A SENSITIVITY ANALYSIS OF AN INPUT-OUTPUT MODEL

A THESIS

Presented to

The Faculty of the Division of Graduate

Studies and Research

By

William MacArthur Arrants

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

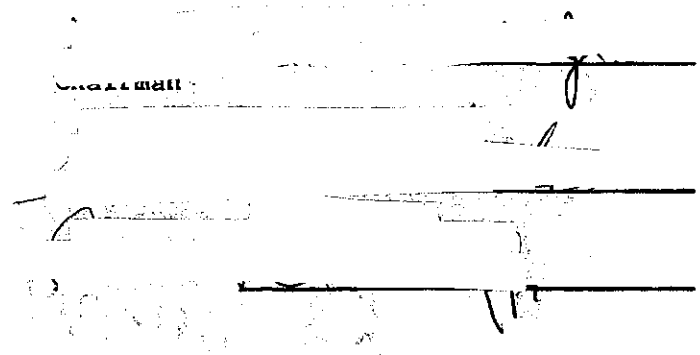
in the School of Industrial and Systems Engineering

Georgia Institute of Technology

August, 1972

A SENSITIVITY ANALYSIS OF AN INPUT-OUTPUT MODEL

Approved:



Date approved by Chairman: _____

ACKNOWLEDGMENTS

I would like to thank the members of my reading committee, Dr. William A. Schaffer and Dr. Russell G. Heikes, for their most helpful advice.

I am especially grateful to my thesis advisor, Dr. Leslie G. Callahan, for the many hours he devoted to giving me technical assistance, encouragement, and suggestions, and most of all I am grateful for his endless patience.

Special acknowledgment is given to Dr. Schaffer, Dr. Eugene A. Laurent and Mr. Ernest M. Sutter, Jr. for allowing me access to the Georgia Input-Output Model.

I would also like to express my deepest appreciation to my wife, Veronica, for her encouragement and assistance in the typing of my many preliminary drafts. Finally a special recognition to Mrs. Betty Sims for her assistance in the preparation of the final draft.

TABLE OF CONTENTS

APPENDIX (Continued) Page

LIST OF TABLES

LIST OF ILLUSTRATIONS

LIST OF SYMBOLS

Δ	Incremental Amount.
$\underline{X}$	The Vector X.
$\underline{X}^T$	The vector X in the year T.
X_i	The *ith* element of the vector X.
X_{ij}	The element in the *ith* row, *jth* column of the transaction table.
a_{ij}	The element in the *ith* row, *jth* column of the table of production coefficients.
$\|\|a_{ij}\|\|$	A matrix consisting of elements a_{ij}. $i = 1,2,\ldots,n \quad j = 1,2,\ldots,m.$
$S^o_{k;j}$	The output sensitivity coefficient of sector k to an incremental change in total output of sector j.
$S^T_{k;(i,j)}$	The transaction sensitivity coefficient of sector k to an incremental change in transaction X_{ij}.
Σ	Summation.
$\|\ \ \|$	Denotes a matrix.

SUMMARY

Although input-output analysis is a useful method of linear economics that shows the interdependence of producing and consuming units of an economy, its projections are dependent upon the accuracy of the parameters of the model. It is advisable to perform sensitivity analysis to determine the effect of changes because the model's parameters are rarely known with complete certainty.

The analysis was based on the theory of the general input-output model and specific values of the Georgia Projection Model developed by Dr. William A. Schaffer, Dr. Eugene A. Laurent and Mr. Ernest M. Sutter, Jr. A sensitivity analysis was performed on the Georgia Projection Model to investigate the effects of changes in parameters on the model's projections.

For an input-output model, the economist is not only interested in the projections made by the model, but he is also concerned with the sensitivity structure of the model. Two types of sensitivity were investigated: (1) transaction sensitivity--the sensitivity of the model to a small incremental change in one of the transactions between the producing sectors--and (2) output sensitivity--the sensitivity of the model to a small incremental change in the total output of a sector in the transaction table.

Both models of analysis allowed the ranking of sensitivity of the 33 producing sectors with respect to the incremental change. During the

output sensitivity analysis it was determined that the transportation sector (which includes Lockheed Corporation) and the textile mill products sector differed significantly from all other sectors of the economy. The transaction sensitivity analysis could not identify any significant differences between the mean sensitivities of the producing sectors of the Georgia economy. This seemed to be due to the large amount of interaction among the sectors that makes the Georgia Projection Model less sensitive to a change in one of its transactions.

An area for future application of sensitivity analysis of input-output models is the investigation of using sensitivity coefficients to aggregate the industries into the producing sectors of the economy.

CHAPTER I

INTRODUCTION

Input-output analysis is a useful method of linear economics that shows the interdependence of producing and consuming units of an economy. The objective of this thesis will be to use sensitivity analysis to determine the sensitivity of the projections of an input-output model to changes in model parameters, and to changes in the original assumptions.

Although an input-output model can give projections of sector inputs, these projections are dependent on the accuracy of the parameters of the model. However, the accuracy of the parameters is dependent upon the accuracy of the data collected. Both Walter Isard[1] and William H. Miernyk[2] stress the importance of obtaining correct data. Therefore, as these parameters are rarely known with complete certainty, it is advisable to perform sensitivity analysis to determine the effect of the projections if the parameters take on other possible values.

The transcendental contribution of input-output analysis to theoretical and empirical economics is one of the features that has made it one of the most productive methods of linear economics. The resulting influence on economists and statisticians from many countries has been astounding.

Input-output analysis was developed by Professor Wassily Leontief. Leontief looks at the economy as a group of interacting industries. In

his model, each industry produces only one good, and uses only one production process to produce this good. Goods made by other industries, labor, and even other inputs from outside the system are needed as inputs by a given industry to produce its product. The output of each industry must be sufficient to satisfy the demands of other industries as well as external demand. External demand is that demand from consumers, government, and foreign trade, all of which are outside the industrial structure in a typical model.[3] Input-output analysis considers the interrelations among industries as purchasers of each output, as users of scarce resources, and as sellers to final consumers.

As Charles M. Tiebout pointed out in "Regional and Interregional Input-Output Models: an Appraisal" in 1957, input-output models have almost completely dominated post-World War II regional research.[4] The most frequent use has been for forecasting the outputs and employees of industries.[5] A recent application has been in Georgia, where initial projections to 1980 have been made based on the 1970 Georgia Economic Model.

Sensitivity analysis is an important technique for determining the parameters of a system that are most critical to the operation of the system and, therefore, require the most careful determination. Often it is fruitful to establish systematic procedures that allow the solution to be controlled. For this to be possible, it is necessary that the critical parameters of any system model be identified. These critical parameters, if changed, would have a significant effect on the outcome of the model. The parameters are varied over their possible

range of values to determine the amount of variation in the model's solution.

The concept of sensitivity analysis is important in an input-output analysis because the model is based on a vector of projections of future final demand multiplied by a matrix representation of the levels of interaction between the sectors of the economy. This multiplication gives a prediction of the future output of the economy. It is important to be able to investigate the sensitivity of the predictions to changes in elements of the vector of future final demand and in the coefficients of the activity matrix.

The objective of this research is to perform a sensitivity analysis on input-output models, specifically, through a discussion of the Georgia Input-Output Model 1970 by William A. Schaffer, Eugene A. Laurent, and Ernest M. Sutter, Jr. This research would be helpful in two ways: (1) a range of output levels within which decision makers can expect the future output levels to lie can be established, and (2) the sensitivity of the projections to changes of errors in the parameters can be determined.

FOOTNOTES FOR CHAPTER I

[1]Walter Isard, *Methods of Regional Analysis: an Introduction to Regional Science,* The M.I.T. Press, 1960, pp. 324, 325 and 326.

[2]William H. Miernyk, *Western Economic Journal,* Vol. VI, No. 3, June, 1968, pp. 165, 166, 167 and 169.

[3]George Hadley, *Linear Programming,* Addison-Wesley Publishing Co., Inc., 1963, p. 487.

[4]Charles M. Tiebout, "Regional and Interregional Input-Output Models: an Appraisal," *Southern Economic Journal* (Oct. 1957), Vol. 24, pp. 140-147.

[5]C. R. Draper, "Input-Output Studies and Industrial Development," *AIDC Journal,* Vol. III, No. 2, 1969, pp. 47-53.

[6]Hollis B. Chenery, and Paul G. Clark, *Interindustry Economics,* John Wiley & Sons, Inc., 1959, p. 15.

CHAPTER II

THE GENERAL INPUT-OUTPUT MODEL

This research is based on an open, static input-output model of traditional form and design. The model emphasizes the structural relationships between the producing and consuming units of an economy. The model is based on the reasoning that the production units of an economy can be divided into sectors; these sectors are related to each other according to the transactions between each sector and the remaining sectors. All sales within the economy are shown, those to sectors within the economy are shown as well as those to consumers outside of the economy. If there are no consumers outside the economy, the system is called a closed model.

Accounting is generally considered to be the keeping, analyzing, and explaining of commercial transactions. In order to form an industry account, the accounts of similar businesses are summed. These results are obtained by addition of asset, liability, and net worth items. Also, similar debt and credit items are included. The input-output table is a tabulation of the source and use accounts of several industries.

The following accounting procedures are usually observed when constructing an input-output model:

1. Transactions are usually recorded at the producer's prices rather than at the purchaser's cost, which means that trade and

transport margins are not ascribed to the using sectors.

Thus, convention one allows sales to be traced back to the industries that produce goods rather than to the trade sectors that simply handle them.

2. In principle, the flows should correspond to the use of inputs for current production rather than to the time when they are purchased. The differences between purchase and use are reflected in stock changes, which are part of final use.

3. Purchases on capital account are normally charged entirely to final use, and depreciation allowances are therefore included with primary inputs.[6]

The input-output model consists of a matrix which represents the transactions among the producing industries, a vector of final demands which are imposed upon the producing industries, and a vector of responses which are dependent upon final demand and the transaction matrix.

Basic Assumptions of Input-Output Analysis

The basic function of the input-output system is to depict the magnitudes of the interindustry flows in terms of the levels of production in each sector. In order for such conventions to be theoretically meaningful, it is necessary to make several assumptions. To begin with, productive sectors are constructed in such a way that only one production function exists for each sector. This is a common assumption made in all general equilibrium models and in Marshallian partial-equilibrium analysis.

However, several assumptions made by the Leontief input-output model that are not necessarily stated in other economic models are:

1. Each commodity is supplied by a single industry or sector of production.
2. The inputs purchased by each sector are a function only of the level of output of that sector.
3. The total effect of carrying on several types of production is the sum of the separate effects.[7]

It is therefore logical to assume that not all problems will be solved by such a simple system. A given aggregation into sectors may be valid for one purpose, but not for another. Under certain circumstances, substitution may be negligible. At other times, it may be a dominating factor. In order to establish a criterion for aggregation, it is necessary to formulate a theoretical analysis of these assumptions. It is also necessary to discern the type of problem for which the model is likely to be useful.[8]

The Theory of Input-Output Tables

The assumptions about economic behavior and definitions of the variables in the model are important when analyzing the basic input-output table. Data availability is the factor that most often determines levels of aggregation. The structure of the input-output model is established by an algebraic formulation of the assumptions and by accounting conventions.

In performing interindustry analysis, the accounting portion is the input-output table. The table statistically describes the inputs and outputs of the different sectors of a given economy. The

input-output system is a set of simultaneous linear equations that forms a model when solved under the assumptions. The solution to the equations are the outputs of the different sectors. The parameters of the equations are estimated from data in the input-output table.

The following schematic chart, Figure 1, is intended to aid the reader in understanding the mechanics of the input-output model. Goods and services are depicted as flows passing from one sector to another. Money payments for those goods and services are flows in the opposite direction. The regional boundary is represented by a solid line. It should be noted that the government and the capital sectors lie only partially within the region. Activities within the intermediate sector engage in interindustry transactions with one another.

The basis of all input-output analysis is the transactions table. It is sometimes referred to as the transactions matrix because it consists of all of the goods and services produced in an economy. The formal properties of the accounting system are shown in Table 1.[10] Each sector of the economic system is represented by one row and one column in the table. Each row in the table accounts for the distribution of output by the sector at the left of the table to the sectors labeled across the top of the table. Each column in the table records inputs to the sector labeled at the top of the column from the sectors named at the left. The intersection of the *ith* row and *jth* column contains the entry denoted x_{ij}. x_{ij} represents the sales of industry i to industry j. The total output of a sector i is denoted as X_i. Table 1 also shows the input-output table divided into four quadrants.

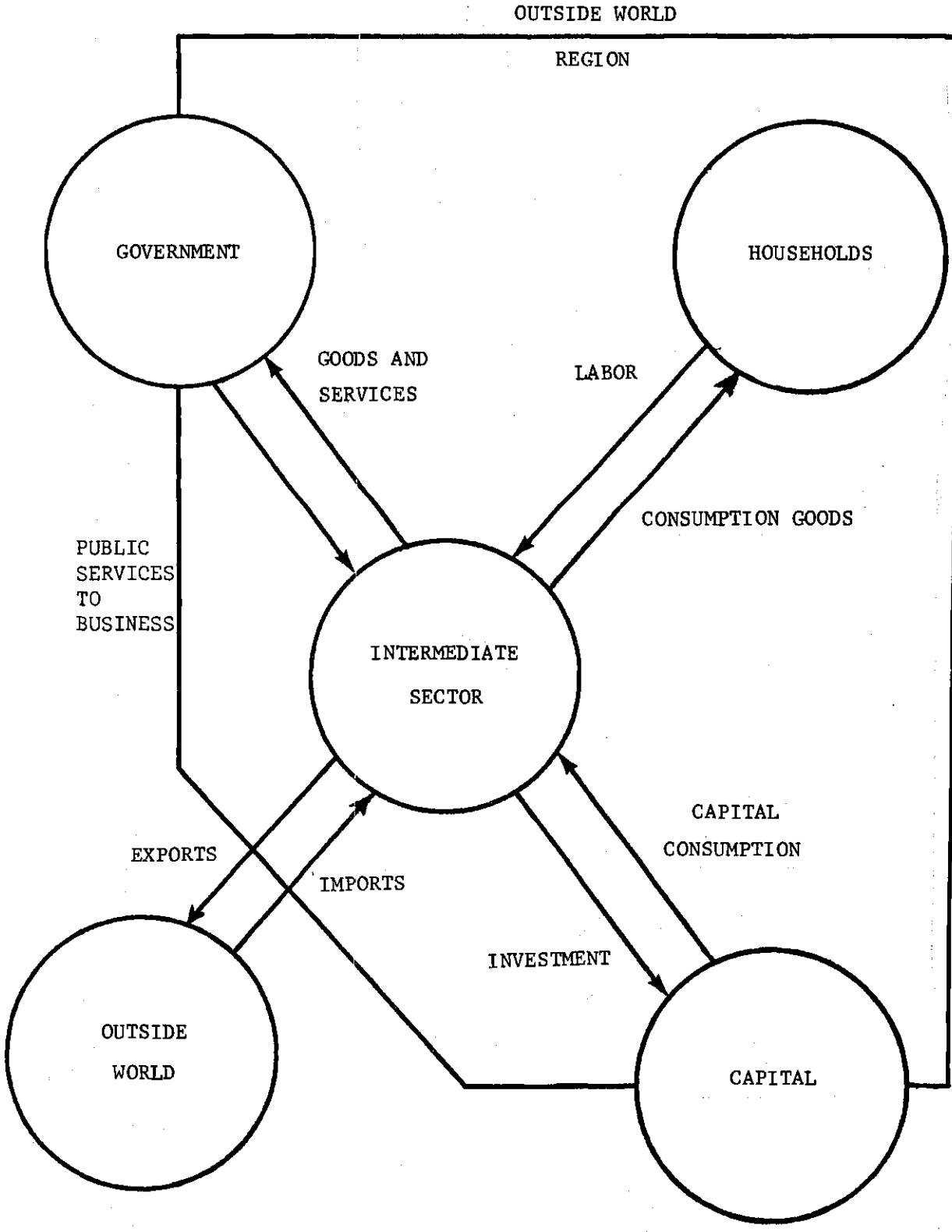


Figure 1. Intersector Flows of Goods and Services in an Input-Output Model

Table 1. Input-Output Transactions Table

		Purchasing Sectors														
		Intermediate Use				Final Use						Supply	
		Sector			Total Intermediate Use	Investment	Consumption	Government	Exports	Total Final Use	Total Use = Total Supply	Imports	Production
Producing Sector	1	X_{11}	...	X_{1j} ... X_{1n}	W_1	I_1	C_1	G_1	E_1	Y_1	Z_1	M_1	X_1
	2	.		.									
	.	.		.									
	.	.	(Quadrant II)			(Quadrant I)							
	.	.		.									
	i	X_{i1}	X_{ij}	X_{in}	W_i	I_i	C_i	G_i	E_i	Y_i	Z_i	M_i	X_i
	.	.		.									
	.	.		.									
	.	.		.									
	n	X_{n1}	...	X_{nj} ... X_{nn}	W_n	I_n	C_n	G_n	E_n	Y_n	Z_n	M_n	X_n
Total Produced Inputs		U_1	U_j	U_n									
Primary Inputs (Value Added)		V_1	V_j	V_n		V_I	V_C	V_G	V_E		V		V
		(Quadrant III)				(Quadrant IV)							
Total Production		X_1	X_j	X_n		I	C	G	E	Y	Z	M	X

Quadrant I describes consumer behavior, identifying consumption patterns of local final users of goods, such as households, private investors, and governments.

Quadrant II represents production relationships in the economy. It presents the methods by which raw materials and intermediate goods are mixed to produce goods for sale to other industries and to final consumers. In an input-output table, Quadrant II is the most important quadrant.

Quadrant III depicts incomes of primary units of the economy. Among these are the incomes of households, the depreciation and retained earnings of industry, and taxes paid to local, state, and federal governments.

Quadrant IV is often referred to as the social transfers quadrant. It identifies primarily nonmarket transfers between primary units of the economy. This quadrant is often omitted from the tables because it is not needed for balance.

Symbolic Structure

The basic elements of the transactions table are defined as follows:

Z_i = total supply of commodity i.

X_i = total production of commodity i.

M_i = import of commodity i.

X_{ij} = amounts of commodity i used in sector j.

Y_i = final demand for commodity i.

W_i = total intermediate use of commodity i $\left(\sum_j X_{ij}\right)$.

U_j = total use by sector j of inputs purchased from other industries $\left(\sum_i X_{ij}\right)$.

V_j = total use of primary inputs (value added in sector j).

The table represents two balance equations. The first equation is concerned with the rows of Table 1. This equation is an identity condition where, for each commodity, supply is equal to demand.

$$Z_i = M_i + X_i = \sum_j X_{ij} + Y_i = W_i + Y_i \quad (i=1...n) \qquad (2\text{-}1)$$

The second balance equation is concerned with the columns of Table 1. This equation states that the total production of each sector is equal to the sum of the values of purchases from other sectors and the value added in that sector.[12]

$$X_j = \sum_i X_{ij} + V_j = U_j + V_j \quad (j=1...n) \qquad (2\text{-}2)$$

By rewriting Equation (2-1), Y_i, the final demand for the *ith* sector's i commodity can be defined as the total supply of the commodity i minus the intermediate use of commodity i by other sectors. From Equation (2-2), V_j, the value of primary input to sector j, is defined as the value of total production in sector j minus payments for commodities purchased from other sectors.

These two definitions make it possible to present the relationship between national income aggregates and input-output accounts.[13]

The addition of Equation (2-1) over all rows of the table produces the following:

$$\sum_i X_i = \sum_i \sum_j X_{ij} + \sum_i Y_i - \sum_i M_i \qquad (2\text{-}3)$$

Likewise, the addition of Equation (2-2) for each column leads to the equation

$$\sum_j X_j = \sum_i \sum_j X_{ij} + \sum_j V_j \qquad (2\text{-}4)$$

Therefore,

$$\sum_i X_i = \sum_j X_j \qquad (2\text{-}5)$$

By using Equation (2-5), and substituting Equations (2-3) and (2-4), the basic national accounts identity is

$$\sum_i Y_i - \sum_i M_i = \sum_j V_j \qquad (2\text{-}6)$$

The input-output model developed above provides a set of identities. Assume the economy is composed of n sectors, and one final demand sector. Then, the output distribution for each sector can be defined in terms of the set of n simultaneous equations.

$$
\begin{aligned}
X_{11} + X_{12} + \ldots + X_{1n} + Y_1 &= X_1 \\
X_{21} + X_{22} + \ldots + X_{2n} + Y_2 &= X_2 \\
\vdots \quad\; \vdots \qquad\quad \vdots \quad\; \vdots \quad\; \vdots & \\
X_{i1} + X_{i2} + \ldots + X_{in} + Y_i &= X_i \\
\vdots \quad\; \vdots \qquad\quad \vdots \quad\; \vdots \quad\; \vdots & \\
X_{n1} + X_{n2} + \ldots + X_{nn} + Y_n &= X_n
\end{aligned}
\tag{2-7}
$$

The *ith* equation states that the total output of sector i is equal to the sum of the X_{ij}'s, where X_{ij} is the sales of industry i to industry j, and Y_i equals the sales of industry i to final demand.

It is assumed that the input from production sector i to production sector j is directly proportional to the output of sector j. Knowing this, a set of values called production coefficients can be defined:

$$X_{ij} = a_{ij}X_j \tag{2-8a}$$

or

$$a_{ij} = \frac{X_{ij}}{X_j} \tag{2-8b}$$

Because the values for X_{ij} are positive, the production coefficient a_{ij} is always positive. The resulting set of n^2 equations are defined as the structural equations, and the n equations of (2-7) are defined as balance equations.

Substituting Equation (2-8a) into (2-1) results in Leontief's original model. Each sector's balance equation becomes

$$X_i - \sum_j a_{ij}X_j = Y_i - M_i \quad (i=1...n) \tag{2-9}$$

In this system of n equations, there are n unknown production levels (X_j), n^2 parameters (a_{ij}) describing the input functions, and two sets of n autonomous variables (Y_i and M_i) whose values are specified for a given problem.[14] If M_i is assumed to be zero, then from Equation (2-9)

$$X_i - \sum_j a_{ij}X_j = Y_i \tag{2-10}$$

Solving Equations (2-7) and (2-8) for Y_i results in n equations in terms of X_i, $a_{ij}X_{ij}$, and Y_i.

$$\begin{aligned}
X_1 - (a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n) &= Y_1 \\
X_2 - (a_{21}X_1 + a_{22}X_2 + \ldots + a_{2n}X_n) &= Y_2 \\
\vdots \quad\quad \vdots \quad\quad \vdots \quad\quad\quad\quad \vdots \quad\quad \vdots & \\
X_i - (a_{i1}X_1 + a_{i2}X_2 + \ldots + a_{in}X_n) &= Y_i \\
\vdots \quad\quad \vdots \quad\quad \vdots \quad\quad\quad\quad \vdots \quad\quad \vdots & \\
X_n - (a_{n1}X_1 + a_{n2}X_2 + \ldots + a_{nn}X_n) &= Y_n
\end{aligned} \tag{2-11}$$

In matrix notation, Equation (2-11) is written as

$$\underline{X} - A\underline{X} = \underline{Y} \tag{2-12}$$

Using matrix notation, X - AX = IX - AX. Therefore, (2-12) may be written as

$$(I-A)\underline{X} - \underline{Y} \tag{2-13}$$

which equals

$$\begin{vmatrix} (1-a_{11}) & -a_{12} & \cdots & -a_{1i} & \cdots & -a_{1n} \\ -a_{21} & (1-a_{22}) & \cdots & -a_{2i} & \cdots & -a_{2n} \\ \vdots & \vdots & & \vdots & & \vdots \\ a_{i1} & -a_{i2} & \cdots & (1-a_{ii}) & \cdots & -a_{in} \\ \vdots & \vdots & & \vdots & & \vdots \\ -a_{n1} & -a_{n2} & \cdots & -a_{ni} & \cdots & (1-a_{nn}) \end{vmatrix} \begin{vmatrix} X_1 \\ X_2 \\ \vdots \\ X_i \\ \vdots \\ X_n \end{vmatrix} = \begin{vmatrix} Y_1 \\ Y_2 \\ \\ Y_i \\ \\ Y_n \end{vmatrix} \tag{2-14}$$

The matrix in Equation (2-14) is called the Leontief matrix.

Solving Equation (2-13) for $\underline{X}$ gives

$$\underline{X} = (I-A)^{-1}\underline{Y} \tag{2-15}$$

which may be written

$$\begin{vmatrix} X_1 \\ X_2 \\ \vdots \\ X_i \\ \vdots \\ X_n \end{vmatrix} = \begin{vmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{i1} & R_{i2} & & r_{in} \\ \vdots & \vdots & & \vdots \\ r_{n1} & r_{n2} & & r_{nn} \end{vmatrix} \begin{vmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_i \\ \vdots \\ Y_n \end{vmatrix} \qquad (2\text{-}16)$$

The r_{ij}'s are the elements of the inverse matrix, R, which is defined below:

$$R = (I-A)^{-1}$$

This inverse matrix is the key to analysis of an input-output model. The inverse is called a Leontief inverse or Leontief's matrix multiplier. The restriction that (I-A) be nonsingular and thus have an inverse can be met in all practical situations if the final demand vector is not the null vector for the year used in constructing the (I-A) matrix.

The matrix $(I-A)^{-1}$ may be written as $I + A + A^2 + A^3 + \ldots$ which in turn allows Equation (2-15) to be written as $X = (I-A)^{-1}Y = (I+A+A^2+A^3+\ldots)Y$.

This allows the total effect of a final demand Y to be written as a direct effect (I+A)Y and a series of indirect effects $(A^2 + A^3 + \ldots)Y$.

Therefore, the sector outputs for a given final demand may be found by inverting the Leontief matrix, (I-A), or by taking terms from the sum $\sum_{n} A^{n}$ (n=0...∞), and multiplying by final demand.

FOOTNOTES FOR CHAPTER II

[6]Hollis B. Chenery, and Paul G. Clark, *Interindustry Economics*, John Wiley & Sons, Inc., 1959, p. 15.

[7]*Ibid.*, pp. 33-34, and p. 16.

[8]G. Hadley, *Linear Programming*, p. 493-494.

[9]Edgar M. Hoover, *An Introduction to Regional Economics*, Alfred A. Knoff, New York, 1971, p. 227.

[10]Hollis B. Chenery, and Paul G. Clark, *Op. cit.*, p. 16.

[11]*Ibid.*, p. 20.

[12]G. Hadley, *Op. cit.*, pp. 493-494.

[13]Hollis B. Chenery, and Paul G. Clark, *Op. cit.*, p. 19.

[14]*Ibid.*, p. 23.

CHAPTER III

THE GEORGIA PROJECTION MODEL

The Georgia Projection Model is an open, static, input-output model consisting of 29 industries, five final payments on value added sectors, and five final demand sectors. This model is constructed for 1970. The model is the basis for making projections of the state's economic condition in 1980 under a series of assumptions concerning changes in final demand. The Georgia Office of Planning and Budget and the Department of Industry and Trade were the joint sponsors of the study begun in 1971 by Dr. William A. Schaffer, Dr. Eugene A. Laurent, and Mr. Ernest M. Sutter, Jr.[15]

The model is based on the theory presented in Chapter II. This thesis will discuss the model without repeating the theory behind the model again. Theory will be discussed only if there is a need to clarify a calculation.

The main discussion of this chapter will be the assumptions of the model, the sources of data for the model, and the projections of the 1980 Georgia Economy made by the model.

In Chapter V, an application of sensitivity analysis will be made on the Georgia Projection Model in order to: (1) investigate the sensitivity of input-output matrices to changes in the direct coefficients, and (2) investigate the impact of changes in the final demand vector upon the output of the sectors. The final demand vector is computed

from projected growth rates.

The Georgia Projection Model systematically identifies the sales and purchase patterns of industries in Georgia in 1970. The data that the authors used to assemble the model was gathered over a 12-month period. The data sources were varied; for example, interviews with Georgia manufacturers and other experts on industry, data taken from a national input-output study, census publications, statistics from the Departments of Agriculture and Commerce, and unpublished data provided by the Georgia Department of Labor and the Georgia Department of Revenue.

Because the Georgia Projection Model is a regional model, it is an open model instead of the general closed model discussed in Chapter II.

Table 13 in Appendix A shows the interindustry transactions, Georgia, 1970. Table 13 is the equivalent to Table 1 in Chapter II. Each row in the table accounts for the sales by the industry named at the left to the industries identified across the top of the table, and to the final consumers listed in the right-hand section of the table under Final Demand. Intermediate goods are sold to local industries for use in producing other products while finished goods are sold to final consumers. Goods exported from the state to other parts of the nation and the world are listed under Exports in the Final Demand Section. The sum of a row is the total sales of an industry.

An example of this is the sales by the Agriculture Industry (row 1); of the Total Output worth $1477.6 million, $178.7 million was sold

to the Agriculture Industry (Col. 1), $5.5 million to the Contract Construction Industry (Col. 2), and $498.2 million to the Food and Kindred Products Industry (Col. 3), etc.

Each column in Table 13 accounts for the inputs purchased by the industry named at the column head. Rows 1 through 29 represent intermediate purchases from industries within the state of Georgia. Rows 31 through 36 represent final purchases from resource owners. These final purchases are payments. An example is the wages and salaries paid to the Households Sector. Because profits are included in the final-payments portion of the table, the sum of each column is equal to the sum of the corresponding row.

Again, as an example, the column for the Agriculture Industry is used. The Total Purchases of the industry are $1477.6 million, which equals the value listed in the Total Sales Column (Col. 39) for Agriculture (Row 1). The purchases were broken down as follows: $178.7 million from Agriculture, $1.6 million from Mining, $12.3 million from Contract Construction, etc. The Total Local Purchases were $448.3 million. The Final Purchases (or Final Payments) were $539.0 million to Households, $168.5 million to Capital Residual, $45.5 million to City and County Government, and $276.3 million to Imports. The Imports Sector represents purchases from industries located outside Georgia.

Mathematically these transactions can be represented by the equations in Chapter II. The authors of the Georgia Projection Model used the same mathematical model to obtain coefficients for a projection. The first step in obtaining the coefficients is the constructing of a

direct-requirements table. This table is the conversion of the transactions table (Table 13) to a table that shows the percentage of purchases by the industry at the head of each column from each row. Therefore, it follows that each column must sum to 100 per cent of the purchases. The formula used to compute the percentage is Equation (2-8), Chapter II. The data obtained for 1970 is denoted X_{ij}^{70}, sales by industry j in 1970, and X_{j}^{70}, total purchases by industry j in 1970. Substituting these values into Equation (2-8) and assuming that the patterns of purchases of 1970 are stable, a projection of sales by industry i to industry j can be written as $X_{ij}^{T} = a_{ij}X_{j}^{T}$. The T superscript denotes a year, T, in the future.

Table 14 shows the direct requirements table of the Georgia Projection Model. As an example of the entries in Table 14, Column 4, the column for the Food and Kindred Products Industry, is investigated. The entry in Row 1 is 21.84, which means that 21.84 per cent of the inputs to the Food and Kindred Product Industry came from the Agriculture Industry. In Row 4, the 7.46 per cent of the total purchases that are from the Food and Kindred Product Industry itself is notated. A star in a column entry means that the percentage was less than .5 per cent of the total purchases. Row 30 lists the total purchases from local industries as being 44.01 per cent of the total purchases. From the Final Payments Sector, the majority of the purchases are from households, 17.88 per cent, and imports, 29.78 per cent.

This table gives an important picture of the Georgia economic structure. The percentages allow each cent of a sales dollar to be

traced. Row 30 shows that Food and Kindred Products spend the largest percentage of its sales dollar with other industries in Georgia (44.01 cents), and the Federal Government the least percentage (12.78). However, the value of Federal Government enterprises to the Georgia economy cannot be discounted. The Federal Government spends 73.26 per cent of its sales dollar in the Households Sector (payrolls, etc.).

Row 36, the Imports row, depicts the leakage out of the state of expenditures on nonlocal goods and services. The importance of leakage will be discussed later in determining the importance of an industry to the state.

The third step in the construction of the Model is based on the assumption that the trade patterns of Table 14 are reasonably stable. The interviews with the authors of the Georgia Projection Model support this assumption. They found that Georgia businessmen are hesitant to change from a good source of supplies until they become convinced that there is a significant advantage in doing so. Technology changes may occur, but the authors felt that this change was not as important as a change in the trade patterns.

Table 14 shows the direct effect of changes in output upon Georgia industries. However, because of the interdependence of the industries upon each other, there is also an indirect effect. If one industry, A, increases its output, each of the industries from which it buys must increase their output to provide the increased inputs to A.

Table 15 is the total-requirements table. This table shows both the direct and indirect effects of changes in final demand for the

industries in Georgia. This table is found to be the method of finding the Leontief inverse discussed on pages 14, 15, and 16 of Chapter II.

The elements of the first 29 rows and 29 columns are the elements r_{ij} of the inverse matrix R. An illustration of the economic interpretation of the table can be given by an increase of $1.00 of sales outside Georgia by the Food and Kindred Products Industry (Col. 4). Row 30 shows the total increase in activity within the state to be $1.64. The increase is broken down within the table as follows: 27 cents to Agriculture, and $1.10 to Food and Kindred Products, etc.

Since the Household Sector is a producer of an important product, labor, it can be considered as another industry and included within the structure of the direct requirements table and the total requirements table. Table 16 is the Total Requirements Table with Households included. The effect of doing this can be determined by examining Column 4. An increase of $1.00 of sales outside Georgia now produces a $2.57 increase in total activity within the state. The increases are: Agriculture 29 cents, Food and Kindred Product $1.13, Households 54 cents, etc. Notice that the direct requirements Table 14 showed only 18 cents going to Households. The indirect effect on Households is thus the difference between 54 cents and 18 cents, or 36 cents. The total increase on inter-industry expenditure is the difference between $2.5688 in Table 16 and $1.6388 in Table 15, or 93 cents.

To get the final Total Requirements Tables used in the computer program, the authors included all sectors in the Georgia Economy except the Federal Government and Imports. The resulting $R = (I-A)^{-1}$ matrix

includes the original 29 industries plus Households, Capital Residual, City and County Government, and State Government.

The model is computerized and yields the projections in tabular form, which not only allows the projections for 1980 to be compared with the base year of 1970 but also allows a comparison with another projection made by Dr. Charles Floyd of Georgia State University using the shift-share method of projecting industry employment.

Appendix B contains the computer printout of the Georgia Projection Model, 1970. Table 4, which is the Total Requirements Matrix $(R=(I-A)^{-1})$, shows the output required from each sector listed at the left (row) for each dollar of Final demand of the sector listed at the top (column).

Table 4 is listed on pages 72 through 76. Page 77 gives other projections for 1980 compared with the data gathered for 1970.

On pages 79 through 80 is the projected interindustry transaction table for 1980.

Page 81 gives the projections of the Georgia Economy in 1980. Each industry is listed; and across the row, the 1970 and 1980 growth rates are compared, the annual growth rates are compared, and the employment levels are compared.

The employment projections were formulated from the output projections using the Leontief inverse by first computing the output of each industry for 1980 and dividing the latter into the former to find the number of employees in each industry in 1980.

$$\frac{\text{projected output in 1980}}{\text{estimated output for employees in 1980}} = \frac{\text{output}}{\frac{\text{output}}{\text{employees}}} = \text{employees}$$

An important projection used in this model that had not been discussed thus far is the projection of the Y vector, the final demand for 1980. The final demand for an industry's output was broken down into three demand sectors. The sectors are: Federal Government Defense only (FDDF); Federal Government, all except Defense (FDOT); and Exports (Ex(s)). The equation for determining the projected final demand for a given sector, S, becomes:

$$Y(S) = (1.0+GRFDDF(S))^{10}\ FDDF(S) + (1.0+FRFDOT(S))^{10}\ FDOT(S) + (1.0+GREX(S))^{10}\ EX(S).$$

GRFDDF(S) is the annual growth rate of Federal Government Defense spending in sector S. GRFDOT(S) is the annual growth rate of Federal Government other spending in sector S. GREX(S) is the annual growth rate of exports from Georgia by sector S.

The growth rates of Exports were obtained by taking the growth rate of industries listed in Table D-9 on page 97 of the U. S. Department of Labor's *Patterns of U. S. Economic Growth*[16] and weighing them by their percentage of output as they were aggregated to 33 industries for the Georgia Model. The growth rates for the Federal Government Defense and others were taken from Table A-22 on page 56 of the U. S. Department of Labor's *The U. S. Economy in 1980.*[17]

$$
\begin{bmatrix} Y(1) \\ Y(2) \\ \vdots \\ Y(S) \\ \vdots \\ Y(34) \end{bmatrix} = \begin{bmatrix} (1.0+GRFDDF(1))^{10} & 0 & \cdots & 0 & \cdots & 0 \\ 0 & (1.0+GRFDDF(2))^{10} & \cdots & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & (1.0+GRFDDF(S))^{10} & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & (1.0+GRFDDF(34))^{10} \end{bmatrix} \begin{bmatrix} FDDF(1) \\ FDDF(2) \\ \vdots \\ FDDF(S) \\ \vdots \\ FDDF(34) \end{bmatrix} +
$$

$$
\begin{bmatrix} (1.0+GRFDOT(1))^{10} & 0 & \cdots & 0 & \cdots & 0 \\ 0 & (1.0+GRFDOT(2))^{10} & \cdots & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & (1.0+GRFDOT(S))^{10} & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & (1.0+GRFDOT(34))^{10} \end{bmatrix} \begin{bmatrix} FDOT(1) \\ FDOT(2) \\ \vdots \\ FDOT(S) \\ \vdots \\ FDOT(34) \end{bmatrix} +
$$

$$
\begin{bmatrix} (1.0+GREX(1))^{10} & 0 & \cdots & 0 & \cdots & 0 \\ 0 & (1.0+GREX(2))^{10} & \cdots & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & (1.0+GREX(S))^{10} & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & (1.0+GREX(34))^{10} \end{bmatrix} \begin{bmatrix} EX(1) \\ EX(2) \\ \vdots \\ EX(S) \\ \vdots \\ EX(34) \end{bmatrix}
$$

FOOTNOTES FOR CHAPTER III

[15]William A. Schaffer, Eugene A. Laurent, and Ernest M. Sutter, Jr., "Georgia's Economic Structure--A Preview of the Georgia Input-Output Model, 1970," *Georgia Business*, May, 1972, Vol. 31, No. 11

[16]*Patterns of U. S. Economic Growth*, Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C., Bulletin 1672, 1970, p. 97.

[17]*The U. S. Economy in 1980*, Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C., Bulletin 1673, 1970, p. 56.

CHAPTER IV

SENSITIVITY ANALYSIS OF THE INPUT-OUTPUT MODEL

For an input-output model, the economist is not only interested in the projections made by the model, but he is also concerned with the sensitivity structure of the model. This sensitivity structure may be investigated by performing sensitivity analysis.

As stated by Dr. Michael Brylinsky, there are several reasons for sensitivity analysis:

1. The Mathematical Model of the real system under construction is only an analog or abstraction of certain specific properties of that system; the model is not an exact mimic of the real world.

2. Even if the model completely replicated the natural system, some discrepancy between the assumed values of the model parameters and their true values is bound to exist due to errors in measurement or estimation.

3. Additionally, even if the above two considerations were not valid, the parameters are quite likely to change with changes in the system's environment.[18]

Sensitivity Analysis is a method that allows uncertainty to be considered in a deterministic model. The results of a sensitivity analysis are based on discrete values instead of stochastic distributions.[19]

The classical definition of sensitivity is $S_K^T = \frac{dT/T}{dK/K}$ which states that the sensitivity of T with respect to K is the percentage change in T divided by the percentage change in K. This definition holds only for small changes.

For a control system, the number chosen for a parameter is its

nominal value. If one of the parameters is changed by a certain amount, the corresponding change in the transfer function of the system allows a measure to be made of the sensitivity of the system to that change.

To investigate the sensitivity structure of an input-output model, the nominal values of the parameters are chosen as the values collected as data in the construction of the transaction table of an economy. If a projected Final demand vector, $\underline{Y}$, is used in Equation (2-15) then the resulting Total Output Vector, $\underline{X}$, is the nominal projected total output vector.

As a measure of the sensitivity of the economy to differences in parameters from the nominal values collected as data, incremental changes in the parameters are made and the corresponding changes in the projected Total output vector are compared with the nominal projected Total output vector.

The differences in the parameters from the nominal value might occur as an error in data collection or as a result of a technological change in the economy.

The sensitivity of the input-output model to a small incremental change in one of the transactions between the producing sectors is called Transaction Sensitivity.

Transaction Sensitivity is defined as

$$S^{T}_{k;(ij)} = \frac{\dfrac{\Delta X_k}{X_k}}{\dfrac{\Delta X_{ij}}{X_{ij}}} \quad \text{where } k = 1,2,\ldots,n \qquad (4\text{-}1)$$

ΔX_k = the incremental change in the output of the k*th* industry.

X_k = the total output of the k*th* industry.

ΔX_{ij} = the incremental change in the sales of industry i to industry j.

X_{ij} = the sales of industry i to industry j.

The sensitivity of the input-output model to a small incremental change in the total output of a sector in the transaction table is called Output Sensitivity.

Output Sensitivity is defined as

$$S^0_{k;j} = \frac{\frac{\Delta X_k}{X_k}}{\frac{\Delta X_j}{X_j}} \qquad k = 1,2,\ldots,n \tag{4-2}$$

ΔX_k and X_k are as defined above.

ΔX_j = the incremental change in total output of sector j.

X_j = the total output of sector j.

Impact Analysis

Before the sensitivity measures are discussed further, an interesting characteristic of the input-output model should be discussed.

The impact of an incremental change in one of the final demand for a sector's output can be easily investigated.

Suppose that one of the final demands, say Y_i, is changed by an incremental amount ΔY_i, then the impact or incremental change upon the projected total output vector is

$$\Delta\underline{X} = (I-A)^{-1}\Delta\underline{Y} \quad \text{where } \Delta\underline{Y} = \begin{vmatrix} 0 \\ \vdots \\ \Delta Y_i \\ \vdots \\ 0 \end{vmatrix} \tag{4-3}$$

In Chapter II, it was shown that the production coefficients, a_{ij}, are always ≥ 0, and the elements of $(I-A)^{-1}$ are non-negative for an input-output model.[20] Knowing this it follows that:

1. The positive incremental change in any element of $\underline{Y}$ results in positive change(s) in the elements of $\underline{X}$.

2. The negative incremental change in any element of $\underline{Y}$ results in negative change(s) in the elements of $\underline{X}$.

Let $(I-A) = D$, then $(I-A)^{-1} = D^{-1} = \|\bar{d}_{ij}\|$, then Equation (4-3) may be written as:

$$\begin{vmatrix} \Delta X_1 \\ \vdots \\ \Delta X_i \\ \vdots \\ \Delta X_n \end{vmatrix} = \begin{vmatrix} \bar{d}_{11} & \bar{d}_{12} & \cdots & \bar{d}_{1n} \\ \vdots & \vdots & & \vdots \\ \bar{d}_{i1} & \bar{d}_{i2} & \cdots & \bar{d}_{in} \\ \vdots & \vdots & & \vdots \\ \bar{d}_{n1} & \bar{d}_{n2} & \cdots & d_{nn} \end{vmatrix} \begin{vmatrix} 0 \\ \vdots \\ 0 \\ \Delta Y_i \\ 0 \\ \vdots \\ 0 \end{vmatrix} = \begin{vmatrix} \bar{d}_{1i}\Delta Y_i \\ \vdots \\ \bar{d}_{ii}\Delta Y_i \\ \vdots \\ \bar{d}_{ni}\Delta Y_i \end{vmatrix} \tag{4-4}$$

Therefore, if the economist is interested in a measure of the impact of ΔY_i on the $\underline{X}$ vector, the *ith* column of the $(I-A)^{-1}$ matrix gives the ratio $\frac{\Delta X_k}{\Delta Y_i}$ $K = 1,2,\ldots,n$.

If a one-way analysis of variance is performed on the $(I-A)^{-1}$ matrix, it is possible to determine if the mean impact upon one sector

from changes in the Y_i's differs significantly from the mean impact upon another sector.

As an illustrative example, consider the transaction table below.

Table 2. Example Transaction Table

		Sectors				
		1	2	3	Final Demand	Total Output
Sectors	1	1	3	2	6	12
	2	4	6	4	10	24
	3	2	3	5	8	18

$$A = \begin{vmatrix} .083 & .125 & .111 \\ .333 & .250 & .222 \\ .167 & .125 & .278 \end{vmatrix} \qquad (I-A)^{-1} = \begin{vmatrix} 1.2264 & .2493 & .2623 \\ .6570 & 1.5498 & .5677 \\ .4003 & .3412 & 1.5465 \end{vmatrix}$$

If the Final Demand is computed from annual growth rates times the present Final Demand, such as Dr. Schaffer computes it in the Georgia Projection Model.

Then:

$$\underline{Y}^T = \begin{vmatrix} (1.0+.03)^T & 0 & 0 \\ 0 & (1.0+.04)^T & 0 \\ 0 & 0 & (1.0+.045)^T \end{vmatrix} \begin{vmatrix} 6 \\ 10 \\ 8 \end{vmatrix}$$

where the annual growth rates are 3 per cent, 4 per cent, and 4.5 per cent, respectively, if T = 10 years.

$$\underline{Y}^T = \begin{vmatrix} 8.06 \\ 14.80 \\ 12.42 \end{vmatrix}$$

However, suppose the annual growth rate for sector 1 (3 per cent) is an error (or is changed), and it becomes 3.5 per cent. Then:

$$\underline{Y}^T = \begin{vmatrix} 8.46 \\ 14.80 \\ 12.42 \end{vmatrix} \quad \text{and} \quad \Delta\underline{Y} = \begin{vmatrix} .40 \\ 0 \\ 0 \end{vmatrix}$$

Using Equation (4-4), where i = 1

$$\Delta\underline{X} = \begin{vmatrix} \Delta X_1 \\ \Delta X_2 \\ \Delta X_3 \end{vmatrix} = \begin{vmatrix} 1.2264(.40) \\ .6570(.40) \\ .4003(.40) \end{vmatrix} = \begin{vmatrix} .4906 \\ .2628 \\ .1601 \end{vmatrix}$$

and

$$\frac{\Delta X_1}{\Delta Y_1} = 1.2264 \qquad \frac{\Delta X_2}{\Delta Y_1} = .6570 \qquad \frac{\Delta X_3}{\Delta Y_1} = .4003$$

which are the corresponding elements of the *1st* column of the Leontief inverse matrix. To the economist this means that for every 1 unit change in Y_1, there will be a 1.2264 unit change in X_1 and similarly .6570 units and .4003 units for X_2 and X_3. To determine more about the mean impact of a change in one of the Y_i's upon the sectors, a one-way analysis of variance is performed.

Table 3. Layout of Data for Anova of Example

Observations:	1	2	3	
	1.2264	.6570	.4003	
	.2493	1.5498	.3412	
	.2623	.5677	1.5465	
Totals	$T._1$=1.7380	$T._2$=2.7745	$T._3$=2.2980	$T..$=6.8105
Numbers	n_1 =3	n_2 =3	n_3 =3	N =9
Means	$\bar{X}_1$ = .5793	$\bar{X}_2$ = .9238	$\bar{X}_3$ = .7660	$\bar{X}..$= .7567

$$SS_{total} = \Sigma\Sigma(X_{ij})^2 - \left(\frac{T..}{N}\right)^2 = 7.4595 - 5.1529 = 2.3066$$

$$SS_{treatmnt} = \Sigma\left(\frac{T._j}{n_j}\right)^2 - \left(\frac{T..}{N}\right)^2 = 5.2008 - 5.1529 = .0479$$

$$SS_{error} = SS_{total} - SS_{treatment} = 2.3066 - .0479 = 2.2587$$

Table 4. Anova of Example

Source	SS	MS
Treatment	.0479	.0239
Error	2.2587	.3764
Total	2.3060	

Suppose that the hypothesis being tested in analysis of variance is that there is no treatment effect for the impact, then the mean of sector 1, μ_1, equals the mean of sector 2, μ_2, equals the mean of sector 3, μ_3.

$$H_o: \mu_1 = \mu_2 = \mu_3$$

If H_o is true, the test of the hypothesis can be made using a critical region of the F distribution.

Thus, for the above example:

$$F_{2;6} = \frac{\text{treatment mean square}}{\text{error mean square}} = \frac{.0239}{.3764} = .063 < F'_{2;6} = 5.14$$

$$\alpha = .05$$

and H_o is not rejected.

If the F ratio had been such that $F > F_{1-\alpha}$, then a significant F indicates that the difference between means has something in it besides the estimate of variance. It probably indicates that H_o should be rejected, and that there is a real difference in treatment means.

To identify a sector whose mean impact differs significantly from the mean sensitivity of other sectors, the Duncan Multiple Range Test is used when the hypothesis H_o is rejected. A discussion of this test will follow later.

Transaction Sensitivity

Assume that element a_{ij} of Matrix A is changed by an incremental amount Δa_{ij}. This change is caused by an incremental change in the sales by the *ith* industry to the *jth* industry, ΔX_{ij}, thus the change in a_{ij} is described by:

$$a_{ij} + \Delta a_{ij} = \frac{X_{ij} + \Delta X_{ij}}{X_j + \Delta X_{ij}} \qquad (4\text{-}9)$$

However, a sensitivity analysis is usually concerned with relatively small incremental changes, and because the size of $X_{.j}$ is usually many times greater than ΔX_{ij}, the influence of ΔX_{ij} upon the denominator of Equation (4-3) is assumed negligible, and the equation becomes:

$$\frac{X_{ij} + \Delta X_{ij}}{X_i + \Delta X_{ij}} \simeq \frac{X_{ij} + \Delta X_{ij}}{X_{.j}} = \frac{X_{ij}}{X_{.j}} + \frac{X_{ij}}{X_{.j}} \qquad (4\text{-}10)$$

Because $a_{ij} = \frac{X_{ij}}{X_{.j}}$, the result of Equation (4-10) in conjunction with Equation (4-9) yields:

$$\Delta a_{ij} = \frac{\Delta X_{ij}}{X_{.j}} \qquad (4\text{-}11)$$

This assumption allows the system to remain balanced, since the sum of the j*th* column is still approximately $X_{.j}$. Similarly, the sum of the i*th* row is considered to be approximately $X_{i.}$.

With this change in the transaction table for X_{ij}, the A matrix has been changed in its (i,j) element by a_{ij}. The incremental A matrix may be written as $(A + \Delta a_{ij}N)$, where N is defined as a matrix with a 1 for its element (i,j) and zeros for all of its other elements.

$$N = \begin{vmatrix} 0 & \cdots & 0 & \cdots & 0 \\ \vdots & & \vdots & & \vdots \\ 0 & \cdots & 1 & \cdots & 0 \\ \vdots & & \vdots & & \vdots \\ 0 & \cdots & 0 & \cdots & 0 \end{vmatrix} \begin{matrix} \\ \\ ith \text{ row} \\ \\ \\ \end{matrix} \qquad (4\text{-}12)$$

(with the 1 in the jth column)

Suppose the Leontief inverse of the incremented A matrix is designated as the matrix L where

$$L = \left[I-(A+\Delta a_{ij}N)\right]^{-1} \qquad (4\text{-}13)$$

$$= \left[(I-A)-\Delta a_{ij}N\right]^{-1}$$

Let D = (I-A) again, then (4-13) is written as:

$$L = (D-\Delta a_{ij}N)^{-1} \qquad (4\text{-}14)$$

By using the identity $(DD^{-1}) = I$ (4-14) is written as:

$$L = \left[D(I-D^{-1}\ \Delta a_{ij}N)\right]^{-1}$$

$$= (I-D^{-1}\ \Delta a_{ij}N)^{-1}D^{-1} \qquad (4\text{-}15)$$

However, now it becomes necessary to investigate $(I-D^{-1}\ \Delta a_{ij}N)^{-1}$ further. Where $D^{-1} = \|\bar{d}_{ij}\|$ and

$$\Delta a_{ij}N = \begin{vmatrix} 0 & \cdots & 0 & \cdots & 0 \\ \vdots & & \vdots & & \vdots \\ 0 & & \Delta a_{ij} & & 0 \\ \vdots & & \vdots & & \vdots \\ 0 & \cdots & 0 & \cdots & 0 \end{vmatrix}$$

therefore,

$$(I-D^{-1}\Delta a_{ij}N)^{-1} = I + \begin{vmatrix} 0 & \cdots & -\bar{d}_{1i}\Delta a_{ij} & \cdots & 0 \\ 0 & \cdots & -\bar{d}_{2i}\Delta a_{ij} & \cdots & 0 \\ \vdots & & \vdots & & \vdots \\ 0 & \cdots & -\bar{d}_{ni}\Delta a_{ij} & \cdots & 0 \end{vmatrix}^{-1}$$

Adding the elements of the two matrices gives the matrix

$$= \begin{vmatrix} 1 & \cdots & -\bar{d}_{1i}\Delta a_{ij} & \cdots & 0 \\ \vdots & \ddots & \vdots & & \vdots \\ 0 & \cdots & 1-\bar{d}_{ji}\Delta a_{ij} & \cdots & 0 \\ \vdots & & \vdots & \ddots & \vdots \\ 0 & \cdots & -\bar{d}_{ni}\Delta a_{ij} & \cdots & 1 \end{vmatrix}^{-1} \qquad (4\text{-}16)$$

The inverse of the matrix (4-16) becomes:

$$\begin{vmatrix} 1 & \cdots & \bar{d}_{1i}\dfrac{\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 0 \\ \vdots & \ddots & \vdots & & \vdots \\ 0 & \cdots & \dfrac{1}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 0 \\ \vdots & & \vdots & \ddots & \vdots \\ 0 & \cdots & \dfrac{\bar{d}_{nj}\Delta a_{nj}}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 1 \end{vmatrix} \qquad (4\text{-}17)$$

Now (4-17) may be written as:

$$\begin{vmatrix} 1 & \cdots & 0 & \cdots & 0 \\ \vdots & \ddots & & & \vdots \\ 0 & & 1 & & 0 \\ \vdots & & & \ddots & \vdots \\ 0 & \cdots & 0 & \cdots & 1 \end{vmatrix} + G$$

where G is the matrix

$$\begin{vmatrix} 0 & \cdots & \dfrac{\bar{d}_{1i}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 0 \\ \vdots & & \vdots & & \vdots \\ 0 & \cdots & \dfrac{\bar{d}_{ji}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 0 \\ \vdots & & \vdots & & \vdots \\ 0 & \cdots & \dfrac{\bar{d}_{ni}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 0 \end{vmatrix} \qquad (4\text{-}18)$$

Therefore $(I-D^{-1}\Delta a_{ij}N)^{-1}$ can be written as the matrix formed by the sum of the matrices I and G

$$(I-D^{-1}\Delta a_{ij}N)^{-1} = I + G \qquad (4\text{-}19)$$

Substitution of (4-19) into (4-15) gives:

$$\begin{aligned} L &= (I+G)D^{-1} \\ &= D^{-1} + GD^{-1} \end{aligned} \qquad (4\text{-}20)$$

Thus,

$$\begin{aligned} \underline{X} + \Delta\underline{X} &= L\underline{Y} \\ &= (D^{-1}+GD^{-1})\underline{Y} \\ &= \left[(I-A)^{-1} + G(I-A)^{-1}\right]\underline{Y} \end{aligned} \qquad (4\text{-}21)$$

Since from Equation (2-18) $\underline{X} = (I-A)^{-1}\underline{Y}$, $\Delta\underline{X}$ may be written as simply:

$$\Delta\underline{X} = G(I-A)^{-1}\underline{Y} \tag{4-22}$$

or:

$$\Delta\underline{X} = G\underline{X} \tag{4-23}$$

Substitution of Equation (4-18) into (4-23) yields:

$$\Delta\underline{X} = \begin{vmatrix} 0 & \cdots & \dfrac{\bar{d}_{li}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 0 \\ \vdots & & & & \vdots \\ 0 & \cdots & \dfrac{\bar{d}_{ji}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}} & \cdots & 0 \\ \vdots & & & & \vdots \\ 0, & \cdots & \dfrac{\bar{d}_{ni}\ a_{ij}}{1-\bar{d}_{ji}\ a_{ij}} & \cdots & 0 \end{vmatrix} \begin{vmatrix} X_1 \\ \vdots \\ X_j \\ \vdots \\ X_n \end{vmatrix} = \begin{vmatrix} \left(\dfrac{\bar{d}_{li}\Delta a_{ij}}{1-\bar{d}_{ji}\ a_{ij}}\right)X_j \\ \vdots \\ \left(\dfrac{\bar{d}_{ji}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}}\right)X_j \\ \vdots \\ \left(\dfrac{\bar{d}_{ni}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}}\right)X_j \end{vmatrix} \tag{4-24}$$

Notice that the K*th* component of ΔX is described by:

$$\left(\frac{\bar{d}_{ki}\Delta a_{ij}}{1-\bar{d}_{ji}\Delta a_{ij}}\right)X_j \tag{4-25}$$

Because $(I-A)^{-1} = \|(\bar{d}_{ij})\|$ is a non-negative matrix, i.e., $\bar{d}_{ij} \geq 0$ for all i and j, for a positive incremental change of Δa_{ij}, the numerator of Equation (4-25) is always non-negative.

Thus, if the value of Δa_{ij} is chosen to be small enough, the denominator of (4-25) will also be positive. Therefore, the quantity in Equation (4-25) is non-negative. This implies that the components of $\Delta\underline{X}$ are non-negative for the positive incremental change of a_{ij}.

Another interesting property of $\Delta\underline{X}$ due to Δa_{ij} is that each component of $\Delta\underline{X}$ is described as the function of the j*th* component of output $\underline{X}$.

If $\bar{d}_{ji}\Delta a_{ij} << 1$ Equation (4-24) is approximately represented by:

$$\Delta\underline{X} = \begin{vmatrix} \bar{d}_{1i}\Delta a_{ij}X_j \\ \vdots \\ \bar{d}_{ji}\Delta a_{ij}X_j \\ \vdots \\ \bar{d}_{ni}\Delta a_{ij}X_j \end{vmatrix} = \begin{vmatrix} \bar{d}_{ji} \\ \vdots \\ \bar{d}_{ji} \\ \vdots \\ \bar{d}_{ni} \end{vmatrix} \Delta a_{ij}X_j = \begin{vmatrix} \bar{d}_{1i} \\ \vdots \\ \bar{d}_{ji} \\ \vdots \\ \bar{d}_{ni} \end{vmatrix} \frac{\Delta X_{ij}}{X_j} X_j = \begin{vmatrix} \bar{d}_{1i} \\ \vdots \\ \bar{d}_{ji} \\ \vdots \\ \bar{d}_{ni} \end{vmatrix} \Delta X_{ij} \quad (4\text{-}26)$$

proportional to the i*th* column elements of $(I-A)^{-1}$ these results are examined in the following example.

As an illustrative example, consider again the transaction table (Table 2). Suppose the largest element $x_{22} = 6$ is incremented by +.006. Using Equation (4-22), the incremental change in the outputs Δx_1, Δx_2, Δx_3 is calculated. The new transaction table is:

Table 5. Incremented Transaction Table

		Sectors 1	2	3	Final Demand	Total Output
Sectors	1	1	3	2	6	12
	2	4	6.006	4	10	24
	3	2	3	5	8	18

$\Delta x_{22} = +.006$. Then $\Delta a_{22} = \frac{\Delta x_{22}}{x_2} = \frac{.006}{.24} = +.00025$ by Equation 4-11 and

$$\Delta a_{22}N = .00025\begin{vmatrix}0 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 0\end{vmatrix} = \begin{vmatrix}0 & 0 & 0\\ 0 & .00025 & 0\\ 0 & 0 & 0\end{vmatrix}$$

NOTE: Because Δa_{22} is to three decimal places, the A and $(I-A)^{-1}$ are now used to six decimal places for accuracy.

$$A_1 = \begin{vmatrix}.0833333 & .1250000 & .1111111\\ .3333333 & .2500000 & .2222222\\ .1666666 & .1250000 & .2777777\end{vmatrix}$$

$$(I-A)^{-1} = \begin{vmatrix}1.2299168 & .2493074 & .2659279\\ .6648196 & 1.5401660 & .5761770\\ .3988917 & .3240996 & 1.5457062\end{vmatrix}$$

It follows from the investigation on page 20 that $(I-D^{-1}\Delta a_{22}N)^{-1}$ for this example equals.

$$\left(\begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} - \begin{vmatrix} 1.2299168 & .2493074 & .2659279 \\ .6648196 & 1.5401660 & .5761770 \\ .3988917 & .3240996 & 1.5457062 \end{vmatrix} \begin{vmatrix} 0 & 0 & 0 \\ 0 & .00025 & 0 \\ 0 & 0 & 0 \end{vmatrix}\right)^{-1}$$

Reduction yields

$$\left(\begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} - \begin{vmatrix} 0 & .2493074(.00025) & 0 \\ 0 & 1.5401660(.00025) & 0 \\ 0 & .3240996(.00025) & 0 \end{vmatrix}\right)^{-1}$$

$$\left(\begin{vmatrix} 1 & -.2493074(.00025) & 0 \\ 0 & 1-1.5401660(.00025) & 0 \\ 0 & -.3240996(.00025) & 1 \end{vmatrix}\right)^{-1}$$

by Equation (4-17) the inverse is

$$\begin{vmatrix} 1 & \dfrac{.2493074(.00025)}{1-1.5401660(.00025)} & 0 \\ 0 & \dfrac{1}{1-1.5401660(.00025)} & 0 \\ 0 & \dfrac{.3240996(.00025)}{1-1.5401660(.00025)} & 1 \end{vmatrix}$$

therefore by Equation (4-18)

$$G = \begin{vmatrix} 0 & \frac{.2493074(.00025)}{1-1.5401660(.00025)} & 0 \\ 0 & \frac{1.5401660(.00025)}{1-1.5401660(.00025)} & 0 \\ 0 & \frac{.3240996(.00025)}{1-1.5401660(.00025)} & 0 \end{vmatrix} = \begin{vmatrix} 0 & .0000623 & 0 \\ 0 & .0003851 & 0 \\ 0 & .0000810 & 0 \end{vmatrix}$$

therefore to find $\Delta\underline{X}$ the Equation (4-23) is used

$$\Delta\underline{X} = G\underline{X}$$

Suppose based on the original values of X_{ij} (i.e. $X_{22} = 6.0$) a projection for $\underline{X}$ is made using the final demand vector

$$\underline{Y}^T = \begin{vmatrix} 8.06 \\ 14.80 \\ 12.42 \end{vmatrix}$$

then $\underline{X} = (I-A)^{-1}Y^T$.

$$\underline{X} = \begin{vmatrix} X_1 \\ X_2 \\ X_3 \end{vmatrix} = \begin{vmatrix} 1.2299168 & .2493074 & .2659279 \\ .6648196 & 1.540166 & .576177 \\ .3988917 & .3240996 & 1.5457062 \end{vmatrix} \begin{vmatrix} 8.06 \\ 14.80 \\ 12.42 \end{vmatrix} = \begin{vmatrix} 16.905702 \\ 35.309019 \\ 27.209412 \end{vmatrix}$$

$$\begin{vmatrix} \Delta X_1 \\ \Delta X_2 \\ \Delta X_3 \end{vmatrix} = G \begin{vmatrix} X_1 \\ X_2 \\ X_3 \end{vmatrix}$$

where ΔX_i is the incremental change in the projected value of X_i, i=1,2,3, due to $\Delta X_{22} = .006$.

$$\begin{vmatrix} \Delta X_1 \\ \Delta X_2 \\ \Delta X_3 \end{vmatrix} = \begin{vmatrix} 0 & .0000623 & 0 \\ 0 & .0003851 & 0 \\ 0 & .0000810 & 0 \end{vmatrix} \begin{vmatrix} 16.905702 \\ 35.309019 \\ 27.209412 \end{vmatrix} = \begin{vmatrix} .0021997 \\ .0135975 \\ .002860 \end{vmatrix}$$

Notice that the size of the components of $\Delta\underline{X}$ are in the same preparation as the size of the elements of the *ith* column (2nd column) of $(I-A)^{-1}$. Using Equation (4-1), the transaction sensitivities are computed.

$$S^T_{k;(i,j)} = \frac{\frac{\Delta X_k}{X_k}}{\frac{\Delta X_{ij}}{X_{ij}}} \quad \text{where } i=2,\ j=2, \text{ and } k=1,2,3$$

Table 6. Computation of Transaction Sensitivities

k	ΔX_k	X_K	$\Delta X_k/X_k$	$\Delta X_{22}/X_{22}$	$S^T_{k;(2,2)}$
1	.0021997	12	.0001833	.001	.1833
2	.0135975	24	.0005665	.001	.5665
3	.002860	18	.0001588	.001	.1588

For the three industries of this model, as might be expected, the industry which was most sensitive to the change in sales of industry 2 to other industries is industry 2. Industry 1 was slightly more sensitive to the change than industry 3. It is felt this is because the largest volume of industry 1's regional sales is to industry 2, while industry 3 sells more to itself.

Output Sensitivity

Assume that the data given for the total output of sector j of the Transactions Table discussed in Chapter II, X_j, is changed by an incremental amount. This change may be a small change caused either by an error in data collection or a technological change.

If the output of sector j is changed by $\pm\Delta X_j$, the elements of the *jth* column of the matrix of coefficients will be changed. Recall from Equation (2-8b):

$$a_{ij} = \frac{X_{ij}}{X_j}$$

Therefore, the new a_{ij} elements, denoted $a_{ij'}$, are now computed by:

$$a_{ij'} = \frac{X_{ij}}{X_j + \Delta X_j} \tag{4-27}$$

From (4-27), it follows that if $\Delta X_j > 0$ that $a_{ij'} < a_{ij}$, and if $X_j < 0$, then $a'_{ij} > a_{ij}$.

Changing the output of sector j in the transaction table will cause each element of the *jth* column of the A matrix to be changed.

$$A' = \begin{vmatrix} a_{11} & \cdots & a'_{ij} & \cdots & a_{1n} \\ a_{21} & \cdots & a'_{2j} & \cdots & a_{2n} \\ \vdots & & \vdots & & \vdots \\ a_{n1} & \cdots & a'_{nj} & \cdots & a_{nn} \end{vmatrix}$$

With the new A' matrix of coefficients, the Leontief Inverse Matrix for projecting the sector total output vector is $(I-A')^{-1}$.

The projected total output is now:

$$\underline{X}' = (I-A')^{-1}\underline{Y} \tag{4-28}$$

The sensitivity of the model to the change in X_j is found by Equation (4-2).

$$S^{o}_{k;j} = \frac{\frac{\Delta X_k}{X_k}}{\frac{\Delta X_j}{X_j}} \qquad k=1,2,\ldots,n$$

where:

$$\begin{vmatrix} \Delta X_1 \\ \vdots \\ \Delta X_k \\ \vdots \\ \Delta X_n \end{vmatrix} = \begin{vmatrix} X'_1 \\ \vdots \\ X'_k \\ \vdots \\ X'_n \end{vmatrix} - \begin{vmatrix} X_1 \\ \vdots \\ X_k \\ \vdots \\ X_n \end{vmatrix}$$

FOOTNOTES FOR CHAPTER IV

[18]*Systems Analysis and Simulation in Ecology*, edited by Bernard C. Patten, from "Steady State Sensitivity Analysis of Energy Flow in a Marine Ecosystem" by Michael Brylinsky. Academic Press, New York and London, 1972, p. 87.

[19]*Ibid.*, p. 88.

[20]Furuya Shigeru, "Matrix and Determinant," BAIFU-KAN, Tokyo, Japan (in Japanese), 1970.

[21]Charles R. Hicks, *Fundamental Concepts in the Design of Experiments*, Holt, Rinehart and Winston, 1964, pp. 21-33.

CHAPTER V

SENSITIVITY ANALYSIS OF THE GEORGIA PROJECTION MODEL

The purpose of this chapter is to perform a sensitivity analysis on the Georgia Projection Model in order to determine an understanding of the model's sensitivity structure. The original model depicts the interdependence of the producing sectors of the Georgia Economy. But, what are the effects of small incremental changes in the nominal values of the data upon the projections of the total output for the sectors?

The measures of sensitivity defined in Chapter IV will be applied in the following pages to determine the sensitivity of each producing sector to a change in one of the model parameters, and to determine if there are any significant differences among the sensitivities of the sectors to change.

Impact of Change in Y, Final Demand

Since the columns of the Total Requirements Table (Table 16) give the unit increase in each sector's total output for a unit increase in the final demand for the commodity of the sector identified at the top of each column, information about the most responsive sector to a change in one of the final demands can be obtained.

Suppose a one-way analysis of variance of Table 16 is performed with the rows taken as treatments (33 treatments), and the columns of the Intermediate Sectors (1-29) taken as observations.

Table 7 shows the ANOVA Table.

Table 7. ANOVA of Impact Analysis

Source	df	SS	MS
Treatments	32	28.17606	.8805
Error	924	31.53204	.0339
Total	956	59.70810	

If the hypothesis tested is that there is no treatment effect for the impact, then H_o: $\mu_1 = \mu_2 = \ldots = \mu_{32} = \mu_{33}$.

To find out if H_o is true, the test of the hypothesis can be made using the F ratio discussed in Chapter IV.

Therefore, for the Georgia Projection Model:

$$F_{32;924} = \frac{.8805}{.0339} = 25.9 > F_{32;\infty} = 1.446$$

$$\alpha = .05$$

and H_o is rejected.

To identify sectors for which the mean impact differs significantly, the Duncan Multiple Range test is performed.

The mean impact of the changes are ranked highest to lowest in Table 8. Then by using the rules for the Duncan Multiple Range (DMR) Test, the least significant ranges are computed and the significant differences between the treatments (sectors) are identified.

The rules for the DMR Test are:

1. Arrange the 33 means in order from high to low.

2. Enter the ANOVA Table (Table 7) and take the error mean square with its degrees of freedom (.0339 with 924 df).

3. Obtain the standard error of the mean for each treatment

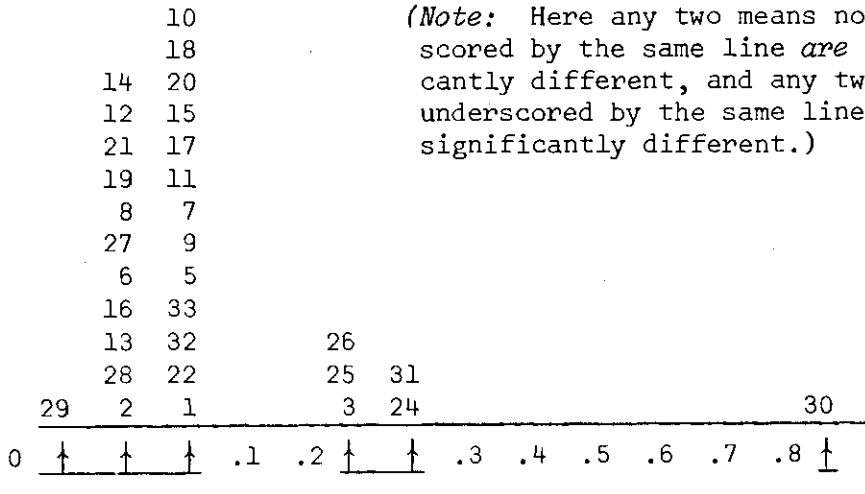
$$S_{\bar{X}_j} = \sqrt{\frac{\text{Error mean square}}{\text{Number of observations in } \bar{X}_j}} \quad .$$

4. Enter Duncan's table of significant ranges at the level desired using 924 df and p = 2,3,...,33.

5. Multiply the significant ranges by the standard error to obtain the 32 least significant ranges (LSR).

6. Test the observed ranges (differences between means, beginning with the largest versus smallest, which is compared with the LSR for p = 32, then test the largest versus the next to smallest, etc. Continue this until all comparisons have been made.

Figure 2 shows the grouping of the means into three groups that differ significantly from each other.



(Note: Here any two means not underscored by the same line *are* significantly different, and any two means underscored by the same line *are not* significantly different.)

Figure 2. Significantly Different Means of Change in Y_i

Table 8. Mean Impacts of Changes in Y_i

Rank	(Sector)	Mean	Rank	(Sector)	Mean
1	(30)	.81523209	18	(15)	.05414285
2	(24)	.25387141	19	(20)	.04956785
3	(31)	.24486070	20	(18)	.04956785
4	(3)	.21274284	21	(10)	.04394999
5	(25)	.21236070	22	(2)	.04808571
6	(26)	.20852142	23	(28)	.04777857
7	(23)	.10571428	24	(13)	.04525000
8	(4)	.09437856	25	(16)	.04493571
9	(1)	.07939999	26	(6)	.04481428
10	(22)	.06655000	27	(27)	.04366786
11	(32)	.06586285	28	(8)	.04281428
12	(33)	.06525357	29	(19)	.04111428
13	(5)	.06195357	30	(21)	.04065714
14	(9)	.06181428	31	(12)	.03734999
15	(7)	.06015714	32	(14)	.03325714
16	(11)	.05784642	33	(29)	.01897928
17	(17)	.05528928			

An interpretation of the results of this analysis is that the mean, or average, impact of changes in the final demand for the output of the commodities of the sectors differs significantly for the sectors in the three groups.

The mean impact of an incremental change of one unit in one of the final demands upon the production of Sector 30, the Household sector (Labor), is .81 units. This mean is very significantly different from any of the other means. For an economy this is an expected and desired characteristic, since as more units of a sector's commodity are demanded, then more units of labor are necessary to meet the demand.

However, although it might be intuitive that the Households Sector is the most significantly different sector; without any analysis of variance it would be difficult to pick other sectors that differ significantly from each other among the remaining sectors.

For the Georgia Projection Model, the second group of significantly more responsive sectors (five sectors) are the Wholesale and Retail Trade Sector (24); Capital Residual Sector (31); Contract Construction Sector (3); Finance Insurance and Real Estate (25); and Services sector (26). The remaining group contains the other 27 sectors.

It is interesting to note that the mean response to impact does not correlate exactly with any data in the transaction table.

For example, by ranking the means, we get the six most responsive sectors as in Table 9. But, a comparison of those six and their rank in other totals shows some difference among the sectors in ranking Total Output, Total Final Demand, and Total Local Sales.

Table 9. Comparison of Most Responsive Sectors

Sector	Mean Response	Total Output	Total Final Demand	Total Local Sales
30	1	1	1	1
24	2	2	2	5
31	3	5	11	2
3	4	7	7	12
25	5	3	5	3
20	6	4	3	4

$$\frac{\text{Sensitivity to Changes in } X_j}{\text{Total Output of Sector } i}$$

The next sensitivity to change investigated was the Output Sensitivity of the sectors. To obtain this sensitivity, Equation (4-2) was used with an incremental change of $\Delta X_j = .05X_j$. The sensitivity of the 33 sectors of the Georgia economy to a change in each of the X_j's was obtained. This produced a 33 row × 29 column array of sensitivities. An analysis of variance produced the data in Table 10.

Table 10. ANOVA of Output Sensitivity

Source	df	SS	MS
Treatments	32	2.72079924	.08502497
Error	924	5.41680801	.00586234
Total	956	8.13760722	

If the hypothesis tested is that there is no treatment effect for

the sensitivity, then:

$$H_o: \mu_1 = \mu_2 = \ldots = \mu_{32} = \mu_{33}$$

To find out if H_o is true, the test of the hypothesis can be made using the F ratio discussed in Chapter IV.

Therefore, for the Georgia Projection Model:

$$F_{32;924} = \frac{.08502}{.00586} = 14.503 > F_{32;00} = 1.446$$

$$\alpha = .05$$

and H_o is rejected.

To identify sectors for which the mean sensitivities differ significantly, the Duncan Multiple Range Test is performed using the same rules as previously discussed.

In Table 11 are the mean sensitivities of the sectors to change. Because the new a_{ij}'s for a positive ΔX_j are less than the a_{ij}'s before the change, the resulting $(I-A)^{-1}$ caused the new projected output to be less than the projections with the nominal data. Therefore, the sensitivities are negative. The sensitivities are ranked from the highest absolute value to the lowest absolute value.

Table 11. Mean Sensitivities to Changes in X_i

Rank	(Sector)	Mean	Rank	(Sector)	Mean
1	(31)	-.08757085	18	(1)	-.04774519
2	(28)	-.08445560	19	(17)	-.04366059
3	(29)	-.08217082	20	(4)	-.03863042
4	(32)	-.07567572	21	(18)	-.03679763
5	(23)	-.07424480	22	(8)	-.03529445
6	(3)	-.07388895	23	(13)	-.03410543
7	(30)	-.07364598	24	(11)	-.03019564
8	(10)	-.06755225	25	(16)	-.02890244
9	(33)	-.06732980	26	(22)	-.02882369
10	(15)	-.06408793	27	(14)	-.02291719
11	(25)	-.06340060	28	(21)	-.02023349
12	(24)	-.06098612	29	(9)	-.01953863
13	(26)	-.05858247	30	(19)	-.01747091
14	(2)	-.05704544	31	(6)	-.01177841
15	(27)	-.05658452	32	(20)	-.01083163
16	(12)	-.05577773	33	(5)	-.01052309

Figure 3 on page 60 shows the grouping of the means into groups of means that differ significantly from each other.

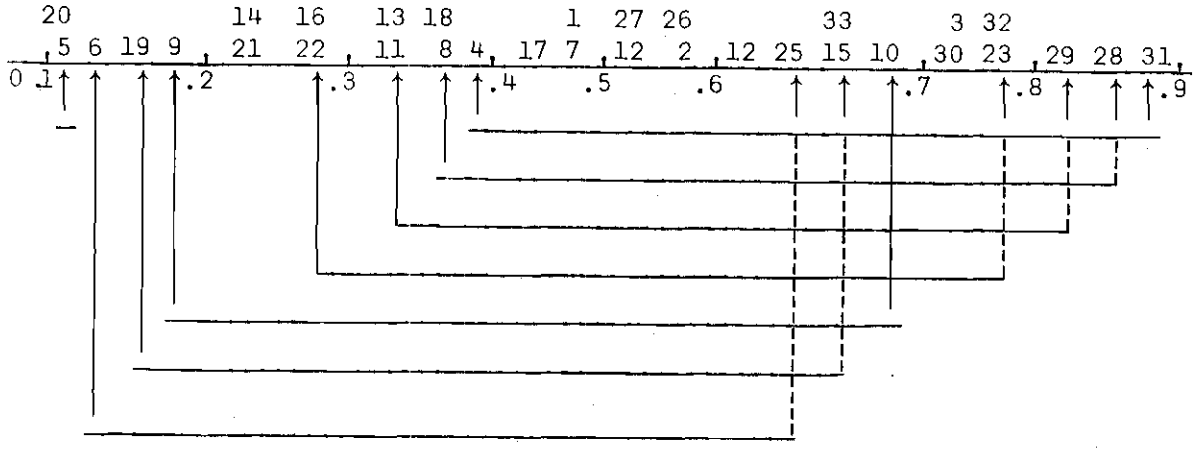


Figure 3. Significantly Different Means of Change in X_i

(*NOTE:* Here any two means not underscored by the same line *are* significantly different, and any two means underscored by the same line *are not* significantly different.)

Sensitivity to Change in X_{ij}, Interindustry Transactions

The sensitivities of the producing sectors to an incremental change in one of the elements of the transaction table were found for several changes in the table. The largest transaction in each row, for each sector was incremented by 10 per cent of its nominal value to see if the Georgia economy was more sensitive to a change in one transaction than to a change in another. Because the largest element in a row produces the largest value for the transaction coefficient, they were the ones chosen to be incremented.

The one way analysis of variance was performed as for the previous measures and the ANOVA table is shown in Table 12.

Table 12. ANOVA of Transaction Sensitivity

Source	df	SS	MS
Treatment	32	.0904726	.0028421
Error	924	1.16875187	.0012648
Total	956	1.25969912	.0012648

$$H_o: \mu_1 = \mu_2 = \ldots = \mu_{32} = \mu_{33}$$

The F ratio is:

$$F_{32;929} = \frac{.0028}{.0012} = 2.247 > F_{32;\infty} = 1.678$$

$$\alpha = .01$$

Therefore, the hypothesis H_o is rejected.

Although the F test indicates that the means of the treatments differ by more than just the variance, for the Georgia Economic Model it was impossible to detect significant differences between the mean transaction sensitivities of the producing sectors when the Duncan Multiple Range Test was performed.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Sensitivity Analysis for an incremental change in one of the nominal values of the Georgia projection model is able to rank the sensitivity of the 33 producing sectors to the incremental change. For Output sensitivity an analysis of Variance was performed on the sensitivities for all changes to determine if there is a treatment effect. The F ratio test rejected the hypothesis that the mean sensitivities of the producing sectors were equal and the Duncan Multiple Range test identified the sectors that differed significantly from each other. For the model an interesting result was that the sensitivity of the transportation sector, which contains the controversial Lockheed Corporation, was significantly different from all sectors except Sector 5, the Textile Mill Products sector.

Although the Transaction Sensitivity gave a measure of the sensitivity of the model to an incremental change in the value of one of the transactions of the model, except for ranking the sensitivity of the producing sectors to each change, no patterns could be identified. The one way analysis of variance provided an F ratio which allowed the hypothesis of equal means to be rejected. However, the Duncan Multiple Range Test could not identify any significant difference between the mean sensitivities of the producing sectors. The one-way analysis of variance was re-done for 58 observations of each treatment, and the

hypothesis of equal means among the treatments was still not rejected. However, the Duncan Multiple Range test did not detect significant difference among the mean transaction sensitivities. This seems to be due to the large amount of interaction among the sectors which makes the Georgia Projection Model less sensitive to a change in one of its transactions.

By changing the Final demand of each sector's product by an incremental amount, the impact of the changes were investigated.

By changing the final demand of each sector's product by an incremental amount ΔY_k, k = 1,2,...,3, computer printouts were obtained illustrating the impact of such a change. An Input Sensitivity was determined using the ratio of $\Delta x_i/\Delta Y_k$ where i = 1,2,...,33 for each k = 1,2,...,33. As might be expected these Input Sensitivities for each ΔY_k turned out to be the k^{th} column of the $(I-A)^{-1}$, Leontief inverse, of the model. The impact of change in one of the Y_k's can be easily determined by looking at the sum of the k^{th} column of Table A-III. The impact upon a chosen sector can be found by looking at that sector's row of the k^{th} column. The investigation of the Georgia Economic Model determined that the mean response of the Household Sector [32] differed significantly from the other 32 sectors. In addition, Contract Construction [3], Wholesale and Retail Trade [24], Finance, Insurance, Real Estate [25], Services [26], and Capital Residual [31] differed significantly from all of the remaining 27 sectors. There was no exact correlation of mean response with any data in the transaction table. However, there was high correlation between mean response and total output

of the producing sector.

The Georgia Economic Model of Dr. Schaffer, Dr. Laurent and Mr. Sutter is a useful regional model. It has as its base data collected from actual transactions within the state in 1970. It is extremely accurate as a framework of the Georgia economy. From the model's projections the most influential industries can be identified and the impact of a change in trade patterns or technology can be readily observed. Furthermore because it is a computer model, it provides a useful tool for simulating the Georgia economy.

As I have done in this thesis, hypothetical data can be introduced to replace collected data and the results can be observed and recorded. This will allow the sensitivities I have developed or other areas of sensitivity to be investigated.

If significant measures of sensitivity can be isolated the Input Output Model can be a more useful tool for the economist, businessman, and government administrator in achieving the desired results from transactions among the producing sectors of an economy and in eliminating undesired results.

Recommendations for Future Research

An area for future application of sensitivity analysis of input-output models is the investigation of using sensitivity coefficients to aggregate the industries into the producing sectors. One of the problem areas for the user of the input-output model is to determine the best aggregation of the industries of the economy into sectors for the model. Some experts are suggesting the use of smaller models containing very

few sectors. One way of grouping sectors for these smaller models is by grouping sectors together which do not differ significantly.

Another area for future investigation is the sensitivity of the multipliers (coefficients of the Leontief inverse) to incremental changes in the X_j's total input. These sensitivities are the percentage change in the Leontief inverse matrix coefficients divided by the percentage change in the nominal model parameter. Each coefficient in the inverse matrix represents the transfer function for the path of one input (Final Demand) and one output (Total Output for a Sector). For example, the coefficient $\bar{d}_{ij}$ is the transfer function for the path of the j^{th} input to the i^{th} output.

APPENDIX A

This Appendix contains the tables of data for the Georgia Input-Output Model, 1970.

TABLE 13

INTERINDUSTRY FLOW OF GOODS AND SERVICES IN GEORGIA, 1970

(MILLIONS OF DOLLARS)

SELLING INDUSTRY		PURCHASING INDUSTRY																									FINAL DEMAND									
		AGRICULTURE	MINING	CONTRACT CONSTRUCTION	FOOD AND KINDRED PRODUCTS	TEXTILE MILL PRODUCTS	APPAREL AND RELATED PRODUCTS	LUMBER AND WOOD PRODUCTS	FURNITURE AND FIXTURES	PAPER AND ALLIED PRODUCTS	PRINTING AND PUBLISHING	CHEMICALS AND ALLIED PRODUCTS	PETROLEUM REFINING	RUBBER AND MISC. PLASTICS	LEATHER AND LEATHER PRODUCTS	STONE, CLAY AND GLASS PRODUCTS	PRIMARY METAL INDUSTRIES	FABRICATED METAL PRODUCTS	MACHINERY, EXCEPT ELECTRICAL	ELECTRICAL MACHINERY & EQUIP.	TRANSPORTATION EQUIPMENT	MISCELLANEOUS MANUFACTURING	TRANSPORTATION SERVICES	COMMUNICATIONS AND UTILITIES	WHOLESALE AND RETAIL TRADE	FINANCE, INS., REAL ESTATE	SERVICES	FEDERAL GOVERNMENT ENTERPRISES	STATE, LOCAL GOVT. ENTERPRISES	UNALLOCATED INDUSTRIES	TOTAL LOCAL SALES	PERSONAL CONSUMPTION EXPENDITURES	GROSS PRIVATE INVESTMENT	LOCAL GOVERNMENT	STATE GOVERNMENT	FEDERAL GOVERNMENT (DEFENSE)	FEDERAL GOVERNMENT (OTHER)	NET EXPORTS	TOTAL FINAL DEMAND	TOTAL SALES
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
AGRICULTURE	1	178.7		5.5	498.2	8.8	3.2	29.5				0.9										0.3	1.1		5.7	67.3	1.1		0.1	2.0	802.3	98.1		0.9	0.8	0.3	81.7	493.6	675.3	1477.6
MINING	2	1.6	2.5	25.5	0.4					7.0		2.7	2.8	0.2		44.5	0.4								0.4	1.4	0.1				89.7	0.4			4.1	0.1	102.2	106.9	196.6
CONTRACT CONSTRUCTION	3	12.3	1.6	0.9	4.9	11.3	0.5	1.8	0.3	8.1	0.5	2.9	04.	0.8	0.1	2.8	1.1	0.9	0.6	0.5	4.6	0.5	30.0	40.6	13.8	108.6	62.4	1.0	50.3		364.2		1079.3	305.8	312.6	47.6	57.3	352.7	2155.4	2519.6
FOOD AND KINDRED PRODUCTS	4	105.6		0.1	170.2					1.5	0.3	13.2			1.2				0.4			0.3	5.8		22.3	3.6	7.1			19.2	350.7	700.9		7.1	5.8	2.6	2.6	1121.4	1930.5	2281.2
TEXTILE MILL PRODUCTS	5	2.4		1.2	2.1	527.9	207.3	0.1	7.4	1.7	0.2	0.1		12.3	1.5	0.1	0.2	0.2	0.2	0.2	2.3	1.3	0.2	0.3	7.3	5.8	0.9	0.1		1.2	784.4	39.1	0.9	0.1	0.1	0.5	0.1	2865.4	2906.3	3690.6
APPAREL AND RELATED PRODUCTS	6	0.5		0.5	1.7	4.7	30.6	0.2	0.2	1.0		0.8		0.8	0.8	3.0	0.1	0.2	0.1	0.1	3.0	0.5	0.1	0.1	5.3	1.5	3.8	0.1		0.1	60.1	109.5		0.5	0.5	1.5	0.5	824.8	937.5	997.6
LUMBER AND WOOD PRODUCTS	7	1.5	0.1	80.1	0.6		0.5	74.5	15.2	45.5	0.4	1.6		0.9	0.4	1.7	0.6	1.7	5.9	0.5	22.6	2.6		0.1	4.3	1.3				0.1	262.6	3.5	0.1	0.1	0.1	0.1		221.5	225.4	488.0
FURNITURE AND FIXTURES	8			6.1		0.4	0.2	0.6	2.6		0.6			0.1		0.5		1.3	0.2	0.3	7.4	0.7			1.4	0.3					22.7	46.3	25.3	2.5	1.5	0.4	0.5	133.7	210.3	232.9
PAPER AND ALLIED PRODUCTS	9	2.9	0.1	6.9	41.9	27.7	3.0	1.3	2.0	174.5	38.8	15.6	2.4	3.2	0.6	3.4	0.3	3.9	1.3	1.5	3.5	4.9	0.2	1.0	14.8	7.2	2.0	0.3	0.4	1.6	367.0	3.3		1.2	1.0	0.4	0.5	842.0	848.4	1215.4
PRINTING AND PUBLISHING	10	0.1			3.9	0.1				3.5	7.6	0.3						0.9			0.2	0.8	0.5		3.2	5.8	154.3	0.4		26.3	207.9	42.7		3.8	2.2	2.9		81.3	133.1	341.0
CHEMICALS AND ALLIED PRODUCTS	11	12.8	0.9	12.5	11.0	46.1	0.3	1.2	1.1	30.6	5.2	64.2	1.8	8.2	0.4	3.1	0.7	3.8	3.7	1.5	4.4	2.3	0.5	0.7	12.0	7.9	19.3	0.1	1.7	0.4	258.5	54.1		4.6	3.6	13.1	1.7	380.8	457.9	716.4
PETROLEUM REFINING	12		0.3	16.4						0.1		1.1	0.1			0.2					0.3		0.1		0.6	0.4				19.9	0.4				8.6	0.8	19.8	29.6	49.5
RUBBER AND MISC. PLASTICS	13	0.6	2.3	10.2	7.4	16.3	3.8	0.2	7.4	4.6	0.7	7.3		2.3	2.2	1.4	0.1	1.5	3.0	4.7	9.2	4.5	1.3	0.1	4.2	1.4	3.0	0.1		0.2	100.0	13.3	0.2	0.9	0.9	2.3	0.7	128.0	145.6	245.6
LEATHER AND LEATHER PRODUCTS	14	0.1				0.5				0.1				0.1	0.5				0.1			0.3			0.3	0.1	0.1			0.2	2.6	17.9				0.1		57.3	75.2	77.8
STONE, CLAY AND GLASS PRODUCTS	15	0.4	3.7	145.7	31.1	0.2		0.2	0.3	0.3		4.5	0.7	0.9		11.2	0.1	3.1	0.6	0.9	1.8	0.4			4.6	1.2	3.2				215.1	2.1		0.1	0.1	0.5	0.1	171.0	173.9	389.0
PRIMARY METAL INDUSTRIES	16		0.5	9.8			0.1	0.3	1.1	1.6		0.7		0.4		0.8	6.0	35.9	7.4	6.7	38.8	1.6	1.0	0.2	0.6	0.3				2.4	116.2		0.1			2.5	0.1	168.6	171.3	287.5
FABRICATED METAL PRODUCTS	17	3.1	0.1	99.5	22.9	0.3	0.1	1.4	4.3	4.1	0.1	11.3	0.4	0.9	0.1	1.1	3.1	13.5	11.6	6.7	25.6	3.9	0.4		4.6	1.1	2.3			1.1	223.8	4.9	10.7	0.2	0.1	6.7	0.5	277.2	300.4	524.1
MACHINERY, EXCEPT ELECTRICAL	18	1.4	1.8	8.1	0.8	3.1		0.3	0.4	0.9	0.3	0.6		0.3		0.7	3.1	7.0	13.2	4.3	28.8	1.0	0.3	0.1	4.1	2.6	5.9			1.2	90.4	2.7	63.7	2.4	1.4	9.6	2.0	253.4	335.1	425.5
ELECTRICAL MACHINERY & EQUIP.	19	0.2	0.1	15.2	0.1									0.1		0.9	1.0	1.4	4.6	3.6	16.6	1.2	1.5	0.1	2.9	1.9	4.8			0.3	56.7	5.6	10.8	0.4	0.3	10.3	1.6	275.2	304.2	360.9
TRANSPORTATION EQUIPMENT	20	0.1	0.1	0.2				0.1	0.5	0.1	0.9	0.1		0.1		0.3	3.6	5.4	10.5	15.5	27.6	2.5	16.7		13.3	1.9	2.0			1.0	102.6	128.0	37.7	0.9	0.6	851.4	4.7	1366.2	2389.5	2492.1
MISCELLANEOUS MANUFACTURING	21			1.5	0.2	1.2	5.1	0.1	0.3	0.4	0.3	2.6		1.6	1.0	0.1	0.2	1.9	1.7	2.4	2.8	3.3		0.2	4.2	0.5	10.7			1.8	43.9	10.7	6.0	0.4	0.3	1.0	0.5	156.5	175.4	219.3
TRANSPORTATION SERVICES	22	10.2	1.3	41.5	31.3	26.2	2.3	5.8	2.0	22.3	1.5	8.6	1.0	2.0	0.3	11.2	3.9	3.7	2.0	1.8	11.8	1.1	45.5	8.0	17.9	9.4	8.6	12.3	0.4	30.9	324.8	116.7	8.1	8.5	5.7	17.7	2.5	843.3	1002.5	1327.3
COMMUNICATIONS AND UTILITIES	23	7.2	7.1	14.7	17.1	33.9	4.4	4.8	2.1	34.9	3.9	12.2	2.1	3.3	0.5	15.8	6.4	5.3	3.3	3.1	22.2	2.2	16.8	104.2	84.2	59.9	210.4	1.8	9.1		692.8	384.4	14.8	27.3	17.9	8.6	0.9	133.7	587.7	1280.5
WHOLESALE AND RETAIL TRADE	24	45.4	7.0	224.2	79.1	171.8	28.6	10.8	10.4	45.1	7.3	26.6	3.1	8.4	2.2	10.9	9.1	15.0	12.3	11.7	58.8	9.3	43.5	8.9	71.9	60.2	129.3	1.7	1.0	12.3	1125.7	2563.4	128.7	11.6	8.8	9.4	2.3	970.4	3694.6	4820.3
FINANCE, INS., REAL ESTATE	25	35.7	7.6	25.6	19.6	27.2	9.0	5.5	4.6	12.5	9.8	8.3	0.9	2.8	0.8	5.8	3.0	7.4	5.7	4.9	14.3	3.0	41.2	17.6	192.1	683.3	232.6	4.3	3.5		1388.7	1842.5	14.0	30.9	20.7	1.4	162.1	787.3	2858.8	4247.4
SERVICES	26	22.5	5.4	124.0	50.2	40.5	7.7	7.1	4.2	22.9	8.4	25.3	1.1	5.5	1.4	10.4	4.3	8.5	6.5	6.0	58.2	6.7	46.3	43.2	177.8	190.2	257.2	4.0	8.2	27.3	1180.9	1875.1		39.6	38.0	50.6	23.5	974.8	3001.6	4182.5
FEDERAL GOVERNMENT ENTERPRISE	27	0.2	0.1	0.7	1.6	3.4	1.6	0.3	0.3	1.0	2.5	0.8		0.3	0.2	0.4	0.2	0.4	0.5	0.3	2.9	0.4	2.1	3.4	30.5	29.9	34.5		0.1		118.6	22.7		2.7	2.6	1.2	0.3	72.2	101.7	220.3
STATE, LOCAL GOVT. ENTERPRISES	28	0.1	0.3	1.4	0.5	0.7	0.1	0.1		0.7	0.1	0.2		0.1		0.5	0.1	0.1	0.1	0.1	0.3		15.4	77.9	20.3	32.4	10.0	0.1	0.1		161.8	20.9		0.7	0.4	0.2	3.7	17.1	42.9	204.6
UNALLOCATED INDUSTRIES	29	2.7	1.5	13.0	6.3	12.5	3.4	1.5	1.4	24.3	4.1	6.0	0.3	1.9	0.4	3.2	7.8	3.4	3.0	2.8	20.0	2.2	9.3	6.7	35.4	37.5	74.8	1.9	0.6		288.3			7.6	6.3	1.2	3.2		18.2	306.5
TOTAL LOCAL PURCHASES	30	448.3	44.6	890.8	1003.9	964.4	312.3	147.9	68.1	449.5	93.2	218.6	17.3	57.4	14.4	134.0	55.3	126.7	98.4	80.1	388.0	57.9	279.8	313.4	760.0	1324.6	1240.5	28.2	75.5	129.6	9822.7	8199.3	1400.4	460.9	432.3	1057.0	353.9	14091.3	25995.1	35817.8
FINAL PAYMENTS	HOUSEHOLDS	31	539.0	56.0	665.0	407.9	825.7	383.0	135.6	63.3	265.3	145.5	139.6	8.9	73.9	26.6	119.6	72.9	151.7	126.8	108.9	577.7	62.5	651.0	344.0	2385.0	1934.7	1482.0	161.4	30.0		11943.6	99.7		842.0	563.4	880.0	1537.3		3922.3	15866.0
	CAPITAL RESIDUAL	32	168.5	35.6	103.7	99.0	153.5	26.6	28.5	12.4	82.5	24.9	62.6	2.1	17.8	5.7	19.9	12.8	28.7	29.2	24.8	199.5	19.2	89.1	264.7	378.3	505.1	540.5		83.8		3019.1	871.6						871.6	3890.7
	CITY AND COUNTY GOVERNMENT	33	45.5	1.8	25.8	10.2	13.3	1.4	7.0	1.3	13.4	2.0	7.5	0.3	2.4	0.3	2.8	2.9	4.1	2.2	2.4	6.9	2.0	8.1	43.6	63.0	106.6	103.6				480.3	377.9			445.9		47.3		871.1	1351.4
	STATE GOVERNMENT	34		0.7	9.3	7.6	11.4	2.7	11.0	0.7	7.2	1.8	4.7	0.1	1.7	0.5	1.0	1.3	2.7	2.0	1.4	20.7	1.6	14.2	8.6	624.3	73.9	47.9				858.8	341.9		22.1			408.8		772.8	1631.6
	FEDERAL GOVERNMENT	35		8.9	101.8	73.2	104.3	32.3	17.8	8.7	60.7	13.8	46.6	0.8	13.4	4.7	10.7	8.2	22.7	18.9	17.9	144.0	12.8	43.1	117.8	299.2	80.2	271.3				1533.9	2197.8			19.1				2216.9	3750.8
	IMPORTS	36	276.3	48.9	723.2	679.4	1618.0	239.2	140.1	78.5	336.8	59.8	236.9	20.1	79.0	25.5	101.1	134.1	187.5	147.9	125.4	1155.5	63.3	241.9	188.4	310.5	222.3	496.7	30.8	15.3	176.9	8159.2	3777.8	802.1	138.8	115.8				4834.5	12993.8
	TOTAL PURCHASES	37	1477.6	196.6	2519.6	2281.2	3690.6	997.6	488.0	232.9	1215.4	341.0	716.4	49.5	245.6	77.8	389.0	287.5	524.1	425.5	360.9	2492.1	219.3	1327.3	1280.5	4820.3	4247.4	4182.5	220.3	204.6	306.5	35817.8	15866.0	2202.5	1463.8	1576.4	1937.0	2347.3	14091.3	39434.3	75302.1

TABLE 14
DIRECT REQUIREMENTS PER DOLLAR OF GROSS OUTPUT, GEORGIA, 1970

(IN PERCENT)

		SELLING INDUSTRY																									FINAL DEMAND								
		AGRICULTURE	MINING	CONTRACT CONSTRUCTION	FOOD AND KINDRED PRODUCTS	TEXTILE MILL PRODUCTS	APPAREL AND RELATED PRODUCTS	LUMBER AND WOOD PRODUCTS	FURNITURE AND FIXTURES	PAPER AND ALLIED PRODUCTS	PRINTING AND PUBLISHING	CHEMICALS AND ALLIED PRODUCTS	PETROLEUM REFINING	RUBBER AND MISC. PLASTICS	LEATHER AND LEATHER PRODUCTS	STONE, CLAY AND GLASS PRODUCTS	PRIMARY METAL INDUSTRIES	FABRICATED METAL PRODUCTS	MACHINERY, EXCEPT ELECTRICAL	ELECTRICAL MACHINERY & EQUIP.	TRANSPORTATION EQUIPMENT	MISCELLANEOUS MANUFACTURING	TRANSPORTATION SERVICES	COMMUNICATIONS AND UTILITIES	WHOLESALE AND RETAIL TRADE	FINANCE, INS., REAL ESTATE	SERVICES	FEDERAL GOVERNMENT ENTERPRISES	STATE, LOCAL GOVT. ENTERPRISES	UNALLOCATED INDUSTRIES	TOTAL LOCAL SALES	PERSONAL CONSUMPTION EXPENDITURES	GROSS PRIVATE INVESTMENT	LOCAL GOVERNMENT	STATE GOVERNMENT	FEDERAL GOVERNMENT (DEFENSE)	FEDERAL GOVERNMENT (OTHER)	NET EXPORTS	TOTAL FINAL DEMAND	TOTAL SALES
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
PURCHASING INDUSTRY	AGRICULTURE 1	12.10		0.22	21.84	0.24	0.32	6.05				0.13							*			0.13	0.08		0.12	1.58	0.03		0.03	0.66	2.24	0.62		0.06	0.05	0.02	3.48	3.50	1.71	1.96
	MINING 2	0.11	1.29	1.01	0.02	*		*		0.57		0.37	5.58	0.09	*	11.45	0.12	*	*	*	*	0.01	*	*	0.01	0.03	*		*		0.25	*		*	*	0.21	*	0.73	0.27	0.26
	CONTRACT CONSTRUCTION 3	0.83	0.83	0.04	0.22	0.31	0.05	0.38	0.13	0.67	0.15	0.41	0.78	0.33	0.12	0.73	0.37	0.17	0.15	0.13	0.19	0.21	2.26	3.17	0.29	2.56	1.49	0.45	24.59		1.02		49.00	20.89	19.83	2.46	2.44	2.50	5.46	3.35
	FOOD AND KINDRED PRODUCTS 4	7.15	*	*	7.46	*	*	*	*	0.12	0.08	1.84	0.03	*	1.49	0.01		*	0.10			0.13	0.43	*	0.46	0.08	0.17			6.25	0.98	4.99		0.48	0.37	0.14	0.11	7.96	4.59	3.03
	TEXTILE MILL PRODUCTS 5	0.16	*	0.05	0.09	14.30	20.78	0.03	3.17	0.14	0.05	0.01	*	5.01	1.95	0.01	0.05	0.05	0.05	0.07	0.09	0.58	0.01	0.02	0.15	0.14	0.02	0.05	*	0.40	2.19	0.25	0.04	0.01	0.01	0.03	*	20.33	7.36	4.90
	APPAREL AND RELATED PRODUCTS 6	0.04	*	0.02	0.08	0.13	3.06	0.04	0.10	0.09		0.11	0.03	0.14	1.01	0.76	0.02	0.04	0.03	0.02	0.12	0.25	0.01	0.01	0.11	0.04	0.09	0.06	0.01	0.03	0.17	0.69		0.04	0.03	0.08	0.02	5.85	2.37	1.32
	LUMBER AND WOOD PRODUCTS 7	0.19	0.03	3.18	0.03	*	0.05	15.26	6.51	3.75	0.11	0.22	0.07	0.35	0.48	0.44	0.22	0.33	1.38	0.14	0.91	1.21	*	0.01	0.09	0.03		*		0.02	0.73	0.02	*	*	*	0.01	*	1.57	0.57	0.65
	FURNITURE AND FIXTURES 8			0.24	*	0.01	0.02	0.11	0.14	*	0.17	*		0.05	0.01	0.13	0.01	0.25	0.04	0.08	0.30	0.34		*	0.03	0.01		*			0.06	0.29	1.15	0.17	0.10	0.02	0.02	0.95	0.53	0.31
	PAPER AND ALLIED PRODUCTS 9	0.20	0.03	0.27	1.84	0.75	0.30	0.27	0.84	14.36	11.39	2.17	3.87	1.39	0.72	0.87	0.09	0.75	0.30	0.41	0.14	2.25	0.02	0.08	0.31	0.17	0.05	0.13	0.20	0.52	1.02	0.02		0.08	0.06	0.02	0.92	5.98	2.15	1.61
	PRINTING AND PUBLISHING 10	0.01	*	*	0.17	*	*	0.01	*	0.29	2.21	0.04	*	0.01	0.03	0.01	*	0.17	0.01	0.01	0.01	0.38	0.03	*	0.07	0.14	3.69	0.16	*	8.57	0.58	0.27		0.26	0.14	0.15	*	0.58	0.34	0.45
	CHEMICALS AND ALLIED PRODUCTS 11	0.86	0.46	0.50	0.48	1.25	0.03	0.25	0.48	2.52	1.53	8.97	3.56	3.33	0.46	0.80	0.24	0.73	0.88	0.42	0.18	1.07	0.04	0.06	0.25	0.19	0.46	0.04	0.81	0.13	0.72	0.34		0.32	0.23	0.68	0.07	2.70	1.16	0.95
	PETROLEUM REFINING 12	*	0.15	0.63	*	*	*	*	*	0.01	*	0.16	0.18	0.01	*	0.05	*	0.01	*	*	0.01	0.01	0.01	*	0.01	0.01	*	*	*	*	0.06	*		*	*	0.45	0.03	0.14	0.07	0.07
	RUBBER AND MISC. PLASTICS 13	0.04	1.19	0.40	0.32	0.44	0.38	0.04	3.19	0.38	0.20	1.03	0.03	0.93	2.87	0.35	0.04	0.29	0.69	1.31	0.37	2.06	0.10	0.01	0.09	0.03	0.07	0.04	0.01	0.08	0.28	0.08	0.01	0.06	0.05	0.12	0.01	0.91	0.37	0.33
	LEATHER AND LEATHER PRODUCTS 14	*	*	*	*	*	0.05	0.01	0.01	*	*	*	*	0.06	0.67	*	*	*	0.02	*	*	0.14	*	*	0.01	*	*	*	*	*	0.06	0.01	0.11		*	*	*	*	0.41	0.19	0.10
	STONE, CLAY AND GLASS PRODUCTS 15	0.03	1.88	5.78	1.37	0.01	*	0.03	0.14	0.02	*	0.63	1.51	0.36	*	2.88	0.04	0.58	0.15	0.25	0.07	0.17	*	*	0.19	0.03	0.08	*	*	*	0.60	0.01		0.01	0.01	0.03	*	1.21	0.44	0.52
	PRIMARY METAL INDUSTRIES 16	*	0.26	0.39	*	*	0.01	0.06	0.45	0.13	*	0.10	0.01	0.15	*	0.21	2.07	6.85	1.74	1.86	1.56	0.74	0.08	0.02	0.01	0.01	*	*	*	0.20	0.32	*	*	*	*	0.13	*	1.20	0.43	0.38
	FABRICATED METAL PRODUCTS 17	0.21	0.08	3.95	1.01	0.01	0.01	0.30	1.85	0.33	0.04	1.58	0.89	0.37	0.08	0.29	1.08	2.58	2.72	1.85	1.03	1.76	0.03	*	0.09	0.02	0.06	0.01	*	0.37	0.62	0.03	0.49	0.02	0.01	0.35	0.02	1.97	0.76	0.70
	MACHINERY, EXCEPT ELECTRICAL 18	0.10	0.92	0.32	0.03	0.08	*	0.06	0.16	0.08	0.08	0.08	0.02	0.13	0.01	0.19	1.07	1.34	3.11	1.19	1.16	0.44	0.03	*	0.08	0.06	0.14	*	0.01	0.39	0.25	0.02	2.89	0.16	0.09	0.49	0.08	1.80	0.85	0.56
	ELECTRICAL MACHINERY & EQUIP. 19	0.02	0.07	0.69	*	*	*	0.01	0.01	*	0.01	0.01	0.01	0.04	*	0.24	0.36	0.26	1.08	0.99	0.66	0.55	0.11	0.01	0.06	0.04	0.12	0.01	0.01	0.09	0.16	0.04	0.49	0.08	0.02	0.53	0.07	1.95	0.77	0.48
	TRANSPORTATION EQUIPMENT 20	0.01	0.07	0.01	*	*	*	0.01	0.21	*	0.25	0.01	*	0.03	*	0.09	1.25	1.03	2.48	4.29	1.11	1.13	1.26	*	0.28	0.05	0.05	0.01	*	0.33	0.29	0.81	1.71	0.06	0.04	43.96	0.20	9.79	6.85	3.31
	MISCELLANEOUS MANUFACTURING 21	*	*	0.06	0.01	0.03	0.51	0.03	0.11	0.03	0.08	0.36	*	0.63	1.25	0.03	0.07	0.37	0.40	0.66	0.11	1.49	*	0.02	0.09	0.01	0.25	*	*	0.59	0.12	0.07	0.27	0.03	0.02	0.05	0.02	1.11	0.44	0.29
	TRANSPORTATION SERVICES 22	0.69	0.67	1.65	1.37	0.71	0.23	1.19	0.88	1.84	0.44	1.20	1.98	0.80	0.43	2.87	1.37	0.71	0.46	0.50	0.47	0.48	3.43	0.62	0.37	0.22	0.21	5.56	0.19	10.08	0.91	0.74	0.37	0.58	0.36	0.92	0.11	5.98	2.54	1.76
	COMMUNICATIONS AND UTILITIES 23	0.49	3.62	0.58	0.75	0.92	0.44	0.98	0.89	2.87	1.13	1.71	4.26	1.34	0.61	4.06	2.23	1.01	0.77	0.86	0.89	1.00	1.26	8.14	1.75	1.41	5.03	0.80	4.43		1.93	2.42	0.67	1.37	1.13	0.44	0.04	0.95	1.49	1.70
	WHOLESALE AND RETAIL TRADE 24	3.07	3.54	8.90	3.47	4.65	2.87	2.21	4.45	3.71	2.13	3.71	6.35	3.42	2.82	2.80	3.18	2.87	2.89	3.23	2.36	4.26	3.28	0.69	1.49	1.42	3.09	0.77	0.49	4.02	3.14	16.16	5.84	0.89	0.56	0.48	0.10	6.89	9.36	6.40
	FINANCE, INS., REAL ESTATE 25	2.42	3.87	1.02	0.86	0.74	0.91	1.13	1.98	1.03	2.88	1.16	1.87	1.13	1.02	1.48	1.04	1.41	1.33	1.35	0.57	1.37	3.19	1.38	3.99	16.09	5.56	1.94	1.73		3.88	11.61	0.64	2.11	1.31	0.07	6.91	5.59	7.24	5.64
	SERVICES 26	1.53	2.75	4.92	2.20	1.10	0.77	1.46	1.80	1.88	2.46	3.53	2.21	2.23	1.76	2.67	1.49	1.63	1.52	1.67	2.34	3.05	3.49	3.37	3.69	4.48	6.15	1.83	3.99	8.89	3.30	11.82		2.71	2.41	2.61	1.00	6.92	7.60	5.55
	FEDERAL GOVERNMENT ENTERPRISES 27	0.01	0.06	0.03	0.07	0.09	0.16	0.05	0.12	0.09	0.74	0.11	0.07	0.10	0.24	0.19	0.06	0.08	0.11	0.09	0.12	0.20	0.15	0.26	0.63	0.70	0.83	0.01	0.04		0.33	0.14		0.19	0.17	0.06	0.01	0.51	0.26	0.29
	STATE, LOCAL GOVT. ENTERPRISES 28	*	0.17	0.05	0.03	0.02	0.01	0.02	0.01	0.06	0.02	0.03	0.03	0.02	0.01	0.12	0.03	0.01	0.01	0.01	0.01	0.02	1.16	6.09	0.42	0.76	0.24	0.05	0.04		0.45	0.13		0.04	0.03	0.01	0.16	0.12	0.11	0.27
	UNALLOCATED INDUSTRIES 29	0.18	0.75	0.52	0.30	0.34	0.34	0.31	0.60	2.00	1.19	0.84	0.52	0.79	0.48	0.83	2.72	0.64	0.71	0.78	0.80	0.99	0.70	0.52	0.73	0.88	1.79	0.86	0.28		0.80			0.52	0.40	0.06	0.14		0.05	0.41
	TOTAL LOCAL PURCHASES 30	30.34	22.69	35.35	44.91	26.13	31.31	30.30	29.23	36.98	27.34	30.51	34.91	23.37	18.53	34.46	19.25	24.17	23.14	22.19	15.57	26.40	21.08	24.48	15.77	31.19	29.66	12.78	36.89	42.27	27.42	51.68	63.58	31.49	27.42	54.57	15.06	100.00	65.84	47.57
FINAL PAYMENTS	HOUSEHOLDS 31	36.48	28.48	26.39	17.89	22.37	38.40	27.80	27.19	21.83	42.68	19.48	17.97	30.10	34.23	30.73	25.35	28.94	29.81	30.17	23.18	28.53	49.05	26.86	49.42	45.55	35.43	73.26	14.67		33.35	0.63		57.52	35.74	45.43	65.49		9.93	21.07
	CAPITAL RESIDUAL 32	11.41	18.13	4.12	4.34	4.16	2.66	5.84	5.33	6.79	7.31	8.73	4.38	7.24	7.33	5.12	4.46	5.48	6.86	6.88	8.90	8.76	6.72	20.67	7.85	11.80	12.92		40.96		8.43	5.49							2.21	5.17
	CITY AND COUNTY GOVERNMENT 33	3.08	0.93	1.02	0.45	0.36	0.14	1.43	0.55	1.10	0.58	1.05	0.58	0.98	0.42	0.71	1.01	0.78	0.51	0.68	0.28	0.89	0.61	3.40	1.31	2.51	2.48				1.34	2.38			28.29		2.02		2.21	1.79
	STATE GOVERNMENT 34		0.34	0.37	0.33	0.31	0.27	2.25	0.28	0.60	0.52	0.66	0.17	0.68	0.70	0.25	0.44	0.52	0.47	0.39	0.83	0.72	1.07	0.67	12.95	1.74	1.15				2.40	2.15		1.51		17.41		1.96	2.17
	FEDERAL GOVERNMENT 35		4.54	4.04	3.21	2.83	3.24	3.65	3.74	4.99	4.05	6.50	1.56	5.46	6.04	2.75	2.85	4.33	4.45	4.97	5.78	5.58	3.25	9.20	6.21	1.89	6.49				4.28	13.85			1.21			5.61	4.98
	IMPORTS 36	18.70	24.89	28.70	29.78	43.84	23.98	28.72	33.68	27.71	17.53	33.06	40.52	32.17	32.75	25.98	46.65	35.78	34.77	34.74	46.37	28.85	18.23	14.71	6.44	5.23	11.88	13.96	7.48	57.73	22.78	23.31	36.42	9.49	7.35				12.34	17.26
	TOTAL PURCHASES 37	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Less than 0.005.

TABLE 15
TOTAL REQUIREMENTS (DIRECT AND INDIRECT) PER DOLLAR OF DELIVERY TO FINAL DEMAND, GEORGIA, 1970[1]

SUPPORTING INDUSTRY		DELIVERING INDUSTRY: 1 AGRICULTURE	2 MINING	3 CONTRACT CONSTRUCTION	4 FOOD AND KINDRED PRODUCTS	5 TEXTILE MILL PRODUCTS	6 APPAREL AND RELATED PRODUCTS	7 LUMBER AND WOOD PRODUCTS	8 FURNITURE AND FIXTURES	9 PAPER AND ALLIED PRODUCTS	10 PRINTING AND PUBLISHING	11 CHEMICALS AND ALLIED PRODUCTS	12 PETROLEUM REFINING	13 RUBBER AND MISC. PLASTICS	14 LEATHER AND LEATHER PRODUCTS	15 STONE, CLAY AND GLASS PRODUCTS	16 PRIMARY METAL INDUSTRIES	17 FABRICATED METAL PRODUCTS	18 MACHINERY, EXCEPT ELECTRICAL	19 ELECTRICAL MACHINERY & EQUIP.	20 TRANSPORTATION EQUIPMENT	21 MISCELLANEOUS MANUFACTURING	22 TRANSPORTATION SERVICES	23 COMMUNICATIONS AND UTILITIES	24 WHOLESALE AND RETAIL TRADE	25 FINANCE, INS., REAL ESTATE	26 SERVICES	27 FEDERAL GOVERNMENT ENTERPRISES	28 STATE, LOCAL GOVT. ENTERPRISES	29 UNALLOCATED INDUSTRIES
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
AGRICULTURE	1	1.1611	0.0016	0.0064	0.2749	0.0041	0.0053	0.0836	0.0067	0.0056	0.0023	0.0085	0.0019	0.0017	0.0054	0.0018	0.0015	0.0013	0.0024	0.0011	0.0015	0.0042	0.0036	0.0011	0.0041	0.0230	0.0032	0.0010	0.0027	0.0259
MINING	2	0.0019	1.0158	0.0178	0.0027	0.0003	0.0002	0.0004	0.0005	0.0073	0.0011	0.0055	0.0594	0.0018	0.0003	0.1201	0.0015	0.0011	0.0005	0.0005	0.0003	0.0008	0.0006	0.0010	0.0004	0.0012	0.0007	0.0002	0.0046	0.0005
CONTRACT CONSTRUCTION	3	0.0125	0.0139	1.0052	0.0090	0.0058	0.0030	0.0077	0.0048	0.0126	0.0060	0.0005	0.0145	0.0065	0.0034	0.0143	0.0069	0.0046	0.0040	0.0038	0.0039	0.0054	0.0296	0.0530	0.0076	0.0357	0.0224	0.0080	0.2514	0.0066
FOOD AND KINDRED PRODUCTS	4	0.0906	0.0014	0.0021	1.1030	0.0015	0.0012	0.0073	0.0017	0.0049	0.0031	0.0239	0.0027	0.0021	0.0176	0.0017	0.0026	0.0014	0.0025	0.0013	0.0011	0.0034	0.0062	0.0009	0.0063	0.0041	0.0042	0.0012	0.0013	0.0712
TEXTILE MILL PRODUCTS	5	0.0027	0.0011	0.0016	0.0025	1.1678	0.2508	0.0010	0.0400	0.0029	0.0013	0.0016	0.0007	0.0003	0.0275	0.0028	0.0011	0.0013	0.0015	0.0021	0.0020	0.0094	0.0006	0.0006	0.0024	0.0023	0.0010	0.0010	0.0006	0.0055
APPAREL AND RELATED PRODUCTS	6	0.0007	0.0003	0.0010	0.0013	0.0017	1.0321	0.0007	0.0014	0.0013	0.0003	0.0016	0.0007	0.0038	0.0108	0.0083	0.0004	0.0007	0.0006	0.0005	0.0014	0.0029	0.0003	0.0002	0.0013	0.0006	0.0012	0.0007	0.0004	0.0007
LUMBER AND WOOD PRODUCTS	7	0.0023	0.0014	0.0390	0.0024	0.0009	0.0012	1.1809	0.0789	0.0525	0.0080	0.0049	0.0045	0.0057	0.0067	0.0068	0.0036	0.0056	0.0179	0.0032	0.0117	0.0168	0.0015	0.0023	0.0017	0.0021	0.0015	0.0005	0.0100	0.0020
FURNITURE AND FIXTURES	8	0.0001	0.0001	0.0028	0.0001	0.0002	0.0003	0.0014	1.0117	0.0002	0.0018	0.0001	0.0001	0.0006	0.0002	0.0015	0.0002	0.0027	0.0007	0.0010	0.0031	0.0036	0.0001	0.0002	0.0003	0.0002	0.0002	0.0000	0.0007	0.0003
PAPER AND ALLIED PRODUCTS	9	0.0056	0.0019	0.0062	0.0259	0.0114	0.0066	0.0047	0.0122	1.1705	0.1377	0.0300	0.0594	0.0179	0.0106	0.0120	0.0024	0.0106	0.0053	0.0065	0.0027	0.0093	0.0014	0.0020	0.0047	0.0038	0.0074	0.0023	0.0047	0.0209
PRINTING AND PUBLISHING	10	0.0019	0.0025	0.0035	0.0041	0.0014	0.0012	0.0016	0.0021	0.0072	1.0261	0.0037	0.0027	0.0024	0.0021	0.0029	0.0037	0.0038	0.0021	0.0022	0.0022	0.0069	0.0031	0.0026	0.0034	0.0053	0.0428	0.0036	0.0031	0.0926
CHEMICALS AND ALLIED PRODUCTS	11	0.0123	0.0068	0.0082	0.0102	0.0170	0.0046	0.0047	0.0084	0.0337	0.0217	1.1010	0.0423	0.0390	0.0075	0.0111	0.0036	0.0097	0.0114	0.0064	0.0030	0.0147	0.0015	0.0022	0.0037	0.0038	0.0072	0.0009	0.0115	0.0054
PETROLEUM REFINING	12	0.0001	0.0016	0.0066	0.0001	0.0001	0.0000	0.0001	0.0001	0.0003	0.0001	0.0018	1.0021	0.0002	0.0000	0.0008	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0003	0.0004	0.0002	0.0004	0.0002	0.0001	0.0017	0.0001
RUBBER AND MISC. PLASTICS	13	0.0012	0.0127	0.0052	0.0042	0.0056	0.0054	0.0008	0.0332	0.0052	0.0031	0.0120	0.0020	1.0106	0.0299	0.0057	0.0009	0.0037	0.0080	0.0142	0.0043	0.0220	0.0014	0.0005	0.0012	0.0008	0.0013	0.0006	0.0016	0.0019
LEATHER AND LEATHER PRODUCTS	14	0.0001	0.0000	0.0000	0.0000	0.0000	0.0006	0.0001	0.0002	0.0001	0.0000	0.0001	0.0000	0.0006	1.0068	0.0001	0.0001	0.0001	0.0003	0.0001	0.0000	0.0015	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0006
STONE, CLAY AND GLASS PRODUCTS	15	0.0026	0.0207	0.0608	0.0164	0.0007	0.0004	0.0011	0.0022	0.0016	0.0007	0.0083	0.0181	0.0046	0.0008	1.0331	0.0011	0.0067	0.0023	0.0032	0.0012	0.0026	0.0020	0.0033	0.0017	0.0027	0.0024	0.0006	0.0154	0.0017
PRIMARY METAL INDUSTRIES	16	0.0005	0.0033	0.0075	0.0011	0.0002	0.0003	0.0012	0.0064	0.0024	0.0006	0.0028	0.0014	0.0023	0.0004	0.0032	1.0229	0.0727	0.0213	0.0218	0.0175	0.0098	0.0014	0.0007	0.0005	0.0006	0.0006	0.0002	0.0029	0.0090
FABRICATED METAL PRODUCTS	17	0.0043	0.0021	0.0419	0.0128	0.0009	0.0006	0.0044	0.0203	0.0056	0.0018	0.0190	0.0110	0.0052	0.0019	0.0045	0.0125	1.0286	0.0303	0.0209	0.0119	0.0199	0.0020	0.0024	0.0017	0.0021	0.0021	0.0006	0.0107	0.0057
MACHINERY, EXCEPT ELECTRICAL	18	0.0015	0.0101	0.0047	0.0011	0.0012	0.0004	0.0011	0.0024	0.0015	0.0013	0.0016	0.0014	0.0018	0.0004	0.0036	0.0120	0.0154	1.0334	0.0137	0.0127	0.0055	0.0008	0.0004	0.0012	0.0012	0.0020	0.0002	0.0014	0.0038
ELECTRICAL MACHINERY & EQUIP.	19	0.0004	0.0011	0.0067	0.0004	0.0002	0.0001	0.0003	0.0004	0.0003	0.0003	0.0004	0.0005	0.0007	0.0002	0.0029	0.0041	0.0034	0.0118	1.0108	0.0071	0.0060	0.0016	0.0005	0.0008	0.0009	0.0015	0.0002	0.0019	0.0014
TRANSPORTATION EQUIPMENT	20	0.0005	0.0014	0.0018	0.0007	0.0004	0.0003	0.0006	0.0030	0.0009	0.0031	0.0009	0.0009	0.0009	0.0005	0.0020	0.0140	0.0126	0.0273	0.0451	1.0125	0.0128	0.0135	0.0003	0.0031	0.0009	0.0011	0.0010	0.0006	0.0057
MISCELLANEOUS MANUFACTURING	21	0.0003	0.0004	0.0013	0.0004	0.0006	0.0057	0.0005	0.0017	0.0009	0.0012	0.0045	0.0006	0.0069	0.0132	0.0007	0.0012	0.0042	0.0047	0.0072	0.0015	1.0158	0.0003	0.0005	0.0011	0.0005	0.0031	0.0002	0.0006	0.0066
TRANSPORTATION SERVICES	22	0.0112	0.0102	0.0224	0.0204	0.0104	0.0058	0.0166	0.0131	0.0274	0.0106	0.0175	0.0257	0.0118	0.0070	0.0346	0.0187	0.0111	0.0079	0.0082	0.0073	0.0091	1.0381	0.0096	0.0063	0.0062	0.0070	0.0592	0.0089	0.1083
COMMUNICATIONS AND UTILITIES	23	0.0110	0.0460	0.0182	0.0167	0.0153	0.0102	0.0162	0.0162	0.0426	0.0215	0.0275	0.0574	0.0206	0.0110	0.0560	0.0285	0.0173	0.0134	0.0144	0.0137	0.0179	0.0198	1.0961	0.0239	0.0241	0.0630	0.0121	0.0565	0.0124
WHOLESALE AND RETAIL TRADE	24	0.0439	0.0432	0.1014	0.0536	0.0590	0.0447	0.0329	0.0555	0.0530	0.0327	0.0500	0.0767	0.0443	0.0359	0.0413	0.0387	0.0375	0.0371	0.0400	0.0292	0.0527	0.0412	0.0161	1.0202	0.0253	0.0410	0.0127	0.0336	0.0569
FINANCE, INS., REAL ESTATE	25	0.0397	0.0542	0.0268	0.0269	0.0159	0.0176	0.0230	0.0324	0.0235	0.0428	0.0245	0.0357	0.0209	0.0181	0.0322	0.0186	0.0238	0.0225	0.0225	0.0123	0.0252	0.0451	0.0248	0.0532	1.1999	0.0775	0.0283	0.0323	0.0200
SERVICES	26	0.0275	0.0397	0.0655	0.0383	0.0199	0.0162	0.0251	0.0293	0.0357	0.0377	0.0508	0.0389	0.0328	0.0256	0.0431	0.0251	0.0260	0.0245	0.0261	0.0305	0.0426	0.0471	0.0485	0.0463	0.0642	1.0792	0.0258	0.0636	0.1095
FEDERAL GOVERNMENT ENTERPRISES	27	0.0011	0.0019	0.0020	0.0018	0.0018	0.0025	0.0013	0.0023	0.0021	0.0086	0.0023	0.0022	0.0020	0.0032	0.0023	0.0014	0.0017	0.0019	0.0018	0.0018	0.0031	0.0027	0.0037	0.0074	0.0093	0.0103	1.0008	0.0017	0.0024
STATE, LOCAL GOVT. ENTERPRISES	28	0.0014	0.0054	0.0028	0.0022	0.0017	0.0012	0.0018	0.0019	0.0041	0.0023	0.0027	0.0049	0.0021	0.0012	0.0059	0.0026	0.0017	0.0014	0.0016	0.0014	0.0019	0.0140	0.0073	0.0064	0.0110	0.0073	0.0022	1.0040	0.0027
UNALLOCATED INDUSTRIES	29	0.0041	0.0102	0.0093	0.0064	0.0056	0.0056	0.0053	0.0089	0.0260	0.0169	0.0123	0.0101	0.0105	0.0068	0.0122	0.0296	0.0105	0.0099	0.0106	0.0101	0.0134	0.0095	0.0077	0.0094	0.0127	0.0218	0.0100	0.0068	1.0058
TOTAL LOCAL PURCHASES	30	1.4428	1.3109	1.4789	1.6388	1.3515	1.4241	1.4265	1.3981	1.5320	1.3949	1.4287	1.4786	1.3206	1.2550	1.4672	1.2596	1.3200	1.3070	1.2910	1.2079	1.3593	1.2893	1.3488	1.2205	1.4449	1.4131	1.1742	1.5347	1.5370

[1]Each entry approximates the total output required from the sector at the beginning of each row for every dollar of delivery to final demand by the sector numbered at the head of each column.

TABLE 16

TOTAL REQUIREMENTS (DIRECT, INDIRECT, AND INDUCED) PER DOLLAR OF DELIVERY TO FINAL DEMAND, GEORGIA, 1970[1]

SUPPORTING INDUSTRY		DELIVERING INDUSTRY																													
		AGRICULTURE	MINING	CONTRACT CONSTRUCTION	FOOD AND KINDRED PRODUCTS	TEXTILE MILL PRODUCTS	APPAREL AND RELATED PRODUCTS	LUMBER AND WOOD PRODUCTS	FURNITURE AND FIXTURES	PAPER AND ALLIED PRODUCTS	PRINTING AND PUBLISHING	CHEMICALS AND ALLIED PRODUCTS	PETROLEUM REFINING	RUBBER AND MISC. PLASTICS	LEATHER AND LEATHER PRODUCTS	STONE, CLAY AND GLASS PRODUCTS	PRIMARY METAL INDUSTRIES	FABRICATED METAL PRODUCTS	MACHINERY, EXCEPT ELECTRICAL	ELECTRICAL MACHINERY & EQUIP.	TRANSPORTATION EQUIPMENT	MISCELLANEOUS MANUFACTURING	TRANSPORTATION SERVICES	COMMUNICATIONS AND UTILITIES	WHOLESALE AND RETAIL TRADE	FINANCE, INS., REAL ESTATE	SERVICES	FEDERAL GOVERNMENT ENTERPRISES	STATE, LOCAL GOVT. ENTERPRISES	UNALLOCATED INDUSTRIES	HOUSEHOLDS
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
AGRICULTURE	1	1.1788	0.0152	0.0214	0.2883	0.0154	0.0228	0.0980	0.0206	0.0184	0.0213	0.0197	0.0135	0.0155	0.0201	0.0176	0.0131	0.0148	0.0161	0.0147	0.0118	0.0180	0.0242	0.0138	0.0239	0.0447	0.0205	0.0286	0.0133	0.0334	0.0345
MINING	2	0.0022	1.0160	0.0182	0.0030	0.0006	0.0005	0.0007	0.0008	0.0076	0.0015	0.0058	0.0596	0.0021	0.0006	0.1205	0.0018	0.0014	0.0008	0.0008	0.0005	0.0011	0.0010	0.0013	0.0009	0.0016	0.0010	0.0008	0.0048	0.0007	0.0008
CONTRACT CONSTRUCTION	3	0.0200	0.0196	1.0115	0.0139	0.0106	0.0104	0.0138	0.0107	0.0181	0.0140	0.0132	0.0194	0.0123	0.0096	0.0210	0.0118	0.0103	0.0098	0.0096	0.0083	0.0113	0.0383	0.0584	0.0160	0.0448	0.0298	0.0197	0.2559	0.0093	0.0146
FOOD AND KINDRED PRODUCTS	4	0.1317	0.0329	0.0369	1.1344	0.0279	0.0419	0.0408	0.0340	0.0347	0.0472	0.0499	0.0296	0.0341	0.0518	0.0387	0.0294	0.0327	0.0342	0.0329	0.0252	0.0357	0.0539	0.0305	0.0524	0.0544	0.0445	0.0655	0.0261	0.0885	0.0803
TEXTILE MILL PRODUCTS	5	0.0068	0.0043	0.0051	0.0056	1.1705	0.2549	0.0043	0.0432	0.0059	0.0058	0.0042	0.0034	0.0635	0.0310	0.0065	0.0038	0.0045	0.0047	0.0053	0.0044	0.0126	0.0053	0.0035	0.0070	0.0074	0.0051	0.0074	0.0031	0.0072	0.0080
APPAREL AND RELATED PRODUCTS	6	0.0061	0.0045	0.0056	0.0054	0.0052	1.0375	0.0051	0.0056	0.0052	0.0061	0.0050	0.0043	0.0081	0.0153	0.0132	0.0039	0.0048	0.0048	0.0047	0.0046	0.0072	0.0066	0.0041	0.0074	0.0073	0.0065	0.0092	0.0037	0.0091	0.0107
LUMBER AND WOOD PRODUCTS	7	0.0035	0.0023	0.0399	0.0033	0.0017	0.0023	1.1818	0.0799	0.0534	0.0092	0.0056	0.0052	0.0065	0.0077	0.0078	0.0043	0.0065	0.0188	0.0041	0.0124	0.0177	0.0028	0.0031	0.0030	0.0035	0.0026	0.0022	0.0106	0.0024	0.0022
FURNITURE AND FIXTURES	8	0.0023	0.0018	0.0046	0.0018	0.0016	0.0024	0.0032	1.0134	0.0018	0.0042	0.0015	0.0016	0.0023	0.0020	0.0035	0.0016	0.0044	0.0024	0.0027	0.0044	0.0054	0.0027	0.0017	0.0028	0.0029	0.0023	0.0035	0.0020	0.0022	0.0043
PAPER AND ALLIED PRODUCTS	9	0.0087	0.0043	0.0088	0.0283	0.0134	0.0097	0.0073	0.0147	1.1728	0.1410	0.0320	0.0614	0.0204	0.0132	0.0148	0.0045	0.0129	0.0077	0.0089	0.0045	0.0317	0.0050	0.0043	0.0082	0.0077	0.0104	0.0072	0.0066	0.0222	0.0061
PRINTING AND PUBLISHING	10	0.0084	0.0076	0.0092	0.0092	0.0057	0.0078	0.0070	0.0074	0.0121	1.0332	0.0079	0.0071	0.0076	0.0076	0.0089	0.0080	0.0089	0.0072	0.0073	0.0061	0.0121	0.0108	0.0074	0.0108	0.0134	0.0494	0.0140	0.0072	0.0955	0.0130
CHEMICALS AND ALLIED PRODUCTS	11	0.0170	0.0103	0.0121	0.0138	0.0200	0.0092	0.0085	0.0121	0.0371	0.0267	1.1040	0.0454	0.0427	0.0114	0.0152	0.0067	0.0132	0.0150	0.0100	0.0057	0.0184	0.0069	0.0055	0.0089	0.0095	0.0117	0.0082	0.0143	0.0073	0.0091
PETROLEUM REFINING	12	0.0003	0.0017	0.0067	0.0002	0.0002	0.0001	0.0002	0.0002	0.0004	0.0002	0.0019	1.0021	0.0003	0.0001	0.0009	0.0001	0.0002	0.0001	0.0001	0.0002	0.0002	0.0004	0.0004	0.0003	0.0005	0.0003	0.0002	0.0018	0.0001	0.0002
RUBBER AND MISC. PLASTICS	13	0.0024	0.0137	0.0063	0.0052	0.0064	0.0067	0.0019	0.0342	0.0062	0.0045	0.0129	0.0029	1.0116	0.0310	0.0068	0.0017	0.0047	0.0090	0.0152	0.0051	0.0230	0.0029	0.0014	0.0026	0.0024	0.0026	0.0026	0.0024	0.0024	0.0025
LEATHER AND LEATHER PRODUCTS	14	0.0009	0.0007	0.0007	0.0007	0.0006	0.0014	0.0008	0.0008	0.0007	0.0009	0.0006	0.0006	0.0013	1.0075	0.0008	0.0006	0.0007	0.0009	0.0007	0.0005	0.0022	0.0010	0.0006	0.0010	0.0011	0.0009	0.0013	0.0005	0.0009	0.0016
STONE, CLAY AND GLASS PRODUCTS	15	0.0040	0.0218	0.0621	0.0175	0.0016	0.0018	0.0023	0.0033	0.0027	0.0022	0.0093	0.0191	0.0057	0.0019	1.0344	0.0021	0.0078	0.0034	0.0043	0.0021	0.0037	0.0037	0.0044	0.0033	0.0044	0.0038	0.0028	0.0162	0.0033	0.0028
PRIMARY METAL INDUSTRIES	16	0.0009	0.0036	0.0078	0.0014	0.0005	0.0007	0.0015	0.0067	0.0027	0.0010	0.0030	0.0017	0.0026	0.0007	0.0036	1.0231	0.0729	0.0216	0.0221	0.0177	0.0100	0.0018	0.0009	0.0009	0.0010	0.0009	0.0008	0.0022	0.0093	0.0007
FABRICATED METAL PRODUCTS	17	0.0058	0.0032	0.0432	0.0140	0.0018	0.0021	0.0056	0.0215	0.0067	0.0034	0.0199	0.0120	0.0064	0.0031	0.0058	0.0135	1.0298	0.0314	0.0221	0.0127	0.0210	0.0037	0.0034	0.0033	0.0040	0.0035	0.0029	0.0116	0.0069	0.0029
MACHINERY, EXCEPT ELECTRICAL	18	0.0022	0.0106	0.0053	0.0017	0.0016	0.0011	0.0017	0.0029	0.0020	0.0020	0.0021	0.0018	0.0023	0.0010	0.0042	0.0124	0.0160	1.0339	0.0143	0.0131	0.0060	0.0016	0.0009	0.0019	0.0020	0.0026	0.0013	0.0018	0.0051	0.0013
ELECTRICAL MACHINERY & EQUIP.	19	0.0010	0.0016	0.0072	0.0008	0.0006	0.0008	0.0008	0.0009	0.0008	0.0010	0.0008	0.0009	0.0011	0.0008	0.0035	0.0046	0.0039	0.0123	1.0113	0.0075	0.0065	0.0023	0.0010	0.0015	0.0017	0.0022	0.0012	0.0022	0.0017	0.0012
TRANSPORTATION EQUIPMENT	20	0.0070	0.0064	0.0072	0.0057	0.0046	0.0068	0.0059	0.0081	0.0056	0.0100	0.0050	0.0052	0.0060	0.0059	0.0078	0.0182	0.0175	0.0323	0.0501	1.0162	0.0179	0.0211	0.0050	0.0104	0.0088	0.0075	0.0112	0.0045	0.0084	0.0127
MISCELLANEOUS MANUFACTURING	21	0.0013	0.0012	0.0021	0.0012	0.0013	0.0067	0.0014	0.0025	0.0017	0.0023	0.0051	0.0012	0.0077	0.0141	0.0016	0.0019	0.0050	0.0055	0.0080	0.0021	1.0166	0.0015	0.0012	0.0023	0.0017	0.0041	0.0018	0.0012	0.0070	0.0020
TRANSPORTATION SERVICES	22	0.0196	0.0167	0.0295	0.0268	0.0158	0.0141	0.0235	0.0198	0.0335	0.0197	0.0229	0.0313	0.0184	0.0140	0.0423	0.0242	0.0176	0.0145	0.0147	0.0123	0.0157	1.0479	0.0157	0.0158	0.0166	0.0153	0.0725	0.0140	0.1119	0.0166
COMMUNICATIONS AND UTILITIES	23	0.0410	0.0691	0.0437	0.0396	0.0347	0.0399	0.0408	0.0398	0.0644	0.0537	0.0465	0.0771	0.0441	0.0360	0.0830	0.0481	0.0402	0.0367	0.0376	0.0313	0.0415	0.0548	1.1178	0.0576	0.0609	0.0925	0.0591	0.0746	0.0281	0.0588
WHOLESALE AND RETAIL TRADE	24	0.1703	0.1401	0.2083	0.1502	0.1402	0.1697	0.1361	0.1547	0.1447	0.1682	0.1297	0.1595	0.1429	0.1409	0.1549	0.1212	0.1339	0.1348	0.1374	0.1031	0.1519	0.1882	0.1070	1.1619	0.1801	0.1649	0.2104	0.1099	0.3178	0.2469
FINANCE, INS., REAL ESTATE	25	0.1538	0.1417	0.1233	0.1141	0.0893	0.1305	0.1162	0.1219	0.1063	0.1651	0.0965	0.1104	0.1099	0.1129	0.1347	0.0931	0.1108	0.1107	0.1104	0.0790	0.1148	0.1778	0.1070	0.1812	1.3397	0.1893	0.2068	0.1012	0.0682	0.2229
SERVICES	26	0.1322	0.1201	0.1541	0.1183	0.0872	0.1197	0.1106	0.1115	0.1116	0.1499	0.1169	0.1074	0.1145	0.1126	0.1372	0.0935	0.1058	0.1054	0.1068	0.0917	0.1247	0.1689	0.1238	0.1657	0.1924	1.1818	0.1895	0.1268	0.1519	0.2045
FEDERAL GOVERNMENT ENTEPPPISES	27	0.0048	0.0047	0.0051	0.0047	0.0042	0.0062	0.0044	0.0052	0.0048	0.0126	0.0047	0.0046	0.0049	0.0063	0.0056	0.0038	0.0045	0.0048	0.0047	0.0040	0.0060	0.0070	0.0062	0.0115	0.0138	0.0139	1.0066	0.0040	0.0240	0.0072
STATE, LOCAL GOVT. ENTERPRISES	28	0.0060	0.0088	0.0067	0.0057	0.0046	0.0057	0.0056	0.0054	0.0074	0.0072	0.0036	0.0079	0.0056	0.0050	0.0099	0.0056	0.0052	0.0049	0.0051	0.0040	0.0055	0.0192	0.0705	0.0115	0.0166	0.0118	0.0094	1.0074	0.0047	0.0089
UNALLOCATED INDUSTRIES	29	0.0087	0.0137	0.0132	0.0099	0.0085	0.0102	0.0090	0.0125	0.0293	0.0219	0.0152	0.0131	0.0141	0.0107	0.0163	0.0326	0.0140	0.0135	0.0142	0.0129	0.0170	0.0148	0.0110	0.0146	0.0184	0.0263	0.0172	0.0096	1.0077	0.0090
HOUSEHOLDS	30	0.7115	0.5460	0.6019	0.5437	0.4576	0.7037	0.5812	0.5582	0.5162	0.7628	0.4491	0.4659	0.5553	0.5916	0.6396	0.4646	0.5425	0.5500	0.5483	0.4161	0.5585	0.8274	0.5123	0.7980	0.8713	0.6972	1.1131	0.4298	0.3017	1.3903
TOTAL LOCAL PURCHASES	31	2.6592	2.2443	2.5078	2.5688	2.1338	2.6272	2.4202	2.3523	2.4144	2.6990	2.1964	2.2751	2.2699	2.2664	2.5606	2.0539	2.2475	2.2472	2.2283	1.9193	2.3141	2.7038	2.2245	2.5847	2.9344	2.6050	3.0771	2.2695	2.1111	2.3767

[1]Each entry approximates the total output required from the sector at the beginning of each row for every dollar of delivery to final demand by the sector numbered at the head of each column.

APPENDIX B

This Appendix contains the computer printout of the Georgia Input-Output Model, 1970.

Table 4. Total Requirements Matrix $(R=(I-A)^{-1})$

TABLE 4. TOTAL REQUIREMENTS (DIRECT, INDIRECT, AND INDUCED) PER DOLLAR OF DELIVERY TO FINAL DEMAND GEORGIA, 1970

(EACH ENTRY APPROXIMATES THE TOTAL OUTPUT REQUIRED FROM THE SECTOR AT THE BEGINNING OF EACH ROWFOR EVERY DOLLAR OF DELIVERY TO FINAL DEMAND BY THE SECTOR NUMBERED AT THE HEAD OF EACH COLUMN)

		PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE)						
	SELLING INDUSTRY	1	2	3	4	5	6	7
1	AGRICULTURE [SIC 01, 07-9]	1.1869	.0228	.0273	.2941	.0197	.0279	.1047
2	MINING [SIC 10-4]	.0056	1.0196	.0205	.0054	.0023	.0026	.0033
3	CONTRACT CONSTRUCTION [SIC 15-7]	.2055	.2156	1.1397	.1448	.1067	.1230	.1534
4	FOOD AND KINDRED PRODUCTS [SIC 20-1]	.1480	.0478	.0488	1.1459	.0364	.0522	.0543
5	TEXTILE MILL PRODUCTS [SIC 22]	.0090	.0064	.0067	.0072	1.1717	.2563	.0061
6	APPAREL AND RELATED PRODUCTS [SIC 23]	.0084	.0066	.0072	.0070	.0064	1.0389	.0070
7	LUMBER AND WOOD PRODUCTS [SIC 24]	.0116	.0108	.0456	.0090	.0058	.0072	1.1879
8	FURNITURE AND FIXTURES [SIC 25]	.0074	.0072	.0081	.0054	.0042	.0055	.0070
9	PAPER AND ALLIED PRODUCTS [SIC 26]	.0115	.0070	.0108	.0302	.0148	.0115	.0095
10	PRINTING AND PUBLISHING [SIC 27]	.0122	.0112	.0120	.0119	.0077	.0103	.0102
11	CHEMICALS AND ALLIED PRODUCTS [SIC 28]	.0210	.0142	.0150	.0166	.0221	.0117	.0117
12	PETROLEUM REFINING [SIC 29]	.0015	.0030	.0076	.0011	.0008	.0009	.0011
13	RUBBER AND MISC. PLASTICS [SIC 30]	.0043	.0155	.0076	.0065	.0074	.0078	.0033
14	LEATHER AND LEATHER PRODUCTS [SIC 31]	.0012	.0010	.0010	.0009	.0007	.0016	.0010
15	STONE, CLAY AND GLASS PROD. [SIC 32]	.0157	.0341	.0702	.0257	.0077	.0089	.0111
16	PRIMARY METAL INDUSTRIES [SIC 33]	.0028	.0057	.0092	.0028	.0015	.0019	.0030
17	FABRICATED METAL PRODUCTS [SIC 34, 19]	.0160	.0141	.0502	.0212	.0071	.0083	.0133
18	MACHINERY, EXCEPT ELECTRICAL [SIC 35]	.0127	.0222	.0123	.0091	.0070	.0073	.0092
19	ELECTRICAL MACHINERY + EQUIP [SIC 36]	.0042	.0050	.0094	.0031	.0022	.0027	.0031
20	TRANSPORTATION EQUIPMENT [SIC 37]	.0155	.0154	.0130	.0116	.0089	.0118	.0122
21	MISCELLANEOUS MANUFACTURING [SIC 38-9]	.0029	.0029	.0032	.0023	.0021	.0076	.0026
22	TRANSPORTATION SERVICES [SIC 40-7]	.0293	.0262	.0364	.0336	.0208	.0201	.0311
23	COMMUNICATIONS + UTILITIES [SIC 48-9]	.0615	.0884	.0585	.0540	.0453	.0528	.0573
24	WHOLESALE AND RETAIL TRADE [SIC 50-9]	.2550	.2241	.2683	.2098	.1842	.2220	.2024
25	FINANCE, INS., REAL ESTATE [SIC 60-7]	.2078	.1920	.1626	.1521	.1175	.1646	.1602
26	SERVICES [SIC 70-9, 80-6, 89]	.1887	.1731	.1952	.1581	.1168	.1555	.1566
27	FEDERAL GOVERNMENT ENTERPRISES	.0071	.0068	.0068	.0063	.0054	.0076	.0062
28	STATE + LOCAL GOVERNMENT ENTERPRISES	.0088	.0115	.0087	.0077	.0061	.0074	.0078
29	UNALLOCATED INDUSTRIES	.0135	.0182	.0167	.0132	.0110	.0132	.0129
30	HOUSEHOLDS	.9691	.7820	.7904	.7249	.5923	.8671	.7928
31	CAPITAL RESIDUAL	.3020	.3403	.2000	.2124	.1539	.1766	.2136
32	CITY AND COUNTY GOVERNMENT	.0972	.0643	.0672	.0622	.0440	.0556	.0764
33	STATE GOVERNMENT	.0642	.0585	.0652	.0543	.0460	.0584	.0779
34	TOTAL LOCAL PURCHASES	3.9081	3.4735	3.4014	3.4505	2.7868	3.4068	3.4109

TABLE 4. TOTAL REQUIREMENTS (DIRECT, INDIRECT, AND INDUCED) PER DOLLAR OF DELIVERY TO FINAL DEMAND GEORGIA, 1970

(EACH ENTRY APPROXIMATES THE TOTAL OUTPUT REQUIRED FROM THE SECTOR AT THE BEGINNING OF EACH ROWFOR EVERY DOLLAR OF DELIVERY TO FINAL DEMAND BY THE SECTOR NUMBERED AT THE HEAD OF EACH COLUMN)

SELLING INDUSTRY	PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE) 8	9	10	11	12	13	14
1 AGRICULTURE [SIC 01, 07-9]	.0259	.0244	.0280	.0254	.0186	.0212	.0256
2 MINING [SIC 10-4]	.0030	.0101	.0043	.0082	.0618	.0045	.0029
3 CONTRACT CONSTRUCTION [SIC 15-7]	.1305	.1544	.1688	.1487	.1367	.1419	.1369
4 FOOD AND KINDRED PRODUCTS [SIC 20-1]	.0446	.0466	.0607	.0613	.0398	.0455	.0627
5 TEXTILE MILL PRODUCTS [SIC 22]	.0447	.0075	.0076	.0058	.0048	.0650	.0325
6 APPAREL AND RELATED PRODUCTS [SIC 23]	.0071	.0069	.0080	.0066	.0057	.0097	.0168
7 LUMBER AND WOOD PRODUCTS [SIC 24]	.0850	.0593	.0160	.0115	.0103	.0122	.0132
8 FURNITURE AND FIXTURES [SIC 25]	1.0167	.0055	.0084	.0052	.0048	.0059	.0085
9 PAPER AND ALLIED PRODUCTS [SIC 26]	.0165	1.1748	.1433	.0340	.0632	.0223	.0151
10 PRINTING AND PUBLISHING [SIC 27]	.0098	.0149	1.0364	.0106	.0095	.0103	.0102
11 CHEMICALS AND ALLIED PRODUCTS [SIC 28]	.0147	.0400	.0301	1.1068	.0479	.0455	.0141
12 PETROLEUM REFINING [SIC 29]	.0010	.0013	.0013	.0028	1.0029	.0012	.0010
13 RUBBER AND MISC. PLASTICS [SIC 30]	.0354	.0075	.0061	.0142	.0040	1.0129	.0322
14 LEATHER AND LEATHER PRODUCTS [SIC 31]	.0010	.0009	.0012	.0008	.0008	.0015	1.0077
15 STONE, CLAY AND GLASS PROD. [SIC 32]	.0108	.0113	.0120	.0178	.0265	.0139	.0100
16 PRIMARY METAL INDUSTRIES [SIC 33]	.0080	.0042	.0027	.0044	.0029	.0039	.0021
17 FABRICATED METAL PRODUCTS [SIC 34, 19]	.0280	.0142	.0119	.0274	.0185	.0135	.0101
18 MACHINERY, EXCEPT ELECTRICAL [SIC 35]	.0096	.0097	.0108	.0098	.0085	.0096	.0082
19 ELECTRICAL MACHINERY + EQUIP [SIC 36]	.0030	.0031	.0036	.0031	.0029	.0034	.0029
20 TRANSPORTATION EQUIPMENT [SIC 37]	.0135	.0117	.0170	.0112	.0105	.0119	.0116
21 MISCELLANEOUS MANUFACTURING [SIC 38-9]	.0035	.0029	.0036	.0063	.0022	.0088	.0151
22 TRANSPORTATION SERVICES [SIC 40-7]	.0260	.0406	.0277	.0298	.0373	.0251	.0206
23 COMMUNICATIONS + UTILITIES [SIC 48-9]	.0530	.0794	.0706	.0610	.0899	.0583	.0498
24 WHOLESALE AND RETAIL TRADE [SIC 50-9]	.2094	.2067	.2385	.1903	.2127	.2019	.1984
25 FINANCE, INS., + REAL ESTATE [SIC 60-7]	.1570	.1458	.2098	.1344	.1443	.1475	.1493
26 SERVICES [SIC 70-9, 80-6, 89]	.1483	.1531	.1968	.1568	.1430	.1540	.1508
27 FEDERAL GOVERNMENT ENTERPRISES	.0067	.0065	.0145	.0063	.0060	.0065	.0078
28 STATE + LOCAL GOVERNMENT ENTERPRISES	.0072	.0095	.0095	.0076	.0097	.0076	.0069
29 UNALLOCATED INDUSTRIES	.0156	.0328	.0258	.0186	.0161	.0175	.0139
30 HOUSEHOLDS	.7257	.7047	.9757	.6294	.6272	.7347	.7648
31 CAPITAL RESIDUAL	.1924	.2209	.2513	.2239	.1905	.2095	.2074
32 CITY AND COUNTY GOVERNMENT	.0558	.0638	.0698	.0577	.0531	.0598	.0544
33 STATE GOVERNMENT	.0551	.0580	.0677	.0531	.0509	.0568	.0569
34 TOTAL LOCAL PURCHASES	3.1648	3.3329	3.7394	3.0908	3.0635	3.1435	3.1176

TABLE 4. TOTAL REQUIREMENTS (DIRECT, INDIRECT, AND INDUCED) PER DOLLAR OF DELIVERY TO FINAL DEMAND GEORGIA, 1970

(EACH ENTRY APPROXIMATES THE TOTAL OUTPUT REQUIRED FROM THE SECTOR AT THE BEGINNING OF EACH ROWFOR EVERY DOLLAR OF DELIVERY TO FINAL DEMAND BY THE SECTOR NUMBERED AT THE HEAD OF EACH COLUMN)

	PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE)						
SELLING INDUSTRY	15	16	17	18	19	20	21
1 AGRICULTURE [SIC 01, 07-9]	.0238	.0176	.0199	.0213	.0200	.0164	.0241
2 MINING [SIC 10-4]	.1231	.0036	.0035	.0030	.0031	.0025	.0037
3 CONTRACT CONSTRUCTION [SIC 15-7]	.1637	.1111	.1254	.1323	.1320	.1184	.1530
4 FOOD AND KINDRED PRODUCTS [SIC 20-1]	.0510	.0385	.0430	.0447	.0435	.0343	.0478
5 TEXTILE MILL PRODUCTS [SIC 22]	.0082	.0050	.0059	.0062	.0067	.0057	.0143
6 APPAREL AND RELATED PRODUCTS [SIC 23]	.0149	.0052	.0063	.0063	.0062	.0059	.0089
7 LUMBER AND WOOD PRODUCTS [SIC 24]	.0140	.0087	.0115	.0241	.0095	.0172	.0239
8 FURNITURE AND FIXTURES [SIC 25]	.0073	.0043	.0075	.0057	.0061	.0074	.0092
9 PAPER AND ALLIED PRODUCTS [SIC 26]	.0169	.0060	.0147	.0096	.0107	.0061	.0338
10 PRINTING AND PUBLISHING [SIC 27]	.0118	.0102	.0113	.0097	.0098	.0082	.0150
11 CHEMICALS AND ALLIED PRODUCTS [SIC 28]	.0183	.0089	.0158	.0176	.0126	.0080	.0214
12 PETROLEUM REFINING [SIC 29]	.0019	.0008	.0010	.0010	.0010	.0010	.0012
13 RUBBER AND MISC. PLASTICS [SIC 30]	.0083	.0027	.0058	.0102	.0164	.0061	.0244
14 LEATHER AND LEATHER PRODUCTS [SIC 31]	.0011	.0008	.0009	.0011	.0009	.0007	.0024
15 STONE, CLAY AND GLASS PROD. [SIC 32]	1.0434	.0083	.0151	.0111	.0121	.0090	.0126
16 PRIMARY METAL INDUSTRIES [SIC 33]	.0051	1.0242	.0742	.0229	.0234	.0189	.0116
17 FABRICATED METAL PRODUCTS [SIC 34, 19]	.0136	.0189	1.0361	.0382	.0288	.0188	.0288
18 MACHINERY, EXCEPT ELECTRICAL [SIC 35]	.0123	.0180	.0224	1.0409	.0212	.0194	.0141
19 ELECTRICAL MACHINERY + EQUIP [SIC 36]	.0059	.0062	.0058	.0144	1.0133	.0094	.0089
20 TRANSPORTATION EQUIPMENT [SIC 37]	.0143	.0227	.0227	.0379	.0556	1.0212	.0243
21 MISCELLANEOUS MANUFACTURING [SIC 38-9]	.0029	.0027	.0060	.0065	.0091	.0031	1.0178
22 TRANSPORTATION SERVICES [SIC 40-7]	.0496	.0295	.0236	.0208	.0210	.0178	.0230
23 COMMUNICATIONS + UTILITIES [SIC 48-9]	.0985	.0594	.0530	.0499	.0509	.0428	.0568
24 WHOLESALE AND RETAIL TRADE [SIC 50-9]	.2193	.1672	.1866	.1900	.1927	.1518	.2157
25 FINANCE, INS., REAL ESTATE [SIC 60-7]	.1755	.1229	.1447	.1456	.1454	.1093	.1551
26 SERVICES [SIC 70-9, 80-6, 89]	.1800	.1248	.1413	.1420	.1435	.1237	.1671
27 FEDERAL GOVERNMENT ENTERPRISES	.0073	.0051	.0059	.0063	.0061	.0053	.0077
28 STATE + LOCAL GOVERNMENT ENTERPRISES	.0121	.0072	.0070	.0068	.0069	.0056	.0076
29 UNALLOCATED INDUSTRIES	.0199	.0352	.0170	.0166	.0173	.0155	.0206
30 HOUSEHOLDS	.8336	.6075	.7044	.7159	.7148	.5599	.7504
31 CAPITAL RESIDUAL	.2331	.1575	.1845	.2003	.1999	.1830	.2318
32 CITY AND COUNTY GOVERNMENT	.0641	.0511	.0551	.0527	.0539	.0416	.0615
33 STATE GOVERNMENT	.0585	.0457	.0522	.0527	.0520	.0462	.0601
34 TOTAL LOCAL PURCHASES	3.5129	2.7374	3.0301	3.0641	3.0462	2.6400	3.2585

TABLE 4. TOTAL REQUIREMENTS (DIRECT, INDIRECT, AND INDUCED) PER DOLLAR OF DELIVERY TO FINAL DEMAND GEORGIA, 1970

(EACH ENTRY APPROXIMATES THE TOTAL OUTPUT REQUIRED FROM THE SECTOR AT THE BEGINNING OF EACH ROWFOR EVERY DOLLAR OF DELIVERY TO FINAL DEMAND BY THE SECTOR NUMBERED AT THE HEAD OF EACH COLUMN)

		PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE)						
	SELLING INDUSTRY	22	23	24	25	26	27	28
1	AGRICULTURE [SIC 01, 07-9]	.0313	.0230	.0352	.0543	.0291	.0350	.0241
2	MINING [SIC 10-4]	.0040	.0055	.0047	.0056	.0047	.0032	.0106
3	CONTRACT CONSTRUCTION [SIC 15-7]	.1972	.2905	.2239	.2614	.2281	.1527	.5744
4	FOOD AND KINDRED PRODUCTS [SIC 20-1]	.0662	.0487	.0757	.0739	.0617	.0785	.0466
5	TEXTILE MILL PRODUCTS [SIC 22]	.0075	.0061	.0099	.0100	.0074	.0091	.0062
6	APPAREL AND RELATED PRODUCTS [SIC 23]	.0086	.0067	.0106	.0100	.0089	.0110	.0067
7	LUMBER AND WOOD PRODUCTS [SIC 24]	.0097	.0132	.0121	.0130	.0112	.0081	.0245
8	FURNITURE AND FIXTURES [SIC 25]	.0070	.0082	.0082	.0088	.0078	.0071	.0110
9	PAPER AND ALLIED PRODUCTS [SIC 26]	.0075	.0076	.0119	.0110	.0134	.0093	.0106
10	PRINTING AND PUBLISHING [SIC 27]	.0142	.0117	.0163	.0180	.0534	.0170	.0120
11	CHEMICALS AND ALLIED PRODUCTS [SIC 28]	.0104	.0102	.0143	.0142	.0160	.0113	.0200
12	PETROLEUM REFINING [SIC 29]	.0015	.0020	.0017	.0020	.0016	.0011	.0039
13	RUBBER AND MISC. PLASTICS [SIC 30]	.0045	.0037	.0049	.0045	.0045	.0040	.0053
14	LEATHER AND LEATHER PRODUCTS [SIC 31]	.0013	.0010	.0014	.0014	.0012	.0016	.0009
15	STONE, CLAY AND GLASS PROD. [SIC 32]	.0137	.0189	.0165	.0181	.0163	.0112	.0361
16	PRIMARY METAL INDUSTRIES [SIC 33]	.0035	.0034	.0031	.0033	.0031	.0022	.0056
17	FABRICATED METAL PRODUCTS [SIC 34, 19]	.0124	.0163	.0145	.0159	.0144	.0102	.0294
18	MACHINERY, EXCEPT ELECTRICAL [SIC 35]	.0104	.0146	.0121	.0141	.0139	.0084	.0216
19	ELECTRICAL MACHINERY + EQUIP [SIC 36]	.0050	.0050	.0048	.0054	.0056	.0035	.0079
20	TRANSPORTATION EQUIPMENT [SIC 37]	.0283	.0156	.0195	.0187	.0165	.0172	.0192
21	MISCELLANEOUS MANUFACTURING [SIC 38-9]	.0028	.0032	.0040	.0036	.0058	.0029	.0039
22	TRANSPORTATION SERVICES [SIC 40-7]	1.0563	.0272	.0279	.0279	.0255	.0797	.0285
23	COMMUNICATIONS + UTILITIES [SIC 48-9]	.0726	1.1411	.0853	.0851	.1141	.0750	.1023
24	WHOLESALE AND RETAIL TRADE [SIC 50-9]	.2613	.2078	1.2677	.2797	.2548	.2739	.2378
25	FINANCE, INS., REAL ESTATE [SIC 60-7]	.2249	.1681	.2558	1.4038	.2464	.2491	.1724
26	SERVICES [SIC 70-9, 80-6, 89]	.2183	.1881	.2419	.2596	1.2416	.2338	.2024
27	FEDERAL GOVERNMENT ENTERPRISES	.0090	.0089	.0147	.0165	.0163	1.0084	.0069
28	STATE + LOCAL GOVERNMENT ENTERPRISES	.0217	.0737	.0152	.0199	.0147	.0115	1.0112
29	UNALLOCATED INDUSTRIES	.0190	.0165	.0210	.0240	.0313	.0209	.0161
30	HOUSEHOLDS	1.0525	.8003	1.1624	1.1779	.9689	1.3170	.7573
31	CAPITAL RESIDUAL	.2530	.3994	.2786	.3467	.3238	.2020	.5885
32	CITY AND COUNTY GOVERNMENT	.0747	.0919	.1216	.1089	.0942	.0752	.0592
33	STATE GOVERNMENT	.0777	.0608	.2013	.0938	.0771	.0750	.0582
34	TOTAL LOCAL PURCHASES	3.7897	3.6990	4.1989	4.4111	3.9333	4.0262	4.1217

TABLE 4. TOTAL REQUIREMENTS (DIRECT, INDIRECT, AND INDUCED) PER DOLLAR OF DELIVERY TO FINAL DEMAND GEORGIA, 1970

(EACH ENTRY APPROXIMATES THE TOTAL OUTPUT REQUIRED FROM THE SECTOR AT THE BEGINNING OF EACH ROWFOR EVERY DOLLAR OF DELIVERY TO FINAL DEMAND BY THE SECTOR NUMBERED AT THE HEAD OF EACH COLUMN)

		PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE)				
	SELLING INDUSTRY	29	30	31	32	33
1	AGRICULTURE [SIC 01, 07-9]	.0365	.0419	.0175	.0359	.0346
2	MINING [SIC 10-4]	.0019	.0035	.0106	.0070	.0077
3	CONTRACT CONSTRUCTION [SIC 15-7]	.0790	.1660	.5850	.3633	.4048
4	FOOD AND KINDRED PRODUCTS [SIC 20-1]	.0948	.0953	.0324	.0782	.0748
5	TEXTILE MILL PRODUCTS [SIC 22]	.0080	.0100	.0054	.0084	.0081
6	APPAREL AND RELATED PRODUCTS [SIC 23]	.0039	.0127	.0048	.0102	.0099
7	LUMBER AND WOOD PRODUCTS [SIC 24]	.0055	.0088	.0254	.0163	.0178
8	FURNITURE AND FIXTURES [SIC 25]	.0031	.0084	.0166	.0092	.0087
9	PAPER AND ALLIED PRODUCTS [SIC 26]	.0233	.0085	.0069	.0100	.0100
10	PRINTING AND PUBLISHING [SIC 27]	.0969	.0165	.0077	.0179	.0171
11	CHEMICALS AND ALLIED PRODUCTS [SIC 28]	.0089	.0127	.0094	.0156	.0155
12	PETROLEUM REFINING [SIC 29]	.0006	.0012	.0039	.0025	.0028
13	RUBBER AND MISC. PLASTICS [SIC 30]	.0031	.0041	.0052	.0052	.0054
14	LEATHER AND LEATHER PRODUCTS [SIC 31]	.0011	.0019	.0006	.0014	.0014
15	STONE, CLAY AND GLASS PROD. [SIC 32]	.0067	.0124	.0364	.0240	.0264
16	PRIMARY METAL INDUSTRIES [SIC 33]	.0099	.0023	.0064	.0038	.0040
17	FABRICATED METAL PRODUCTS [SIC 34, 19]	.0101	.0112	.0327	.0191	.0206
18	MACHINERY, EXCEPT ELECTRICAL [SIC 35]	.0089	.0094	.0378	.0112	.0108
19	ELECTRICAL MACHINERY + EQUIP [SIC 36]	.0029	.0038	.0106	.0050	.0052
20	TRANSPORTATION EQUIPMENT [SIC 37]	.0115	.0195	.0271	.0166	.0160
21	MISCELLANEOUS MANUFACTURING [SIC 38-9]	.0076	.0033	.0050	.0034	.0033
22	TRANSPORTATION SERVICES [SIC 40-7]	.1155	.0249	.0252	.0318	.0313
23	COMMUNICATIONS + UTILITIES [SIC 48-9]	.0329	.0771	.0456	.0865	.0822
24	WHOLESALE AND RETAIL TRADE [SIC 50-9]	.1423	.3197	.2227	.2774	.2697
25	FINANCE, INS., REAL ESTATE [SIC 60-7]	.0889	.2717	.1153	.2403	.2286
26	SERVICES [SIC 70-9, 80-6, 89]	.1754	.2556	.1234	.2415	.2390
27	FEDERAL GOVERNMENT ENTERPRISES	.0049	.0093	.0048	.0101	.0101
28	STATE + LOCAL GOVERNMENT ENTERPRISES	.0057	.0114	.0063	.0116	.0111
29	UNALLOCATED INDUSTRIES	1.0095	.0133	.0109	.0189	.0191
30	HOUSEHOLDS	.3997	1.6258	.5200	1.2173	1.1533
31	CAPITAL RESIDUAL	.1096	.2276	1.1339	.2081	.2028
32	CITY AND COUNTY GOVERNMENT	.0334	.0881	.0452	1.0795	.3569
33	STATE GOVERNMENT	.0344	.0880	.0486	.0891	1.0757
34	TOTAL LOCAL PURCHASES	2.5764	3.4658	3.1094	4.1763	4.3848

OTHER PROJECTIONS

	AGGREGATE PROJECTIONS 1970	1980	AVERAGE ANNUAL GROWTH RATE
GROSS STATE PRODUCT	20459.15	30181.77	3.96
PERSONAL INCOME	15866.00	22863.27	3.72
PER CAPITA INCOME	3456.96	4267.11	2.13
EMPLOYMENT	1728318.00	2017696.48	1.56
POPULATION	4589575.00	5358023.94	1.56

OTHER PROJECTIONS

	AGGREGATE PROJECTIONS 1970	1980	AVERAGE ANNUAL GROWTH RATE
HOUSEHOLDS	15866.00	22863.27	3.72
CAPITAL RESIDUAL	3890.70	5788.63	4.05
CITY AND COUNTY GOVE	1351.40	1992.36	3.96
STATE GOVERNMENT	1631.62	2332.28	3.64
FEDERAL GOVERNMENT	3750.81	5525.43	3.95

Regional Transactions Projected for Georgia 1980

	SELLING INDUSTRY	PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE) 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	AGRICULTURE [SIC 01, 07-9]	245.47	.00	10.66	701.80	13.00	4.66	45.02	.00	.00	.00	1.45	.00	.00	.00
2	MINING [SIC 10-4]	2.25	3.84	49.57	.63	.05	.00	.02	.00	10.93	.00	4.29	4.13	.38	.00
3	CONTRACT CONSTRUCTION [SIC 15-7]	16.91	2.46	1.73	6.91	16.61	.74	2.82	.52	12.76	.78	4.70	.58	1.37	.11
4	FOOD AND KINDRED PRODUCTS [SIC 20-1]	145.07	.00	.15	239.73	.05	.00	.02	.00	2.28	.39	21.34	.02	.01	1.41
5	TEXTILE MILL PRODUCTS [SIC 22]	3.24	.01	2.37	2.91	775.96	300.40	.21	12.50	2.71	.23	.16	.00	20.79	1.84
6	APPAREL AND RELATED PRODUCTS [SIC 23]	.75	.00	1.01	2.45	8.95	44.28	.32	.38	1.64	.00	1.29	.02	1.40	.95
7	LUMBER AND WOOD PRODUCTS [SIC 24]	2.09	.08	155.85	.91	.01	.67	113.55	25.66	71.47	.57	2.57	.05	1.47	.45
8	FURNITURE AND FIXTURES [SIC 25]	.00	.00	11.90	.01	.53	.26	.85	4.48	.02	.85	.00	.00	.21	.01
9	PAPER AND ALLIED PRODUCTS [SIC 26]	3.87	.08	13.37	59.09	40.71	4.32	1.98	3.30	273.84	58.31	25.11	3.61	5.41	.67
10	PRINTING AND PUBLISHING [SIC 27]	.13	.00	.06	5.48	.09	.03	.04	.02	5.57	17.33	.48	.00	.03	.03
11	CHEMICALS AND ALLIED PRODUCTS [SIC 28]	17.55	1.38	24.35	15.49	67.78	.40	1.85	1.88	48.06	7.81	103.72	2.64	13.83	.43
12	PETROLEUM REFINING [SIC 29]	.05	.44	31.86	.02	.01	.00	.02	.00	.21	.00	1.83	.13	.04	.00
13	RUBBER AND MISC. PLASTICS [SIC 30]	.83	3.56	19.83	10.37	23.91	5.48	.31	12.59	7.20	1.04	11.86	.02	3.88	2.70
14	LEATHER AND LEATHER PRODUCTS [SIC 31]	.07	.00	.01	.02	.06	.78	.04	.05	.08	.01	.02	.00	.24	.63
15	STONE, CLAY AND GLASS PROD. [SIC 32]	.54	5.60	283.48	43.87	.36	.01	.25	.53	.43	.00	7.23	1.12	1.50	.00
16	PRIMARY METAL INDUSTRIES [SIC 33]	.00	.77	19.03	.00	.00	.17	.47	1.78	2.52	.01	1.13	.01	.64	.00
17	FABRICATED METAL PRODUCTS [SIC 34, 19]	4.23	.23	193.58	32.32	.44	.20	2.20	7.29	6.37	.19	18.27	.66	1.54	.08
18	MACHINERY, EXCEPT ELECTRICAL [SIC 35]	1.98	2.75	15.73	1.10	4.52	.06	.48	.63	1.47	.42	.97	.02	.52	.01
19	ELECTRICAL MACHINERY & EQUIP [SIC 36]	.31	.21	29.54	.13	.03	.01	.04	.06	.06	.03	.06	.00	.17	.00
20	TRANSPORTATION EQUIPMENT [SIC 37]	.14	.21	.32	.05	.01	.01	.08	.84	.08	1.30	.10	.00	.13	.00
21	MISCELLANEOUS MANUFACTURING [SIC 38-92	.01	.00	2.99	.21	1.71	7.43	.21	.44	.66	.39	4.18	.00	2.63	1.18
22	TRANSPORTATION SERVICES [SIC 40-7]	14.03	1.99	80.73	44.10	38.58	3.32	8.85	3.47	35.01	2.24	13.90	1.47	3.31	.40
23	COMMUNICATIONS & UTILITIES [SIC 48-9]	9.93	10.80	28.61	24.11	49.88	6.36	7.26	3.50	54.82	5.80	19.77	3.15	5.58	.57
24	WHOLESALE AND RETAIL TRADE [SIC 50-9]	62.29	10.56	436.29	111.39	252.54	41.45	16.44	17.55	70.77	10.89	42.93	4.70	14.20	2.66
25	FINANCE, INS., REAL ESTATE [SIC 60-7]	49.02	11.55	49.82	27.62	39.96	13.10	8.41	7.81	19.59	14.74	13.44	1.39	4.71	.96
26	SERVICES [SIC 70-9, 80-5, 89]	30.95	8.20	241.37	70.72	59.59	11.09	10.86	7.08	35.89	12.58	40.86	1.64	9.26	1.66
27	FEDERAL GOVERNMENT ENTERPRISES	.25	.19	1.45	2.25	5.02	2.31	.40	.47	1.64	3.77	1.25	.05	.43	.23
28	STATE & LOCAL GOVERNMENT ENTERPRISES	.08	.50	2.68	1.08	1.07	.09	.17	.04	1.07	.12	.30	.02	.09	.01
29	UNALLOCATED INDUSTRIES	3.66	2.23	25.31	9.53	18.31	4.97	2.31	2.37	38.13	6.10	9.70	.41	3.28	.46
30	HOUSEHOLDS	740.33	84.92	1294.27	574.61	1213.84	555.07	206.88	107.20	416.24	218.45	225.30	13.32	124.98	32.24
31	CAPITAL RESIDUAL	231.48	54.05	201.79	139.51	225.62	38.49	43.49	21.03	129.46	37.42	101.01	3.17	30.08	6.90
32	CITY AND COUNTY GOVERNMENT	62.45	2.77	50.23	14.30	19.61	2.08	10.68	2.18	21.02	2.97	12.16	.43	4.07	.40
33	STATE GOVERNMENT	.00	1.01	18.06	10.73	16.78	3.90	16.78	1.10	11.35	2.65	7.62	.12	2.82	.66
34	TOTAL LOCAL PURCHASES	1650.07	210.39	3298.01	2153.48	2893.60	1052.15	503.33	246.76	1283.38	401.40	699.01	42.93	259.00	57.65
35	FEDERAL GOVERNMENT	.00	13.55	198.18	103.14	153.30	46.83	27.16	14.73	95.20	20.74	75.18	1.16	22.65	5.69
36	IMPORTS	379.47	74.22	1407.59	957.08	2378.49	346.58	213.71	132.82	528.53	89.71	382.42	30.04	133.59	30.84
37	TOTAL PURCHASES	2029.53	298.16	4903.78	3213.71	5425.39	1445.56	744.20	394.30	1907.11	511.86	1156.62	74.12	415.23	94.17

Regional Transactions Projected for Georgia 1980 (Continued)

		PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE)													
		15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	AGRICULTURE [SIC 01, 07-9]	.00	.00	.00	.00	.00	.00	.48	1.61	.00	8.68	99.59	1.64	.00	.09
2	MINING [SIC 10-4]	75.29	.53	.02	.01	.00	.03	.05	.00	.02	.62	2.12	.19	.00	.00
3	CONTRACT CONSTRUCTION [SIC 15-7]	4.77	1.56	1.38	1.09	.75	5.50	.78	44.70	62.42	21.07	160.84	94.43	1.53	76.64
4	FOOD AND KINDRED PRODUCTS [SIC 20-1]	.03	.00	.02	.68	.00	.00	.48	8.60	.03	34.10	5.32	10.79	.00	.00
5	TEXTILE MILL PRODUCTS [SIC 22]	.09	.23	.38	.36	.41	2.71	2.16	.24	.49	11.23	8.54	1.34	.17	.00
6	APPAREL AND RELATED PRODUCTS [SIC 23]	4.99	.09	.35	.23	.14	3.59	.93	.16	.11	8.15	2.22	5.75	.20	.04
7	LUMBER AND WOOD PRODUCTS [SIC 24]	2.87	.95	2.71	9.85	.81	26.81	4.49	.05	.15	6.56	1.95	.00	.00	.00
8	FURNITURE AND FIXTURES [SIC 25]	.87	.03	2.05	.30	.45	8.76	1.26	.00	.00	2.13	.41	.00	.00	.00
9	PAPER AND ALLIED PRODUCTS [SIC 26]	5.71	.38	6.19	2.18	2.43	4.13	8.39	.37	1.51	22.59	10.70	3.00	.44	.63
10	PRINTING AND PUBLISHING [SIC 27]	.03	.01	1.41	.08	.06	.20	1.41	.68	.06	4.83	8.55	233.37	.54	.01
11	CHEMICALS AND ALLIED PRODUCTS [SIC 28]	5.23	1.02	6.04	6.28	2.49	5.25	3.97	.72	1.12	18.41	11.67	29.18	.13	2.53
12	PETROLEUM REFINING [SIC 29]	.33	.00	.05	.00	.01	.32	.02	.18	.02	.09	.65	.06	.00	.00
13	RUBBER AND MISC. PLASTICS [SIC 30]	2.32	.17	2.36	4.97	7.74	10.99	7.68	1.89	.17	6.39	2.00	4.52	.14	.03
14	LEATHER AND LEATHER PRODUCTS [SIC 31]	.03	.01	.02	.16	.01	.02	.54	.00	.00	.47	.14	.18	.01	.00
15	STONE, CLAY AND BRASS PROD. [SIC 32]	18.97	.18	4.82	1.06	1.48	2.09	.63	.05	.06	7.05	1.78	4.81	.00	.00
16	PRIMARY METAL INDUSTRIES [SIC 33]	1.37	8.78	56.47	12.43	10.94	46.18	2.76	1.49	.31	.92	.39	.02	.00	.00
17	FABRICATED METAL PRODUCTS [SIC 34, 19]	1.93	4.56	21.32	19.44	10.90	30.45	6.57	.58	.00	6.98	1.57	3.55	.03	.00
18	MACHINERY, EXCEPT ELECTRICAL [SIC 35]	1.24	4.54	11.05	22.23	7.03	34.26	1.63	.51	.08	6.26	3.84	8.86	.01	.03
19	ELECTRICAL MACHINERY & EQUIP [SIC 36]	1.59	1.53	2.17	7.74	5.84	19.68	2.04	2.21	.13	4.42	2.75	7.28	.02	.03
20	TRANSPORTATION EQUIPMENT [SIC 37]	.57	5.27	8.52	17.72	25.27	32.86	4.23	24.90	.05	20.39	2.83	3.08	.05	.01
21	MISCELLANEOUS MANUFACTURING [SIC 38-9]	.18	.31	3.03	2.85	3.86	3.30	5.55	.01	.37	6.37	.67	16.13	.00	.01
22	TRANSPORTATION SERVICES [SIC 40-7]	18.89	5.78	5.87	3.32	2.94	13.97	1.80	67.95	12.24	27.45	13.87	13.07	18.85	.59
23	COMMUNICATIONS & UTILITIES [SIC 48-9]	26.68	9.43	8.35	5.48	5.07	26.41	3.73	25.05	160.19	128.97	88.67	318.18	2.72	13.80
24	WHOLESALE AND RETAIL TRADE [SIC 50-9]	18.41	13.44	23.68	20.68	19.03	69.84	15.87	64.97	13.64	110.09	89.08	195.59	2.60	1.54
25	FINANCE, INS., REAL ESTATE [SIC 60-7]	9.72	4.41	11.65	9.54	7.97	16.99	5.11	61.43	27.10	294.10	1011.54	351.86	6.58	5.40
26	SERVICES [SIC 70-9, 80-6, 89]	17.59	6.32	13.44	10.87	9.87	69.19	11.37	69.11	66.36	272.27	280.56	389.02	6.19	12.44
27	FEDERAL GOVERNMENT ENTERPRISES	.67	.26	.65	.77	.55	.46	.73	3.06	5.19	46.75	44.24	52.23	.04	.14
28	STATE & LOCAL GOVERNMENT ENTERPRISES	.82	.13	.09	.07	.09	.39	.06	23.05	119.85	31.06	47.92	15.07	.16	.12
29	UNALLOCATED INDUSTRIES	5.47	11.53	5.29	5.08	4.57	23.79	3.70	13.91	10.29	54.19	55.52	113.14	2.90	.88
30	HOUSEHOLDS	202.16	107.25	238.76	213.22	177.74	686.71	106.32	971.42	529.00	3651.30	2864.02	2241.64	248.23	45.72
31	CAPITAL RESIDUAL	33.68	18.86	45.21	49.08	40.52	237.11	32.64	133.01	407.02	579.19	747.65	817.57	.00	127.64
32	CITY AND COUNTY GOVERNMENT	4.66	4.28	6.45	3.62	3.99	8.16	3.32	12.10	67.02	96.37	157.78	156.76	.00	.00
33	STATE GOVERNMENT	1.67	1.87	4.27	3.36	2.27	24.55	2.68	21.14	13.26	955.78	109.42	72.45	.00	.00
34	TOTAL LOCAL PURCHASES	468.83	213.71	494.06	434.77	355.22	1417.71	243.35	1555.18	1498.28	6446.11	5839.80	5164.76	291.54	288.32
35	FEDERAL GOVERNMENT	18.07	12.06	35.71	31.81	29.28	171.12	21.81	64.37	181.16	458.09	118.80	410.31	.00	.00
36	IMPORTS	170.89	197.38	295.17	248.67	204.66	1373.54	107.52	361.00	289.73	475.39	329.10	751.33	47.31	23.31
37	TOTAL PURCHASES	657.80	423.14	824.94	715.26	589.16	2962.37	372.67	1980.55	1969.17	7379.58	6287.69	6326.40	338.85	311.63

Regional Transactions Projected for Georgia 1980 (Continued)

		PURCHASING INDUSTRY NUMBER (SEE LEFT FOR TITLE)										
		29	30	31	32	33	34	35	36	37	38	39
1	AGRICULTURE [SIC 01, 07-9]	3.03	141.34	.00	1.25	1.14	1280.92	.28	100.52	647.82	748.62	2029.53
2	MINING [SIC 10-4]	.00	.60	.00	.01	.01	155.59	3.54	.14	138.89	142.57	298.16
3	CONTRACT CONSTRUCTION [SIC 15-7]	.00	.00	2836.70	416.20	462.43	4261.81	40.95	70.57	530.45	641.97	4903.78
4	FOOD AND KINDRED PRODUCTS [SIC 20-1]	28.85	1139.76	.00	9.64	8.63	1657.39	2.26	3.21	1550.84	1556.31	3213.71
5	TEXTILE MILL PRODUCTS [SIC 22]	1.84	56.36	2.48	.17	.18	1212.70	.46	.07	4212.16	4212.69	5425.39
6	APPAREL AND RELATED PRODUCTS [SIC 23]	.16	157.85	.00	.70	.80	247.90	1.32	.63	1195.71	1197.66	1445.56
7	LUMBER AND WOOD PRODUCTS [SIC 24]	.08	5.08	.25	.08	.07	438.16	.12	.05	305.87	306.04	744.20
8	FURNITURE AND FIXTURES [SIC 25]	.00	66.73	66.41	3.44	2.29	174.26	.32	.67	219.05	220.04	394.30
9	PAPER & ALLIED PRODUCTS [SIC 26]	2.40	4.81	.00	1.58	1.43	572.65	.38	.60	1333.48	1334.46	1907.11
10	PRINTING AND PUBLISHING [SIC 27]	39.57	61.60	.00	5.23	3.31	384.26	2.51	.01	125.08	127.60	511.86
11	CHEMICALS AND ALLIED PRODUCTS [SIC 28]	.60	77.95	.00	6.30	5.35	491.40	11.29	2.12	651.81	665.21	1156.62
12	PETROLEUM REFINING [SIC 29]	.00	.52	.00	.02	.01	37.79	7.41	1.00	27.91	36.33	74.12
13	RUBBER AND MISC. PLASTICS [SIC 30]	.35	19.17	.42	1.21	1.27	177.35	1.98	.19	235.72	237.88	415.24
14	LEATHER & LEATHER PRODUCTS [SIC 31]	.25	25.73	.00	.00	.00	29.62	.05	.02	64.49	64.56	94.17
15	STONE, CLAY & GLASS PROD. [SIC 32]	.02	3.07	.00	.16	.14	391.29	.42	.11	265.97	266.51	657.80
16	PRIMARY METAL INDUSTRIES [SIC 33]	3.68	.07	.16	.01	.00	172.52	2.11	.12	248.39	250.62	423.14
17	FABRICATED METAL PRODUCTS [SIC 34, 19]	1.71	7.03	28.14	.28	.16	412.80	5.75	.67	405.71	412.13	824.94
18	MACHINERY, EXCEPT ELECTRICAL [SIC 35]	1.80	3.86	167.35	3.21	2.02	310.48	8.24	2.45	394.08	404.78	715.26
19	ELECTRICAL MACHINERY & EQUIP [SIC 35]	.41	8.12	28.49	.50	.45	126.05	8.86	1.98	452.27	463.10	589.16
20	TRANSPORTATION EQUIPMENT [SIC 37]	1.53	184.42	99.17	1.28	.93	436.36	732.01	5.73	1788.27	2526.00	2962.37
21	MISCELLANEOUS MANUFACTURING [SIC 38-9]	2.74	15.39	15.70	.54	.43	99.51	.87	.63	271.67	273.16	372.67
22	TRANSPORTATION SERVICES [SIC 40-7]	46.51	168.16	21.31	11.51	8.49	713.98	15.24	3.07	1248.26	1266.57	1980.55
23	COMMUNICATIONS & UTILITIES [SIC 48-9]	.00	554.00	38.98	37.20	26.46	1709.56	7.39	1.07	251.16	259.62	1969.17
24	WHOLESALE AND RETAIL TRADE [SIC 50-9]	18.54	3693.87	338.17	15.85	13.01	5832.55	8.06	2.81	1536.16	1547.03	7379.58
25	FINANCE, INS., REAL ESTATE [SIC 60-7]	.00	2655.06	36.78	42.02	30.61	4850.00	1.19	199.54	1236.97	1437.70	6287.69
26	SERVICES [SIC 70-9, 80-6, 89]	41.03	2702.10	.00	53.92	56.15	4630.56	43.53	28.89	1623.42	1695.84	6326.41
27	FEDERAL GOVERNMENT ENTERPRISES	.00	32.66	.00	3.74	3.87	218.73	1.02	.41	118.69	120.11	338.84
28	STATE & LOCAL GOVERNMENT ENTERPRISES	.00	30.08	.00	.90	.61	277.78	.17	4.50	29.18	33.85	311.63
29	UNALLOCATED INDUSTRIES	.00	.00	.00	10.35	9.27	456.63	1.02	3.91	.00	4.94	461.57
30	HOUSEHOLDS	.00	143.66	.00	1146.00	833.52	20214.32	756.56	1892.39	.00	2648.96	22863.27
31	CAPITAL RESIDUAL	.00	1255.95	.00	.00	.00	5788.63	.00	.00	.00	.00	5788.63
32	CITY AND COUNTY GOVERNMENT	.00	544.56	.00	.00	659.69	1934.13	.00	58.23	.00	58.23	1992.36
33	STATE GOVERNMENT	.00	492.69	.00	30.10	.00	1829.09	.00	503.20	.00	503.20	2332.28
34	TOTAL LOCAL PURCHASES	195.11	14252.25	3680.52	1803.39	2132.74	61526.79	1665.32	2889.50	21109.47	25664.28	87191.07
35	FEDERAL GOVERNMENT	.00	3167.13	.00	.00	28.21	5525.43	.00	.00	.00	.00	5525.43
36	IMPORTS	266.45	5443.87	2108.11	188.97	171.33	20138.83	.00	.00	.00	.00	20138.83
37	TOTAL PURCHASES	61.57	22863.26	5788.63	1992.36	2332.28	87191.05	1665.32	2889.50	21109.47	25664.28	112855.33

PROJECTIONS OF THE GEORGIA ECONOMY TO 1980
(OUTPUTS IN MILLIONS OF DOLLARS, EMPLOYMENT IN NUMBER OF EMPLOYEES)

	GEORGIA OUTPUTS 1970	1980	ANNUAL GROWTH IN PERCENT GA	BASE	GA-BS	(DIFF	GA. EMPLOYMENT 1970	1980
AGRICULTURE [SIC 01, 07-9]	1477.610	2029.535	3.225	2.757	.468	16.964	72710.	60615.
MINING [SIC 10-4]	196.565	298.160	4.254	3.112	1.142	36.709	6304.	6669.
CONTRACT CONSTRUCTION [SIC 15-7]	2519.575	4093.776	6.886	4.165	2.721	65.327	84875.	131591.
FOOD AND KINDRED PRODUCTS [SIC 20-1]	2281.214	3213.706	3.487	3.295	.192	5.814	47276.	46716.
TEXTILE MILL PRODUCTS [SIC 22]	3690.639	5425.393	3.928	3.928	.000	.002	110548.	103748.
APPAREL AND RELATED PRODUCTS [SIC 23]	997.556	1445.557	3.779	3.783	-.004	-.104	67174.	77014.
LUMBER AND WOOD PRODUCTS [SIC 24]	487.956	744.197	4.311	3.281	1.030	31.397	22348.	24256.
FURNITURE AND FIXTURES [SIC 25]	232.911	394.304	5.406	5.062	.344	6.789	10976.	13614.
PAPER AND ALLIED PRODUCTS [SIC 26]	1215.425	1907.113	4.608	4.705	-.097	-2.062	24883.	28219.
PRINTING AND PUBLISHING [SIC 27]	341.004	511.856	4.145	4.400	-.255	-5.793	14164.	15366.
CHEMICALS AND ALLIED PRODUCTS [SIC 28]	716.413	1156.617	4.907	5.523	-.616	-11.161	15516.	16649.
PETROLEUM REFINING [SIC 29]	49.490	74.120	4.122	3.500	.622	17.765	1019.	928.
RUBBER AND MISC. PLASTICS [SIC 30]	245.645	415.235	5.390	6.300	-.910	-14.447	8074.	10057.
LEATHER AND LEATHER PRODUCTS [SIC 31]	77.844	94.174	1.923	1.191	.732	61.433	4667.	5071.
STONE, CLAY AND GLASS PROD. [SIC 32]	389.017	657.795	5.393	4.519	.874	19.343	14068.	17343.
PRIMARY METAL INDUSTRIES [SIC 33]	287.496	423.143	3.941	3.950	-.009	-.236	6734.	7184.
FABRICATED METAL PRODUCTS [SIC 34, 19]	524.138	824.936	4.640	3.881	.759	19.555	17373.	21486.
MACHINERY, EXCEPT ELECTRICAL [SIC 35]	425.458	715.259	5.332	4.514	.818	18.123	13440.	17361.
ELECTRICAL MACHINERY & EQUIP [SIC 36]	360.887	589.159	5.023	5.094	-.071	-1.385	11213.	13581.
TRANSPORTATION EQUIPMENT [SIC 37]	2492.129	2962.367	1.744	2.729	-.985	-36.111	49663.	48239.
MISCELLANEOUS MANUFACTURING [SIC 38-9]	219.256	372.673	5.448	5.670	-.222	-3.918	7153.	8237.
TRANSPORTATION SERVICES [SIC 40-7]	1327.270	1980.549	4.084	4.000	.084	2.092	79849.	84468.
COMMUNICATIONS & UTILITIES [SIC 48-9]	1280.511	1969.174	4.397	6.505	-2.108	-32.398	37732.	33585.
WHOLESALE AND RETAIL TRADE [SIC 50-9]	4820.279	7379.581	4.351	4.700	-.349	-7.429	340753.	399664.
FINANCE, INS., REAL ESTATE [SIC 60-7]	4247.452	6287.692	4.001	4.622	-.621	-13.442	75189.	86192.
SERVICES [SIC 70-9, 80-6, 89]	4182.537	6326.404	4.225	5.233	-1.008	-19.263	173085.	217741.
FEDERAL GOVERNMENT ENTERPRISES	220.344	338.847	4.398	5.100	-.702	-13.774	19408.	29846.
STATE & LOCAL GOVERNMENT ENTERPRISES	204.635	311.630	4.296	5.500	-1.204	-21.898	10407.	15848.
UNALLOCATED INDUSTRIES	306.514	461.567	4.179	3.868	.311	8.029	0.	0.
HOUSEHOLDS	15866.004	22863.257	3.721	.000	3.721	.000	0.	0.
CAPITAL RESIDUAL	2202.509	5788.630	10.145	.000	10.145	.000	0.	0.
CITY AND COUNTY GOVERNMENT	1463.800	1992.359	3.131	.000	3.131	.000	151483.	206182.
STATE GOVERNMENT	1576.441	2332.284	3.994	.000	3.994	.000	61142.	90457.
FEDERAL GOVERNMENT	4284.305	4554.817	.000	.000	.000	.000	169092.	179769.
TOTAL	61210.828	91745.866	.000	.000	.000	.000	1728318.	2017696.

BIBLIOGRAPHY

Bonner, Ernest R., and Fahle, Vernon L. Fahle, *Technique for Area Planning*, Regional Economic Development Institute, Pittsburgh, Pa., 1967.

Caldwell, Sam, and Brooks, Walter O., *Georgia, Jobs for the Future*, Georgia Department of Labor Employment Security Agency, 1965.

Carter, A. P., and Brody, A., *Contributions to Input-Output Analysis*, North-Holland Publishing Company, Amsterdam, London, 1970.

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

Gale, David, *The Theory of Matrix Games and Linear Economic Models*, Office of Naval Research, 1957.

Hadley, George, *Linear Programming*, Addison-Wesley Publishing Co., Inc., 1964.

Hicks, Charles R., *Fundamental Concepts in the Design of Experiments*, Holt, Rinehart and Winston, New York, 1964.

Hoover, Edgar M., *An Introduction to Regional Economics*, Alfred A. Knopf Inc., New York, 1971.

Leontief, Wassily W., *The Structure of American Economy, 1919-1939*, Oxford University Press, New York, 1951.

Leontief, Wassily W., *Input-Output Economics*, Oxford University Press, New York, 1966.

Miernyk, William H., and Shelhammer, Kenneth L., *Simulating Regional Economic Development With an Input-Output Model*, Regional Research Institute, Morgantown, West Virginia, 1968.

Occupational Manpower and Training Needs, *U. S. Department of Labor*, Bureau of Labor Statistics, 1971.

Patterns of U. S. Economic Growth, U. S. Department of Labor Bureau of Labor Statistics, Bulletin, 1970, Washington, D. C.

Shaffer, William, Laurent, Eugene A., and Sutter, Ernest M., Jr., "Georgia's Economic Structure--A Preview of the Georgia Input-Output Model, 1970," *Georgia Business*, May, 1972, Vol. 31, No. 11.

Shinners, Stanley M., *Modern Control System, Theory and Application,* Addison-Wesley Publishing Company, Reading, Mass., 1970.

Shigeru, Furuya, "Matrix and Determinant," BAIFU-KAN, Tokyo, Japan (In Japanese).

Stone, Richard, *Mathematical Models of the Economy and Other Essays,* Chapman and Hall Ltd., London, 1970.

The U. S. Economy in 1980, U. S. Department of Labor, Bureau of Labor Statistics, Washington, D. C., Bulletin 1673, 1970.

Technique for Area Planning, Regional Economic Development Institute, Inc., Pittsburgh, Pa., 1967.

Vandermeulen, Daniel C. *Linear Economic Theory,* Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1971.

Volk, William, *Applied Statistics for Engineers,* McGraw-Hill Book Co., New York, 1969.