. Furniture, home furnishings and equipment stores	3.50	1.14
144. Eating and drinking places	3.22	0.87
145. Other retail	3.24	1.07
146. Banking and credit agencies	3.10	1.03
147. Insurance carriers	3.10	0.99
148. F.I.R.E. nec	3.37	0.97
149. Legal services	3.28	1.15
150. Lodging services	3.11	0.93
151. Personal services	3.32	1.09
152. Advertising	3.27	0.86
153. Duplicating and addressing	3.14	1.02
154. Employment agencies; private	3.87	1.40
155. Photographic services	3.04	0.88

(Continued)

Table 31 Continued

	Sector	Change in Output ^{a/}	Change in Income ^{b/}
156.	Research and development	3.21	1.06
157.	Other business services	2.96	0.92
158.	Motion picture, amusement and recreation services	3.24	1.04
159.	Automobile rental services	2.69	0.64
160.	Automobile parking	2.60	0.73
161.	Electrical repair	2.85	0.87
162.	Miscellaneous repair services	2.88	0.93
163.	Physicians and dentist services	3.64	1.30
164.	Hospital and laboratory services	3.43	1.18
165.	Other medical services	3.54	1.16
166.	Education (public and private)	3.88	1.40
167.	Colleges and universities	3.48	1.20
168.	Other educational services	3.23	1.16
169.	Engineering and architectural services	3.69	1.34
170.	Accounting, auditing and bookkeeping	3.30	1.16
171.	Other professional services	3.69	1.32
172.	Other services	3.36	1.04
173.	Ordnance and ordnance accessories	2.84	0.72
174.	Outdoor recreation	3.31	1.10
175.	Scrap	3.18	0.97
176.	Households	3.14	1.68

^{a/} Final demand multiplier of Appendix A, Table 4 (column total) times one million.

^{b/} Household row Appendix A, Table 4 times one million.

SUMMARY

The objectives of the project were to calculate an input-output model of the Texas economy, to estimate the interdependence among the sectors of the Texas economy, and to interpret and illustrate the use of the interdependence estimates for analytic and planning purposes within Texas state government. The need for current information about the state's economy was the major reason for conducting the study. The information provided includes an in-depth analysis of total production, sector-by-sector purchases of the outputs of each producing sector for use in further production, consumption, exports, costs of materials, services, labor expenses, taxes, capital and imports plus economy-wide effects of potential changes in markets, resource supplies, and supplies of other inputs for use in planning and evaluating alternative public programs and resource development projects.

A wide range of secondary and primary data were required for the completion of the models. Samples of Texas manufacturing, fisheries, construction, mining, transportation, communications, utilities, wholesale trade, retail trade, and services sectors were interviewed to obtain primary interindustry transactions data for 1967, the most recent census year. Secondary data from the 1967 censuses of manufacturing, trades, mineral industries, services, and other published reports and agency data files were combined and used in the calculation of a 183-sector, Leontief type, input-output model. In the model there are 175 producing or endogenous sectors and eight final demand or exogenous sectors. The model relates the consumption of the Texas population, exports and government purchases to the individual producing sectors.

In 1970, the population of Texas was 11.2 million, 79 percent of which resided in urban areas. Average annual growth rate of the population since 1960 has been 1.5 percent. The Texas population in 1970 was 5.51 percent of the national population, slightly higher than the 5.34 percent of 1960. In 1970 per capita income in Texas was \$3,531, or 90 percent of the national per capita income of \$3,910.

Between 1960 and 1968, employment in Texas increased from 3.2 to 4.1 million. During this eight-year period, employment increased in all major industry groups except agriculture and mining. Employment in these two groups decreased both in number employed and in proportion of total employment. Employment in the services sectors increased from 22 to 26 percent of total employment between 1960 and 1968, while employment in the manufacturing sectors increased from 15.5 to 17.8 percent of total employment during the same period. Although employment in public administration increased from 200 thousand to 221 thousand between 1960 and 1968, this represented a decrease from 6.1 to 5.4 percent of total employment.

The Texas Input-Output Model arrays the purchases and sales of the 183 sectors of the Texas economy in a transactions table. Intersector trading is shown along with total value of output of each sector, sales to other sectors for use as inputs, sales to households for final consumption, sales to local, state, and federal government, and exports out-of-state. In addition, the dollar value of input materials,

services purchased, payments for wages and salaries, taxes paid to local, state, and federal governments, and imports are tabulated in detail and arranged for use in calculating measures of interdependency among the various sectors of the Texas economy. The output, final demand, and income multipliers are tabulated for use in planning and evaluating alternative public spending programs and industrial development projects.

Petroleum refining had the largest dollar value of output or production during the study year. Total value of petroleum production was \$6.3 billion. The sector with the second highest value of output was crude petroleum mining with \$4.4 billion in outputs. The twelve sectors of agriculture produced \$3.2 billion of crop and livestock products, and total value of construction was \$6.0 billion, of which facility construction was \$2.2 billion and residential construction was \$1.3 billion. Manufacturing sectors output was \$26.7 billion; transportation sectors were recorded as \$2.5 billion in transportation services; communications sectors' outputs were \$0.9 billion; utilities sectors outputs were \$2.8 billion; wholesale trade margins were estimated at \$4.2 billion; retail trade margins were estimated at \$6.4 billion; finance, insurance, and real estate outputs were estimated at \$4.4 billion; education expenditures were \$1.9 billion, services outputs were \$5.6 billion; and personal income was \$30.7 billion.

Of the 175 producing sectors, three had gross outputs that exceeded \$2.0 billion, 14 had gross outputs that ranged from \$1.0 to \$2.0 billion, 24 had outputs between \$0.5 and \$1.0 billion, 85 ranged between \$100 thousand and \$0.5 billion and 49 sectors had outputs less than \$100 thousand. Even though the outputs of some sectors are low in relation to outputs of other sectors, it should be recognized that each sector is important to the entire economy due to both the direct as well as the indirect contributions to production.

Both the producing and the consuming sectors of the Texas economy import a significant quantity of materials and goods. Total imports were estimated at approximately \$18.7 billion, of which \$1.36 billion were imports of finished goods for household consumption. Construction sectors imported approximately 25 percent of inputs and manufacturing sectors such as apparel, furniture, primary and fabricated metals, machinery and equipment manufacturers imported from 40 to 70 percent of the value of inputs used.

The Texas economy is a major exporter of unfinished agricultural products, such as cotton, and of mining and manufactured goods. Total exports were estimated at approximately \$18.5 billion -- just slightly less than total imports. Meat, grain milling, and canning sectors of the food processing group exported more than 30 percent of total value of production. Apparel, furniture, chemicals, petroleum refining, rubber and plastics, primary metals, machinery, instruments, and transportation equipment manufacturers exported more than 50 percent of total value of production. Transportation, communications, utilities, and wholesale trade had exports of 50 to 60 percent of total outputs.

The transactions data of the Texas economy were used to estimate the parameters of a system of equations which expresses the intersectoral trading within the Texas economy and at the same time takes into account the exports and imports of the Texas economy. The interindustry transactions are necessary for production by specialized sectors of an economy. An in-depth analysis of the transactions data is required if planners are to understand the pervasive effects of changes within individual sectors of the economy. These analyses have been done and they show estimates of the direct, indirect, and induced requirements of each producing sector from every other individual producing sector of the Texas economy per dollar of output as well as per dollar of sales of finished goods for final demand or final consumption. From these interindustry dependency calculations, income and output multipliers were calculated for each of the 175 producing sectors of the economy. The output multiplier for a sector shows the total requirements of the Texas economy to produce one dollar of product or service by that sector; i.e., the output multiplier for the meat products sector is 3.97 which means that each dollar of meat products, f.o.b. the shipper, requires a total output of all sectors of the Texas economy of \$3.97.

The numeric value of the multipliers depends upon the amount of leakage from the economy for each sector. For example, if a sector imports a high proportion of inputs, then payment is made to business establishments located outside Texas. Such payments are leakages from the Texas economy and fail to contribute to the Texas income and output multiplier effects within Texas. Of the 175 producing sectors of the Texas economy, 77 had output multipliers between 3.0 and 5.0, 63 had output multipliers between 2.5 and 3.0, 33 had output multipliers between 2.0 and 2.5 and two had output multipliers between 1.5 and 2.0. The poultry products processing sector had the highest output multiplier -- 4.67. This sector purchased its inputs from within Texas and thus had a low leakage factor. On the other hand, automobile assembly imports a major proportion of the materials used in its activities. The output multiplier for the automobile assembly sector was one of the lowest found in the study -- 1.54.

Income multipliers show the relationship between salaries and wages paid by a sector and total salaries and wages paid within the economy as a result of production which generated the initial payment of salaries and wages. Income multipliers ranged from a high of 21.32 for feedlot livestock to 1.86 for both electrical communications equipment manufacture and accounting, auditing and bookkeeping sectors.

Within the report, several economic impact analyses were presented to illustrate the uses of the input-output model in planning and evaluating various public spending and potential private sector market changes upon personal income, taxes, and output within Texas. Such analyses are essential if public and private sector planners, administrators, and managers are to adjust to changes in defense spending by the federal government, changes in welfare payments to the people, and declining supplies of essential natural resources such as crude oil and water. Input-output

analyses, such as those presented in this study, can show the total effects as well as identify the sectors to which such effects are distributed both directly and indirectly as a result of the interindustry relationships within the economy. When these analyses are used in conjunction with projections of future consumption of each sector's products or services, both public and private sector analysts can gain information about future resource and production requirements to satisfy expected future consumption. The input-output models include the direct, indirect, and induced effects, and thus planners gain a good deal more information than that provided through many traditional analytic tools that yield only direct industry analyses or partial indirect analyses of each industry or sector considered. But those who use input-output analyses should be aware of the weaknesses and limitations of these techniques.

A major limitation of the input-output model is the assumption that inputs are combined in fixed proportions in each production process regardless of level of output. The assumption may not hold for wide deviations in output or when resource input prices change, thus analyses and projections should be made with caution. In addition to weaknesses in the assumptions, there are also some weaknesses in the available data. Although the Texas model was estimated from the best available data, the estimates are subject to sampling error and are expected to change with time. Outputs of the various sectors are changing with each passing year and no doubt the interindustry relationships and individual sector multipliers are also changing along with output changes. These latter changes are thought to be slower than output changes and thus the multipliers should be usable for several years for the purpose of making projections of incremental economic changes resulting from output changes due either to market demand or changing resource supply effects. The input-output model must be updated from time to time if it is to be an effective tool for continuous planning in the future.

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Agricultural Sector Data Sources -- Texas Input-Output Model

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