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Economic Analysis of Cache County, Utah: An Input-Output Approach

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ECONOMIC ANALYSIS OF CACHE COUNTY, UTAH:

AN INPUT-OUTPUT APPROACH

by

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of

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ABSTRACT

Economic Analysis of Cache County, Utah:

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The purpose of this paper is to discuss the theory of input-output analysis, its applications, and its empirical implementations to the Cache County economy. The historical development, the static open input-output model, and the dynamic input-output analysis are presented in the theoretical discussion, and emphasis is made on the empirical applications of the model to structural analysis, forecasting, developmental planning, and regional analysis.

In the empirical implementation of the model to the Cache County economy, the 1971 total output is estimated, the Cache County total output is projected to 1981, the output and income multipliers are computed, and the total impact of the Utah State University and USU students on Cache County economy is determined.

(97 pages)

INTRODUCTION

This study is concerned with some aspects of the input-output analysis. It considers the basic static open input-output model, the dynamic input-output analysis, its applications, with emphasis to its applications in regional analysis, and the empirical implementation of the model for the economic analysis of Cache County, Utah.

Most of the economic analysis work done has been oriented towards national economic systems. As a result, both from theoretical and practical standpoints, very little is known about the functioning of local economies. However, local economies, such as county economies, do not operate in isolation. All the income results from a county's ability to produce goods and services that find a market both within and outside the area.

Local economies are affected by the national economy. Public or private decisions made outside may have effects upon the well-being of the people in the region, as well as local policy decisions. Therefore, the policy makers need more knowledge of how a local economy functions or operates that should be of considerable value in choosing between alternative courses of action. Interindustry analysis can help better understanding and appreciation of the economic problems and can guide the economic development in a region.

Study Area Description

Cache County is the portion of Cache Valley positioned in northern Utah. The 1970 Census of population for Cache County showed a total of 42,331 people. This was an increase of 6,600, 18.4 percent over 1960. Nearly 45 percent of the county's inhabitants live in Logan. The civilian labor force was 15,700, with 6.7 percent unemployed.

Cache County is mainly rural area. Farming and dairy ranching are complemented with food manufacturing such as pea canning factory in Smithfield, cheese factory in Amalga, and meat packing in Hyrum.

Cache County's strategic location near to populated centers of the Pacific Coast seems ideal for manufacture and distribution of products to serve this growing area.

Objectives of the Study

The general objective of the study is to discuss the theory of the input-output model and make an application of the tool in Cache County, Utah.

The specific objectives for the study of Cache County are:

1. To calculate the 1971 total output for Cache County by using the static input analysis concept.
2. To project the Cache County total output to 1981, taking into account the change of the technical coefficients and trade patterns.

3. To compare the previous projection with the new total output vector generated by randomly adjusted technical coefficients.

4. To calculate the income and output multipliers of Cache County economy.

5. To quantify the effect of the Utah State University and USU student expenditures on the Cache County economy.

In order to accomplish the general objective, a review of literature in both theoretical and empirical interindustry analysis was made.

The first specific objective was obtained by using the 1967 input-output technical coefficients, according to the formula:

$$X_{(1971)} = (I - A)^{-1} \; Y_{(1971)} \qquad (1)$$

$X_{(1971)}$ = 1971 total output

$(I - A)^{-1}$ = Leontief's inverse matrix, where

I = n x n unitary matrix

$A = a_{ij}$, i, j = 1, 2, . . ., n is the 1967 technical coefficient matrix

$Y_{(1971)}$ = the 1971 final demand vector, estimated mainly using secondary data.

In order to achieve the second specific objective, a new table of input-output coefficients was constructed by sampling the most efficient firms in each sector, and assuming that their input structures will represent those of average establishments at some time in the future:

$$X_{(1981)} = (I - A)^{-1} Y (1981) \tag{2}$$

$X_{(1981)}$ = 1981 total output

$(I - A)^{-1}$ = the projected Leontief inverse matrix

$Y_{(1981)}$ = the projected final demand vector to 1981, estimated assuming exponential rate of growth.

For the most efficient firms selected, the data reflected that the ratio of employment expenditures to other expenditures would be lower than the average ratio for all firms of each sector.

To compare the 1981 projected total output obtained by sampling with that obtained by randomly adjusting the technical coefficients, the sign test, called the Wilcoxon test, was used.

To calculate the income multipliers, use was made of the $(I - A)^{-1}$ matrix projected to 1981, where I is an n x n 33 x 33 unitary matrix; $A = a_{ij}$, $i, j = 1, 2, \ldots, 33$, is the 1981 technical coefficient matrix closed with respect to households. To obtain the output multipliers, the 1981 $(I - A)^{-1}$ matrix, with household exogenous, was utilized.

For the fulfillment of the fifth objective, the university and USU student expenditures were subtracted from the 1981 final demand vector, and a new set of total outputs was obtained.

REVIEW OF LITERATURE

Historical Development of the Input-Output Model

Interindustry analysis as a form of applied economics begins with the work of Leontief (referred to in (2)).

Professor Wassily Leontief, of Harvard University, saw in Walras' ideas ". . . not simply a tool for the theoretician but a practical instrument for attacking some of the most complex and perplexing real problems of our modern industrial economic environment." (11, p. 97)

Leontief's ideas were published in his article, "Quantitative Input-Output Relations in the Economic System of the United States," the Review of Economics and Statistics, XVIII (August, 1936), pp. 105-125. His first complete investigation was published in 1941 under the title "The Structure of American Economy, 1919-1929."

The Leontief study stimulated empirical work on interindustry relations in a number of nations and small areas. Input-output analysis has in recent years absorbed more funds and more professional resources than any other field of applied economics (11).

The rapid spread of interindustry analysis throughout the world stimulated a large number of both theoretical and empirical works. By 1961, a partial bibliography of input-output studies published by the United Nations ran to 222 pages with agencies in about 40 countries involved in interindustry studies (25, p. 79).

Three ad hoc international input-output conferences have taken place. The first conference, in 1950, at Driebergen in the Netherlands, brought together 15 non-Dutch participants interested in the theoretical, statistical, and computational problems of interindustry analysis.

In 1954, at Varenna, Italy, 25 non-Italian participants from different countries contributed to the complete proceedings (2).

The third conference was held in 1961, in Geneva, Switzerland, where 240 economists and statisticians from more than 41 countries participated. They came from capitalist and communist, and from developed and underdeveloped countries.

Although the applications of the theory in the last two decades have resulted in the construction of input-output tables for several national economies and for a growing number of regions and subregions, the underlying theory of the technique extends far back into the history of economic thought. The origins were primarily in the writings of Francois Quesnay, Leon Walras, and Gustav Gassel.

Francois Quesnay (1694-1774) was the leader of a group of thinkers called "Physiocrats." He published his <u>Tableau Economique</u> in 1758. In this book, ". . . the notion of the compartmentized treatment of necessarily interdependent productive activities was perhaps first formally advanced." (11, p. 97) The <u>Tableau</u> divided the society into three classes, and presented the picture of the transfers of products and money through the economy.

The physiocratic doctrine replaced the partial dynamic analysis of the Mercantilists with the static point of view of the whole economy, and is regarded as "the first system in the history of economic theory, the real beginning of the science as a formalized body of knowledge." (28, p. 36)

Although intersectoral analysis is traced back to the Tableau Economique, Walras contributed more to the modern theory.

Leon Walras (1834-1910), a skilled mathematician, published his Elements d'economie Politique Pure. He was interested in the general equilibrium of exchange and in the general equilibrium of production.

In the theory of general equilibrium, Walras showed how the unknown prices of quantities of goods and services can be determined under conditions of pure competition, given the utility functions of each individual, the individual demand and supply functions for each commodity, and the technological relations of production.

In the theory of production used by Walras, the coefficients of fabrication ". . . are defined as the respective quantities of each of the productive services which enter into the production of a unit of each of the products." (9, p. 348) These are determined by technology, ". . . and they measured the quantities of factors required to produce a unit of each kind of finished goods." (25, p. 5)

To present the Walrasian model, let us assume an economy with m commodities and n resorces or factors of production.

Let r_i be the amount of ith resource supplied and x_j be the amount of the jth commodity produced. Then the production possibilities will be characterized by fixed numbers a_{ij}. The a_{ij} represent the physical amount of the ith resource used up in the production of a unit of the jth commodity. In other words, a_{ij} is an input coefficient of the Leontief type (9, p. 351).

Producers of the first commodity demand $a_{i1}x_1$ units of resource i, producers of the second commodity need $a_{i2}x_2$. Thus the total demand for the ith resource is

$$a_{i1}x_1 + a_{i2}\,x_2 + \ldots + a_{in}x_n + Y_i \tag{3}$$

Since the equilibrium condition establishes supply to be equal to demand for each resource, the m equations follow:

$$\begin{aligned} &a_{11}x_1 + a_{12}x_2 + \ldots\ a_{1n}x_n + Y_1 = r_1 \\ &\vdots \\ &a_{m1}x_1 + a_{m2}x_2 + \ldots\ a_{mn}x_n + Y_n = r_n \end{aligned} \tag{4}$$

Walras believed that the data and computational problems would be insurmountable; therefore, he considered his system a purely theoretical model.

Gustav Gassel of Sweden and Wilfredo Pareto of Italy perfected the Walrasian system and a more precise statement of the mathematical properties of its solution can be found in Wald (9, p. 366).

Theory of Static Input-Output System

Leontief conceives an economy in which goods are produced in their respective industries by combining primary factors with other inputs. He finds that the real world requires the interindustrial relationships. To produce a given good, each industry has to purchase goods from other industries. For example, the automobile industry needs to purchase steel from the steel industry and glass from the glass industry, etc.

In addition, a given industry faces exogenous demands from consumers, the government, and foreign trade.

Input-output coefficients

Suppose that there are n + 1 sectors, n industries, and (n + 1)th final demand sector. If X_i represents the output of each sector i and x_{ij} stands for the amount of sector i absorbed by sector j, and the quantity of the product of sector i delivered to the final demand sector is $x_{i,n+1} = Y_i$, then

$$
\begin{aligned}
X_1 &= x_{11} + x_{12} + \ldots + x_{1n} + Y_1 \\
X_2 &= x_{21} + x_{22} + \ldots + x_{2n} + Y_2 \\
&\vdots \\
X_i &= x_{i1} + x_{i2} + \ldots + x_{in} + Y_i \\
X_n &= x_{n1} + x_{n2} + \ldots + x_{nn} + Y_n
\end{aligned}
\tag{5}
$$

$X_i > 0$ and $x_{ij} \geq 0$.

System (3) is a set of balanced equations.

If industry k is going to produce X units of good k, the amount of good i required as an input depends on the technology of the industry. Leontief assumes that the amount of good i required to produce one unit of good k is directly proportional to the amount of good k produced, that is,

$$x_{ik} = a_{ik} X_k \tag{6}$$

In other words, the quantity of the output of the sector i absorbed by sector k per unit of its total output k is $a_{ik} = \frac{x_{ik}}{X_k}$. a_{ik} is the input coefficient of product of sector i into sector k (20).

Substitution of Equation (4) into System (3) yields

$$\begin{array}{l} (1 - a_{11}) X_1 - a_{12} X_2 - \ldots \quad a_{in} X_n = Y_1 \\ - a_{21} X_1 (1 - a_{22}) X_2 - \ldots \quad a_{2n} X_n = Y_2 \\ \cdot \\ \cdot \\ \cdot \\ - a_{n1} X_1 - a_{n2} X_2 - \ldots + (1 - a_{nn}) X_n = Y_n \end{array} \tag{7}$$

This n x n system of simultaneous equations can be solved for a unique set, X_k, by specifying the exogeneous demands Y_i.

There is no a priori reason for the existence of a unique solution to System (5). The consistency is guaranteed only if all elements A_{ij} of the inverted matrix are non-negative.

According to Leontief, a sufficient condition for this is that in the original structural matrix,

$$\begin{array}{l} a_{11}\ a_{12} \ldots a_{1n} \\ a_{21}\ a_{22} \ldots a_{2n} \\ \cdot \\ \cdot \\ \cdot \\ a_{n1}\ a_{n2} \ldots a_{nn} \end{array}$$

the sum of coefficients of each column (or each row), $\sum_{j=1}^{j=n} a_{ij}$ be no larger than 1 and that at least one of these column (or row) sums be smaller than 1 (20, p. 140).

$$\begin{bmatrix} (1-a_{11}) & -a_{12} & \cdots & -a_{1n} \\ -a_{21} & (1-a_{22}) & \cdots & -a_{2n} \\ \vdots & & & \\ -a_{n1} & -a_{n2} & \cdots & +(1-a_{nn}) \end{bmatrix} \begin{bmatrix} X_1 & Y_1 \\ X_2 & Y_2 \\ \vdots & \vdots \\ X_n & Y_n \end{bmatrix} \tag{8}$$

or

$$(I - A)\, X = Y \tag{9}$$

If (I - A) is non-singular, then the solution follows:

$$X = (I - A)^{-1}\, Y \tag{10}$$

The same type of analysis can be used to determine the prices which prevail in the model. If P_k is the price of one unit of k, then the cost of inputs required to produce one unit of k is

$$a_{1k}P_1 + \ldots + a_{nk}P_n \tag{11}$$

The difference between the price of one unit of k and the cost of inputs required to produce this unit is the value added by industry k. Thus, if the value added is denoted by V_k,

$$P_k - \sum_{i=1}^{n} a_{ik}\, P_i = V_k \qquad k = 1, \ldots, n \tag{12}$$

Equation (12) represents a set of n simultaneous linear equations in n prices P_k.

$$
\begin{array}{lllll}
(1 - a_{11}) P_1 & - a_{21} P_2 & - \ldots & - a_{n1} P_n & = V_1 \\
- a_{12} P_1 & + (1 - a_{22}) P_2 & - \ldots & - a_{2n} P_n & = V_1 \\
\vdots & & & & \\
- a_{1n} P_1 & - a_{2n} P_2 & - \ldots & + (1 - a_{nn}) P_n & = V_n
\end{array}
\tag{13}
$$

Once the value added is specified for each product, the prices can be determined (14).

$$
P = (I - A^1)^{-1} V \tag{14}
$$

<u>Basic assumptions of input-output analysis</u>

In addition to the Walrasian assumption of static equilibrium and pure competition, the special assumptions are threefold (6, pp. 33-34):

1. Each commodity is produced by a single sector.
2. Inputs to each sector are a direct linear function of that sector's output.
3. There are not externalities involved in the production process.

The first assumption implies that each sector uses only one method of production and produces one product.

The second assumption implies constant technical or input coefficients; that is, the employment of input x_{ij} is dependent upon and in direct proportion to the level of output X_j, i.e.,

$$
x_{ij} = a_{ij} X_j \qquad i, j = 1, 2, \ldots, n \tag{15}
$$

In other words, the proportion of inputs used to produce any output is fixed.

The third assumption refers to the external economies in the production process. Alfred Marshall used the phrase "internal economies" to describe a situation in which expansion of production by a firm would result in lower total costs per unit of output (22, p. 266).

Graphically, internal economies (diseconomies) are represented by the downward (upward) sloping segment of the firm's ATC cost curve a (see Figure 1). External economies (diseconomies) are represented by the shift from a to b (b to a), which states that any given level of output now costs less (more) to produce.

In Leontief's input-output model, this kind of externalities in the production process cannot occur.

In order to point out some important aspects of these assumptions, consider an example of an economy with two industries, with following information given:

	Inputs to Industry 1	Inputs to Industry 2	Final Consumption	Total Output
Industry 1	x_{11}	x_{12}	C_1	X_1
Industry 2	x_{21}	x_{22}	C_2	X_2
Labor Services	x_{01}	x_{02}	--	X_0

In order to describe the technological possibilities, a set of production functions is required. These can be written:

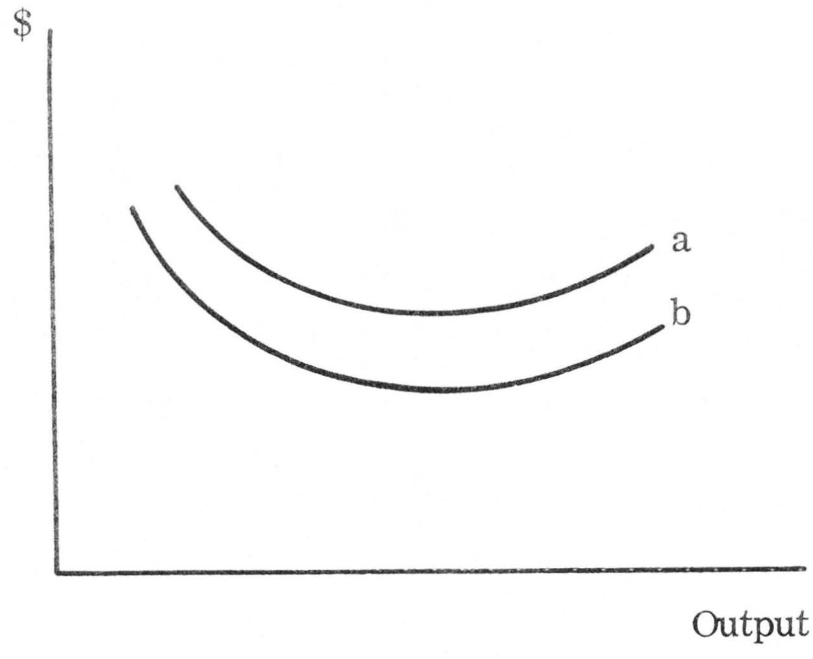

Figure 1. Average total cost curves.

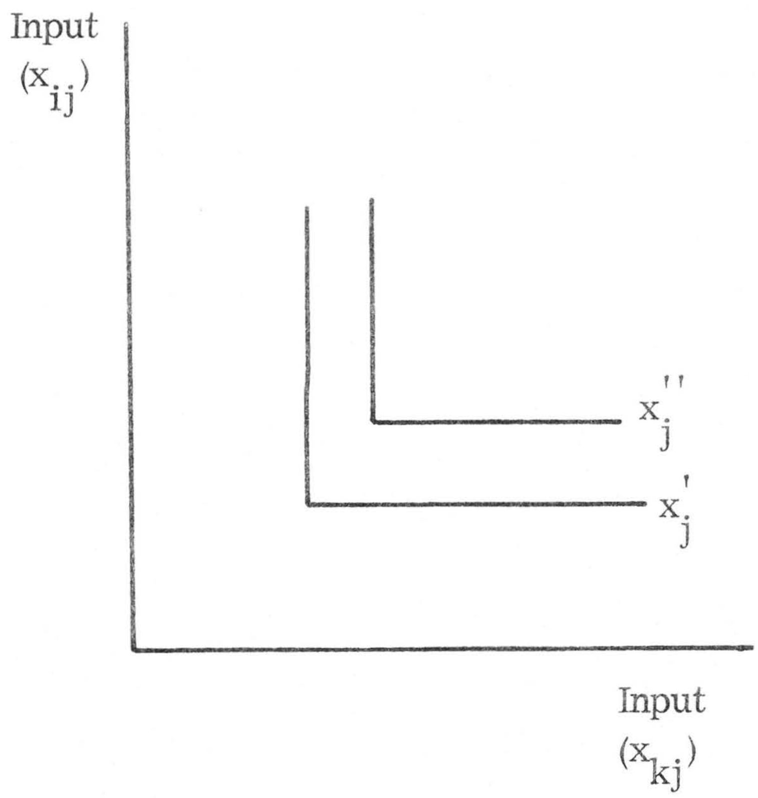

Figure 2. Isoquants under assumption of fixed coefficients.

$$X_1 = F_1 (x_{11}, x_{21}, x_{01})$$
$$X_2 = F_2 (x_{12}, x_{22}, x_{02}) \tag{16}$$

Under the assumption of fixed coefficients, the isoquants are of the form shown in Figure 2.

Besides, he supposes that it takes a certain minimal output of each commodity (possibly zero) per unit of output of each commodity (9, p. 209). If it takes two tons of steel to produce six automobiles, no firm will use more than the required two tons.

If a_{ij} stands for the minimal input of commodity i per unit of output of commodity j, the production function (14) can be written:

$$X_1 = \min \left(\frac{x_{11}}{a_{11}}, \frac{x_{21}}{a_{21}}, \frac{x_{01}}{a_{01}}\right)$$
$$X_2 = \min \left(\frac{x_{12}}{a_{12}}, \frac{x_{22}}{a_{22}}, \frac{x_{02}}{a_{02}}\right) \tag{18}$$

Dynamic Input-Output Model

Up to now, concern has been with the problem of determining how much each industry should produce in order to satisfy the input requirements of all industries and the final demand. When additional considerations of intersectoral dependence involving lags or rates of change over the time are incorporated, the dynamic input-output model emerges.

The basic technological assumptions still remain, ". . . (1) joint products are rules out; and (2) for each output there is only one possible activity or technological process, with fixed proportions." (9, p. 283)

Consider three dynamizing aspects: time lag in production, excess demand and output adjustment, and capital formation.

Time lag in production

Assume that there are n industries in the economy, and that there is one period lag in the production, i.e., that the amount demanded in period t will determine the output of period (t + 1).

Let $x_{i,t}$ be the output of the ith industry in the base period, and $x_{i,t+1}$ in the next period, a_{ij}, measured in monetary terms, represents the dollar input of the ith commodity required in the production of a dollar's worth of the jth good, and $y_{i,t}$ indicates the final demand in period t.

The new situation can be described by:

$$
\begin{aligned}
x_{1,t+1} &= a_{11}x_{1,t} + a_{12}x_{2,t} + \cdots + a_{1n}x_{n,t} + y_{1,t} \\
x_{2,t+1} &= a_{21}x_{2,t} + {}^{2}{}_{aa}x_{2,t} + \cdots + a_{2n}x_{n,t} + y_{2,t} \\
&\vdots \\
x_{n,t+1} &= a_{n1}x_{n,t} + a_{n2}x_{2,t} + \cdots + a_{nn}x_{n,t} + y_{n,t}
\end{aligned}
\tag{19}
$$

or

$$X_{t+1} + A\,X_t = Y_t$$

$$
X_{t+1} = \begin{bmatrix} x_{1,t+1} \\ \vdots \\ x_{n,t+1} \end{bmatrix} \qquad
A = \begin{bmatrix} a_{i1} & \cdots & a_{in} \\ \vdots & & \\ a_{n1} & \cdots & a_{nn} \end{bmatrix} \qquad
X_t = \begin{bmatrix} x_{1,t} \\ \vdots \\ x_{n,t} \end{bmatrix}
$$

$$Y_t = \begin{bmatrix} y_{1,t} \\ \cdot \\ \cdot \\ \cdot \\ y_{n,t} \end{bmatrix}$$

The solution of these simultaneous difference equations can be found once the final demand vector, which is a function of time, is known. This solution essentially consists of the particular and the complementary solutions, whose sum will describe the desired time path.

The particular solution yields the equilibrium values, and the values of the complementary solution indicate whether the time path converges to or diverges from the equilibrium.

Consider an example of an open economy consisting of two industries.

$$\begin{aligned} x_{1,t+1} &= a_{11}x_{1,t} + a_{12}x_{2,t} + Y_{1,t} \\ x_{2,t+1} &= a_{21}x_{2,t} + a_{22}x_{2,t} + Y_{2,t} \end{aligned} \qquad (21)$$

or

$$X_{t+1} - A\,X_t = Y_t \qquad (22)$$

Given the exponential final demand vector

$$Y_t - \begin{bmatrix} \delta^t \\ \delta^t \end{bmatrix} \qquad (23)$$

Where δ is a positive real number, it is necessary to find the particular and the complementary solutions.

For the complementary solution, try $X_{1,t} = \beta_1 \delta^t$ and $X_{2,t} = \beta_2 \delta^t$ where β_1 and β_2 are undetermined coefficients.

$$X_t = \begin{bmatrix} \beta_1 \delta^t \\ \beta_2 \delta^t \end{bmatrix} \quad \text{and } X_{t+1} = \begin{bmatrix} \beta_1 \delta^{t+1} \\ \beta_2 \delta^{t+1} \end{bmatrix} \tag{24}$$

Substitution of (22) into (20) yields

$$\begin{bmatrix} \delta & 0 \\ 0 & \delta \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} \delta^t - \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} \delta^t = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \delta^t \tag{25}$$

since $\delta^t \neq 0$

$$\begin{bmatrix} \delta - a_{11} & - a_{12} \\ - a_{21} & \delta - a_{22} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \tag{26}$$

Assuming that

$$\begin{vmatrix} \delta - a_{11} & - a_{12} \\ - a_{21} & \delta - a_{22} \end{vmatrix} \neq 0 \tag{27}$$

$$\beta_1 = \frac{\delta - a_{22} + a_{12}}{(\delta - a_{11})(\delta - a_{22}) - a_{12} a_{21}}$$

$$\beta_2 = \frac{\delta - a_{11} + a_{21}}{(\delta - a_{11})(\delta - a_{22}) - a_{12} a_{21}} \tag{28}$$

Thus, we can write the particular solution

$$X_t = \begin{bmatrix} \dfrac{\delta - a_{22} + a_{12}}{\Delta} \\ \dfrac{\delta - a_{11} + a_{21}}{\Delta} \end{bmatrix} \delta^t$$

$$X_{t+1} = \begin{bmatrix} \delta & 0 \\ 0 & \delta \end{bmatrix} \begin{bmatrix} \overline{\delta - a_{22} + 12} \\ \overline{\delta - a_{11} + a_{21}} \end{bmatrix} \delta^t \tag{29}$$

For the complementary solution, we take the homogeneous system

$X_{t+1} - A X_t = 0$

$$\left| b I - A \right| = \begin{vmatrix} b - a_{11} & - a_{12} \\ - a_{21} & - b - a_{22} \end{vmatrix} = 0 \tag{30}$$

and the complete solution will be

$$X_t = \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} \delta^t + b_1^t \qquad X_{t+1} = \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} + b_2^t \tag{31}$$

See (7, p. 564).

Excess demand and output adjustment

If we assume that there exists an excess demand for each product which tends to induce an increment in the output equal to the excess demand, the amount for the excess demand for the ith output in time t can be expressed:

$$\underbrace{a_{i1} X_{1,t} + a_{i2} X_{2,t} \ldots + a_{in} X_{n,t} + Y_{i,t}}_{\text{demanded}} - \underbrace{X_{i,t}}_{\text{supplied}} \tag{32}$$

since the output increment $\Delta X_{i,t}$ needs to be adjusted to that level, then

$$\Delta X_{i,t} = a_{i1} X_{1,t} + a_{i2} X_{2,t} + \ldots + a_{in} X_{n,t} - X_{i,t} \tag{33}$$

or

$$X_{i,t+1} - X_t = a_{i1} X_{1,t} + a_{i2} X_{2,t} + \ldots + a_{in} X_{n,t} - X_{i,t} \qquad (34)$$

If we add $X_{i,t}$ to both sides of (32), we get (17). Thus, the identical mathematical model is derived from different economic assumptions (7, p. 564).

Capital formation

The static model only considered the output level needed to satisfy the intermediate and final demands. The needs for capital formation were ignored. If S_{ik} (t) represents the stock of a commodity produced by industry i and used by industry k at the time t, the rate of change in that stock at this particular point of time can be written as

$$\frac{d\, S_{ik}(t)}{d\, t} = S'_{ik} \qquad \text{(See 21, p. 56).} \qquad (35)$$

The stock flow requirement can be expressed as

$$S'_{ik} = b_{ik} X_k \qquad (36)$$

The b_{ik} are referred to as the capital coefficients of the system, and each is defined as the stock of goods produced by the ith sector which sector j holds per unit of its output. For example, "if i stands, say, for power tools and k for automobiles, the coefficient, b_{ik}, indicates the amount, i.e., the stock, of power tools used per unit of the annual automobile output." (21, p. 56)

The matrix $B = b_{ij}$

$$\begin{matrix} b_{11} & b_{12} & \ldots & b_{1n} \\ b_{21} & b_{22} & \ldots & b_{2n} \\ \vdots \\ b_{n1} & b_{n2} & \ldots & b_{nn} \end{matrix} \qquad (37)$$

describes the capital of a national economy as a whole (20, p. 145).

Like the input coefficients, a_{ij}, the capital coefficient, b_{ij}, is assumed to be fixed.

The main idea of this model is that the economy has to produce each commodity in sufficient quantity to satisfy the intermediate and final demand, as well as the capital requirements demand.

If time is continuous, the output of each industry can be determined by the following simultaneous differential equations:

$$\begin{matrix} X_1(t) = a_{11}X_1(t) + \ldots + a_{1n}X_n(t) + B_{11}X_1'(t) + \ldots + b_{1n}X_n'(t) + Y_1(t) \\ \vdots \\ X_n(t) = a_{n1}X_1(t) + \ldots + a_{nn}X_n(t) + b_{n1}X_1'(t) + \ldots + b_{nn}X_n'(t) + Y_n(t) \end{matrix} \qquad (38)$$

or

$$I X = A X + B X' + Y = B X' + (A - I) X = -Y \qquad (39)$$

The derivative $X_i'(t)$ indicates the output increment.

If time is discrete, the capital requirements in period t will be $\Delta X_{i,t-1} = X_{i,t} - X_{i,t-1}$, and the model can be expressed by the following system of difference equations:

$$\begin{bmatrix} X_{1,t} \\ X_{2,t} \\ \cdot \\ \cdot \\ \cdot \\ X_{n,t} \end{bmatrix} = \begin{bmatrix} a_{11} \dots a_{1n} \\ a_{21} \dots a_{2n} \\ \cdot \\ \cdot \\ \cdot \\ a_{n1} \dots a_{nn} \end{bmatrix} \begin{bmatrix} X_{1,t} \\ X_{2,t} \\ \cdot \\ \cdot \\ \cdot \\ X_{n,t} \end{bmatrix} + \begin{bmatrix} b_{11} \dots b_{1n} \\ b_{21} \dots b_{2n} \\ \cdot \\ \cdot \\ \cdot \\ b_{n1} \dots b_{nn} \end{bmatrix} \begin{bmatrix} X_{1,t} - X_{1,t-1} \\ X_{2,t} - X_{2,t-1} \\ \cdot \\ \cdot \\ \cdot \\ X_{n,t} - X_{n,t-1} \end{bmatrix} + \begin{bmatrix} Y_{1,t} \\ Y_{2,t} \\ \cdot \\ \cdot \\ \cdot \\ Y_{n,t} \end{bmatrix} \quad (40)$$

or

$$I\,X_t = A\,X_t + B\,(X_t - X_{t-1}) + Y_t \quad (41)$$

(41) can be rewritten as

$$X_t - A\,X_t - B\,(X_t - X_{t-1}) = Y_t \quad (42)$$

or

$$(I - A - B)\,X_t + B\,X_{t-1} = Y_t \quad (43)$$

Solving for X_t, we can obtain

$$X_t = (I - A - B)^{-1}\,(Y_t - B\,X_{t-1}) \quad (44)$$

Applications of the Input-Output Analysis

The input-output model is applied to study a variety of economic problems. Among these applications, we will review the use of the model for structural analysis, its application as a forecasting tool, and as a device of developmental planning.

Structural analysis

"Structural analysis is concerned with the qualitative properties of an input-output table, especially the properties of the technical input-output matrix." (55, p. 86)

Each element of the matrix $(I - A)^{-1}$ gives the total direct and indirect demand on the ith industry generated by a unit of final demand for industry j. The total impact of the demand for a commodity on all industries can be found by reading down the column. Likewise, the effect of all demands on the sales of ith industry can be determined by reading across the appropriate row.

It is of interest to work out the effect of changes in one or more of the parameters on the outputs of all sectors. Assuming changes in one of the final demand components and holding the others constant, we can quantify the total effect on the outputs of the economy.

Studies of the role of individual industries in a national or regional economy is one of the most common applications of interindustry research. Examples are the Cao-Pinna studies of the repercussions of the declining textile exports on all other industries, and ". . . Leontief's first study of the different amounts of employment throughout the economy supported by final demands on individual industries." (6, p. 234)

Marketing analysis and international trade studies are another example of applied input-output analysis. For example,

> . . . the work in the Netherlands on "import quotas,"--total direct and indirect import requirements of various elements of final demand, calculated with an interindustry model and then used in an aggregative model oriented toward policy decision. (6, p. 241)

Studies of international comparison of production structures, using the input-output framework, were attempted. An earlier study in this field compared the production structure of advanced countries such as Italy, Japan, Norway, and the United States. A recent interesting study in this field is one by K. V. Santhanam and R. H. Patil. They compared the production structure of India, a developing country, with that structure of advanced countries (30).

Input-output as a forecasting tool

In a society in which the government assumes responsibility for economic stability and high employment, forecasting becomes a part of the public domain. If the forecast of the national economy were available, businessmen could adjust their individual production and employment schedules to conform to the overall projections.

The economic forecasting chances of success are very limited, because forecasting attempts to predict decisions conditioned by human behavior. In addition, the accuracy of economic forecasting is constrained by many forces which affect production and consumer demand.

Different techniques for forecasting business conditions are available. It is appropriate to use the partial forecasting which involves the projection of one or more time series. The simplest method of partial forecasting is to fit a mathematical curve to an individual time series and extrapolate this to some future date.

Another way of forecasting is by using econometric models. An econometric model tries to express economic theories in strictly mathematical form. It tries to gain new economic insights through the manipulation of those forms, and it uses historical statistics for purposes of testing the mathematical hypothesis.

Ordinarily, econometric models take the form of a collection of simultaneous behavioral equations, with stochastic variables on error terms (8).

The technique of forecasting by means of the input-output table is labeled the consistent forecast. If we project the input-output table, ". . . the output of each industry is consistent with demands, both final and from other industries, for its products." (1, p. 4)

The consistent forecast insures that projection for individual industries and sectors will add up to a total projection if the structural relations of the economy do not vary significantly.

But one of the major problems involved in using this technique is the assumption of fixed coefficients of production. It is obvious that coefficients of production are not fixed, and all sorts of variations are possible and occur.

The changes in direct input coefficients might be small, but these are magnified when the table of direct coefficients is inverted to obtain the general solution and this is multiplied by final demand entries (4).

Few economists have been critical of the input-output technique when it is used for describing the structure of an economy in a given time. The critics have questioned its usefulness as a predictive device. For example, Milton Firedman has pointed out:

> Viewed as a predictive device, input-output analysis specifies a method of predicting the total output . . . Its actual use to forecast total output for a future year involves, first, forecasting final demand then predicting total output from this final demand. . . .

> The central feature of input-output analysis as a predictive device is that it proceeds to make predictions as if all coefficients were fixed. (27, p. 171)

There are many projections that have been made by applying the input-output technique and they were compared with the alternative multiple regression technique and with other kinds of naive projections. Tests of statistical significance applied to the difference observed show the margin of superiority of input-output technique over the others in many cases. An example is the projection made by Michio Hatanaka (6, p. 173).

"In Italy . . . a one year projection, based on actual output, of all industries rather than actual final demands, generated a median error in intermediate output for (31 basic products) of 5%." (6, p. 177)

There are some other examples in Japan made by Shishido, with median errors of 4%, 8%, and 9%. ". . . in Norway (Sevaldon, 1956) a one-year projection, compared to two kinds of naive projections, showed input-output best for 14 sectors, second-best for 12, and poorest for 2." (6, p. 177)

It does not mean that forecasting problems are completely solved by applying the input-output technique. Forecasting and projections are subject to certain margins of error. For example, errors resulting from assumptions and data are almost impossible to avoid.

Input-output in developmental planning

Few words in our time are more fashionable in economic and political discussions than "planning." The current literature is closely connected with planning in different economic systems and with expanding discussion of economic growth and development in both the developed and developing countries (12, p. 30).

One of the analytical tools which has been applied in many countries is an input-output model. For example, in France they attempt to determine the detailed industrial outputs which will be required to meet these aggregated projections. Many other countries have engaged in planning and have made use of input-output models.

Although the static open input-output model is widely used for regional, interregional, and national analysis, it continues to have critics. They argue that the analysis using the input-output approach is time consuming and expensive. On the other hand, those who have engaged in this type of research are aware of its limitations and the high cost involved, but they feel that the results justify the efforts and costs.

There are also some critics of the usefulness of input-output tables in underdeveloped countries. They argue that underdeveloped economies are so simple that interindustry analysis is not needed. Countries having per capita income under $100 derived only 10 to 12 percent of their income from manufacturing and 60 percent from primary production. There is hardly any significant interdependence between the different sectors.

Another argument is the lack of statistics, particularly of that type which is necessary for the construction of the input-output table.

Although the lack of reliable statistics is a stumbling block for the construction of input-output tables in underdeveloped countries, this should not be a hindrance and the model should not be regarded as useless on this account (2, p. 203).

Most of the tables constructed for underdeveloped countries show that there exists a substantial interdependence among the different productive sectors, despite the heavy reliance on imports.

> On the other hand, experience in Latin American Countries proves that the construction of input-output models is not impossible as far as the basic statistical data are concerned. The experience of ECCA in Colombia, shows, however, that there is heavy reliance on imports for both intermediate and final demand; nevertheless it was found that the input-output model provided a unique tool for calculating the effects of an import-substitution policy. (2, p. 202)

Input-Output and Regional Analysis

There have been three approaches to defining a region. One emphasizes homogeniety with respect to particular characteristics such as physical geography, social characteristics, etc. Another centers around the concept of polarization, and is usually concerned with an urban complex. The third approach focuses on administrative characteristics. It gives emphasis to politically defined areas such as the city, the county, etc. (23, pp. 22-23).

Since the end of World War II, there has been a great deal of interest in regional economic analysis. In attacking regional problems, input-output techniques have been more widely used by writers than others. As Charles Tiebout has commented:

> It is not too much of an overstatement to say that post World War II regional research has been almost completely dominated by regional applications of input-output models. Whatever the forms of the variations, the basic input-output theme is present. (31, p. 140)

Basic input-output model

The conceptual framework of the regional analysis is based in the static input-output model. Regional models differ from national in the spatial dimension that must be added to the analysis.

Let X_i be the output of the ith industry. ${}_rX_i$ will be the total output X of industry i in region r. ${}_{rs}X_{ij}$ represents the flow from industry i in region r to industry j in region s.

If the number of regions r, s = 1, 2, . . ., n is known, the interregional model takes the form

$$ {}_rX_i - \sum_{s=1}^{n} \sum_{j=1}^{n} {}_{rs}x_{ij} = {}_rY_i \qquad a, j = 1, 2, \ldots, n \qquad (45)$$

In equation (45) ${}_rY_i$ represents the final demand for the products of industry i in region r.

Production coefficients are given by

$$ \frac{{}^r{}_s x_{ij}}{{}_rX_i} = {}_{rs}a_{ij} \qquad (46)$$

which states that inputs from industry i in region s are same proportion of the total production X of good j in region r. Spatial as well as technical components for the production coefficients are taken into consideration (21).

Most of the empirical applications of the input-output technique in regional analysis dealt with one of the following problems:

1. Local impact studies
2. Regional balance of payments studies
3. Interregional flows studies

Local impact studies are used to quantify the total changes in the level of economic activity, if a new industry were located in an area. An example of this kind of study we can find in Walter Isard and Robert E. Kuenne (17).

Regional balance of payments studies seek to show the relation of a region to the rest of the nation. For example, an autonomous change in the level of exports can be shown to have certain implications for the regional economy.

Interregional flows studies attempt to show the structural relationships between regions.

In recent years, there have been some attempts to apply the input-output model for studying the economic structure of large areas as well as small areas within the country. The model used is similar to that described in the basic static framework, with some variations to suit local conditions.

Some regional studies cover broad geographic areas such as a Federal Reserve District. For example, the one made by Walter Isard covers the New England Federal Reserve District (16). Others have been limited to specific states, like the Interindustry Model of Utah by Frederick T. Moore and James W. Petersen (31). Some are interested in a group of counties within the state, such as "An Interindustry Analysis of the Central New York," by Robert J. Kalter (22). Many have been concerned with small communities. An example is the Interindustry Analysis of San Benito County, California, by Ananda S. Rao (29).

The present study deals with one microregional analysis of Cache County, Utah.

INPUT-OUTPUT MODEL, CACHE COUNTY

Cache County was selected for the empirical implementation of this study because the county is not too large, either in area or population, to permit the collection of primary data through field interviews within reasonable cost and time limitations. Besides, the county is easily accessible from the campus of Utah State University.

However, the main reason for this selection was that some previous economic analyses of Cache County have been made using the input-output approach.

The Cache County input-output model consists of 32 endogenous sectors. The economic activity of the region was classified using the Standard Industrial Classification (SIC) system. The classification scheme used is listed in Appendix A.

The original input-output study was accomplished by Dr. Reed R. Durtschi in 1962. This table was updated to 1967 ". . . through the use of secondary data and check interviews with key businesses." (54, p. 38)

The 1967 tables were used to study the impact of the university and university student expenditures on the Cache County economy.

In addition to the endogenous sectors, six categories of final demand were distinguished in the model. They were: households, governmental operations (all types), Utah State University, Utah State University students, regional investment, and exports.

Calculating the 1971 Cache County Total Output

The 1967 Leontief inverse matrix, $(I - A)^{-1}$, is given in Table 12, Appendix C. I is a 32 x 32 identity matrix. $A - a_{ij}$, i, j = 1, 2, . . ., 32. It was calculated using the 1967 technical coefficients taken from Reed Williams' thesis (54).

It is assumed that technical coefficients are invariant with respect to time.

The accuracy of the estimated total output will be dependent upon the accuracy with which the demand vector can be obtained.

1971 final demand vector

The levels and operations of final demand sector are not explained by the open input-output model itself. They are explained by exogenous factors within the region, and sometimes they are influenced by decisions taken outside of the region, as is the case of exports and governmental expenditures.

The various components of final demand will vary with the problem at hand, the region under study, and especially with the availability of information.

In the Cache County models, Utah State University and Utah State University students are included as separate components of the final demand vector, instead of treating them as part of higher education or government and households, respectively.

A variety of secondary sources provided data for estimating the original components of the final demand vector. The individual components were developed from data on personal income; personal and business taxes; state, local, and federal receipts and expenditures; current business statistics in construction; and Utah State University financial reports.

Households. From Utah Labor Market Information by Planning District and County (45, p. 124), it is known that $112,988,000 was the 1971 personal income for Cache County. From the Utah Foundation Research Reports (46, p. 295), we can get the individual income tax as 12.49 per cent of the personal income. The property tax, according to the State Tax Commission Report (50, Table 7), is given in Table 1. Putting all together provides the information in Table 2. The total $17,012,000 figure was obtained by assuming that each of the 8,790 students at Utah State University spent an average of $1,936 during the 1971 school year.

The regression line which fits the trends in consumption and disposable income for the State of Utah is:

$$C = 0.11 + .85\ D\ I \qquad (47)$$

0.11 thousands of dollars

Accordingly, that gives:

Disposable Income	$79,196
Consumption	67,853
Investment	11,343

Once the total figures for households and Utah State University students were obtained, two ways of distributing the totals among the expenditures on

Table 1. Cache County individual property tax (1971)

Items	Totals
Residential buildings	$1,603,143
Agricultural real estate	471,466
Agricultural buildings	64,271
Total individual property tax	2,667,808

Table 2. Cache County personal income distribution (1971) - ($000)

Items	Totals
Personal income	$112,988
Individual income tax (-)	14,112
Property tax (-)	2,667
Disposable income	96,208
Cache County households	79,196
Utah State University students	17,012

different sectors were considered. The first consisted of assuming that Cache County consumption patterns are the same as the national average. This assumption has been made in many regional studies.

The second method assumes that the consumption patterns of a region do not vary significantly in the short run. The latter assumption is made in this study.

Government. According to the Federal Information Exchange System State-Federal Outlays Report (47), the 1971 government expenditures for Cache County were as shown in Table 3.

Government expenditures other than for higher education and households were distributed among the different sectors by using operating budgets of 19 cities and the county budget (48). The total government payments to households in the county were \$29,166,000 (45, p. 60). Of this, \$11,391,000 was to households in higher education and \$17,775,000 to other services.

Utah State University. There is complete information about the university expenditures in the Financial Report for the Year Ending June 30, 1971 (52). The data from this report were arranged according to the different sectors in the model.

Capital formation. There exists some information available about investment in Utah Construction Report (42, p. 18), where \$9,238,400 is the value of total construction in Cache County for 1971. Of this, \$7,516,400 was for new residential construction and \$1,721,000 is the figure for general construction.

Table 3. Government expenditures in Cache County (1971)

Items	Expenditure
Federal outlays	$30,203,683
State expenditure, Federal outlays	7,302,203
State expenditure, State outlays	16,974,428
State expenditure, Local outlays	10,041,100
Total	64,527,014
Expenditure in Higher Education and Basic Research	34,659,000
Other government expenditures	29,863,014

Table 4. Cache County capital formation (1971) - ($000)

Sectors	Investment
Building supplies and equipment	$ 450
Farm and industry equipment	921
Food stores	462
Autos, gas, and durable ag. repair	127
Home furnishing	464
Clothing stores	550
General guilding and subcontracting	7,517
General construction	1,721

Taking two consecutive years of the information contained in the Statistical Study of Assessed Valuations, Utah, 1970 and 1971 (50 and 51, Table 4), provides the other figures for investment by subtracting the 1970 assessed values from 1971. The difference would be the net investment or disinvestment in assessed valued terms whose market value is obtained by multiplying by 5. For example, the total investment for farm and industry equipment was obtained by taking the 1971 assessed values of machinery and livestock, \$4,176,136. The assessed values in 1970 for the same items were \$3,991,920. The difference, \$184,216, multiplied by 5, is equal to \$921.080. Table 4 summarizes the results of these computations. It was impossible to get data for changes in inventories.

Exports. The remaining component of the final demand is the export vector. There are no time series data available which would permit approximations of the trends in export sales.

In order to get the 1971 export estimates, the annual rate of growth in each sector was obtained taking the difference between exports in 1962 and 1967, and, assuming linear growth, the 1971 export vector was extrapolated.

The results of the final demand estimates for 1971 are given in Table 11, Appendix B. They were used to make the static projection of 1971 output. The results of calculating the total output are shown in Table 12, Appendix C.

Comparative Static Projections to 1981

As indicated above, there was criticism of the assumption of fixed technical coefficients or linearity and proportionality in the static input-output model. Evans and Hoffenberg pointed out in their paper on the 1947 U.S. model that ". . . the question as to proportionality, linearity or non-linearity is not properly conceptual, but rather a subject for empirical investigation and an appeal to facts." (11, p. 100)

Dr. Anne Carter made a complete analysis of structural changes resulting from technological advancements between 1947 and 1958 (4 and 5). According to her, "the many substitutions, technological developments, and innovations introduced between 1947 and 1958 result in definite changes in input-output patterns." (4, p. 223)

However, she found that even in this period of rapid technological advance, changes were moderated, and there was a relative increase in the so-called general inputs, which are energy, communication, maintenance, construction, business services, printing and publishing, finance, insurance, and real estate.

There is evidence that changing technology affects the pattern of inputs in the economy. Therefore, for a long-run projection of 5 years or more, the technical coefficients become a function of time.

In addition, the regional input-output coefficients can change over time with changes in interregional trade patterns (24).

In order to use the input-output model to make a long-run projection, we have to take into account the effects of changes in technology and changes in trade patterns.

One method used in applied input-output analysis is the "comparative static projection," which was developed by William H. Miernyk. He applied the model in his studies of the Colorado River Basin and in the Interindustry Analysis of the West Virginia Economy (24). It consists of identifying the "best practice establishments."

The assumption is that the "best practice establishments" are technologically more advanced than the average of the sector. Thus, some time in the future they will represent the average.

This method of projection was adopted in this study because it takes into account the effects of changes in technology and changes in trade patterns.

Selecting the most efficient firms

The selection of the most efficient firms in each sector was accomplished with the information given in Utah Labor Market Information (45), County Economic Potential Profile, Utah Industrial Information System (35), and Directory of Utah Manufacturers, 1971-1972 (44).

The criterion applied in the selection of the most efficient firms was based on the assumption that a highly efficient firm could have a low wage-output ratio, i.e., be more capital intensive. It is possible that some efficient firms are labor intensive and the assumption would be unrealistic if this is the case; despite this the indicated criterion was adopted because of the lack of further information.

Data sources and method

The basic data were obtained from a mail survey. The questionnaire asked the firms to break down sales to final demand sectors or local industry groups, purchases from local industry, and purchases from out of the county.

The results were aggregated on an Industry Classification basis.

In addition, recourse was made to published and unpublished data, interviews with firms, State Tax Commission Office, Cache County Chamber of Commerce, Employment Security Office, State Auditor's Office, and the Bureau of Economic and Business Research.

The transaction table was constructed with the data in the questionnaire. The column of total output was calculated using secondary data in the following way.

The total output of a firm for a given year is equal to labor productivity times total year working hours.

If T is total output, Lp stands for total hours worked, and α the labor productivity, then

$$T = \alpha Lp \qquad (48)$$

The labor productivity data was obtained from Economic Indicators, February, 1972 (32, p. 15).

The number of employees for each firm is given in County Business Patterns (33, pp. 21-23), Directory of Utah Manufacturers (44), Utah Labor Market Information by County (45), and in City Economic Potential Profile, Utah (see 42, 35, 36, 37, 38, 39, 40, and 41).

For example, let us calculate the total output for the first sector, meat packing.

The known figures are number of workers, 95, and labor productivity, \$2.63, according to Economics Indicators (32). The total output for this sector is \$2.63 x 95 x 40 x 52 = \$5,206,000.

It is assumed that each worker works an average of 40 hours a week.

The interindustry flow table depicting transactions and total output appropriate to the most efficient firms is found in Table 13, Appendix D.

Projecting final demand to 1981

Two methods of projecting final demand were considered. There is a study on changes in final demand in the nation (34). The projection of total demand by sector could be made on the assumption that Cache County would maintain a constant share of national final demand. But there are some difficulties in applying this method. The differences in sectoral definitions between the national and Cache County tables are big and there is no reason to assume that Cache County follows the national trade patterns.

The other method was to calculate the rate of growth between 1962 and 1967 and between 1967 and 1971 final demands. Further, it was assumed that growth of final demand is exponential.

The results shown in Table 14, Appendix E, were obtained according to the formula:

$$1981\ Y_i = 1971\ Y_i\ (1 + i)^{10} \qquad (49)$$

i = annual rate of growth.

Finally, the 1981 total output projection was calculated using the Leontief projected $(I - A)^{-1}$ matrix, which comes from Table 13, Appendix D.

$(I - A)^{-1}$ multiplied by the projected to 1981 final demand vector is shown in Table 15, Appendix F.

1981 Randomly Projected Output

Since there is no way to check how accurate the previous projection is, another set of total outputs was calculated, adjusting at random the 1962 technical coefficients.

Each number of the 1962 technical coefficiency matrix was multiplied by a positive random integer and the sums of each column were checked to be sure that they were less than 1.

With the new randomly adjusted technical coefficients, the inverted matrix $(I - A)^{-1}$ was computed and multiplied by the 1981 project final demand to obtain the randomly projected total output to 1981. The results are given in Table 16, Appendix G.

Testing the randomness of 1981 projected output

We have two projections of total output to 1981. One was obtained by using the sample of the most efficient firms and the other was calculated by randomly adjusting the 1962 technical coefficients. Is there some statistical difference between these two projections?

The easiest way to perform the test would be to use the sign test. However, the sign test shows which member of a pair of observations is the larger, but does not indicate the magnitude of the difference.

A non-parametric test utilizing both magnitude and direction was proposed in 1945 by Frank Wilcoxon (53, p. 239).

The only assumption is ". . . that the variables under consideration form a continuous distribution. We can then assume that by altering the input-output coefficients we can derive continuous distributions of outputs." (18, p. 88)

To test the hypothesis that $u_1 - u_2 = d_0$ by Wilcoxon test, we discard all differences equal to zero and then rank the remaining d_i's without regard to sign.

If there is no difference between the two population means, the total of the ranks corresponding to the positive differences should be almost equal to the total of the ranks corresponding to the negative differences.

Let W represent the sum of the ranks by W_+, W_-, respectively and w the smallest between w_+ and w_-.

If we want to think of w as a value of some random variable W, the problem is to find the probability of obtaining a value less than or equal to w, when H_0 is true, P_r ($W \leq w$ / H_0 is true). For a level of significance equal to α, we reject H_0 when P_r ($W \leq w$ / H_0 is true) (53, p. 239).

Let u_1 and u_2 represent the means of X_i and X_i', the coefficients projected by random adjustment and the sample survey projected output, in order to test whether there is any significant difference between the projections:

$$H_0 \quad u_1 - u_2 = d_0 \tag{50}$$

H_1: alternatives are $u_1 - u_2 < d_0$, $u_1 - u_2 > d_0$, or $u_1 - u_2 \neq d_0$

$\alpha = .05$

According to Wilcoxon table (53, p. 344), when n = 32, the critical region, W, is equal to or less than 174. The smaller value of w = 247 $\neq d_0$; therefore, H_0 must be rejected, i.e., the 1981 projected total output obtained by using sample survey is not simply random.

Table 5. Test of the randomness of 1981 projected total output

	X_i	X_i'	di	$d_i - d_0$	Rank
1	32,874	26,447	6,427	3,052	18
2	27,101	25,923	1,178	- 2,197	10
3	12,827	4,427	8,400	5,025	28
4	16,628	11,624	5,004	1,629	8
5	4,729	4,768	- 39	- 3,414	25
6	3,029	4,005	- 976	- 4,351	27
7	3,088	2,980	108	- 3,267	20
8	2,844	2,032	812	- 2,563	11
9	17,038	8,263	8,775	5,400	29
10	9,904	6,829	3,075	- 300	2
11	35,381	33,222	2,159	- 1,216	5
12	43,052	30,278	12,774	9,399	31
13	10,777	10,803	- 26	- 3,401	24
14	7,363	5,582	1,781	- 1,594	7
15	2,749	2,334	415	- 2,960	16
16	15,249	8,149	7,100	3,725	22
17	5,584	4,979	605	2,770	15
18	33,675	32,976	699	- 2,676	13
19	3,484	3,395	89	- 3,286	21
20	17,638	16,052	1,586	- 1,789	9
21	4,080	3,932	148	- 3,227	19
22	2,959	2,329	630	- 2,745	14
23	3,875	3,791	84	- 8,291	23
24	10,587	6,340	4,247	875	3
25	15,624	12,002	3,622	247	1
26	7,394	5,367	2,027	- 1,348	6
27	28,183	27,172	1,011	- 2,364	11
28	16,641	16,307	334	- 3,041	17
29	57,858	42,935	14,935	11,560	32
30	16,589	9,052	7,537	4,162	26
31	23,417	13,272	10,145	6,770	30
32	16,703	12,375	4,328	953	4

$d_0 = 3,375$ $w_+ = 247$ $w_- = 230$

MULTIPLIER ANALYSIS

Economists have been interested in measuring the total impact on income, employment, and output resulting from changes in investment.

One of the most useful analytical techniques developed by John Maynard Keynes to treat the total impact caused on the economy by changes in investment were the multipliers.

Keynes noted that if a certain amount of income were injected into the economy, consumer spending would rise by an amount less than the income. The proportion of added income spent became someone else's new income. The latter spent some fraction of their additional income and this procedure of spending continued through several rounds (10).

Income Multiplier

The income multiplier analysis in macroeconomics is based on the following consideration. Suppose an economy in which the national income (Y) is equal to consumption of goods (C), investment goods (I), and government expenditures (G). Let the consumer's purchases be related to the national income. Then

$$Y = C + I + G$$

$$C = a\,Y + F_c \qquad (51)$$

a is a constant indicating the influence of national income and

F_c is consumer preference influencing consumption.

If investment and government expenditures are given, equation (51) becomes

$$\begin{aligned} Y - C &= I + G \\ -aY + C &= F_c \end{aligned} \tag{52}$$

or

$$\begin{bmatrix} 1 & -1 \\ -a & 1 \end{bmatrix} \begin{bmatrix} Y \\ C \end{bmatrix} = \begin{bmatrix} I + G \\ F_c \end{bmatrix} \tag{53}$$

since

$$\begin{bmatrix} 1 & -1 \\ -a & 1 \end{bmatrix}^{-1} = \begin{bmatrix} \frac{1}{1-a} & \frac{1}{1-a} \\ \frac{a}{1-a} & \frac{1}{1-a} \end{bmatrix}$$

$$\begin{bmatrix} Y \\ C \end{bmatrix} = \begin{bmatrix} \frac{1}{1-a} & \frac{1}{1-a} \\ \frac{a}{1-a} & \frac{1}{1-a} \end{bmatrix} \begin{bmatrix} I + G \\ F_c \end{bmatrix} \tag{54}$$

Equation (54) shows that the value of Y and C depends on I, G, and F_c. If we observe the economy at two points in time and assume constant government expenditures, then

$$\begin{bmatrix} Y_1 \\ C_1 \end{bmatrix} = \begin{bmatrix} \frac{1}{1-a} & \frac{1}{1-a} \\ \frac{a}{1-a} & \frac{1}{1-a} \end{bmatrix} \begin{bmatrix} I_1 + G_1 \\ F_{c_1} \end{bmatrix} \tag{55}$$

$$\begin{bmatrix} Y_2 \\ C_2 \end{bmatrix} = \begin{bmatrix} \frac{1}{1 - a} & \frac{1}{1 - a} \\ \frac{a}{1 - a} & \frac{1}{1 - a} \end{bmatrix} \begin{bmatrix} I_2 + G_2 \\ F_{c_2} \end{bmatrix} \tag{56}$$

Subtracting (55) from (56) gives:

$$\begin{bmatrix} Y_2 - Y_1 \\ C_2 - C_1 \end{bmatrix} = \begin{bmatrix} \frac{1}{1 - a} & \frac{1}{1 - a} \\ \frac{a}{1 - a} & \frac{1}{1 - a} \end{bmatrix} \begin{bmatrix} I_2 - I_1 \\ F_{c_2} - F_{c_1} \end{bmatrix} \tag{57}$$

If $\Delta Y = Y_2 - Y_1$ represents the change in income and $\Delta C \quad C_2 - C_1$ represents the change in consumption, then (57) can be written as

$$\begin{bmatrix} \Delta Y \\ \Delta C \end{bmatrix} = \begin{bmatrix} \frac{1}{1 - a} & \frac{1}{1 - a} \\ \frac{}{1 - a} & \frac{}{1 - a} \end{bmatrix} \begin{bmatrix} \Delta I \\ \Delta F_c \end{bmatrix} \tag{58}$$

If we suppose $\Delta F_c = C_2 - C_1 = 0$, and allow a change in investment

$$\begin{bmatrix} \Delta Y \\ \Delta C \end{bmatrix} = \begin{bmatrix} \frac{1}{1 - a} & \frac{1}{1 - a} \\ \frac{a}{1 - a} & \frac{1}{1 - a} \end{bmatrix} \begin{bmatrix} \Delta I \\ 0 \end{bmatrix} \tag{59}$$

or

$$\Delta Y = \frac{1}{1 - a} \qquad \text{and} \quad \Delta C = \frac{a}{1 - a} \tag{60}$$

That means that if consumers spend part $(a < 1)$ of their additional income, when investment increases by \$1 the national income rises more than \$1. This total increase can be measured by adding the direct and indirect effects:

$$1 + \frac{a}{1 - a} = \frac{1}{1 - a} \qquad (61)$$

$\frac{1}{1 - a}$ is referred to as the income multiplier (55).

The income multiplier defined in the previous discussion is useful in the general sense, and it is useful when we deal with macroaggregates, but it cannot answer what will happen to each industry when changes in some variables occur. Using the income multipliers evaluated by the input-output method, it is possible to analyze the impact on each sector if changes happen.

Income Payments and Income Multiplier Analysis

In Table 17, Appendix H, are shown two types of multipliers. Type I income multiplier and Type II income multiplier.

The first column shows the household coefficients calculated using Table 13, Appendix D. It measures the direct income change.

The second column is the sum of each row entry in Table 15, $(I - A)^{-1}$ projected to 1981, multiplied by the household coefficients of matrix A projected to 1981, closed with respect to households.

The third column is the Type I multiplier. It ". . . is defined for each processing sector as the sum of the direct and indirect household payments, divided by the direct household payments." (3, p. 7) This was obtained by dividing column 2 by column 1.

The fourth column is the household column of the 1981 inverse matrix $(I - A)^{-1}$, after moving the household sector into the processing sectors.

The fifth column is the Type II income multiplier. It is defined as the sum of the direct, indirect, and induced income payments, divided by the direct income payments. It was calculated by dividing column 4 by column 1.

RESULTS OF STUDY

General Objectives

The general objective of this study was to analyze the input-output model and its applications. In order to accomplish this objective, an extensive review of literature was made. Some conclusions from this section are the following:

1. Input-Output is of interest in economic theory because it provides the simplest form of the Walrasian model, and its simplicity allows empirical applications. Besides, it provides a detailed breakdown of the macroaggregates and money flows.
2. The static open model is widely used for regional and inter-regional and national economic analysis, in planned and unplanned economies, and by nations in all stages of economic development.
3. The input-output method is used as an analytical and forecast-tool in many countries.
4. There are continuing efforts to improve on static open input-output models and on the analytical tools, such as sectoral multipliers, derived from them.
5. The main effort of input-output research in recent years has been in the direction of dynamic analysis.

Table 6. Cache County 1967 and 1971 final demands ($000)

Final Demand Components	1967 Final Demand	1971 Final Demand	Percent Change
Households	74,571	84,865	13.80
Cache County	64,310	67,853	5.51
USU Students	10,261	17,012	65.73
Government	34,803	64,522	85.39
Federal, State, and Local	6,254	29,863	377.50
Utah State University	28,549	34,659	21.40
Capital Formation	8,433	12,207	44.75
Exports	108,066	114,492	5.95
TOTALS	215,855	276,086	27.90

2. The sector 13, home furnishing, shows the greatest growth because of the presence of new firms in this sector.

3. The ranks of growth for each sector would have been the same as those shown in Table 7.

The 1981 Projected Total Output

A summary of the projection of total output by sector to 1981 is given in Table 8. It compares the 1971 and 1981 total outputs.

The projection depends on the two specific assumptions:

1. In the 10 year span, the Cache County technical coefficients will reach the 1971 average technology of the 1971 average of the most efficient firms of each sector.
2. The final demand of Cache County economy grows according to the exponential rate of growth.

Under these assumptions, we can predict that:

1. Every sector of the Cache County economy is expected to grow, but the growth will be at varying rates.
2. The Cache County gross output is expected to increase by slightly less than 70 percent between 1971 and 1981.
3. The most rapid growth is projected for concrete products and recreation.
4. Table 7 summarizes the rate and comparative ranking of growth of each sector of the Cache County economy.

Table 7. Cache County 1967 and 1971 total outputs ($000)

Processing Sectors	1967	1971	Annual Rate of Growth	Rank
1. Meat Packing	21,103	22,607	1.78	31
2. Milk Processing	18,499	20,280	2.41	30
3. Grain Grinding	1,755	2,105	4.96	21
4. Other Food Manufacturing	7,972	9,018	3.28	27
5. Primary Metal Goods	4,253	4,380	.75	32
6. Conc. & Conc. Products	841	1,034	5.74	14
7. Textiles & Apparel	1,377	1,791	7.52	8
8. Printing & Engraving	866	1,032	4.73	23
9. Bldg. Supplies & Equip.	3,681	4,530	5.77	13
10. Farm & Industry Equip.	3,198	3,811	4.79	23
11. Food Stores	12,390	16,129	7.54	7
12. Autos, Gas, & Durable Equip. Rep.	16,991	20,133	4.62	25
13. Home Furnishings	2,700	5,869	29.34	1
14. Eating & Drinking	3,644	4,066	2.90	29
15. Specialty Stores	1,504	1,694	3,16	28
16. Farm Supplies & Feed	3,487	4,270	5.61	17
17. Drug & Variety	2,379	2,894	5.41	19
18. Clothing Stores	12,671	15,544	5.67	15
19. Other Trades	1,232	1,606	7.59	5
20. Medical, Dental, & Legal	7,014	8,692	5.98	12
21. Amusement & Recreation	1,165	1,602	9.38	4
22. Apparel Care & Rep.	850	1,101	7.38	9
23. Other Services	1,825	2,225	5.48	18
24. Commercial Banks	2,671	3,320	6.07	11
25. Real Estate & Insurance	5,593	6,720	5.04	20
26. Other Lending	2,018	3,648	20.19	2
27. Gen. Bldg. & Subcontracting	11,628	14,683	6.57	10
28. Gen. Construction	7,630	9,359	5.67	15
29. Farm & Fisheries	19,167	22,318	4.11	26
30. Transportation	3,587	4,940	9.43	3
31. Utilities	6,634	7,945	4.94	22
32. Rental & Lodging	4,597	5,989	7.57	6
TOTALS	194,822	235,335	20.79	

NOTE: The rank 1 corresponds to the highest percent of growth.

Table 8. Cache County 1971 and 1981 total outputs ($000)

Processing Sector	1971	1981	Annual Rate of Growth	Rank
1. Meat Packing	22,607	26,447	1.70	31
2. Milk Processing	20,280	25,923	2.78	30
3. Grain Grinding	2,105	4,427	11.03	6
4. Other Food Manufacturing	9,018	11,624	2.89	29
5. Primary Metal Goods	4,380	4,768	.89	32
6. Conc. & Conc. Products	1,034	4,005	28.73	1
7. Textiles & Apparel	1,791	2,980	6.64	23
8. Printing & Engraving	1,032	2,032	9.69	9
9. Bldg. Supplies & Equip.	4,530	8,263	8.24	16
10. Farm & Industry Equip.	3,811	6,829	7.92	17
11. Food Stores	16,129	33,222	10.60	8
12. Autos, Gas, & Durable Equip. Rep.	20,133	30,278	5.04	24
13. Home Furnishings	5,869	10,803	8.41	14
14. Eating & Drinking	4,066	5,582	3.73	27
15. Specialty Stores	1,694	2,334	3.78	26
16. Farm Supplies & Feed	4,270	8,149	9.08	11
17. Drug & Variety	2,894	4,978	7.20	20
18. Clothing Stores	15,544	32,976	11.21	3
19. Other Trades	1,606	3,395	11.14	4
20. Medical, Dental, & Legal	8,692	16,052	8.47	13
21. Amusem ent & Recreation	1,602	3,932	14.54	2
22. Apparel Care & Rep.	1,101	2,328	11.14	4
23. Other Services	2,225	3,791	7.06	22
24. Commercial Banks	3,320	6,340	3.01	28
25. Real Estate & Insurance	6,720	12,002	7.86	18
26. Other Lending	3,648	5,367	4.71	25
27. Gen. Bldg. & Subcontracting	14,683	27,172	8.51	12
28. Gen. Construction	9,359	16,307	7.42	19
29. Farm & Fisheries	22,318	42,923	9.23	10
30. Transportation	4,940	9,052	8.32	15
31. Utilities	7,945	13,272	6.70	21
32. Rental & Lodging	5,989	12,375	10.66	7
TOTALS	235,335	399,928	69.94	

NOTE: The rank of 1 corresponds to the highest percent of growth.

5. Deriving the 1981 projected output by sampling the most efficient firms differs significantly from the outcome projected by adjusting randomly the 1962 technical coefficients.

<u>Output and Income Multipliers</u>

The sum of each vertical column in the projected $(I - A)^{-1}$ matrix shows the total requirements from the processing sectors resulting from a \$1.00 change in final demand for the sectors listed across the top of the table.

These total requirements and rankings from the processing sectors needed to support each \$1.00 increase in the final demand sectors are shown in Table 9.

The greatest output multipliers for Cache County economy occur in the following sectors: grain grinding, milk processing, farm and fisheries, transportation, other food manufacturing, general building and subcontracting, and meat packing. For example, if an increase of \$1000 in the final demand exists, it will be necessary to increase in \$1810 the total output of sector 2, milk processing.

Thus, if policy makers are interested in increasing the Gross Local Output, they should think in how to increase the consumption for the product of these sectors, because they are highly related to the other sectors.

Income multipliers for all Cache County sectors are given in Table 17, Appendix H. Two types of multipliers have been calculated. The Type I multipliers show the direct and indirect impacts of an increase in output by

Table 9. Total requirements per dollar value of final demand

Processing Sector	Output Multipliers	Rank
1. Meat Packing	1.39	8
2. Milk Processing	1.81	2
3. Grain Grinding	1.88	1
4. Other Food Manufacturing	1.52	5
5. Primary Metal Goods	1.10	21
6. Concrete and Concrete Products	1.08	25
7. Textiles and Apparel	1.09	22
8. Printing and Engraving	1.09	22
9. Building Supplies and Equipment	1.04	30
10. Farm and Industry Equipment	1.04	30
11. Food Stores	1.25	11
12. Autos, Gas, and Durable Equipment Repair	1.21	12
13. Home Furnishings	1.13	17
14. Eating and Drinking	1.52	5
15. Specialty Stores	1.11	19
16. Farm Supplies and Feed	1.32	10
17. Drug and Variety	1.14	16
18. Clothing Stores	1.15	15
19. Other Trades	1.11	19
20. Medical, Dental, and Legal	1.08	25
21. Amusement and Recreation	1.03	32
22. Apparel Care and Repair	1.19	13
23. Other Services	1.16	14
24. Commercial Banks	1.06	29
25. Real Estate and Insurance	1.09	22
26. Other Lending	1.12	17
27. General Building and Subcontracting	1.49	7
28. General Construction	1.12	17
29. Farm and Fisheries	1.63	3
30. Transportation	1.55	4
31. Utilities	1.08	25
32. Rental and Lodging	1.36	9

NOTE: The rank 1 corresponds to the largest output multiplier.

each sector. The type II multipliers add the induced or consumption effects, which were calculated by shifting households into the processing sectors.

The following sectors--milk processing, meat packing, grain grinding, farm supplies and feed, general building and subcontracting, clothing stores, and food manufacturing--have the greatest income multipliers, according to Table 17, Appendix H. If policy makers were interested in increasing the area's income they should think of expanding the production of these sectors.

The output and income multipliers can be useful in regional development planning, but they must be interpreted cautiously. The sector with the largest direct impact is not necessarily one that should be encouraged to expand in a region, but the multipliers can be useful guides to those concerned with regional development policy.

Impact of Utah State University and USU Students on Cache County Economy

In order to quantify the Utah State University and USU student impact on the Cache County economy, the total output was calculated multiplying the projected $(I - A)^{-1}$ matrix to 1981 by the projected final demand to 1981 without taking into account the Utah State University and USU student expenditures.

The results are given in Table 10. The partial impact will be a decrease in the business income of $26,283,000. When the final payments of the university to households are considered, the decrease becomes some figure around $37,674,000.

Table 10. Impact of the USU and USU students on Cache County economy

Processing Sector	With USU	Without USU	Relative Change
1. Meat Packing	26,447	26,176	1.04
2. Milk Processing	25,923	25,445	1.88
3. Grain Grinding	4,427	4,352	1.72
4. Other Food Manufacturing	11,624	11,389	2.06
5. Primary Metal Goods	4,768	4,729	.82
6. Concrete & Concrete Products	4,005	3,953	1.32
7. Textiles & Apparel	2,980	2,916	2.19
8. Printing & Engraving	2,032	1,889	7.57
9. Bldg. Supplies & Equip.	8,263	7,885	4.79
10. Farm & Industry Equip.	6,829	6,728	1.50
11. Food Stores	33,222	29,891	11.14
12. Autos, Gas, & Durable Equip. Rep.	30,278	26,573	13.94
13. Home Furnishings	10,803	9,476	14.00
14. Eating & Drinking	5,582	3,771	48.00
15. Specialty Stores	2,334	1,850	26.16
16. Farm Supplies & Feed	8,149	7,929	2.76
17. Drug & Variety	4,978	4,461	11.59
18. Clothing Stores	32,976	31,111	5.99
19. Other Trades	3,395	3,284	3.38
20. Medical, Dental, & Legal	16,052	14,813	8.36
21. Amusement & Recreation	3,932	3,094	27.08
22. Apparel Care & Rep.	2,328	1,607	44.87
23. Other Services	3,791	2,797	35.54
24. Commercial Banks	6,340	5,618	12.85
25. Real Estate & Insurance	12,002	11,760	2.01
26. Other Lending	5,367	5,173	3.75
27. Gen. Bldg. & Subcontracting	27,172	27,021	.56
28. Gen. Construction	16,307	16,257	.31
29. Farm & Fisheries	42,923	42,393	1.25
30. Transportation	9,052	8,609	5.15
31. Utilities	13,272	11,715	13.29
32. Rental & Lodging	12,375	8,974	37.90
TOTALS	399,928	373,645	

The largest impacts would be for sectors 14, 22, 32, 23, and 21; eating and drinking, apparel care and repair, rental and lodging, other services, and amusement and recreation.

Final Comments

There are clearly a number of limitations to this type of study. Most of them center upon the empirical data. In the complete absence of information, recourse has to be made to assumptions whose validity is subject to many criticisms.

Given the nature of the model, the main problem arises that there is no way to check on the output flows to each industry. In the case of small area studies, the problem of estimating the money flows from the region and into the region is a crucial one.

However, in spite of the data problems, there is a continuing effort to improve the statistical techniques.

This study has limitations. The sample data from manufacturers and businesses, obtained by mail survey, are subject to response errors and various biases. Especially, estimates of the export and import components of the 1971 final demand vector and the projected final demand vector to 1981 can be criticized.

Sector 13, home furnishings, in the 1971 transaction table, includes a new manufacturing industry--Wurlitzer. It was included in this sector because it does not fit in any of the manufacturing sectors.

There is a very old Latin proverb which says: "Errando discitur." i.e., by making mistakes, we can learn. That is what, ultimately, the author of this study seeks, to learn how to use empirically a widely known economic technique.

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APPENDIXES

Appendix A: Sector Definitions

Manufacturing

1. Meat Packing, (201), includes slaughtering, packing, and processing meat animals.

2. Milk Processing, (202), includes processing and distribution of milk and milk products.

3. Grain Grinding, (204), includes grain grinding and processing.

4. Other Food Manufacturing, (203, 206, 207, 208, 209), includes processing or canning meat by-products, sugar or sugar products, vegetables, soda drinks, etc.

5. Primary Metal Goods, (34, 35, 3722), includes production of machines, machinery, and goods from metal products.

6. Concrete and Concrete Products, (32), includes production and distribution of liquid concrete.

7. Textiles and Apparel, (22, 23) includes production of clothing and mattresses.

8. Printing and Engraving, (27), includes printing, publishing, and distribution of newspapers; custom printing; and sales of publications.

Trade

9. Building Supplies and Equipment, (521, 522, 523, 524, 5077), includes selling and distribution of lumber, building paints, hardware supplies, and building equipment.

10. Farm and Industry Equipment, (5082, 5083, 5252), includes selling and servicing farm, industrial and commercial equipment.

11. Food Stores, (54, 504, 5095), includes retail and wholesale food products, bakeries, liquor stores, and beverage distribution.

12. Autos, Gas, and Durable Equipment Repair, (501, 551, 552, 5936, 554, 5092, 553, 75, 76), includes selling, servicing, and repairing of automobiles and trucks; retail and wholesale gas, oil, and tires; durable equipment repair; recapping; auto parts stores; and self service stations.

13. Home Furnishings, (57), includes retailing home furnishings, appliances, and musical instruments.

14. Eating and Drinking, (58), includes restaurants, cafes, drive-ins, clubs, and specialty eating places.

15. Specialty Stores, (5942, 5943, 5992, 5997, 5998), includes optical, sporting goods, jewelry, gift, and book stores.

16. Farm Supplies and Feed, (596), includes farm supply and feed stores, and nursery and floral shops.

17. Drug and Variety, (5912), includes pharmacies and drug stores.

18. Clothing Stores, (56, 503, 539, 5311, 5251, 5331), includes men's, women's, babies', teens', and children's stores; shoe stores, and general and specialty clothing stores.

19. Other Trades, (5093, 5099, 5982, 5989, 505, 5086, 47), includes stamp stores, coal and hardware, metal scrap yards, stocks and bonds, misc. trades.

Services

20. Medical, Dental, and Legal, (80, 81, 89), includes doctors, clinics, hospitals, nursing homes, dental services, and lawyers' service.

21. Amusement and Recreation, (78, 79), includes golf clubs, theaters, ski resorts, bowling alleys, pool halls, skating rinks, etc.

22. Apparel Care and Repair, (7211, 7215, 7251, 7216, 7271), includes dry cleaning service, shoe repair shops, laudromats.

23. Other Servies, (723, 724, 7221, 7261, 7312, 7321, 7349, 7399), includes barber shops, beauty shops, travel agencies, mortuaries, photography services, sign painting, etc.

Banking, Insurance, and Real Estate

24. Commercial Banks, (60), includes loans, checking, and savings accounts.

25. Real Estate and Insurance, (64, 66, 6512, 6513, 6531, 6541), includes insurance service, real estate sales, and service.

26. Other lending, (61), includes credit unions, finance companies, agricultural land and operating loans and services, mortgage and loan services.

Construction

27. General Building and Subcontracting, (15, 24, 25, 26, 3791, 17), includes building contractors and subcontractors.

28. General Construction, (16), includes road construction and general construction.

Other Sectors

29. Farm and Fisheries, (01, 09), includes commercial fisheries, all farm activities, auction yards, veterinarians, artificial insemination service.

30. Transportation, (40, 46), includes air service, freight trucking, local bus service, cold storage service, mail service, moving service.

31. Utilities, (48, 49), includes electricity, telephone, and natural gas service, irrigation companies, radio and television service, and telegraph service.

32. Rental and Lodging, (6515, 6519, 70), includes hotels, motels, apartments, and dormitories.

Final Demand Sectors

Households, includes all the consumer expenditures of the total Cache County population, but USU student expenditures.

USU Students, includes all the expenditures of USU students.

Federal, State, and Local Government, includes all federal, state, county, and city government purchases and expenditures, except those of higher education.

Utah State University, includes all expenditures of Utah State University.

Exports, includes the shipment of goods and services to markets and firms outside Cache County.

Capital Formation, includes the sales of all goods that are not part of the current production processes.

Final Payments

Households, includes all income payments to Cache County residents, mostly wages, profits, and government payments.

Government, includes all payments to federal, state, and city governments, mostly taxes.

Appendix B: 1971 Final Demand

Table 11. 1971 final demand

	HOUSEHOLDS		GOVERNMENT		Capital Formation	Exports	Totals
	Cache County	USU Students	Government	USU			
1. Meat Packing	244	57	58	10	---	20,689	21,058
2. Milk Processing	821	199	74	24	---	18,361	19,479
3. Grain Grinding	37	7	6	---	---	532	582
4. Other food Manufacturing	149	34	---	---	---	7,976	8,159
5. Primary metal goods	115	---	10	28	---	4,211	4,364
6. Concrete & Concrete Products	---	---	318	6	---	214	538
7. Textiles & Apparel	48	---	---	62	---	1,623	1,733
8. Printing & Engraving	224	34	79	---	---	109	446
9. Building Supplies & Equip.	34	---	108	276	450	1,809	2,677
10. Farm and Industry Equip.	20	---	16	63	921	2,521	3,541
11. Food Stores	9,038	2,893	692	17	462	1,541	14,643
12. Auto, Gas & Durable Eq. Repair	9,601	2,528	532	561	122	1,410	14,754
13. Home Furnishing	2,083	644	101	558	464	1,795	5,645
14. Eating & Drinking	1,472	1,400	15	364	---	614	3,865
15. Specialty Stores	970	464	---	3	---	164	1,601
16. Farm Supplies & Feed	292	---	15	24	---	1,910	2,241
17. Drug & Variety	1,899	379	13	107	---	205	2,603
18. Clothing Stores	9,527	1,831	125	14	550	3,274	15,321
19. Other trades	298	62	18	38	---	1,141	1,557
20. Medical, dental & Legal	3,393	1,159	35	14	---	3,697	8,298
21. Amusement & Recreation	441	816	132	17	---	191	1,597
22. Apparel Care & Repair	312	69	18	604	---	---	1,003
23. Other Services	935	446	160	545	---	218	2,204
24. Commercial Banks	332	160	146	478	---	1,310	2,426
25. Real Estate & Insurance	2,076	112	722	---	---	2,856	5,766
26. Other Lending	950	41	1,311	10	---	723	3,035
27. Gen. Building & Subcontracting	---	---	---	---	7,517	4,533	12,050
28. General Construction	---	---	---	87	1,721	7,437	9,245
29. Farm & Fisheries	427	---	1,011	10	---	5,916	7,364
30. Transportation	556	258	993	28	---	286	2,121
31. Utilities	2,829	411	179	322	---	641	4,382
32. Rental & Lodging	977	2,710	466	454	---	---	4,607
33. Households	129	5	17,775	11,391	---	12,807	42,107
34. Government	930	293	185	---	---	3,778	5,186
35. Imports	16,794	---	4,550	18,544	---	---	39,888
TOTAL	67,853	17,012	29,863	34,659	12,207	114,492	276,086

Appendix C: 1967 $(I - A)^{-1}$ Matrix and 1971 Total Output

Table 12. 1967 $(I - A)^{-1}$ matrix and 1971 total output

DETERMINANT IS 0.45947

1	1.00203	0.00075	0.00066	0.03768	0.00009	0.00013	0.00014	0.00012
	0.00002	0.00007	0.05608	0.00014	0.00006	0.05425	0.00012	0.00095
	0.00066	0.00579	0.00029	0.00183	0.00969	0.00071	0.00017	0.00015
	0.00006	0.00007	0.00007	0.00002	0.00037	0.00369	0.00006	0.00267
2	0.00029	1.00227	0.00564	0.00016	0.00006	0.00010	0.00004	0.00004
	0.00001	0.00002	0.02321	0.00003	0.00002	0.07460	0.00004	0.00011
	0.00564	0.00365	0.00019	0.00308	0.00375	0.00004	0.00004	0.00014
	0.00007	0.00005	0.00005	0.00002	0.00055	0.00171	0.00006	0.00088
3	0.00581	0.02213	1.07567	0.01433	0.00002	0.00003	0.00002	0.00002
	0.00001	0.00001	0.00745	0.00005	0.00001	0.00931	0.00002	0.01683
	0.00027	0.00237	0.00014	0.00062	0.00106	0.00006	0.00004	0.00002
	0.00002	0.00002	0.00002	0.00001	0.07649	0.00007	0.00001	0.00036
4	0.00014	0.00102	0.01128	1.00212	0.00057	0.00137	0.00148	0.00121
	0.00031	0.00068	0.03857	0.00214	0.00044	0.02129	0.00073	0.00057
	0.00744	0.00249	0.00177	0.00079	0.01075	0.00364	0.00230	0.00043
	0.00041	0.00053	0.00024	0.00022	0.00108	0.00060	0.00020	0.00140
5	0.00000	0.00000	0.00000	0.00000	1.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000
	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00165	0.00000
	0.00000	0.00000	0.00101	0.00000	0.00000	0.00000	0.00000	0.00004
6	0.00006	0.00017	0.00042	0.00011	0.00006	1.00002	0.00011	0.00004
	0.00353	0.00001	0.00003	0.00002	0.00048	0.00007	0.00004	0.00011
	0.00007	0.00004	0.00008	0.00005	0.00009	0.00122	0.00951	0.00013
	0.00001	0.00001	0.03481	0.00240	0.00051	0.00008	0.00026	0.00129
7	0.00000	0.00000	0.00002	0.00000	0.00001	0.00000	1.00002	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00006	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00001	0.00001	0.00001	0.00000	0.00002	0.00002
	0.00000	0.00000	0.00467	0.00001	0.00000	0.00001	0.00001	0.00016
8	0.00015	0.00060	0.00300	0.00048	0.00106	0.00022	0.00228	1.01299
	0.00227	0.00073	0.00578	0.00192	0.01026	0.00168	0.00822	0.00054
	0.01890	0.00999	0.00192	0.00284	0.00451	0.00383	0.00415	0.00464
	0.00461	0.00510	0.00121	0.00054	0.00084	0.00121	0.00184	0.00256
9	0.00054	0.00550	0.00605	0.00380	0.00352	0.00367	0.00044	0.00599
	1.00032	0.00013	0.00130	0.00074	0.00381	0.00410	0.00167	0.00797
	0.00042	0.00131	0.00208	0.00036	0.00094	0.00037	0.01006	0.00050
	0.00012	0.00011	0.10524	0.01647	0.00445	0.00307	0.00225	0.01054
10	0.00042	0.00375	0.00777	0.00201	0.00707	0.00360	0.00000	0.00001
	0.00002	1.00064	0.00028	0.00048	0.00001	0.00064	0.00001	0.00167
	0.00004	0.00004	0.00003	0.00002	0.00006	0.00002	0.00005	0.00000
	0.00001	0.00000	0.00015	0.00239	0.01100	0.00002	0.00000	0.00006
11	0.00003	0.00030	0.00014	0.00022	0.00028	0.00019	0.00010	0.00012
	0.00002	0.00016	1.04531	0.00085	0.00030	0.09576	0.00064	0.00009
	0.00608	0.00108	0.00033	0.00610	0.12570	0.00062	0.00066	0.00016
	0.00025	0.00021	0.00021	0.00005	0.00015	0.00023	0.00020	0.02861
12	0.01095	0.02935	0.07230	0.01963	0.03040	0.07393	0.00292	0.00585
	0.01594	0.02249	0.01192	1.14487	0.01800	0.02508	0.00587	0.04193
	0.00184	0.00485	0.02909	0.00186	0.00957	0.01569	0.00851	0.00298
	0.01125	0.00287	0.01408	0.03815	0.07857	0.01119	0.00680	0.00881

Table 12. Continued

13	0.00042	0.00006	0.00013	0.00005	0.00013	0.00005	0.00008	0.00008
	0.00001	0.00009	0.00029	0.00059	1.00028	0.00029	0.00034	0.00007
	0.00022	0.00036	0.00011	0.00036	0.00095	0.00035	0.00412	0.00191
	0.00010	0.00009	0.00864	0.00005	0.00013	0.00012	0.00057	0.01527
14	0.00011	0.00012	0.00008	0.00029	0.00050	0.00125	0.00002	0.00002
	0.00002	0.00001	0.00333	0.00009	0.00003	1.02458	0.00003	0.00003
	0.00004	0.00011	0.00172	0.00034	0.00134	0.00005	0.00005	0.00155
	0.00093	0.00052	0.00027	0.00015	0.00010	0.00030	0.00067	0.00025
15	0.00007	0.00006	0.00011	0.00004	0.00007	0.00125	0.00002	0.00003
	0.00002	0.00065	0.00012	0.00030	0.00042	0.00009	1.00073	0.00004
	0.00088	0.00036	0.01069	0.00137	0.00016	0.00126	0.00172	0.00039
	0.00198	0.00349	0.00028	0.00003	0.00015	0.00002	0.00050	0.00114
16	0.00808	0.03073	0.06594	0.02097	0.00005	0.00007	0.00004	0.00003
	0.00001	0.00003	0.00984	0.00047	0.00002	0.00756	0.00004	1.02304
	0.00038	0.00048	0.00593	0.00053	0.00227	0.00009	0.00006	0.00002
	0.00002	0.00002	0.00002	0.00002	0.10724	0.00010	0.00001	0.00049
17	0.00003	0.00015	0.00029	0.00006	0.00010	0.00008	0.00003	0.00004
	0.00004	0.00005	0.00005	0.00004	0.00009	0.00014	0.00012	0.00006
	1.00045	0.00003	0.00009	0.03314	0.00011	0.00013	0.00006	0.00005
	0.00000	0.00008	0.00015	0.00004	0.00031	0.00002	0.00004	0.00029
18	0.00065	0.00253	0.00527	0.00161	0.00002	0.00001	0.00002	0.00118
	0.00000	0.00001	0.00023	0.00002	0.00008	0.00078	0.00004	0.00132
	0.00007	1.00015	0.00003	0.00077	0.00356	0.00122	0.00060	0.00002
	0.00001	0.00002	0.00377	0.00001	0.00879	0.00002	0.00002	0.00126
19	0.00000	0.00001	0.00002	0.00001	0.00333	0.00122	0.00000	0.00000
	0.00001	0.00001	0.00001	0.00027	0.00036	0.00114	0.00134	0.00001
	0.00000	0.00008	1.00903	0.00000	0.00261	0.00001	0.00003	0.00000
	0.00001	0.00001	0.00005	0.00001	0.00002	0.00000	0.00000	0.00001
20	0.00080	0.00277	0.00862	0.00187	0.00292	0.00251	0.00077	0.00123
	0.00113	0.00162	0.00133	0.00106	0.00271	0.00414	0.00343	0.00177
	0.00096	0.00077	0.00261	1.00559	0.00297	0.00371	0.00182	0.00156
	0.00005	0.00254	0.00141	0.00113	0.00940	0.00061	0.00132	0.00204
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00001	0.00000	0.00000	0.00000	1.00086	0.00000	0.00164	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00010	0.00002	0.00003	0.00015	0.00053	0.00002	0.00003	0.00003
	0.00000	0.00004	0.00006	0.00019	0.00008	0.00326	0.00017	0.00002
	0.00011	0.00089	0.00005	0.00118	0.00133	1.00608	0.00233	0.00001
	0.00005	0.00004	0.00005	0.00001	0.00004	0.00005	0.00004	0.00771
23	0.00000	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000	0.00117
	0.00000	0.00000	0.00001	0.00007	0.00001	0.00001	0.00001	0.00000
	0.00507	0.00009	0.00001	0.00046	0.00001	0.00001	1.00001	0.00001
	0.00001	0.00001	0.00000	0.00000	0.00001	0.00000	0.00000	0.00001
24	0.00357	0.01036	0.02059	0.00717	0.00109	0.00129	0.00083	0.00128
	0.00139	0.00073	0.00205	0.00073	0.00100	0.00452	0.00098	0.00622
	0.00117	0.00140	0.00155	0.00141	0.00196	0.00153	0.00087	1.00008
	0.00117	0.00108	0.00660	0.00100	0.03330	0.00126	0.00089	0.01238

Table 12. Continued

25	0.00426	0.00693	0.00996	0.00470	0.00317	0.00638	0.00310	0.00375
	0.00502	0.00430	0.00425	0.00500	0.00591	0.00659	0.00508	0.00467
	0.00466	0.00357	0.00623	0.00586	0.01092	0.00476	0.00766	0.00241
	1.00071	0.00213	0.00315	0.00542	0.00633	0.00522	0.00174	0.01270
26	0.00138	0.00526	0.01114	0.00344	0.00029	0.00005	0.00014	0.00017
	0.00001	0.00021	0.00089	0.00037	0.00044	0.00163	0.00087	0.00286
	0.00057	0.00098	0.00023	0.00136	0.00248	0.00085	0.00229	0.00153
	0.00059	1.00071	0.00320	0.00003	0.01657	0.00029	0.00035	0.04004
27	0.00062	0.00041	0.00390	0.00023	0.00143	0.00009	0.00363	0.00025
	0.00003	0.00025	0.00039	0.00042	0.01577	0.00085	0.00095	0.00022
	0.00060	0.00104	0.00224	0.00132	0.00257	0.00099	0.00532	0.00451
	0.00026	0.00024	1.18085	0.00374	0.00063	0.00227	0.00304	0.04103
28	0.00015	0.00002	0.00004	0.00002	0.00008	0.00001	0.00004	0.00003
	0.00000	0.00161	0.00007	0.00006	0.00014	0.00015	0.00019	0.00002
	0.00011	0.00020	0.00005	0.00020	0.00051	0.00018	0.00015	0.00002
	0.00005	0.00005	0.00442	1.00002	0.00003	0.00006	0.00005	0.00868
29	0.09574	0.36485	0.77393	0.23613	0.00020	0.00041	0.00038	0.00032
	0.00008	0.00019	0.03047	0.00062	0.00015	0.06833	0.00026	0.19418
	0.00392	0.00411	0.00169	0.00234	0.00605	0.00094	0.00061	0.00022
	0.00017	0.00018	0.00011	0.00007	1.29404	0.00114	0.00011	0.00338
30	0.00348	0.07366	0.03373	0.02503	0.00447	0.00018	0.01973	0.01533
	0.00116	0.00696	0.00366	0.00042	0.00325	0.01175	0.00760	0.00824
	0.01192	0.02104	0.02978	0.00082	0.00113	0.00031	0.00466	0.01399
	0.00051	0.00016	0.00321	0.00009	0.04463	1.00051	0.00089	0.00336
31	0.00385	0.02202	0.02415	0.00871	0.00438	0.01873	0.01079	0.01956
	0.00500	0.00677	0.01314	0.01127	0.02299	0.03773	0.01787	0.01467
	0.01404	0.01899	0.01560	0.02281	0.05858	0.05275	0.03589	0.00960
	0.01197	0.01003	0.00891	0.00330	0.01942	0.00664	1.06507	0.15376
32	0.00024	0.00100	0.00136	0.00138	0.00701	0.00070	0.00317	0.00384
	0.00019	0.00501	0.00695	0.00731	0.00975	0.01573	0.02169	0.00197
	0.01265	0.02295	0.00493	0.02243	0.05921	0.02073	0.01546	0.00029
	0.00559	0.00521	0.00602	0.00034	0.00162	0.00661	0.00449	1.00569

INVERSE MULT BY VECTOR

1	22607.34059		
2	20279.60557	21	1602.02964
3	2104.75871	22	1100.96556
4	9017.95968	23	2224.64858
5	4380.27230	24	3320.34976
6	1034.26271	25	6720.38850
7	1791.07364	26	3648.06785
8	1032.12212	27	14683.14648
9	4530.29823	28	9359.26151
10	3811.30275	29	22317.63580
11	16128.72973	30	4940.47589
12	20132.79798	31	7944.78957
13	5868.85178	32	5988.59480
14	4066.31062		
15	1693.78284		
16	4269.76645		
17	2894.11729		
18	15544.38772		
19	1605.93515		
20	8691.90119		

Appendix D: Interindustry Transactions of the Most Efficient Firms (1971)

Table 13.- Interindustry Transactions of the Most Efficient Firms (1971)

Processing Sectors:	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	TOTAL OUTPUT
1. Meat Packing	9	4	--	120	--	--	--	--	--	--	232	--	--	73	--	--	--	--	--	7	5	--	--	--	--	--	--	--	12	9	--	6	258	5,206
2. Milk Processing	3	18	--	3	16	--	--	--	--	--	143	--	--	165	--	--	12	17	--	5	2	--	--	--	--	--	--	--	--	3	--	2	762	8,324
3. Grain Grainding	--	--	26	--	--	--	--	--	--	--	27	--	--	9	--	11	--	--	--	--	--	2	--	--	--	--	--	--	834	--	--	--	39	671
4. Other Food Manufacturing	2	7	9	11	2	1	3	2	2	1	253	13	12	43	--	1	8	21	--	--	5	3	3	3	4	3	4	3	--	--	1	2	92	3,270
5. Primary Metal Goods	--	--	--	--	--	--	--	--	5	--	--	8	--	--	--	--	--	--	--	--	--	--	5	--	--	--	12	--	--	--	--	--	61	1,935
6. Concrete and Concrete Products	--	--	--	--	--	--	--	--	35	--	--	--	--	--	--	--	--	--	--	--	--	2	19	--	--	--	672	28	13	--	4	--	8	676
7. Textiles & Apparel	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	52	--	--	--	--	--	23	735
8. Printing & Engraving	3	2	5	4	6	1	3	7	5	6	34	16	15	2	8	3	35	84	--	19	3	2	6	7	25	8	5	4	23	9	5	--	114	589
9. Building Supplies & Equipment	4	33	2	18	8	4	1	3	1	--	6	7	39	1	15	--	3	7	1	--	--	--	14	--	--	--	428	196	58	11	15	17	17	2,562
10. Farm and Industry Equipment	6	15	3	17	27	2	3	2	3	--	12	14	--	--	--	7	--	--	--	--	6	7	--	--	--	--	15	19	137	--	--	--	11	1,354
11. Food Stores	3	5	--	4	--	--	--	--	--	--	327	4	--	119	--	--	8	6	--	29	78	--	--	--	--	--	--	--	--	--	--	98	4941	7,325
12. Auto, Gas and Durable Eq. Repair	31	37	13	11	40	18	2	3	15	21	30	715	112	18	3	31	3	13	11	2	3	4	3	2	22	2	28	81	311	12	13	8	2972	5,721
13. Home Furnishing	--	--	--	--	--	--	--	--	--	3	4	8	--	--	--	--	--	--	--	--	--	8	7	--	--	--	56	--	33	--	4	79	832	2,932
14. Eating and Drinking	3	1	--	--	1	2	--	--	--	--	21	48	--	1	--	--	--	1	3	2	3	--	--	2	7	--	2	2	--	1	3	--	965	1,722
15. Specialty Stores	1	--	--	--	--	--	--	--	1	3	2	1	--	--	2	--	1	2	7	5	1	2	1	5	6	3	3	--	--	--	1	2	378	801
16. Farm Supplies & Feed	2	5	1	6	--	--	--	--	--	--	44	4	--	2	--	13	--	1	3	2	--	--	--	--	--	--	--	--	--	795	--	--	198	1,796
17. Drug & Variety	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	2	105	--	--	--	--	--	--	--	3	7	5	--	--	--	1	697	1,225
18. Clothing Stores	--	1	1	--	1	--	--	2	--	--	--	--	--	--	--	--	--	--	2	--	3	2	2	1	--	--	19	--	165	--	--	4	4870	6,870
19. Other trades	--	--	--	--	6	1	--	--	--	--	--	2	12	3	--	--	--	2	6	--	2	--	--	--	--	--	--	--	--	--	--	--	365	957
20. Medical, dental & Legal	1	1	3	1	7	3	2	2	3	3	7	8	4	7	3	1	3	4	2	26	2	7	3	2	--	3	5	7	171	3	7	6	3314	4,289
21. Amusement & Recreation	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	4	--	--	--	--	--	--	--	--	--	4216	6,175
22. Apparel Care & Repair	3	--	--	2	3	--	--	--	--	--	--	3	--	7	--	--	--	5	--	6	1	3	4	--	--	--	--	--	--	--	--	19	315	489
23. Other Services	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	7	2	--	3	--	--	--	--	--	--	--	--	--	--	--	--	489	976
24. Commercial Banks	16	9	2	3	2	2	3	2	3	2	6	5	23	5	2	2	1	7	3	3	1	2	1	--	4	2	33	4	255	3	2	27	702	1,582
25. Real Estate & Insurance	39	37	5	13	5	3	2	2	3	1	7	5	18	13	4	6	6	18	4	19	5	4	7	4	8	4	12	18	351	18	6	28	1456	2,966
26. Other lending	--	--	--	--	--	--	--	--	--	--	3	2	--	--	--	--	--	--	--	2	--	2	2	1	5	20	142	--	52	--	1	101	676	1,125
27. General Building & Subcontracting	6	2	3	--	2	--	3	--	--	--	--	2	38	--	--	--	--	--	2	2	--	--	3	6	--	--	898	13	--	3	7	81	--	6,321
28. General Construction	2	--	--	--	--	--	--	--	--	--	--	--	--	16	--	--	2	--	--	--	--	--	4	6	--	--	22	--	--	--	--	21	--	3,825
29. Farm & Fisheries	1127	3412	282	776	--	--	--	--	--	--	10	--	--	38	--	254	--	--	--	3	--	--	--	--	--	--	--	--	1893	--	--	6	506	11,326
30. Transportation	2	573	6	78	11	--	19	7	3	12	2	3	4	7	6	3	14	8	18	2	3	1	5	19	49	19	29	10	359	2	3	7	434	2,105
31. Utilities	28	135	10	19	6	8	7	8	9	8	62	75	27	58	12	19	15	7	19	72	28	19	27	14	46	29	31	11	121	11	205	328	1560	3,846
32. Rental & Lodging	2	--	--	4	9	--	4	3	--	8	42	63	14	27	18	3	11	56	4	81	37	10	16	--	26	17	28	--	--	14	14	10	1956	2,784
33. HOUSEHOLDS	758	946	95	832	721	193	292	317	302	253	562	1358	1270	783	245	792	225	405	272	2212	1872	196	375	631	523	651	1012	435	2900	558	730	650	62	38,112

Appendix E: 1981 Projected Final Demand

Table 14. 1981 projected final demand

		1962	1967	1971	Absolute change	Rate of growth	1981 final demand
1.	Meat Packing	4,935	19,837	21,058	1,223	1.54	24,533
2.	Milk Processing	11,973	17,836	19,479	1,643	2.30	24,453
3.	Grain Grinding	420	458	582	124	6.77	1,120
4.	Other Food Manufacturing	6,424	7,292	8,159	867	2.97	10,933
5.	Primary Metal Goods	1,762	4,240	4,364	154	0.92	4,782
6.	Concrete and Concrete Products	480	446	538	92	5.16	889
7.	Textiles and Apparel	1,240	1,331	1,733	402	7.55	3,588
8.	Printing and Engraving	281	415	446	31	1.87	537
9.	Building Supplies and Equipment	1,248	2,192	2,677	485	5.53	4,586
10.	Farm and Industry Equipment	1,292	2,963	3,541	578	4.88	5,702
11.	Food Stores	10,145	11,206	14,643	3,437	7.66	30,632
12.	Autos, Gas and Durable Equipment	9,163	12,483	14,754	2,271	4.55	23,022
13.	Home Furnishing	2,047	2,524	5,645	3,121	5.82	9,939
14.	Eating and Drinking	2,654	3,473	3,865	392	2.82	5,104
15.	Specialty Stores	1,216	1,433	1,601	168	2.93	2,137
16.	Farm Supplies and Feed	2,192	1,756	2,241	485	6.90	4,367
17.	Drug and Variety	1,849	2,144	2,603	459	5.35	4,383
18.	Clothing Stores	9,199	12,484	15,321	2,837	7.71	32,199
19.	Other Trades	721	1,189	1,557	368	7.73	3,278
20.	Medical, Dental, and Legal	3,759	6,692	8,298	1,606	6.00	14,853
21.	Amusement and Recreation	840	1,161	1,597	436	9.38	3,915
22.	Apparel Care and Repair	562	771	1,003	232	7.52	2,071
23.	Other Services	1,725	1,808	2,204	396	5.47	3,754
24.	Commercial Banks	1,426	1,919	2,426	507	6.60	4,597
25.	Real Estate and Insurance	3,099	4,807	5,766	959	4.98	9,374
26.	Other Lending	1,372	1,517	3,035	1,518	2.64	3,938
27.	General Building and Subcontracting	12,385	9,569	12,050	2,481	6.48	22,577
28.	General Construction	7,077	7,540	9,245	1,705	5.65	16,017
29.	Farm & Fisheries	5,607	5,912	7,364	1,452	6.14	13,363
30.	Transportation	905	131	2,121	990	6.24	3,885
31.	Utilities	218	3,763	4,382	619	4.11	6,555
32.	Rental & Lodging	6,359	3,498	4,607	1,109	7.92	9,873

Appendix F: $(I - A)^{-1}$ Matrix Projected to 1981

Table 15. $(I - A)^{-1}$ matrix projected to 1981

DETERMINANT IS 0.48076

1	1.00216	0.00153	0.00131	0.03745	0.00014	0.00022	0.00030	0.00022
	0.00005	0.00009	0.03479	0.00062	0.00021	0.04614	0.00013	0.00029
	0.00058	0.00034	0.00026	0.00198	0.00133	0.00037	0.00022	0.00019
	0.00027	0.00025	0.00014	0.00009	0.00164	0.00446	0.00007	0.00348
2	0.00070	1.00239	0.00018	0.00107	0.00639	0.00033	0.00006	0.00005
	0.00003	0.00003	0.02086	0.00099	0.00006	0.09766	0.00006	0.00006
	0.01001	0.00274	0.00037	0.00140	0.00065	0.00009	0.00011	0.00015
	0.00028	0.00009	0.00015	0.00010	0.00020	0.00152	0.00010	0.00151
3	0.02090	0.04007	1.08278	0.02393	0.00043	0.00009	0.00031	0.00019
	0.00003	0.00009	0.00687	0.00023	0.00013	0.01368	0.00008	0.02040
	0.00183	0.00039	0.00027	0.00024	0.00015	0.00465	0.00016	0.00016
	0.00021	0.00022	0.00010	0.00006	0.09609	0.00788	0.00003	0.00062
4	0.00083	0.00162	0.01490	1.00390	0.00119	0.00168	0.00417	0.00353
	0.00085	0.00078	0.03657	0.00297	0.00431	0.02606	0.00014	0.00097
	0.00701	0.00335	0.00018	0.00036	0.00132	0.00650	0.00332	0.00198
	0.00152	0.00284	0.00127	0.00095	0.00167	0.00046	0.00034	0.00243
5	0.00003	0.00005	0.00008	0.00004	1.00005	0.00005	0.00002	0.00004
	0.00196	0.00000	0.00001	0.00160	0.00012	0.00003	0.00005	0.00004
	0.00002	0.00001	0.00003	0.00001	0.00000	0.00002	0.00517	0.00001
	0.00001	0.00001	0.00239	0.00014	0.00008	0.00004	0.00002	0.00009
6	0.00053	0.00082	0.00139	0.00052	0.00023	1.00011	0.00058	0.00019
	0.01368	0.00004	0.00012	0.00016	0.00185	0.00039	0.00038	0.00027
	0.00034	0.00018	0.00034	0.00019	0.00004	0.00431	0.02023	0.00053
	0.00007	0.00011	0.12511	0.00646	0.00166	0.00039	0.00142	0.00407
7	0.00001	0.00001	0.00005	0.00000	0.00001	0.00000	1.00004	0.00000
	0.00000	0.00000	0.00000	0.00001	0.00013	0.00001	0.00001	0.00000
	0.00002	0.00001	0.00002	0.00001	0.00000	0.00001	0.00004	0.00004
	0.00000	0.00001	0.00959	0.00003	0.00001	0.00002	0.00002	0.00029
8	0.00171	0.00261	0.01028	0.00263	0.00338	0.00171	0.00439	1.01229
	0.00208	0.00236	0.00527	0.00336	0.00549	0.00235	0.01035	0.00255
	0.02927	0.01307	0.00036	0.00468	0.00060	0.00476	0.00662	0.00466
	0.00875	0.00765	0.00183	0.00138	0.00459	0.00545	0.00146	0.00113
9	0.00252	0.00748	0.00698	0.00756	0.00445	0.00605	0.00200	0.00544
	1.00057	0.00021	0.00158	0.00171	0.01458	0.00275	0.01919	0.00120
	0.00311	0.00166	0.00164	0.00040	0.00012	0.00087	0.01547	0.00072
	0.00037	0.00050	0.08028	0.05167	0.00726	0.00595	0.00437	0.00996
10	0.00463	0.00850	0.01183	0.00926	0.01415	0.00307	0.00423	0.00353
	0.00128	1.00004	0.00253	0.00290	0.00024	0.00200	0.00010	0.00632
	0.00057	0.00018	0.00012	0.00010	0.00103	0.01458	0.00033	0.00010
	0.00011	0.00011	0.00339	0.00515	0.01580	0.00247	0.00004	0.00042
11	0.00075	0.00082	0.00028	0.00146	0.00030	0.00032	0.00025	0.00025
	0.00003	0.00025	1.04729	0.00203	0.00029	0.07323	0.00089	0.00016
	0.00692	0.00191	0.00045	0.00788	0.01350	0.00094	0.00073	0.00012
	0.00053	0.00064	0.00032	0.00012	0.00032	0.00038	0.00023	0.03711
12	0.01632	0.02408	0.04252	0.01530	0.02418	0.03070	0.00381	0.00635
	0.00734	0.00201	0.00713	1.14333	0.04414	0.01775	0.00488	0.02640
	0.00423	0.00308	0.01392	0.00099	0.00078	0.01106	0.00533	0.00195
	0.00904	0.00272	0.01123	0.02500	0.04293	0.01685	0.00430	0.00637

Table 15. Continued

13	0.00087	0.00162	0.00177	0.00102	0.00023	0.00005	0.00024	0.00023
	0.00223	0.00074	0.00178	0.00042	1.00035	0.00102	0.00073	0.00062
	0.00023	0.00074	0.00020	0.00063	0.00021	0.01717	0.00784	0.00007
	0.00030	0.00050	0.01070	0.00017	0.00377	0.00048	0.00125	0.02918
14	0.00079	0.00046	0.00049	0.00023	0.00075	0.00325	0.00007	0.00009
	0.00011	0.00003	0.00311	0.00963	0.00043	1.00107	0.00008	0.00027
	0.00009	0.00023	0.00332	0.00053	0.00054	0.00018	0.00017	0.00131
	0.00247	0.00007	0.00087	0.00078	0.00055	0.00067	0.00087	0.00033
15	0.00029	0.00014	0.00018	0.00011	0.00009	0.00005	0.00005	0.00005
	0.00041	0.00224	0.00033	0.00024	0.00010	0.00015	1.00256	0.00007
	0.00088	0.00030	0.00742	0.00122	0.00018	0.00426	0.00111	0.00318
	0.00206	0.00277	0.00071	0.00006	0.00027	0.00006	0.00029	0.00098
16	0.00420	0.03376	0.01268	0.01516	0.00264	0.00016	0.01004	0.00476
	0.00051	0.00344	0.00800	0.00124	0.00083	0.00767	0.00303	1.01043
	0.00554	0.00819	0.01056	0.00088	0.00035	0.00124	0.00221	0.00470
	0.00646	0.00674	0.00252	0.00114	0.01635	0.38215	0.00037	0.00187
17	0.00013	0.00025	0.00340	0.00015	0.00002	0.00000	0.00001	0.00006
	0.00000	0.00000	0.00003	0.00001	0.00002	0.00010	0.00001	0.00011
	1.00165	0.01532	0.00004	0.00001	0.00001	0.00010	0.00006	0.00002
	0.00001	0.00273	0.00143	0.00131	0.00059	0.00005	0.00001	0.00054
18	0.00402	0.00778	0.00974	0.00459	0.00063	0.00003	0.00009	0.00349
	0.00002	0.00003	0.00057	0.00008	0.00011	0.00217	0.00008	0.00270
	0.00047	1.00015	0.00216	0.00009	0.00052	0.00424	0.00216	0.00069
	0.00008	0.00009	0.00354	0.00003	0.01844	0.00108	0.00002	0.00167
19	0.00001	0.00002	0.00003	0.00001	0.00313	0.00151	0.00000	0.00000
	0.00004	0.00000	0.00002	0.00043	0.00414	0.00177	0.00001	0.00001
	0.00000	0.00030	1.00632	0.00000	0.00033	0.00008	0.00008	0.00000
	0.00001	0.00000	0.00024	0.00002	0.00004	0.00001	0.00001	0.00013
20	0.00454	0.00851	0.01357	0.00533	0.00388	0.00459	0.00291	0.00360
	0.00129	0.00231	0.00172	0.00179	0.00158	0.00610	0.00397	0.00355
	0.00309	0.00092	0.00232	1.00629	0.00040	0.01487	0.00348	0.00139
	0.00018	0.00294	0.00182	0.00203	0.01978	0.00288	0.00198	0.00290
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	1.00032	0.00000	0.00410	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00055	0.00005	0.00009	0.00067	0.00162	0.00004	0.00005	0.00007
	0.00001	0.00005	0.00010	0.00074	0.00007	0.00427	0.00017	0.00004
	0.00578	0.00099	0.00006	0.00156	0.00021	1.00636	0.00426	0.00001
	0.00008	0.00013	0.00007	0.00003	0.00009	0.00007	0.00004	0.00692
23	0.00001	0.00002	0.00006	0.00002	0.00002	0.00001	0.00002	0.00344
	0.00001	0.00001	0.00002	0.00021	0.00003	0.00002	0.00004	0.00002
	0.00092	0.00035	0.00001	0.00072	0.00000	0.00003	1.00003	0.00002
	0.00003	0.00003	0.00001	0.00001	0.00004	0.00002	0.00001	0.00001
24	0.00940	0.01324	0.01601	0.00830	0.00133	0.00306	0.00434	0.00361
	0.00127	0.00161	0.00201	0.00126	0.00814	0.00592	0.00286	0.00541
	0.00564	0.00156	0.00338	0.00103	0.00029	0.00473	0.00150	1.00014
	0.00159	0.00214	0.00687	0.00123	0.02884	0.00366	0.00065	0.01058

Table 15. Continued

25	0.01639	0.02203	0.02596	0.01464	0.00304	0.00462	0.00325	0.00381
	0.00132	0.00098	0.00292	0.00139	0.00649	0.01242	0.00549	0.00941
	0.00117	0.00337	0.00470	0.00486	0.00098	0.00908	0.00785	0.00282
	1.00315	0.00417	0.00333	0.00494	0.04049	0.01238	0.00177	0.01121
26	0.00140	0.00258	0.00287	0.00159	0.00028	0.00006	0.00036	0.00025
	0.00002	0.00025	0.00087	0.00093	0.00060	0.00123	0.00089	0.00098
	0.00022	0.00092	0.00028	0.00126	0.00025	0.00509	0.00287	0.00078
	0.00209	1.01873	0.02692	0.00013	0.00608	0.00070	0.00049	0.03808
27	0.00160	0.00085	0.00594	0.00039	0.00144	0.00008	0.00506	0.00028
	0.00006	0.00026	0.00038	0.00097	0.01540	0.00095	0.00086	0.00028
	0.00202	0.00095	0.00273	0.00127	0.00023	0.00116	0.00440	0.00449
	0.00040	0.00066	1.16610	0.00401	0.00091	0.00204	0.00241	0.03492
28	0.00044	0.00007	0.00010	0.00007	0.00006	0.00005	0.00008	0.00007
	0.00001	0.00005	0.00010	0.00020	0.00013	0.00947	0.00019	0.00004
	0.00004	0.00019	0.00009	0.00016	0.00005	0.00019	0.00425	0.00382
	0.00010	0.00013	0.00414	1.00003	0.00014	0.00009	0.00005	0.00775
29	0.27236	0.52017	0.55328	0.31097	0.00520	0.00086	0.00318	0.00201
	0.00038	0.00091	0.03637	0.00212	0.00155	0.10295	0.00072	0.18227
	0.02270	0.00426	0.00233	0.00249	0.00123	0.00463	0.00157	0.00161
	0.00193	0.00226	0.00101	0.00061	1.25299	0.07095	0.00028	0.00565
30	0.00988	0.08692	0.02887	0.03478	0.00683	0.00033	0.02636	0.01248
	0.00131	0.00904	0.00407	0.00105	0.00203	0.01547	0.00793	0.00810
	0.01439	0.02107	0.01937	0.00092	0.00069	0.00315	0.00578	0.01234
	0.01695	0.01770	0.00659	0.00295	0.04246	1.00446	0.00095	0.00428
31	0.01032	0.02620	0.02605	0.01191	0.00504	0.01345	0.01148	0.01592
	0.00417	0.00731	0.01205	0.01814	0.01168	0.04370	0.01936	0.01487
	0.01123	0.03320	0.02268	0.02076	0.00585	0.04557	0.03264	0.00990
	0.01826	0.03033	0.01023	0.00404	0.01925	0.01251	1.05709	0.12809
32	0.00110	0.00166	0.00172	0.00218	0.00529	0.00061	0.00591	0.00567
	0.00019	0.00617	0.00644	0.01301	0.00557	0.01712	0.02300	0.00238
	0.00064	0.02329	0.00498	0.01939	0.00619	0.02181	0.01717	0.00037
	0.00929	0.01593	0.00613	0.00047	0.00226	0.00785	0.00402	1.00564

Table 16. Randomly adjusted and randomly projected output to 1981

DETERMINANT IS 0.34653

1	1.00612	0.00503	0.00618	0.07637	0.00147	0.00095	0.00199	0.00126
	0.00041	0.00085	0.17731	0.00083	0.00046	0.14692	0.00074	0.00324
	0.00444	0.01239	0.00177	0.00750	0.02889	0.00082	0.00120	0.00069
	0.00065	0.00052	0.00064	0.01194	0.00344	0.01030	0.00041	0.00945
2	0.00570	1.00643	0.01422	0.00179	0.00083	0.00047	0.00082	0.00028
	0.00009	0.00023	0.02547	0.00017	0.00006	0.15164	0.00020	0.00086
	0.01730	0.00750	0.00117	0.00739	0.00616	0.00011	0.00033	0.00036
	0.00055	0.00029	0.00032	0.01223	0.00395	0.00406	0.00026	0.00187
3	0.08881	0.11583	1.27829	0.05975	0.00049	0.00053	0.00092	0.00064
	0.00025	0.00042	0.04400	0.00047	0.00030	0.04987	0.00030	0.06209
	0.00387	0.00468	0.00062	0.00462	0.00740	0.00048	0.00053	0.00026
	0.00024	0.00025	0.00028	0.00410	0.28665	0.00178	0.00015	0.00187
4	0.00488	0.00705	0.05632	1.01807	0.00266	0.00589	0.00861	0.00855
	0.00380	0.00532	0.15848	0.00474	0.00456	0.06295	0.00297	0.00463
	0.02488	0.00120	0.00370	0.00460	0.03801	0.00719	0.00554	0.00223
	0.00109	0.00218	0.00241	0.00614	0.01447	0.00328	0.00099	0.00554
5	0.00001	0.00001	0.00001	0.00000	1.00002	0.00000	0.00003	0.00003
	0.00000	0.00000	0.00000	0.00001	0.00004	0.00001	0.00001	0.00000
	0.00005	0.00001	0.00000	0.00002	0.00002	0.00001	0.00466	0.00002
	0.00000	0.00000	0.00301	0.00002	0.00001	0.00001	0.00003	0.00011
6	0.00068	0.00090	0.00162	0.00077	0.00066	1.00049	0.00084	0.00077
	0.01730	0.00021	0.00043	0.00028	0.00125	0.00067	0.00025	0.00087
	0.00063	0.00136	0.00018	0.00038	0.00062	0.00356	0.03793	0.00061
	0.00008	0.00009	0.07456	0.00976	0.00182	0.00048	0.00131	0.00345
7	0.00002	0.00003	0.00004	0.00002	0.00011	0.00001	1.00015	0.00002
	0.00001	0.00002	0.00002	0.00003	0.00019	0.00003	0.00003	0.00001
	0.00003	0.00004	0.00001	0.00004	0.00008	0.00003	0.00014	0.00011
	0.00001	0.00001	0.01392	0.00009	0.00003	0.00006	0.00014	0.00051
8	0.00349	0.00631	0.02131	0.00273	0.00508	0.00215	0.00836	1.02638
	0.00702	0.00127	0.01361	0.00667	0.00592	0.00987	0.01700	0.00333
	0.07770	0.00140	0.00272	0.00830	0.01064	0.01155	0.00909	0.00505
	0.01446	0.01045	0.00523	0.00238	0.00802	0.00284	0.00581	0.00600
9	0.01028	0.01382	0.03777	0.02444	0.00451	0.02216	0.00513	0.02770
	1.00798	0.00162	0.01129	0.00465	0.01830	0.01494	0.00541	0.03536
	0.00464	0.06327	0.00443	0.00373	0.00743	0.00277	0.00719	0.00315
	0.00106	0.00103	0.32048	0.02198	0.02770	0.01059	0.00968	0.03376
10	0.00900	0.11432	0.02628	0.00591	0.02930	0.00397	0.00020	0.00017
	0.00017	1.00183	0.00579	0.00246	0.00014	0.02002	0.00009	0.00469
	0.00215	0.00105	0.00030	0.00100	0.00127	0.00014	0.00042	0.00007
	0.00013	0.00007	0.00056	0.00884	0.02744	0.00059	0.00008	0.00053
11	0.00105	0.00163	0.00172	0.00620	0.00289	0.00115	0.00153	0.00073
	0.00021	0.00111	1.04794	0.00159	0.00030	0.28491	0.00151	0.00053
	0.01312	0.00365	0.00208	0.01309	0.12921	0.00085	0.00161	0.00061
	0.00121	0.00082	0.00071	0.02303	0.00157	0.00437	0.00073	0.02962
12	0.07912	0.09468	0.22481	0.09180	0.16807	0.22511	0.01881	0.03607
	0.03679	0.06843	0.06411	1.14817	0.04622	0.05125	0.01908	0.12741
	0.01008	0.01384	0.05834	0.00531	0.02940	0.03495	0.03442	0.00294
	0.02356	0.00780	0.04808	0.04583	0.21422	0.00303	0.01465	0.02794

Table 16. Continued

13	0.00087 0.00013 0.00130 0.00026	0.00050 0.00093 0.00211 0.00036	0.00087 0.00091 0.00024 0.00894	0.00055 0.00332 0.00151 0.00027	0.00194 1.00040 0.00373 0.00084	0.00069 0.00089 0.00081 0.00027	0.00055 0.00138 0.00931 0.00041	0.00058 0.00050 0.00011 0.03032
14	0.00210 0.00027 0.00078 0.00361	0.00395 0.00090 0.00109 0.00136	0.00210 0.00773 0.00668 0.00123	0.00344 0.00063 0.00118 0.08293	0.00468 0.00017 0.00403 0.00226	0.00266 1.03127 0.00039 0.01488	0.00137 0.00023 0.00042 0.00148	0.00071 0.00054 0.00181 0.00282
15	0.00144 0.00031 0.00541 0.00612	0.00104 0.00129 0.00135 0.01103	0.00178 0.00116 0.01127 0.00114	0.00074 0.00161 0.00571 0.00034	0.00061 0.00058 0.00096 0.00197	0.00405 0.00103 0.00385 0.00020	0.00056 1.00352 0.00368 0.00233	0.00036 0.00057 0.00334 0.00288
16	0.07882 0.00029 0.00370 0.00027	0.10303 0.00050 0.00269 0.00024	0.16866 0.05095 0.00067 0.00032	0.05823 0.00205 0.00305 0.00412	0.00071 0.00035 0.00815 0.24772	0.00082 0.04954 0.00052 0.00167	0.00083 0.00031 0.00053 0.00017	0.00065 1.05344 0.00025 0.00203
17	0.00078 0.00030 1.00189 0.00003	0.00125 0.00036 0.00021 0.00068	0.00237 0.00061 0.00060 0.00084	0.00074 0.00009 0.06730 0.00033	0.00036 0.00013 0.00040 0.00241	0.00050 0.00101 0.00007 0.00023	0.00419 0.00091 0.00030 0.00020	0.00016 0.00047 0.00040 0.00104
18	0.00647 0.00016 0.00151 0.00020	0.00901 0.00025 1.00058 0.00032	0.01378 0.00254 0.00023 0.00779	0.00442 0.00031 0.01567 0.00053	0.00046 0.00024 0.00827 0.02070	0.00022 0.00486 0.00028 0.00028	0.00122 0.00060 0.02364 0.00023	0.00974 0.00336 0.00022 0.00526
19	0.00001 0.00008 0.00002 0.00002	0.00001 0.00001 0.00002 0.00002	0.00002 0.00002 1.01905 0.00039	0.00001 0.00005 0.00002 0.00014	0.00922 0.00418 0.00724 0.00002	0.00434 0.00114 0.00003 0.00002	0.00001 0.00162 0.00025 0.00001	0.00001 0.00001 0.00001 0.00015
20	0.01169 0.00454 0.00517 0.00031	0.01634 0.00507 0.00223 0.01007	0.03569 0.00914 0.00900 0.00677	0.01097 0.00089 1.01760 0.00488	0.00465 0.00179 0.00441 0.03628	0.00752 0.01467 0.00066 0.00339	0.06317 0.01315 0.00390 0.00291	0.00219 0.00706 0.00595 0.00191
21	0.00029 0.00013 0.00004 0.00009	0.00034 0.00025 0.00005 0.00003	0.00091 0.00023 0.00021 0.00017	0.00033 0.00416 0.00002 0.00017	0.00061 0.00017 1.00247 0.00076	0.00082 0.00019 0.00013 0.00001	0.00007 0.00007 0.00012 0.00005	0.00013 0.00046 0.00001 0.00010
22	0.00109 0.00008 0.00139 0.00025	0.00044 0.00086 0.00522 0.00040	0.00074 0.00088 0.00021 0.00035	0.00356 0.00100 0.00468 0.00087	0.00510 0.00023 0.00753 0.00063	0.00029 0.00997 1.01390 0.00040	0.00067 0.00145 0.00632 0.00033	0.00058 0.00029 0.00008 0.03160
23	0.00008 0.00006 0.01046 0.00008	0.00011 0.00005 0.00034 0.00007	0.00029 0.00011 0.00006 0.00007	0.00008 0.00067 0.00173 0.00004	0.00012 0.00006 0.00006 0.00022	0.00015 0.00010 0.00007 0.00002	0.00015 0.00011 1.00008 0.00004	0.00476 0.00010 0.00003 0.00006
24	0.03691 0.00734 0.00383 0.00390	0.04749 0.00288 0.00550 0.00290	0.07654 0.01567 0.00636 0.02204	0.02466 0.00296 0.00301 0.00484	0.00277 0.00865 0.00500 0.11529	0.00351 0.02919 0.00294 0.00336	0.00201 0.00340 0.00392 0.00408	0.00740 0.02214 1.00054 0.01482

Table 16. Continued

25	0.05516	0.01998	0.05411	0.03117	0.01243	0.02297	0.00967	0.01517
	0.01617	0.00221	0.02696	0.02529	0.00790	0.02530	0.01085	0.01603
	0.01554	0.00899	0.01408	0.01843	0.02483	0.01848	0.01652	0.00795
	1.00336	0.00628	0.00811	0.01906	0.04036	0.01740	0.00543	0.00523
26	0.07005	0.02597	0.04160	0.01366	0.00227	0.00052	0.00096	0.00084
	0.00018	0.00118	0.00813	0.00157	0.00048	0.01141	0.00191	0.01041
	0.00288	0.00336	0.00037	0.00403	0.00632	0.00122	0.00371	0.00159
	0.00150	1.00055	0.00930	0.00110	0.06375	0.00076	0.00118	0.04092
27	0.00196	0.00287	0.00302	0.00143	0.00919	0.00116	0.01241	0.00157
	0.00048	0.00149	0.00130	0.00234	0.01584	0.00258	0.00216	0.00111
	0.00218	0.00350	0.00118	0.00361	0.00639	0.00275	0.01182	0.00920
	0.00072	0.00093	1.18195	0.00803	0.00295	0.00476	0.01191	0.04340
28	0.00178	0.00109	0.00045	0.00037	0.00118	0.00017	0.00034	0.00028
	0.00003	0.00831	0.00042	0.00056	0.00023	0.00075	0.00079	0.00018
	0.00072	0.00124	0.00008	0.00089	0.00216	0.00044	0.00092	0.00009
	0.00013	0.00020	0.00897	1.00021	0.00046	0.00019	0.00026	0.01770
29	0.45545	0.59450	0.95367	0.30590	0.00226	0.00253	0.00390	0.00309
	0.00123	0.00203	0.16349	0.00217	0.00146	0.23875	0.00132	0.23408
	0.01901	0.01242	0.00294	0.01139	0.03017	0.00239	0.00233	0.00125
	0.00115	0.00110	0.00125	0.01959	1.47203	0.00885	0.00071	0.00774
30	0.03612	0.22905	0.08986	0.05797	0.02125	0.00166	0.07914	0.03376
	0.00705	0.00879	0.02515	0.00255	0.00291	0.05419	0.00349	0.02109
	0.03236	0.02715	0.06110	0.00728	0.01270	0.00261	0.00422	0.02829
	0.00183	0.00133	0.01046	0.00492	0.10910	1.00337	0.00374	0.05672
31	0.04129	0.07130	0.12697	0.03930	0.02553	0.07164	0.04654	0.06277
	0.02877	0.02590	0.06288	0.07720	0.01573	0.10259	0.02471	0.04476
	0.02639	0.04573	0.06468	0.03169	0.12716	0.15973	0.04818	0.02987
	0.03656	0.03054	0.03761	0.02383	0.08277	0.01584	1.06802	0.16603
32	0.00985	0.00957	0.01257	0.01151	0.05151	0.00726	0.01406	0.01555
	0.00168	0.02618	0.00570	0.03062	0.00652	0.02047	0.04490	0.00754
	0.03971	0.06946	0.00363	0.04905	0.12021	0.02429	0.04836	0.00117
	0.00691	0.01131	0.00878	0.00337	0.01250	0.00773	0.00975	1.01251

INVERSE MULT BY VECTOR

1	32874.65007		
2	27100.65629	21	4080.10567
3	12826.72020	22	2959.19456
4	16627.67303	23	3875.45369
5	4728.81773	24	10586.91257
6	3029.28497	25	15624.25417
7	3087.85472	26	7393.52929
8	2843.87714	27	28182.99071
9	17038.04372	28	16641.05174
10	9904.09642	29	57858.44069
11	35381.35074	30	16589.15898
12	43052.37521	31	23416.52929
13	10777.20424	32	16703.25934
14	7362.77652		
15	2748.76401		
16	15249.40598		
17	5583.64865		
18	33674.96091		
19	3483.71743		
20	17637.72358		

Table 17. **Income payments and income multipliers**, Cache County (1981)

Processing Sector	Direct Income Payments		Direct and Indirect Income Payments		Type I Income Multipliers		Direct, Indirect, and Induced Income Payments		Type II Income Multipliers	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1 Meat Packing	.146	25	.185	27	1.27	14	.356	13	2.438	3
2 Milk Processing	.114	28	.168	29	1.48	8	.480	14	4.211	1
3 Grain Grinding	.142	26	.215	24	1.52	6	.542	11	3.817	2
4 Other Food Manufacturing	.254	17	.291	19	1.14	16	.541	12	2.130	7
5 Primary Metal Goods	.373	10	.376	13	1.01	31	.531	13	1.424	26
6 Conc. & Conc. Products	.286	14	.322	15	1.13	17	.409	20	1.430	24
7 Textiles & Apparel	.397	8	.399	9	1.00	32	.564	9	1.421	27
8 Printing & Engraving	.538	2	.595	3	1.11	18	.755	2	1.403	29
9 Bldg. Supplies & Equip.	.118	27	.176	28	1.51	7	.174	30	1.475	19
10 Farm & Industry Equip.	.187	21	.219	23	1.17	15	.265	27	1.417	28
11 Food Stores	.077	31	.135	30	1.77	4	.170	31	2.208	9
12 Autos, Gas, & Durable Equip. Rep.	.237	18	.385	12	1.62	5	.389	11	1.641	14
13 Home Furnishings	.433	5	.457	6	1.05	23	.623	6	1.439	23
14 Eating & Drinking	.454	4	.463	5	1.02	27	.750	3	1.652	13
15 Specialty Stores	.306	12	.316	16	1.04	24	.446	16	1.458	12
16 Farm Supplies & Feed	.107	30	.253	21	2.37	1	.262	29	2.449	3
17 Drug & Variety	.184	22	.188	26	1.02	26	305	24	1.658	12
18 Clothing Stores	.059	32	.078	32	1.32	13	.127	32	2.153	6
19 Other Trades	.284	15	.291	19	1 02	28	.416	18	1.465	21
20 Medical, Dental, & Legal	.516	3	.556	4	1.08	21	.719	4	1.393	30
21 Amusement & Recreation	.303	13	.305	18	1.01	30	.416	19	1.373	32
22 Apparel Care & Rep.	.401	6	.412	8	1.03	25	.610	7	1.521	17
23 Other Services	.384	9	.387	11	1.01	29	571	8	1.487	18
24 Commercial Banks	.399	7	.441	7	1.11	19	.554	10	1.388	31
25 Real Estate & Insurance	.176	23	243	22	1.38	10	.268	26	1.523	16
26 Other Lending	.579	1	.613	2	1.06	22	.825	1	1.425	25
27 Gen. Bldg. & Subcontracting	.160	24	.214	25	1 34	11	.366	12	2.288	5
28 Gen. Construction	.114	28	.124	31	1.09	20	.182	28	1.596	15
29 Farm & Fisheries	.344	11	.795	1	2.31	2	691	5	2.009	8
30 Transportation	.265	16	.373	14	1.41	9	.473	15	1.785	11
31 Utilities	.190	20	.391	10	2.06	3	.279	25	1.468	30
32 Rental & Lodging	.233	19	.312	17	1.33	12	.434	17	1.863	10