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A Study of Input-Output Adjustments

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A STUDY OF INPUT-OUTPUT ADJUSTMENTS

by

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ABSTRACT

A Study of Input-Output Adjustments

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The effects of using the United States input-output table to explain Israel's economic structure was studied, by comparing price data generated on the basis of the U. S. tables and prices observed in the two countries. A substantial difference between prices generated and observed led to the conclusion that the technological structure of the United States cannot be used to approximate Israel's structure.

Various adjustments were then applied to the United States coefficient matrix to determine if it could be transformed into a new technological structure which would more closely approximate Israel's economy.

Significant improvements were noted by three of the adjustments while one showed no noticeable difference from the results obtained using the unadjusted U. S. matrix.

One of the adjustments was found to transform the U. S. coefficient matrix into a new matrix which when multiplied by the observed final demand vector of Israel would predict accurately, output levels and effects of changes in the Israel economy.

(78 pages)

INTRODUCTION

Nature of the Problem

Estimates of gross national product, total consumption, income per capita, rate of investment, and other economic indices are now compiled in almost every country. These statistics point out a quantitative difference between the rich and the poor economies and, plotted over time, suggest that the gap is widening. These statistics, however, do not in themselves offer any explanation of the difference in the performance of the economies, nor do they offer any suggestion as to how to narrow the gap.[1]

Each economic system, even that of an underdeveloped country, has a complicated internal structure. The system's performance is greatly determined by the interrelations of its different component parts. During the past several years the internal economic gear work of a large number of countries has been described with increasing clarity and precision by a technique known as "input-output analysis." In underdeveloped countries input-output methods are being effectively employed to show how "development" of the economy is to be accomplished. The advantage of using input-output analysis is that it shows in detail how changes in one or more sectors will affect the total economy.

The main reason more underdeveloped countries cannot obtain this tool is the great amount of bookkeeping and statistical effort required

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[1] Wassily Leontief, "The Structure of Development," Scientific American, Vol. 209 (September, 1963) p. 148.

to build a model. In many countries the needed information is either unavailable or unreliable. However, as more and more countries have begun to compile tables, comparative studies have shown that from one economy to the next the ratios between these internal transactions and external total activity of the system (true gear ratios in the sense that they are determined largely by technology) turn out to be "relatively" constant. Leonteif points out, however, that the more developed the economy, the more its internal structure resembles that of other developed economies.[2] Input-output tables for underdeveloped economies show that they are slightly different in that they are incomplete as compared with the developed economies. The process of development consists essentially of installing an approximation of the structure of a more advanced economy and modifying it by the existence of regional resources and the techniques available to exploit them.

Objectives

It is the hypothesis of this study that a fairly reliable input-output model can be constructed for an underdeveloped country by performing proper adjustments on a well developed country's reliable model. The parameters required for the adjustments are relatively easy to obtain. Thus, the large amount of statistical information that would ordinarily be needed could now be avoided to give underdeveloped countries an inexpensive, working model. It is conceivable that a model constructed in this manner may even be more reliable than many countries could develop with undependable data.

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[2] Ibid., p. 148

The analysis that follows is divided into three parts:

First, there is a brief summary of input-output concepts showing how a model is constructed, its underlying assumptions, and relationships to other variables.

Second, transformed United States' input-output tables will be used to approximate Israel's internal structure. United States and Israel were chosen for this analysis because of the amount of information available.[3] Both countries have input-output tables already constructed for the year 1958 which will be used to test accuracy of the adjustments. A statistical test will be applied to the coefficient matrix of the U. S. to determine how closely it approximates Israel's internal structure, and if there is a need for adjustment.

Third, three feasible methods of adjustment will be reviewed theoretically and finally tested empirically.

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[3] We do not mean to imply here that Israel is an underdeveloped country in the true sense of the word. It is used in this study because it has good input-output data with which to test results.

SUMMARY OF INPUT-OUTPUT CONCEPTS

Basic Structure

Input-output is an analysis concerned with the structure of an economic system during a particular phase of its development. It is designed to explain the way component parts of an economy fit together and influence one another. The economy is visualized as a large number of interdependent activities such as branches of production, distribution, transportation, consumption, etc. Each one of these activities involves the purchase of inputs from other sectors and the production of goods and services which are, eventually, sold to and absorbed by the other sectors of the economy.

The basis of the interindustry structure is the input-output transactions table.

This table shows how the output of each industry is distributed among other industries and sectors of the economy. At the same time, it shows the inputs to each industry from other industries and sectors. In Table 1, $X_i \leq 0$ denotes the quantity produced by the i^{th} industry in units of dollars worth of its product for some time period (generally accepted as one year), and $x_{ij} \leq 0$ denotes the amount of the i^{th} good consumed by the j^{th} industry. Then Y_i is referred to as the amount consumed by exogenous demand, which consists of government, household consumption, net exports, and investment. It follows that

$$X_i = x_{i1} + x_{i2} + \ldots\ldots x_{in} + Y_i \qquad (1)$$

is the total amount produced.

Table 1. Input-output transaction table.

	Purchasing / Producing	Processing Sectors: Outputs $I_1, I_2, \ldots\ldots I_n$	Final demand Y_i	Total outputs Y_i
Processing Sectors — Inputs	I_1	$x_{11} \ldots\ldots x_{1j} \ldots\ldots x_{1n}$	Y_1	X_1
	I_2	. . . . .	Y_2	X_2
	.		.	.
	.	. . . . .	.	.
	.	$x_{i1} \ldots\ldots x_{ij} \ldots\ldots x_{in}$	.	.
	.		.	.
	.	. . . . .	.	.
	.	. . . . .	.	.
	I_n	$x_{n1} \ldots\ldots x_{nj} \ldots\ldots x_{nn}$	Y_n	X_n
Value Added = V_i		$V_1, V_2 \ldots\ldots V_n$		
Total Input = X_i		$X_1, X_2 \ldots\ldots X_n$		

Having described briefly the transactions table, we turn to the underlying theoretical scheme.

Development of the Leontief Model

In its simplest form, the input-output system is derived from a set of accounting identies showing the total disposition of the physical output of each sector. Given an economy divided into n sectors:

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

The input-output system is designed to provide a solution for the n unknown levels of output of the production sectors in terms of the final demand for each sector, which is assumed to be known.

Let a_{ij} be the required minimum amount of the i^{th} input per unit of the j^{th} output. Then X_j can be defined as the smallest of

$$x_{1j}/a_{1j} \, , \, x_{2j}/a_{2j} \, \ldots . x_{nj}/a_{nj} \, ,$$

and it follows that $X_j \leq x_{ij}/a_{ij}$. However, since no more than the minimum amount of any input will be used it may be written $x_{ij} = a_{ij}X_j$ and solving for the a_{ij}

$$a_{ij} = x_{ij}/X_j \qquad (3)$$

This term describes the technical coefficients of the processing sector and is expressed as an index of physical value. By a technical coefficient is meant the amount of inputs required from each industry to produce one dollars worth of the output of a given industry. Referring back to the input-output table, the calculation of coefficients consists of dividing all entries in each sectors' column by gross output (X_j) for that industry.

The desired solution for the system can be obtained by substituting for each x_{ij} the corresponding $a_{ij}\,X_j$ into the above set of equations, which yields:

$$\begin{aligned} X_1 &= a_{11}X_1 + a_{12}X_2 + \ldots . \, a_{1n}X_n + Y_1 \\ X_2 &= a_{21}X_1 + a_{22}X_2 + \ldots . \, a_{2n}X_n + Y_2 \\ . \;\; &. \;\; . \;\; . \;\; . \;\; . \;\; . \;\; . \;\; . \;\; . \;\; . \\ X_n &= a_{n1}X_1 + a_n 2X_2 + \ldots . a_{nn}X_n + Y_n \end{aligned} \qquad (4)$$

Transferring the X_i's and a_{ij}'s to the left side this becomes:

$$\begin{aligned}
(1-a_{11})X_1 - a_{12}X_2 \cdots\cdots - a_{1n}X_n &= Y_1 \\
-a_{21}X_1 + (1-a_{22})X_2 \cdots\cdots - a_{2n}X_n &= Y_2 \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad & \cdot \\
-a_{n1}X_1 - a_{n2}X_2 \cdots\cdots + (1-a_{nn})X_n &= Y_n
\end{aligned} \tag{5}$$

Where Y represents the final bill of goods vector and X the outputs, the above equations may be stated in matrix form as:

$$\begin{matrix}
(1-a_{11}) - a_{12} \cdots\cdots - a_{1n} & X_1 & Y_1 \\
-a_{21} + (1-a_{22}) \cdots\cdots - a_{2n} & X_2 & Y_2 \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot & \cdot & \cdot \\
-a_{n1} - a_{n2} \cdots\cdots + (1-a_{nn}) & X_n & Y_n
\end{matrix} \tag{6}$$

or

$$(I-A)\ X = Y$$

Solving for the X's it becomes:

$$X = (I-A)^{-1}Y \tag{7}$$

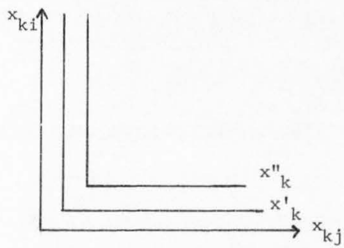
The theoretical scheme described above should be referred to as the "open static input-output system", that is: final demand is determined exterior to the system. The open static system described here is the one of input-output analysis.

The problem to which the above equations are applied may be stated as follows: Given the processing structure of an economy represented by the matrix $(I-A)^{-1}$, what is the set of output levels (X) that will be consistent with the desired "bill of demand" (Y)?

Review of Assumptions

Having given this brief description of Leontief's Model, we turn now to the assumptions underlying input-output analysis. The characteristic assumption is that of constant returns to scale; i.e., doubled output is a function of doubled inputs. Although this assumption is contested on grounds that more complex functions are needed to describe production processes realistically, it is defended on grounds of simplicity; that is, a productive process can be observed at a point in time, to obtain estimates of all the parameters of a simple-proportion production function.[4]

We also assume that there is only one process used for the production of each output. This assumption too is defended on the grounds of simplicity; data gathering and computation are easier if an industry can be regarded as a single process with fixed technical coefficients. This implies a production function of the form:



which indicates no possibility of substitution between the various inputs and generalized diminishing returns.

Another assumption underlying input-output analysis is that of fixed coefficients of production; i.e., that a certain minimum amount of

[4] Carl F. Christ, "A Review of Input-Output Analysis", Input-Output Analysis: An Appraisal, Studies on Income and Wealth, Vol. 18 (Princeton: Princeton University Press, 1955), p. 140.

each input is required per unit of each output.

Some of the theoretically limiting characteristics of the equation $X = (I-A)^{-1}Y$ implied by the preceding assumptions are listed below:

1. The a_{ij}'s are invariant to changes in the final "bill of demand", and therefore disregard the human element.
2. The a_{ij}'s do not allow for price changes, that is, $a_{ij} = x_{ij}(P_i)/X_j(P_j)$. We assume the relative prices remain constant.
3. The equation does not allow for disinvestment. The fact that inputs must equal outputs doesn't take into account outflows of stocks already on hand.

It may be asked then with all these restrictions, is it of real value to us? The assumption of relative invariance of the structural characteristics is considered as a good first approximation to the more complex production functions of the real world. However, input-output's chief value is found in its use as a predictive device.

Interrelationship with Price Structure

Under perfectly competitive statical conditions, the equilibrium price for each producible good must be exactly equal to its unit cost of production. The unit cost of any good is composed of its material costs (the purchase of inputs from other sectors) and its direct primary costs, which include such items as wage costs, taxes, imports, and possibly others. Thus for each of the n produced goods, we have the following market conditions:

$$\begin{aligned}
P_1 &= a_{11} P_1 + a_{21} P_2 + \ldots\ldots a_{n1} P_n + V_1 \\
P_2 &= a_{12} P_1 + a_{22} P_2 + \ldots\ldots a_{n2} P_n + V_2 \\
&\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
P_n &= a_{1n} P_1 + a_{2n} P_2 + \ldots\ldots a_{nn} P_n + V_n
\end{aligned} \tag{8}$$

where P_i is the price of good i, a_{ij} is the familiar input coefficient representing the quantity of output of sector i consumed per unit of sector j's output, and V_i is the sum of all primary costs.

The foregoing system consists of n equations with 2n unknowns, the n prices of goods and the n primary costs in each sector. Accordingly, if all of the primary costs per unit in each sector are known, the set of product prices can be determined. Conversely, if all goods prices are given, the system of equations determines the corresponding primary costs per unit of output in each sector.

When the terms of the above equations are rearranged, the general solution for the price system becomes:

$$\begin{aligned}
(1-a_{11}) P_1 - a_{21} P_2 \ldots\ldots - a_{n1} P_n &= V_1 \\
-a_{12} P_1 + (1-a_{22}) P_2 \ldots - a_{n2} P_n &= V_2 \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad & \\
-a_{1n} P_1 - a_{2n} P_2 \ldots\ldots + (1-a_{nn}) P_n &= V_n
\end{aligned} \tag{9}$$

The analogy between this set of equations and the set in Leontief's model now becomes apparent. It can be seen that the row and column subscripts of the a_{ij}'s have been interchanged, i.e., the inverse matrix in the price solution is the transpose of the inverse matrix of the output solution. The complete system of equations may be written compactly in matrix notation as follows:

$$P\ (I-A)_t = V$$

solving for P (10)

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

To summarize then, there is a "duality" relation between quantities and prices in the Leontief system: Transpose the a_{ij}'s of the quantity problem and you get the price problem. Similarly, transpose the a_{ij}'s of the price problem and you get the quantity problem.[5]

It should be noted that the unit primary cost V_i can be split into several items; wages, profits, imports, taxes, each of which, except taxes, may be written as the product of their price and quantity.

$$V_i = P_L\ L_i + P_k\ K_i + P_m\ M_i + t_i \qquad (11)$$

Where L_i, K_i, and M_i are the quantities of labor, capital, and imports absorbed per unit of output of sector 'i' and P_L, P_k, and P_m are respective factor prices. The result, however, is a system of equations in which there are many more unknowns than equations. The number of primary costs can be reduced to two, labor and non-labor costs, so that

$$V_i = P_L\ L_i + NL_i \qquad (12)$$

where NL_i = all non-labor cost elements. In this system L_i is assumed to be a given coefficient and NL_i are all constants. Accordingly, there are n equations and n + 1 unknowns making it necessary to specify one price in order to obtain a numerical solution. Or another possibility is to make all other prices a ratio of one price. In the latter case, the price of labor is often selected as numeraire.[6]

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[5] Robert Dorfman, Paul A. Samuelson, Robert M. Solow, Linear Programming and Economic Analysis (New York: McGraw-Hill Book Company, 1958), p. 240.

[6] United Nations, Problems of Input-Output Tables and Analysis, Studies in Methods, Series F, No. 14 (New York: United Nations, 1966), p. 21.

Consolidation and Aggregation

When we consolidate two or more industries and treat them as if they were a single industry, two relationships become apparent between the new industry and its constituents.[7] First, the composite industry must provide to other industries the single sum of what its constituents provide. Second, the new a's giving the requirements of the composite industry are weighted averages of the requirements of the constituent parts, the weight being the proportionate importance of each constituent industries production.

Even the most common forms of aggregation involve a certain loss of information. Therefore, if interest is in detail, no amount of aggregation will be satisfactory. There are certain principles, however, that can help to minimize the undesirable effects of a necessary sacrifice in detail.

First, any new "a" will be a close approximation to the needed correct value if we classify industries so that we get those requiring the same types and relative quantities of inputs for their production. Automobiles and military tanks serve different purposes but would meet this test.

A second principle is to find those industries in which production of all the constituent parts of the aggregate change in about the same proportion; i.e., the industries goods are needed in the same proportion by other industries. Examples may include the need for nuts and bolts or spinning and weaving. A third criterion for aggregation, and perhaps the most important, is that of irrelevancy. If the analysis is primarily concerned with a few sectors, then other sectors which are only weakly

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[7] Dorfman, p. 236.

related can often be aggregated without introducing significant errors into the result.[8]

After a large matrix has been aggregated into a smaller one and the latter is inverted, the results of aggregation may be determined. Particular coefficients may be compared if one or more industries are defined in the same manner in the aggregated system as in the original. Also for the distinct industries, the column sums of two inverses may be compared, each sum representing the number of dollars of increased output on the economy required by a $1 increase in consumption in the particular industry under consideration.

Construction of Tables by Aggregating and Adjusting

In attempting to construct an input-output model to accurately reflect the internal workings of an underdeveloped economy from a developed economy's model, we are faced with two main problems. First, classifying and aggregating the economic activities of the two economies to a common or comparable base. The second problem that confronts us, assuming we are successful in accomplishing the first, is that of adjusting the developed economies' coefficients to make them a close approximation of the actual interindustry ratios that exist in the underdeveloped economy. Each of these problems will be discussed in turn.

If the units of both economies are classified into sectors in a way that the conditions of the previous section are met, then we have,

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[8] United Nations, p. 33.

at least, minimized the undesirable effects of aggregation. "In practice, experience in the preparation of input-output tables has shown that most existing industrial classifications are remarkably satisfactory because they tend to group activities with homogeneous input requirements."[9] We find that the specification of sectors in well-developed economies conform to National Standard Industrial Classifications.[10] One of the reasons for using a developed economy's model then, is that we can generally assume that it has been constructed in such a way that errors of aggregation are minimized.

Our first problem now becomes one of making the underdeveloped country's economic units correspond to the sectors of the developed country. Differences among countries in the resources available makes it unreasonable to assume that we could adopt any general or uniform standard for accomplishing this. But few could object to the suggestion that the data from the underdeveloped country should be aggregated using methods similar to those used in the developed country. Since it is unlikely that exact comparability in every detail can ever be established, we may find it necessary to use an unallocated sector. If correspondence in the two models cannot be established even for sectors which contain a significant proportion of the transactions, it is probably better not to make a distribution of their outputs.

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[9] Ibid., p. 34.

[10] Ibid., p. 157

To do so would only decrease the accuracy of some of the recorded transactions.[11]

In the case of the two countries to be considered in this study, the United States table was aggregated to correspond as nearly as possible to the sectors defined in the Israel table. Although this may not always be necessary, in the test proposed to determine accuracy of the adjustments near exact compatibility is required. Refer to Appendix A for the basis of aggregation.

Assuming that we have satisfactorily provided a way to accomplish the first task, we move on to the second. The problem of adjusting input-output coefficients is not new. It has traditionally been the case in the use of input-output tables, that minor revisions of the data have been made periodically in order to keep the basic tables up to date. However, after a considerable time lapse (5-10 years) it is usually necessary to either gather the data again or perform some major transformation on the coefficients.[12]

Three major sources of variation over time have been identified as: (1) changes in prices; (2) changes in technology; (3) changes in the composition of sector output.[13] If these are, in fact, the major changes that an economy goes through as it develops in time, would it not be reasonable to assume that these are also the major differences between a developed and an underdeveloped economy?

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[11] Ibid., p. 130

[12] Ibid., p. 135

[13] Ibid., p. 106

Changes in prices will cause changes in the coefficients even though the physical units may remain the same, because we assume that relative prices remain constant. Changes in technology refer to alterations in the interrelationships of sectors. General substitution of some products for others, or changes in processes of production are examples of this. Changes in the composition of sector output arise from the need to reclassify certain products because of different input structures. This last change would not then be a difference between economies for any given time period if we classify correctly in the first place.

Leontief, in discussing the differences between developed and underdeveloped countries tends to support these as the differences although in more detail.[14] Therefore, we conclude that there are two major differences our adjustment must account for: (1) prices; and (2) technology. It should be noted here that availability of resources would be taken into account in price changes. Also, imports are not distinguished from production in the Leontief model.

We shall proceed in the ensuing pages to determine the need for an adjustment on the coefficients and to provide several possible methods by which this adjustment may be accomplished.

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[14] Leontief, p. 169

ANALYSIS OF COEFFICIENTS

Comparing Calculated with Observed Prices

Suppose that country A has gathered the necessary data and constructed an input-output table and a matrix of structural coefficients. Suppose now that country B has no input-output table nor adequate information to construct one, but desires to know if A's matrix of coefficients would adequately describe its technological structure. How could we test the adequacy of A's coefficients to explain B's economy? The following analysis suggests a method of answering this question through the use of generated and observed prices.

Within the framework of input-output analysis we can, using A's coefficients, generate price data for each corresponding sector of B's economy which can be compared with B's observed prices to determine the effectiveness of A's coefficients in explaining B's technical structure. If the prices calculated do not vary from observed prices which exist in B, the implication is that A's a_{ij}'s adequately describe B's technical relationships. If, on the other hand, the two sets of prices vary widely A's technical coefficients are not compatible with B's inter-industrial relations. This is possible because of the duality relationship between prices and quantities in the Leontief system.

Consider first the role of prices in the static Leontief model. Assuming perfect competition, the equilibrium price for each producible good must be exactly equal to its unit cost of production. The latter consists of cost per unit of each intermediate input plus the cost of value added. Let P_j be the price of one unit of j. Then the cost of materials required to produce one unit of j could be expressed as

$$a_{1j} P_1 + a_{2j}P_2 \pm \cdot \cdot \cdot \cdot \cdot a_{nj}P_n$$

The difference between the price of one unit of j and the cost of materials is called value added and is denoted by v_jP_{vj}. Thus for the output of each of the m sectors the following market conditions exist:

$$P_j - \sum_{i=1}^{n} a_{ij}P_i = v_jP_{vj} \quad (13)$$

$$\text{and } P_j = a_{1j}P_1 + a_{2j}P_2 + \cdot \cdot \cdot a_{nj}P_n + v_jP_{vj} \quad (14)$$

Thus equation (12) may be written as

$$\begin{aligned} (1-a_{11})P_1 - a_{21}P_2 - \cdot \cdot \cdot \cdot - a_{n1}P_n &= v_1P_{v1} \\ -a_{12}P_1 - (1-a_{22})P_2 - \cdot \cdot \cdot \cdot \cdot - a_{n2}P_n &= v_2P_{v2} \\ \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \\ -a_{1m}P_1 - a_{2m}P_2 - \cdot \cdot \cdot (1-a_{nm})P_n &= v_mP_{vm} \end{aligned} \quad (15)$$

In matrix notation these equations become:

$$\begin{matrix} (1-a_{11}) - a_{21} \cdot \cdot \cdot \cdot -a_{n1} & P_1 & v_1P_{v1} \\ - a_{12} - (1-a_{22}) \cdot \cdot \cdot -a_{n2} & P_2 & v_2P_{v2} \\ \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot & & \\ - a_{1m} - a_{2m} \cdot \cdot \cdot -(1-a_{nm}) & P_m & v_mP_{vm} \end{matrix} \quad (16)$$

which can be solved to determine the unknown prices.

$$(I-A)_t \; P = (VP_v) \quad (17)$$

$$P = (I-A)_t \; -1 \; (VP_v) \quad (18)$$

Equations (16), (17), and (18) are similar to those of an earlier section but were arrived at by a slightly different approach. These equations again point out the duality relationship between quantities and prices in the Leontief system: Transpose the a_{ij}'s of the quantity problem to derive the price problem; similarly, transpose the a_{ij}'s of the price problem to derive the quantity problem. The prices thus obtained are completely determined by technological relationships and an exogenously determined value added.

The above theoretical framework has been restricted to a single homogeneous value added factor. In actuality the value added sector may be divided into the following: (a) labor income, (b) capital revenue, (c) depreciation, (d) indirect taxes less subsidies, and (e) imports. If capital revenue and depreciation can be grouped together and indirect taxes minus subsidies are disregarded, the analysis would involve three primary inputs: labor, capital, and imports.[15] If we break value added down then into these component parts, we must reformulate (12) as follows:

$$P_j - \sum_{i=1}^{n} a_{ij} P_i = m_j P_m + k_j P_k + l_j P_l \qquad (19)$$

where m_j, k_j, and l_j are the required amounts of imports, capital and labor required per unit of output of the j^{th} industry; P_m, P_k and P_l are uniform prices of imports, capital and labor. If we decide, however, for simplicity of calculations, to assume the value added to be one single homogeneous factor then we must in some way determine an average

[15] Bartell C. Jensen, The Impact of Reparations on the Post-War Finnish Economy An Input-Output Study, (Homewood, Illinois: Irwin Company, 1966), p. 76.

price for the factor. Throughout the rest of this analysis we will follow the latter alternative and the factor price will become a weighted average of the above three factors; i.e., labor, capital and income.

We have thus far developed a method whereby we may determine a set of prices which are determined jointly by structural parameters and exogenously determined price variables, i.e., equation (18). The objective of our analysis is to generate, within the above framework, price data which can be compared with actual or observed price data to determine the effectiveness of a given set of coefficients in explaining another economy's structure. If the above framework is used to generate prices for country A and also for country B and if the values of the exogenous variables are determined separately for each of the two countries, the following two sets of price data (20) and (21) can be calculated:[16]

$$P(\text{country A}) = (I - A^{(\text{"A"})})_t^{-1} V^{(\text{"A"})} \qquad (20)$$

$$P(\text{country B}) = (I - A^{(\text{"A"})})_t^{-1} V^{(\text{"B"})} \qquad (21)$$

In order then to establish whether the given set of A's input coefficients adequately describe B's structure, we can, by calculating P (country A) and P (country B) and by forming the ratio P_i("A") / P_i("B") (i = 1 ...m) for each sector included in the system, compare these ratios with the ratios of the actual prices P_i'("A") / P_i'("B") (i = 1 ...m), corresponding to each of the sectors. If, when plotting P_i("A") / P_i("B") on the vertical and P_i' ("A") / P_i' ("B") on the horizontal axis of a two variable plane, the observed points lie on or

[16] Ibid., p. 83

cluster about a 45 degree straight line through the origin, it follows that the structural coefficients of A are compatible with B's technical structure; that is, that the coefficients of country B, if known, would not differ significantly from those of country A. If, on the other hand, a wide divergent scatter results, the implication is that the input structure of country B differs substantially from that of country A.[17]

In general we would not expect the points formed by the two ratios to coincide exactly with the straight 45 degree line. However, the stronger the tendency for the scatter to converge to the 45 degree line the less the structural parameters of the two systems differ.

Analysis of Findings

Having set forth a method whereby the validity of using one country's coefficients to represent the internal structure of another can be tested, our objective becomes that of applying the method to the United States and Israel. We will attempt to determine whether or not the United States coefficient matrix can be used to represent Israel's interindustrial structure. It may be well to note here that the difference in the volume of production between the United States and Israel does not have any effect on the analysis since the coefficient matrix is in per unit terms. To restate our objective in more specific terms then; we are to determine whether the inputs per unit output effective in the United States economy in 1958 accurately

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[17] Ibid., p. 84

define the inputs per unit output in the Israel economy in 1958. It is assumed that processing n units implies the use of n times as much of each input.

Figure 1 and Table 2 compare the calculated price ratios P_i(U.S.)/P_i (Israel), with the observed price ratios P_i'(U.S.)/P_i'(Israel) for 1958 in the two countries. As might be expected there is a substantial divergence between the observed and calculated prices. The technological structure of the United States economy as defined by the input-output coefficients does not estimate, with any degree of accuracy Israel's technological structure. The points in Figure 1 on the basis of the United States coefficient matrix in every case generated prices which were less than the observed.[18] It appears that the U. S. coefficients overstate or are larger in every case than Israel's true coefficients. Therefore, if we are to generate technological coefficients for Israel, it must be on the basis of some transformed United States coefficient matrix rather than the one that now exists.

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[18] Because exact price data was not available observed prices were approximated by using a weighted average of import and export prices effective between the two countries.

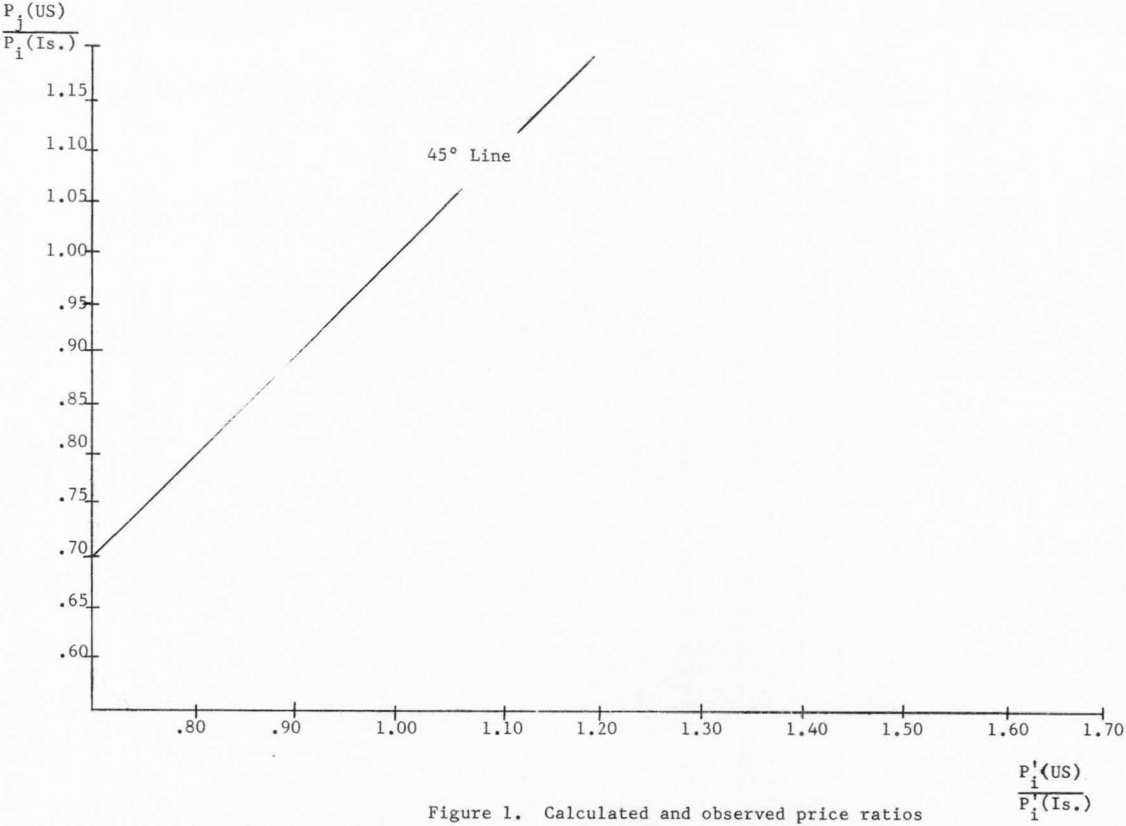

Figure 1. Calculated and observed price ratios

Table 2. Ratios of United States to Israel prices by sectors

Sectors	Calculated Price Ratios $P_i(US)/P_i(Is.)$	Observed Price Ratios $P_i'(US)/P_i'(Is.)$
01 Agriculture	.922	1.691
02 Food.	.870	1.030
03 Mining.	1.133	1.664
04 Textiles and apparel. . . .	.627	1.032
05 Wood and carpentry.	.673	.752
06 Paper and publishing. . . .	.883	.997
07 Leather products.	.596	.915
08 Rubber and plastic.	.714	1.173
09 Chemicals	.767	.888
10 Oil refineries.	.747	.994
11 Glass and ceramics.	.851	1.039
12 Basic metals.	.713	.937
13 Metal products.	.767	.893
14 Machinery and appliances	.713	1.061
15 Construction and housing. .	.867	.900
16 Services.	.967	1.556
17 Transportation.	.923	1.213

Source: Calculated by the author from information given in the following references: Interdependence, Resource Use and Structural Change in Israel by Michael Bruno, Israel 1962.

also, Annual Report 1965 by the Bank of Israel.

ADJUSTMENTS

We have defined a systematic scheme based on the comparison of prices generated within the open system with actual or observed prices to establish the feasibility of using United States structural coefficients as a working model for Israel. We have determined that there is a substantial difference between United States coefficients and those that would be needed to explain Israel's economy. The question now arises as to whether we can, by some adjustment, cause these coefficients to more closely approximate those that existed in Israel. Our objective in this section then is to examine several possible transformations, theoretically and empirically.

A Review of Existing Methods of Adjustment

In a previous section we discussed the differences that may exist between two countries' input-output models. They were: (1) difference in price level and (2) difference in technology. We assume here that we have classified and aggregated in such a way that the composition of sector output is similar, otherwise this too would become a factor. Differences in prices will cause differences in coefficients derived from the flow table, even though physical input coefficients may be identical. Differences in technology can be identified as the difference in the interrelationships of sectors. These then are the factors that we must consider in any recommended adjustment.

Undoubtedly the most effective, but most costly, method of adjusting the United States coefficient matrix would be to make a detailed study of the sectors of the Israel economy, incorporating all available information into a precise adjustment on each coefficient. On a simpler level, several more or less mechanical methods may be adopted and, although perhaps not as accurate, should generate an inexpensive working model.

The first transformation we shall consider was devised, or at least suggested, by the Statistical Office of the United Nations.[19] It, like most other adjustments, is designed to correct the coefficients for changes over time. However, it is here assumed that any adjustment that is able to adjust one set of coefficients into another set based on new information, should be able to adjust for differences in structure between two countries.[20]

This method, which we shall refer to henceforth as the UN method, requires one independently observed coefficient matrix as a basis. The matrix is then revised systematically by multiplying each coefficient by three factors representing the sources of difference. The matrix is first corrected for any differences in the price level. This is done by multiplying each a_{ij} by the ratio of the two price indexes $\frac{P_i}{P_j}$ where P_i and P_j are ratios of Israel's price of 'i' to the United States price of 'j'. Secondly, technological differences in intermediate use of products is projected by multiplying each row by the ratio of Israel's total intermediate use of product 'i' to the United States intermediate use of 'i'. The third stage of revision takes account of the differences in the share

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[19] Ibid., p. 108.

[20] Whether or not this is a valid assumption will be discussed later in the paper, as we observe the predictive ability of the transforms.

of value added in total input, by multiplying each column in the matrix of coefficients by factors representing the ratio of Israel's intermediate input to the United States intermediate input for each sector.

Intuitively the UN transformation appears adequate to adjust the U.S. coefficients for factor differences between the two economies. As we take a closer look into the reasoning and the parameters needed, however, problems and inconsistencies arise. The parameters that are needed for the adjustment are: (1) some meaningful ratio of Israel's prices to those in the United States for each sectors' product, and (2) total output, final demand, and value added for each sector of both the Israel and U. S. economies. Estimates of total output, final demand, and value added may be obtained from the national income accounts, but price ratios pose a problem. Almost any method that could be suggested, short of a detailed price study of each country's sectors, would be open to criticism. Should producers' prices or market prices be used? Is an aggregate price for products that are not homogeneous obtainable without a detailed study? The validity of the price adjustment, then, depends on whether these and other questions can be resolved and accurate prices found.

Although a price study is beyond the scope of this study, it is necessary in order to use the UN method of adjustment, to devise some way to approximate a ratio of prices in Israel to those in the United States. In the method devised, import and export prices between the U. S. and Israel were weighted by volume of transactions to determine an effective exchange ratio for each sector.[21] Minor adjustments were necessary in certain sectors where imports or exports were few or non-existent.

The inconsistency in the UN method previously referred to has to do with the order in which the proposed adjustments should be carried out. It was suggested that all three adjustments be performed on the coefficient matrix; but it was found that a ratio of Israel/U. S. intermediates reflected the volume difference between the two countries. This ratio, then, has meaning only when applied to the flow matrix, since the coefficient matrix is on a per unit basis. Therefore the order of adjustment more logically would proceed as follows: (1) adjust for changes in technology, using the ratios of intermediate uses, on the flow matrix, and (2) calculate a new coefficient matrix and adjust for price differences.

Stating our own interpretation of the UN method in mathematical form, each row of the U. S. flow matrix is multiplied by the factor

$$\frac{\hat{X}_i^{(\text{Israel})} - \hat{Y}_i^{(\text{Israel})}}{X_i^{(\text{U. S.})} - Y_i^{(\text{U. S.})}} \qquad (22)$$

for the first stage of the technology transform where $\hat{X}_i^{(\text{Israel})}$ and $\hat{Y}_i^{(\text{Israel})}$ are the estimated output and final demand for each sector of Israel's economy, while $X_i^{(\text{U. S.})}$ and $Y_i^{(\text{U. S.})}$ are taken from the U. S. input-output table.

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[21] Michael Bruno, Interdependence, Resource Use and Structural Change in Israel, (Jerusalem, Israel, 1962), p. 110-145.

The second stage of the technology transform is to multiply each column or the altered U. S. flow matrix by the factor

$$\frac{\hat{X}_j^{(Israel)} - \hat{V}_j^{(Israel)}}{X_j^{(U.\ S.)} - V_j^{(U.\ S.)}} \qquad (23)$$

where $\hat{X}_j^{(Israel)}$ and $\hat{V}_j^{(Israel)}$ are estimated total inputs and value added for each sector while $X_j^{(U.\ S.)}$ and $V_j^{(U.\ S.)}$ are again taken from the U. S. flow table.

The final stage of adjustment, that of price differences, is made by multiplying each element of the new coefficient matrix by

$$\frac{P_i^{(Israel)}}{P_i^{(U.\ S.)}} \bigg/ \frac{P_j^{(Israel)}}{P_j^{(U.S.)}} \qquad (24)$$

If we assume that the preceding equations accomplish the purpose for which they are designed, then the one weakness apparent in the UN method would be in the availability of accurate price data. Its strong point, at least in a theoretical sense, would be that it attempts to adjust for the two main differences in the input-output tables, that of price and technology.

The next method of adjustment we shall review is one of several designed by T. I. Matuszewski, P. R. Petts, and J. A. Sawyer in an attempt to accurately update the 1949 Canadian input-output study to 1956.[22] This particular method turned out to be quite accurate in that study, and requires less information than some of the others presented.

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[22] T. I. Matuszewski, P. R. Petts, and J. A. Sawyer. "Periodical Adjustment of the System of Interindustry Relations, Canada 1949-1958" Econometrica Vol. 31 Nr. 1-2 (January-April, 1963) p. 13-15.

Following the notation used in their study we shall refer to this method as the "$\bar{d}$" adjustment. Altering it to our own use, the "$\bar{d}$" adjustment rests upon the hypothesis that all elements of a given row of the (I-A) matrix for the U. S. differ in the same proportion from those that exist in Israel. This hypothesis means that the utilization of a good differs in the same proportion in all sectors. In mathematical terms the new matrix (I-A)* is such that there exists a diagonal matrix $\bar{d}$ which satifies the relation:

$$(I-A)^* = (I-\bar{d}A) \tag{25}$$

The one demand placed on the new matrix is that it must describe correctly the relationship between production and final demand for the country for which the adjustment is effected. The diagonal elements of $\bar{d}$ would appear as:

$$d_{ii} = \frac{X_i^{(Israel)} - Y_i^{(Israel)}}{\Sigma_j a_{ij}^{(U.S.)} \; X_j^{(Israel)}} \tag{26}$$

In matrix notation we hypothesize that the relation

$$(I-\bar{d}A)\ X\ (Israel) = Y\ (Israel) \tag{27}$$

is satisfied. Solving for X we arrive at the relationship

$$X(Israel) = (I-\bar{d}A)^{-1}\ Y(Israel) \tag{28}$$

which serves as a prediction of Israel's output.

The parameters needed in this adjustment are X (Israel) and Y (Israel) which are estimated total output and final demand for Israel. The unique feature of the "$\bar{d}$" adjustment is that it changes the coefficient matrix in such a way that when it is multiplied by the estimated final demand it must yield the output that was used in the adjustment.

It is clearly seen that this adjustment is a type of technological transform.

The third and final adjustment to be reviewed here is one devised by Bartell C. Jensen for use in a study of the post-war Finnish economy.[23] The adjustment was used to 'backcast' Finland's 1956 input-output structure to 1952. We shall hereafter refer to this method as the "D" adjustment. The basis of the "D" adjustment is the duality relationship of quantity and price. In order to keep the proposed transformation consistent with input-output theory, it becomes necessary to 'close' the original system. For our study this is done by including value added and final demand in the processing sector of the U. S. coefficient matrix. Once closed the system's price and quantity relationships can be expressed as follows:

$$X(U.S.) = A(U.S.)\ X(U.S.) \tag{29}$$

$$P(U.S.) = A_t(U.S.)\ P(U.S.) \tag{30}$$

If changes in the structural makeup of the U. S. economy are reflected in the corresponding price structure it is inferred that the price structure logically forms a basis for effecting a transformation to compensate for such changes.[24] Restating this, if differences between the structural makeup of the U. S. and the Israel economy are reflected in their corresponding price structures then the price structure gives a basis for effecting a transformation to compensate for these differences.

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[23] Jensen, p. 105-107.

[24] _Ibid._, p. 106

Thus following Dr. Jensen's procedure, the desired transformation is derived in the following way:

$$P(U.S.) = D\ P(Israel) \tag{31}$$

where D is chosen to be the diagonal matrix so that each diagonal element is:

$$d_{ii} = \frac{P_i^{(U.S.)}}{P_i^{(Israel)}} \tag{32}$$

If we substitute (31) into (30) and rearrange the terms we get

$$P(Israel) = \left[D^{-1} A_t^{(U.S.)} D \right] P(Israel)$$

By transposing the expression in brackets, we arrive at the corresponding quantity problem:

$$X(Israel) = \left[D_t\ A^{(U.S.)} D_t^{-1} \right] X(Israel) \tag{33}$$

from which the desired transformation is implied, since

X(Israel) = A(Israel) X(Israel).

$$A(Israel) = D_t A^{(U.S.)}\ D_t^{-1} \tag{34}$$

As can be readily observed, this adjustment depends entirely on observed prices in the two countries. As was stated earlier these are difficult parameters to obtain and inaccurate price data obviously would render this adjustment void. While such a transform proves invaluable in projecting coefficients over periods of time within one country, it is questionable whether it can be expected to account for all the differences which may exist between two countries.

Accuracy of the Transformed Coefficients

We have briefly reviewed three methods of adjustment to determine how they may be used to transform U. S. coefficients to more closely approximate those that exist in Israel. Inherent in the analysis is the necessity to test the various methods to see which adjustment most accurately generates a working input-output model for Israel. One method that could be used to test the various adjustments is implied from equation (7)

$$X = (I-A)^{-1} Y$$

By using estimated or observed final demand and total output for each sector of the Israel economy we can test the predictive power of any transformed or untransformed coefficient matrix. Post multiplying the given structural matrix by Israel's vector of final demand we get a corresponding vector of outputs which can be compared with the estimated outputs.

Since the main use of the input-output table is to predict what changes in output are required with a given change in final demand, we shall proceed to follow this method as a basis for determining accuracy of the transformed coefficients. We are, in effect, saying then that the closer the transformed coefficients can predict Israel's observed output the more accurate the adjustment.

A comparison of the output levels observed and those generated on the basis of the untransformed and each of the transformed U. S. coefficient matrices is presented in Table 3. The U. N. adjustment was divided into three separate adjustments to allow a better analysis. UN (P)

Table 3. Comparison of observed Israel output levels and those projected on the basis of the transformed and untransformed United States coefficient matrix.

Sector No.	Observed output	$\bar{d}$ transform	D transform	UN(P) transform	UN(T) transform	UN(PT) transform	Untransformed
01	766,330	766,338	1,219,022	936,036	860,590	786,611	1,041,260
02	434,187	434,193	492,639	560,045	451,510	475,124	517,773
03	31,327	31,325	201,286	85,321	17,892	14,429	118,807
04	371,015	371,011	407,578	415,532	385,272	392,935	409,818
05	139,491	139,511	142,658	186,900	142,292	161,048	160,020
06	111,069	111,063	171,590	230,596	101,352	119,834	193,264
07	80,103	80,105	83,488	84,731	85,520	86,859	83,977
08	51,268	51,270	120,319	106,996	46,312	45,501	111,533
09	141,222	141,224	150,647	219,659	126,215	154,584	176,576
10	65,963	65,959	118,636	125,725	69,368	82,014	104,475
11	106,403	106,420	94,248	87,505	110,492	103,612	89,306
12	39,336	39,339	191,590	223,749	24,656	25,809	202,878
13	142,744	142,734	195,427	232,288	134,904	142,096	209,446
14	298,065	298,072	472,642	516,829	259,510	268,530	485,414
15	561,965	561,973	620,836	692,766	562,359	565,234	647,597
16	1,558,886	1,558,899	2,132,081	1,649,544	1,543,176	1,436,387	1,695,896
17	436,225	436,230	424,517	303,829	432,116	430,704	407,489

Source: Calculated by the author from the United States coefficient matrix.

represents the UN price adjustment alone, UN (T) the technological adjustment, and UN (PT) both price and technology combined. Deviations of the generated output levels from the observed are contained in Table 4.

Evidence presented in Tables 3 and 4 indicate that for the particular problem considered, the deviations between Israel's observed output levels and output levels generated on the basis of adjustments "$\bar{d}$", UN(T) and UN(PT) are obviously less than the deviations between observed and the U. S. untransformed matrix. This indicates that these adjustments have made some improvement in our ability to predict Israel's output. Adjustments "D" and UN(P), the two price adjustments, show sporadic improvements but in the same light go to opposite extremes. It is not apparent whether this result is an effect of inaccurate price data or the inability of the price adjustment to reflect differences between the two economies. It is probable, however, that an investigation would reveal it to be mainly the former.

Without doubt, the "$\bar{d}$" adjustment presents itself as the best adjustment for our purpose. It is assumed that the small difference between observed output and output generated on the basis of the transformed U. S. matrix, using "$\bar{d}$", is due only to rounding errors. The adjustment then, has accomplished what was called for; that is, to effectively change the U. S. coefficient matrix that it may be used to predict changes in the Israel economy.

It may be of interest to know the probability at which output levels based on the transformed matrices will more closely approximate the observed output levels than output levels based on the untransformed

Table 4. Comparison of deviations between observed Israel output levels and those projected on the basis of the transformed and untransformed United States coefficient matrix.

Sector number	Untrans-formed $(X_i - X_i)$	$\bar{d}$ $(X'_i - \bar{X}_i)$	D $(X'_i - \bar{X}_i)$	UN(F) $(X'_i - \bar{X}_i)$	UN(T) $(X'_i - X_i)$	UN(TP) $(X'_i - \bar{X}_i)$
01	274,930	8	452,692	169,706	94,260	20,281
02	83,586	6	58,452	125,858	17,323	40,937
03	87,480	-2	169,959	53,994	-13,435	-16,898
04	38,803	-4	36,563	44,517	14,257	21,920
05	20,528	19	3,166	47,408	2,800	21,556
06	82,195	-6	60,521	119,527	-9,717	8,765
07	3,874	2	3,385	4,628	5,417	6,756
08	60,265	2	69,051	55,728	-4,956	-5,767
09	35,354	2	9,425	78,437	-15,007	13,362
10	38,512	-4	52,673	59,762	3,405	16,051
11	-17,097	17	-12,155	-18,898	4,089	-2,791
12	163,542	3	152,254	184,413	-14,680	-13,527
13	66,702	-10	52,683	89,544	-7,840	-648
14	187,349	7	174,577	218,764	-38,555	-29,535
15	85,632	8	58,871	130,801	394	3,269
16	137,010	13	573,195	90,658	-15,710	-122,499
17	-28,736	5	-11,708	-132,396	-4,109	-5,521

Source: Calculated by the author from Table 3.

matrix. Since we have shown that "$\bar{d}$" generates output equivalent to that of Israels' observed output, we shall exclude it from this analysis. Therefore, a simple test will be made to find out at what probability level the improvement, made by the other four transformations, is significant. Since we do not know the distribution of the output levels, one approach to the problem is to use a 'distribution-free' or 'non-parametric' method which requires no assumptions about the population.[25] The one which we shall use in this case is the 'sign test'.

In the sign test a plus or minus is given to each of 17 paired sample values, depending on whether the absolute value of the untransformed output level is greater or less than the absolute value of the untransformed output level for each sector. If there is no improvement made by the adjustment, there should be an excess of plus signs and on the other hand where improvement was great an excess of minus signs. Table 5 shows the results of the analysis.

Under these assumptions we can test the hypothesis that any given set of output levels generated by an adjustment is from the same population as the output levels based on the untransformed matrix. Consider the null hypothesis:

$$H_o : \theta = \theta_o \tag{35}$$

and the alternate hypothesis

$$H_A : \theta \leq \theta_o \tag{36}$$

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[25] Jerome C.R. Li, Statistical Inference, Vol. 1 (Ann Arbor, Michigan:Edward Brothers, Inc., 1964) p. 527.

Table 5. Comparison of improvements made by each transformation using the 'sign test'.

Sector No.	D	UN(P)	UN(T)	UN(PT)
01	+	-	-	-
02	-	+	-	-
03	+	-	-	-
04	-	+	-	-
05	-	+	-	+
06	-	+	-	-
07	-	+	+	+
08	+	-	-	-
09	-	+	-	-
10	+	+	-	-
11	-	+	-	-
12	-	+	-	-
13	-	+	-	-
14	-	+	-	-
15	-	+	-	-
16	+	-	-	-
17	-	+	-	-
Total	5+ 12-	13+ 4-	1+ 16-	2+ 15-

where O is the parameter of the binomial population based on the actual number of plus signs obtained in the n observations. When dealing with composite alternatives, the 'likelihood ratio technique' provides a critical region criterion for testing the null hypothesis.[26] The critical region for testing the $H_o : \theta_o = \theta_o$ against the alternative that $\theta \geq \theta_o$ is

$$x \geq k\alpha \tag{37}$$

where $k\alpha$ is the smallest integer for which

$$\sum_{y=kd}^{n} b(y;n,\theta_o) \leq \alpha$$

[26] John E. Fruend, Mathematical Statistics, (Englewood Cliffs, New Jersey: Prentice Hall, 1962) p. 276.

and $b(y;n,\theta_o)$ is the probability of getting y successes in n trials with $\theta = \theta_o$. The probability of committing a Type I error with this criterion is thus as close as possible to α without exceeding it.

We shall use a significance level of $\alpha = .05$ to test the $H_o : \theta = .50$ against the alternative that $\theta \leq .50$. If our test is based on 17 trials, we find from the appropriate binomial probabilities table that k (.05) = 4. Using this criterion we determine that the UN(T) adjustment and UN(PT) adjustment have made significant improvements at the .05 level while the improvements made by the "D" adjustment becomes significant at the .10 level.

We may conclude then that although there is a substantial difference between the U.S. and Israel's internal economic structure, that this difference can be lessened significantly by several of the proposed transforms. The most effective transform, as defined by ability to predict, is the type "$\bar{d}$". The "$\bar{d}$" adjustment having been performed properly, with good estimates of the parameters required, will accurately predict the output required for given changes in the Israel economy. This could be considered as having provided a working model for a relatively underdeveloped economy from a developed economy's model. With the relatively few parameters required the adjustment could be effected at the minimum cost. Our initial objective then has been accomplished.

LITERATURE CITED

Bank of Israel, Annual Report 1965. Jerusalem, Israel. 1966.

Bruno, Michael. Interdependence, resource use and structural change in Israel. Jerusalem: Jerusalem Post Press. 1962.

Christ, Carl F. "A review of input-output analysis," Input-Output Analysis: An appraisal. Studies on Income and Wealth Vol. 18 Princeton: Princeton University Press. 1955.

Dorfman, Robert, Paul A. Samuelson, Robert M. Solow. Linear programming and economic analysis. New York: McGraw-Hill Company, Inc. 1958.

Fruend, John E. Mathematical statistics. Englewood Cliffs, New Jersey: Prentice Hall. 1962.

Ghosh, A. Experiments with input-output models. Cambridge, England: The Cambridge University Press. 1964.

Jensen, Bartell C. The impact of reparations on the Post-War Finnish economy an imput-output study. Homewood, Illinois: Irwin Company, 1966.

Leontief, Wassily W. Studies in the structure of the American economy. New York: Oxford University Press. 1953.

Leontief, Wassily W. The structure of American economy, 1919-1938. New York: Oxford University Press. 1953.

Leontief, Wassily W. "The structure of development," Scientific American Vol. 209, Sept. 1963. p. 148-166.

Li, Jerome C. R. Statistical inference. Vol. 1, Ann Arbor, Michigan: Edward Brothers, Inc. 1964.

Matuszewski, T. I., P. R. Petts, and J. A. Sawyer. "Periodical adjustment of the system of interindustry relations, Canada 1949-1958", Econometrica Vol. 31, Nr. 1-2, Jan.-April 1963.

Miernyk, William H. A primer of input-output economics. Boston, Mass.: Northeastern University. 1957.

Miernyk, William H. The elements of input-output analysis. New York: Random House. 1965.

Patinkin, Don. The Israel economy the first decade. Jerusalem: Jerusalem Post Press. 1963.

Scientific Conference on Statistical Problems. Input-output tables: their compilation and use. Budapest: Publishing House of the Hungarian Academy of Sciences. 1962.

Stone, Richard (ed.). Input-output relationships 1954-1966, a program for growth. Cambridge, England: Chapman & Hall. 1963.

United Nations. Problems of input-output tables and analysis, studies in methods. Series F, Nr. 14. New York: United Nations. 1966.

U. S. Department of Labor. Wholesale prices and price indexes 1958. Bulletin Nr. 1257. Washington, D. C.: U. S. Government Printing Office, July, 1959.

APPENDIXES

Appendix A

Sector Classification

Table 6 was compiled by the author to show the aggregation of the United States and Israeli input-output tables to a common base for comparative purposes. The new sector in this table refers to the aggregated input-output tables in Appendix B. The contents of the sectors have been enumerated where deemed necessary for comparative purposes.

The sectors listed under Israel are from the Israeli input-output tables for 1958 (25 x 25) found in Interdependence, Resource Use and Structural Change in Israel, by Michael Bruno.

The sectors listed under United States are from the United States input-output tables for 1958 (86 x 86) found in Survey of Current Business, September 1965, by the National Economics Division Staff.

Table 6. Sector classification

New sector		Israel		United States
01 Agri-culture	01	Field crops	2	Other agricultural products
		-cereals & legumes		-food grains
		-roughage		-feed grains
		-cotton		-cotton
		-peanuts		-tobacco
		-tobacco		-oil bearing crops
		-sugar beets		-vegetables
		-oilseeds		-fruits & nuts
				-legumes
	03	Citrus		-miscellaneous crops
	02	Livestock	1	Livestock & livestock prod.
		-cattle		-meat animals
		-goats		-hides
		-beehives		-wool
		-other livestock		-poultry & eggs
		-fishing		-butterfat & milk
		-poultry & eggs		-bees & honey
				-rabbits
				-dogs
				-fur bearing animals
				-farm rental income
	04	Other agriculture	3	Forestry & fishery products
		-melons		-standing timber
		-vegetables		-Christmas trees
		-potatoes		-misc. forest products
		-other fruits		-products of fisheries
		-grapes		
		-bananas	4	Agricultural, forestry & fishing services
		-olives		
				-cotton ginning
		-forestry		-fruit picking
		-crude rubber		-crop dusting
		-coffee beans		-other agri. services
		-cocoa		-animal breeding
		-agri. services		-forestry services
		-other agriculture		-fish & chicken hatcheries
02 Food	06	Food	14	Food & kindred products
		-meat processing		-fresh & prepared meats
		-fish processing		-feed grains
		-dairy products		-bakery products

Table 6. Continued

New Sector		Israel		United States
		-margarine & oil -flour mills -backeries -cakes & biscuits -maxot manufacture		-frozen foods -dairy products -dried fruits & vegetables -other manufactured foods
		-noodles & related products -fruit & vegetable canning -sugar and sweets -drinks & ice -tobacco products	15	Tobacco manufactures -tobacco (stemmed, dried, etc.)
03 Mining	05	Mining -metal mining	5	Iron and ferroalloy ores mining
		-stone & clay quarrying -sand pits -oil prospecting	6	Nonferrous metal ores mining
		-crude oil production	7	Coal mining
		-salt & potash -diamonds (imp) -coal & coke (imp)	8	Crude petroleum & natural gas
		-non-metalic minerals	9	Stone, clay mining & quarrying
			10	Chemical & fertilizer minerals
04 Textiles & apparel	07	Textiles & apparel -cotton spinning -wool spinning	16	Broad & narrow fabrics, yarn, & thread mills
		-fabrics, weaving, & dyeing -knitting & twine	17	Misc. textile goods & floor coverings
		-apparel & textile products	18	Apparel
			19	Misc. fabricated textile products

Table 6. Continued

New Sector		Israel		United States
05	Wood & carpentry	08	Wood & carpentry -basic wood products -wood & cork -joinery -other carpentry -metal furniture -upholstery	20 Lumber & wood products 21 Wooden containers 22 Household furniture 23 Other furniture & fixtures
06	Paper & publishing	09	Paper, printing, & publishing -basic paper -paper & paper products -printing & pub.	24 Paper & allied products 25 Paperboard containers & boxes 26 Printing & publishing
07	Leather products	10	Leather & leather products -tanneries -footwear -shoe repair -leather products	33 Leather tanning & industrial leather products 34 Footwear & other leather products
08	Rubber & plastic products	11	Rubber & plastic products	28 Plastics & synthetic materials 32 Rubber & miscellaneous plastic products
09	Chemicals	12	Chemicals, oil & soap -basic chemicals -paints -pharmaceuticals -insecticides -explosives -chemical products -oil & soap	27 Chemicals & selected products -basic chemicals -fertilizer -misc. derivatives 29 Drugs, cleaning & toilet preparations 30 Paints and allied products
10	Oil refineries	13	Oil refineries	31 Petroleum refining & related industries

Table 6. Continued

New Sector	Israel	United States
11 Glass, ceramics & cement	14 Glass, ceramics, & cement	35 Glass & glass products 36 Stone & clay products
12 Basic metals	16 Basic metals -iron & steel -non-ferrous metals	37 Primary iron & steel man. 38 Primary non-ferrous metals man.
13 Metal products	17 Metal products -plumbing fixtures -tin & wire -kitchen ware -structural metal -other metal prod.	39 Metal containers 40 Heating, plumbing & fab. structural metal products 41 Screw mach. products, bolts, nuts & metal stamping 42 Other fab. metal products
14 Mach. & appl.	18 Mach., electrical appl. & vehicles -industrial mach. -agricultural mach. -pumps & pumping equipment -household equip. -generators & transformers -elec. appliances -batteries & accumulators -radios & phonographs -communication equip. -cars & motorcycles -repair of autos -repair of railroad equipment -transport equip. -ship bldg. & rep. -aircraft bldg. & repair -scientific & precision equipment -optical equip. -jewelry & watches	43 Engines & turbines 44 Farm machinery & equipment 45 Construction, mining, oil field mach. & equip. 46 Material handling mach. & equipment 47 Metal working mach. & equip. 48 Special industry mach. & equipment 49 General industrial mach. & equipment 50 Machine shop products 51 Office, computing & accounting machines 52 Service industries mach. 53 Electric transmission & distribution equip. & elec. industrial apparatus 54 Household appliances 55 Elec. lighting & wiring equipment 56 Radio, TV, and communication equipment 57 Electronic components & accessories 58 Misc. elec. machinery 59 Motor vehicles & equip.

Table 6. Continued

New Sector		Israel		United States	
			-office equipment	60	Aircraft & parts
			-other manufacturing	61	Other trans. equipment
				62	Prof. scientific & controlling instruments & supplies
		15	Polishing diamonds		
				63	Optical, ophthalmic & photographic equip. & supplies
				64	Misc. manufacturing
				13	Ordinance & accessories
				75	Automobile repair & serv.
15	Const. & housing	19	Construction & housing	11	New construction
				12	Maintenance and rep. const.
16	Services	20	Electric power	66	Communications, except radio & TV broadcasting
		21	Water	67	Radio & TV broadcasting
				68	Electric, gas, water & sanitary services
		25	Services & trade		
				69	Wholesale & retail trade
		24	Other communication services	70	Finances and insurance
				71	Real estate & rental
				72	Hotels & lodging places personal & repair services
				73	Business services
				74	Research & development
				76	Amusements
				77	Medical, educational serv. & non-profit organ.
				78	Fed. Gov. enterprises
				79	State & local government enterprises
				81	Business travel, entertainment & gifts
				82	Office supplies
				83	Scrap, used & second hand goods.
17	Transportation	22	Inland transportation	65	Transportation & warehousing
		23	Shipping & aviation		

Note: Special industries in the United States tables were deleted as there was no interindustrial transactions in either rows or columns for these sectors. This included sectors 84, 85, and 86.

Appendix B

Aggregated Input-Output Tables

Tables 7, 8, and 9 were compiled by the author from 1958 Israeli input-output tables (25 x 25) found in _Interdependence, Resource Use and Structural Change in Israel_, by Michael Bruno.

Tables 10, 11, and 12 were compiled by the author from 1958 United States input-output tables (86 x 86) found in _Survey of Current Business_, September 1965, by the National Economics Division Staff.

Table 7. Israel interindustry transactions, 1958

		01	02	03	04	05	06	07	08	09	10
01	Agriculture	104,784	134,739	162	6,794	286	7	--	--	3,254	--
02	Food	18,402	66,106	139	1,813	81	104	817	--	1,157	--
03	Mining	254	514	247	34	--	2	37	33	3,566	2,742
04	Textiles & apparel	1,643	187	32	144,625	3,742	674	1,591	3,133	490	--
05	Wood & carpentry	7,112	343	7	320	21,408	59	326	26	133	--
06	Paper & publishing	1,236	4,037	35	901	10	32,363	232	217	1,221	--
07	Leather products	--	2	2	136	--	--	17,892	57	--	--
08	Rubber & plastics	--	200	3	372	1,283	3	161	2,115	465	6
09	Chemicals	47,654	16,699	554	2,091	911	1,926	764	787	9,429	980
10	Oil refineries	4,143	3,022	1,285	796	468	414	64	265	2,815	928
11	Glass & ceramics	--	2,075	253	9	185	7	12	2	569	44
12	Basic metals	5,155	456	683	47	399	19	--	19	3	103
13	Metal products	3,443	4,355	300	63	3,920	66	540	319	1,319	21
14	Machinery & appliances	9,874	931	849	1,560	351	236	109	168	283	402
15	Construction & housing	--	--	--	--	--	--	--	--	--	--
16	Services	58,113	39,982	7,137	23,577	15,411	15,973	6,477	6,583	23,513	7,472
17	Transportation	21,569	5,402	881	1,575	1,009	776	173	307	3,100	126
Total intermediate		283,382	279,050	12,569	184,713	49,464	52,629	29,195	14,031	51,317	12,824
Value added		482,948	155,137	18,758	186,302	90,028	58,440	50,908	37,237	89,905	53,139
Total		766,330	434,187	31,327	371,015	139,492	111,069	80,103	51,268	141,222	65,963

Table 7. Continued

		11	12	13	14	15	16	17	Total intermed.	Final demand	Total
01	Agriculture	250	--	912	601	53	17	--	251,859	514,471	766,330
02	Food	6	--	16	98	--	2,454	--	91,193	342,994	434,187
03	Mining	3,211	1,797	94	91	12,986	84	--	25,692	5,635	31,327
04	Textiles & apparel	67	10	195	1,174	--	1,783	803	160,149	210,866	371,015
05	Wood & carpentry	159	2	1,020	1,773	37,047	3,421	71	73,227	66,265	139,492
06	Paper & publishing	1,434	28	346	1,702	187	32,809	193	76,951	34,118	111,069
07	Leather products	--	--	--	281	1	--	140	18,511	61,592	80,103
08	Rubber & plastics	93	4	609	2,436	65	5,965	8,078	21,858	29,410	51,268
09	Chemicals	486	356	2,029	2,221	7,707	3,317	77	97,988	43,234	141,222
10	Oil refineries	2,952	656	682	469	2,111	11,088	15,010	47,168	18,795	65,963
11	Glass & ceramics	9,264	243	350	1,448	76,738	3,549	2	94,750	11,653	106,403
12	Basic metals	112	756	6,687	5,224	19,099	802	3	39,567	-231	39,336
13	Metal products	1,810	859	14,032	9,038	27,196	6,863	206	74,350	68,394	142,744
14	Mach. & appliances	1,066	1,105	5,895	26,674	10,232	23,153	26,259	109,147	188,918	298,065
15	Const. & housing	--	--	--	--	--	4,700	--	4,700	557,265	561,965
16	Services	13,521	3,866	15,379	28,262	47,574	323,397	45,732	681,969	876,917	1,558,886
17	Transportation	5,579	683	1,182	1,636	34,669	115,976	5,689	200,332	235,893	436,225
Total intermediate		40,010	10,365	49,428	83,128	275,665	539,378	102,263	2,069,411	3,266,189	5,335,600
Value added		66,393	28,971	93,316	214,937	286,300	1,019,508	333,962	3,266,189	xxx	xxx
Total		106,403	39,336	142,744	298,065	561,965	1,558,886	436,225	5,335,600	xxx	xxx

Table 8. Israel direct requirements per dollar of gross output, 1958

		01	02	03	04	05	06	07	08	09
01	Agriculture	.13673	.31032	.00517	.01831	.00205	.00006	--	--	.02304
02	Food	.02401	.15225	.00444	.00489	.00058	.00094	.01020	--	.00819
03	Mining	.00033	.00118	.00788	.00009	--	.00002	.00046	.00064	.02525
04	Textiles and apparel	.00214	.00043	.00102	.38981	.02683	.00607	.01986	.06111	.00347
05	Wood & carpentry	.00928	.00079	.00022	.00086	.15347	.00053	.00407	.00051	.00094
06	Paper & publishing	.00161	.00930	.00112	.00243	.00007	.29138	.00290	.00423	.00865
07	Leather products	--	--	.00006	.00037	--	--	.22336	.00111	--
08	Rubber & plastics	--	.00046	.00010	.00100	.00920	.00003	.00201	.04125	.00329
09	Chemicals	.06218	.03846	.01768	.00564	.00653	.01734	.00954	.01535	.06677
10	Oil refineries	.00541	.00696	.04102	.00215	.00336	.00373	.00080	.00517	.01993
11	Glass & ceramics	--	.00478	.00808	.00002	.00133	.00006	.00015	.00004	.00403
12	Basic metals	.00673	.00105	.02180	.00013	.00286	.00017	--	.00037	.00002
13	Metal products	.00449	.01003	.00958	.00017	.02810	.00059	.00674	.00622	.00934
14	Machinery & appliances	.01288	.00214	.02710	.00420	.00252	.00212	.00136	.00328	.00200
15	Construction & housing	--	--	--	--	--	--	--	--	--
16	Services	.07583	.09208	.22782	.06355	.11048	.14381	.08086	.12840	.16650
17	Transportation	.02815	.01244	.02812	.00425	.00723	.00699	.00216	.00599	.02195
Value added		.63023	.35730	.59878	.50214	.64540	.52616	.63553	.72632	.63662
Total		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 8. Continued

		10	11	12	13	14	15	16	17
01	Agriculture	--	.00235	--	.00639	.00202	.00009	.00001	--
02	Food	--	.00006	--	.00011	.00033	--	.00157	--
03	Mining	.04157	.03018	.04568	.00066	.00031	.02311	.00005	
04	Textiles & apparel	--	.00063	.00025	.00137	.00394	--	.00114	.00184
05	Wood & carpentry	--	.00149	.00005	.00715	.00595	.06592	.00219	.00016
06	Paper & publishing	--	.01348	.00071	.00242	.00571	.00033	.02105	.00042
07	Leather products	--	--	--	--	.00094	--	--	.00032
08	Rubber & plastic	.00009	.00087	.00010	.00427	.00817	.00012	.00383	.01852
09	Chemicals	.01486	..00457	.00905	.01421	.00745	.01371	.00213	.00018
10	Oil refineries	.01407	.02774	.01668	.00478	.00157	.00376	.00711	.03441
11	Glass & ceramics	.00067	.08707	.06618	.00245	.00486	.13655	.00228	.00001
12	Basic metals	.00156	.00105	.01922	.04685	.01753	.03399	.00051	.00001
13	Metal products	.00032	.01701	.02184	.09830	.03032	.04839	.00440	.00047
14	Machinery & appliances	.00609	.01002	.02809	.04130	.08949	.01821	.01485	.06020
15	Construction & housing	--	--	--	--	--	--	.00302	--
16	Services	.11328	.12707	.09828	.10774	.09482	.08466	.20745	.10484
17	Transportation	.00191	.05243	.01736	.00828	.00549	.06169	.07440	.01304
Value added		.80559	.62398	.73650	.65373	.72111	.50946	.65400	.76557
Total		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 9. Israel direct and indirect requirements per dollar of final demand

		01	02	03	04	05	06	07	08
01	Agriculture	1.17322	.43135	.00930	.03917	.00519	.00213	.00736	.00332
02	Food	.03438	1.19308	.00644	.01101	.00174	.00251	.01640	.00129
03	Mining	.00347	.00482	1.01204	.00087	.00098	.00124	.00126	.00164
04	Textiles & apparel	.00613	.00437	.00347	1.64002	.05401	.01526	.04323	.10549
05	Wood & carpentry	.01368	.00687	.00178	.00266	1.18237	.00184	.00692	.00150
06	Paper & publishing	.00895	.02455	.01236	.01058	.00640	1.41990	.01043	.01271
07	Leather products	.00005	.00005	.00016	.00081	.00007	.00004	1.28764	.00156
08	Rubber & plastic	.00221	.00294	.00303	.00289	.01292	.00199	.00388	1.04454
09	Chemicals	.08096	.07987	.02275	.01385	.01066	.02772	.01556	.01920
10	Oil refineries	.01161	.01639	.04790	.00609	.00711	.00923	.00347	.00851
11	Glass & ceramics	.00126	.00749	.01052	.00069	.00255	.00113	.00090	.00081
12	Basic metals	.00919	.00574	.02432	.00095	.00568	.00082	.00088	.00121
13	Metal products	.00938	.01854	.01506	.00210	.03861	.00313	.01129	.00889
14	Machinery & appliances	.02351	.01723	.04130	.01217	.01039	.01034	.00644	.00955
15	Construction & housing	.00046	.00066	.00099	.00045	.00057	.00083	.00045	.00058
16	Services	.15212	.21941	.32665	.14808	.18752	.27368	.14972	.19218
17	Transportation	.04796	.04688	.05594	.02011	.02425	.03175	.01547	.02221
	Totals	1.57854	2.08024	1.59401	1.91250	1.55102	1.80354	1.58130	1.43519

Table 9. Continued

		09	10	11	12	13	14	15	16	17
01	Agriculture	.03357	.00108	.00406	.00126	.00944	.00379	.00240	.00131	.00056
02	Food	.01206	.00076	.00092	.00075	.00103	.00104	.00090	.00257	.00042
03	Mining	.02889	.04335	.03536	.04866	.00434	.00209	.03094	.00107	.00179
04	Textiles & apparel	.00795	.00084	.00288	.00162	.00472	.00930	.00536	.00427	.00612
05	Wood & carpentry	.00256	.00064	.00300	.00110	.01048	.00863	.07955	.00400	.00121
06	Paper & publishing	.02149	.00546	.02783	.00672	.01016	.01405	.00994	.03897	.00606
07	Leather products	.00005	.00003	.00007	.00007	.00009	.00137	.00009	.00009	.00054
08	Rubber & plastic	.00584	.00128	.00371	.00193	.00686	.01073	.00416	.00742	.02110
09	Chemicals	1.07679	.01784	.00865	.01265	.01971	.01100	.01939	.00474	.00241
10	Oil refineries	.02716	1.01840	.03712	.02240	.00951	.00480	.01560	.01339	.03741
11	Glass & ceramics	.00598	.00180	1.09662	.00820	.00436	.00668	.15126	.00406	.00093
12	Basic metals	.00201	.00304	.00373	1.02288	.05457	.02183	.03955	.00178	.00169
13	Metal products	.01381	.00243	.02334	.02781	1.11397	.03901	.06276	.00795	.00402
14	Machinery & appliances	.01209	.01226	.02333	.03944	.05740	1.10494	.03608	.02847	.07109
15	Construction & housing	.00078	.00051	.00065	.00049	.00055	.00047	1.00057	.00391	.00047
16	Services	.25960	.16803	.21655	.16295	.18179	.15437	.19012	1.29342	.15688
17	Transportation	.04633	.01663	.07667	.03303	.02567	.01958	.08846	.09882	1.02598
	Totals	1.55696	1.29438	1.56449	1.39196	1.51465	1.41368	1.73713	1.51624	1.33868

Table 10. United States interinudstry transactions, 1958

	01	02	03	04	05	06	07	08	09	10
01 Agriculture	15,578	22,467	--	1,501	998	--	53	--	35	--
02 Food	3,000	11,744	--	39	28	76	209	18	390	11
03 Mining	103	53	1,129	20	4	125	3	47	577	9,365
04 Textiles & apparel	107	149	6	12,597	283	127	140	632	44	4
05 Wood & carpentry	104	112	32	20	3,268	678	31	15	43	2
06 Paper & publishing	55	1,530	38	322	238	7,911	88	320	544	92
07 Leather products	5	--	--	57	8	3	1,036	13	--	--
08 Rubber & plastic	188	273	91	1,635	260	293	194	1,378	638	22
09 Chemicals	1,210	452	191	247	199	561	88	1,857	4,255	579
10 Oil refineries	968	287	150	38	89	157	5	73	738	1,243
11 Glass & ceramics	29	609	118	29	158	56	15	71	217	37
12 Basic metals	2	44	166	11	294	33	1	29	402	3
13 Metal products	120	1,802	98	37	407	175	28	118	419	315
14 Machinery & appliances	432	373	581	433	253	293	31	160	257	38
15 Construction & housing	613	233	10	15	17	99	--	33	9	25
16 Services	6,232	6,106	3,083	2,448	1,267	3,524	348	991	2,960	1,176
17 Transportation	848	2,697	522	485	544	697	59	280	588	907
Total intermediate	29,594	48,931	6,215	19,934	8,315	14,808	2,329	6,035	12,116	13,819
Value added	23,138	22,180	12,135	10,035	5,371	11,992	1,705	5,115	8,504	4,178
Total	52,732	71,111	18,350	29,969	13,686	26,800	4,034	11,150	20,620	17,997

Table 10. Continued

		11	12	13	14	15	16	17	Total inter.	Final demand	Total
01	Agriculture	4	--	--	17	237	3,083	37	44,010	8,722	52,732
02	Food	6	8	--	22	17	3,153	100	18,821	52,290	71,111
03	Mining	623	2,463	9	67	756	2,058	29	17,431	919	18,350
04	Textiles & apparel	22	45	35	630	6	876	42	15,745	14,224	29,969
05	Wood & carpentry	74	35	145	603	4,215	233	26	9,636	4,050	13,686
06	Paper & publishing	428	136	225	1,051	400	9,246	117	22,741	4,059	26,800
07	Leather products	1	--	5	100	--	74	3	1,305	2,729	4,034
08	Rubber & plastic	169	197	138	2,366	377	631	257	9,107	2,043	11,150
09	Chemicals	302	351	190	780	1,514	1,465	87	14,328	6,292	20,620
10	Oil refineries	92	189	101	304	1,361	1,848	1,518	9,161	8,836	17,997
11	Glass & ceramics	1,087	347	165	1,161	4,800	356	9	9,264	545	9,809
12	Basic metals	51	7,474	6,126	9,544	3,650	429	87	28,346	1,144	29,490
13	Metal products	126	714	1,289	4,754	7,103	633	57	18,195	2,219	20,414
14	Machinery & appliances	132	926	1,511	28,793	3,371	10,416	1,746	49,746	59,959	109,705
15	Construction & housing	4	132	14	278	8	9,715	1,249	12,454	56,836	69,290
16	Services	1,146	3,633	1,753	11,147	10,432	63,688	4,684	124,618	178,700	303,318
17	Transportation	512	1,238	351	1,492	2,105	5,220	2,107	20,652	13,463	34,115
Total intermediate		4,779	17,888	12,057	63,109	40,352	113,124	12,155	425,559		
Value added		5,030	11,602	8,357	46,596	28,938	190,194	21,960		417,030	
Total		9,809	29,490	20,414	109,705	69,290	303,318	34,115			842,590

Table 11. United States direct requirements per dollar of gross output, 1958

		01	02	03	04	05	06	07	08	09
01	Agriculture	.29563	.31738	--	.05017	.07291	--	.01235	--	.00168
02	Food	.05693	.16590	--	.00130	.00205	.00283	.04871	.00161	.01876
03	Mining	.00195	.00075	.06115	.00067	.00029	.00465	.00070	.00422	.02776
04	Textiles & apparel	.00203	.00210	.00033	.42101	.02067	.00472	.03263	.05669	.00212
05	Wood & carpentry	.00197	.00158	.00173	.00067	.23873	.02520	.00722	.00135	.00207
06	Paper & publishing	.00104	.02161	.00206	.01076	.01739	.29408	.02051	.02870	.02617
07	Leather products	.00010	--	--	.00191	.00058	.00011	.24144	.00117	--
08	Rubber & plastic	.00357	.00386	.00493	.05464	.01899	.01089	.04521	.12361	.03070
09	Chemicals	.02296	.00639	.01035	.00826	.01454	.02085	.02051	.16658	.20471
10	Oil refineries	.01837	.00405	.00812	.00127	.00650	.00584	.00117	.00655	.03551
11	Glass & ceramics	.00055	.00860	.00639	.00097	.01154	.00208	.00350	.00637	.01044
12	Basic metals	.00004	.00062	.00899	.00037	.02148	.00123	.00023	.00260	.01934
13	Metal products	.00228	.02546	.00531	.00124	.02973	.00651	.00653	.01058	.02016
14	Machinery & appliances	.00820	.00527	.03147	.01447	.01848	.01089	.00722	.01435	.01236
15	Construction & housing	.01163	.00329	.00054	.00050	.00124	.00368	--	.00296	.00043
16	Services	.11827	.08626	.16698	.08182	.09256	.13100	.08110	.08889	.14241
17	Transportation	.01609	.03810	.02827	.01621	.03974	.02591	.01375	.02512	.02829
	Adjustment	-.00070	-.00455	.00612	-.00158	+.00022	+.00375	+.05989	-.00018	+.00794
	Value added	.43909	.31333	.65726	.33538	.39236	.44578	.39734	.45883	.40914
	Total	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 11. Continued

		10	11	12	13	14	15	16	17
01	Agriculture	--	.00041	--	--	.00016	.00342	.01016	.00109
02	Food	.00061	.00061	.00027	--	.00020	.00025	.01039	.00294
03	Mining	.52054	.06324	.08202	.00044	.00061	.01090	.00678	.00085
04	Textiles & apparel	.00022	.00223	.00150	.00172	.00576	.00009	.00289	.00123
05	Wood & carpentry	.00011	.00751	.00117	.00713	.00551	.06076	.00077	.00076
06	Paper & publishing	.00511	.04344	.00453	.01106	.00961	.00577	.03046	.00344
07	Leather products	--	.00010	--	.00025	.00091	--	.00024	.00009
08	Rubber & plastic	.00122	.01715	.00656	.00678	.02164	.00543	.00208	.00755
09	Chemicals	.03218	.03065	.01169	.00934	.00713	.02182	.00483	.00256
10	Oil refineries	.06909	.00934	.00629	.00497	.00278	.01962	.00609	.04459
11	Glass & ceramics	.00206	.11033	.01156	.00811	.01062	.06919	.00117	.00026
12	Basic metals	.00017	.00518	.24888	.30114	.08727	.05261	.00141	.00256
13	Metal products	.01751	.01279	.02378	.06336	.04347	.10239	.00209	.00167
14	Machinery & appliances	.00211	.01340	.03083	.07428	.06329	.04859	.03432	.05128
15	Construction & housing	.00139	.00041	.00440	.00069	.00254	.00012	.03201	.03668
16	Services	.06537	.11632	.12098	.08617	.10193	.15037	.20984	.13757
17	Transportation	.05041	.05197	.04123	.01725	.01364	.03034	.01720	.06189
Adjustment		-.00033	+.00436	+.01798	-.00349	-.00318	+.00123	+.00060	-.00200
Primary inputs		.23223	.51056	.38635	.41080	.42609	.41712	.62667	.64499
Total		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 12. United States direct and indirect requirements per dollar of final demand

		01	02	03	04	05	06	07	08
01	Agriculture	1.47321	.56601	.00694	.13665	.15294	.01609	.07354	.01943
02	Food	.10560	1.24248	.00458	.01735	.01870	.01119	.08682	.01311
03	Mining	.02962	.02370	1.07972	.01508	.02453	.02313	.01368	.03230
04	Textiles & apparel	.00947	.01114	.00438	1.74212	.05481	.01846	.08570	.11789
05	Wood & carpentry	.00815	.00926	.00514	.00593	1.31898	.05022	.01693	.00768
06	Paper & publishing	.02242	.05672	.01857	.04742	.05292	1.43613	.05966	.07246
07	Leather products	.00040	.00031	.00021	.00476	.00143	.00050	1.31878	.00226
08	Rubber & plastic	.01217	.01429	.01076	.11504	.03959	.02500	.07966	1.16192
09	Chemicals	.05231	.03699	.02144	.05174	.04553	.04925	.05983	.25260
10	Oil refineries	.03698	.02540	.01526	.01311	.02186	.01738	.01103	.02436
11	Glass & ceramics	.00653	.01687	.01080	.00635	.02238	.00787	.00986	.01481
12	Basic metals	.01573	.02789	.02822	.01625	.07035	.02061	.01644	.02964
13	Metal products	.01520	.04370	.01327	.01178	.05277	.01921	.01923	.02611
14	Machinery & appliances	.04067	.04426	.06622	.05894	.06658	.04702	.03700	.05245
15	Construction & housing	.02849	.02308	.01124	.01345	.01552	.01733	.01038	.01428
16	Services	.28111	.28217	.26585	.26154	.25855	.29292	.21982	.24332
17	Transportation	.04348	.07543	.04369	.04795	.07755	.05494	.03943	.05456
	Totals	2.18154	2.49970	1.60629	2.56546	2.29499	2.10725	2.15779	2.13918

Table 12. Continued

		09	10	11	12	13	14	15	16	17
01	Agriculture	.02551	.00818	.01014	.00851	.00861	.00987	.02276	.02963	.01029
02	Food	.03516	.00661	.00671	.00589	.00514	.00559	.00762	.01934	.00809
03	Mining	.07925	.61162	.09494	.13495	.05452	.02991	.05243	.02099	.03802
04	Textiles & apparel	.01348	.00490	.01100	.00875	.01046	.02127	.00965	.00942	.00664
05	Wood & carpentry	.00875	.00505	.01645	.00668	.01518	.01438	.08601	.00797	.00700
06	Paper & publishing	.06871	.02727	.08665	.02817	.03774	.03834	.03730	.06152	.02041
07	Leather products	.00032	.00022	.00041	.00029	.00071	.00192	.00042	.00057	.00037
08	Rubber & plastic	.05135	.01145	.02990	.01774	.02013	.04152	.01917	.00837	.01473
09	Chemicals	1.27971	.05967	.05820	.03230	.03108	.03072	.04724	.01624	.01492
10	Oil refineries	.05729	1.08934	.02171	.01894	.01653	.01250	.03306	.01371	.05644
11	Glass & ceramics	.02003	.01077	1.12865	.02283	.02042	.02264	.08609	.00738	.00691
12	Basic metals	.05805	.03044	.02836	1.36472	.45881	.19552	.14097	.02086	.02594
13	Metal products	.03810	.03167	.02440	.04460	1.09118	.07472	.12710	.01400	.01529
14	Machinery & appliances	.05461	.05585	.05004	.08987	.15081	1.39382	.11294	.07251	.09555
15	Construction & housing	.01429	.01449	.01240	.01887	.01377	.01488	1.01422	.04461	.04814
16	Services	.31582	.27422	.25138	.29205	.25568	.26160	.31292	1.32328	.24086
17	Transportation	.06121	.08936	.08027	.07747	.05493	.04284	.06432	.03393	1.08165
	Totals	2.18164	2.33111	1.91161	2.17263	2.24570	2.21204	2.17422	1.70433	1.69125

Appendix C

Adjusted Input-Output Tables

Tables 13, 14, 15, 16, 17 were compiled by the author by using five different types of adjustments on the United States flow matrix and coefficient matrix found in tables 10, 11, in Appendix B.

These tables represent in each case an attempt to approximate the predictive ability of the Israel inverse matrix found in Table 9.

Table 13. ($\overline{d}$) transform (inverse matrix)

		01	02	03	04	05	06	07	08	09
01	Agriculture	1.23458	.26965	.00241	.06401	.07474	.00541	.02741	.00677	.00868
02	Food	.05296	1.13301	.00208	.00626	.00720	.00509	.04793	.00627	.01968
03	Mining	.00574	.00396	1.02585	.00262	.00461	.00521	.00264	.00781	.02180
04	Textiles & apparel	.00545	.00615	.00225	1.62981	.04245	.01181	.06542	.09079	.00731
05	Wood & carpentry	.00384	.00440	.00306	.00272	1.28756	..03822	.01266	.00413	.00523
06	Paper & publishing	.00808	.02617	.00831	.02081	.02599	1.24494	.02860	.03553	.03517
07	Leather products	.00023	.00013	.00010	.00363	.00105	.00030	1.27044	.00165	.00014
08	Rubber & plastic	.00275	.00314	.00279	.03381	.01136	.00648	.02366	1.05068	.01553
09	Chemicals	.03979	.02155	.01716	.02881	.03341	.03780	.04286	.22700	1.26918
10	Oil refineries	.01935	.01105	.00916	.00583	.01213	.00936	.00511	.01382	.03566
11	Glass & ceramics	.00378	.01864	.01281	.00482	.02808	.00708	.01059	.01708	.02507
12	Basic metals	.00144	.00358	.00513	.00169	.01458	.00275	.00208	.00484	.01218
13	Metal products	.00480	.02272	.00582	.00364	.03006	.00845	.00896	.01300	.02101
14	Machinery & appliances	.01200	.01253	.02534	.02019	.02355	.01542	.01193	.01783	.01844
15	Construction & housing	.00134	.00095	.00057	.00058	.00074	.00083	.00044	.00070	.00069
16	Services	.18771	.17367	.21032	.18117	.18480	.20914	.15448	.17355	.23850
17	Transportation	.04520	.08664	.05638	.05438	.09868	.06447	.04420	.06552	.07531
	Totals	1.62904	1.79794	1.38954	2.06478	1.88099	1.67276	1.75941	1.73697	1.80958

Table 13. Continued

		10	11	12	13	14	15	16	17
01	Agriculture	.00200	.00380	.00232	.00227	.00282	.00958	.01236	.00352
02	Food	.00254	.00331	.00220	.00161	.00193	.00330	.01027	.00405
03	Mining	.20634	.03226	.03665	.00618	.00375	.01295	.00498	.00806
04	Textiles & apparel	.00190	.00697	.00434	.00500	.01233	.00539	.00630	.00367
05	Wood & carpentry	.00157	.01301	.00289	.01037	.00903	.07582	.00269	.00202
06	Paper & publishing	.01022	.04908	.01071	.01521	.01525	.01837	.03196	.00858
07	Leather products	.00008	.00027	.00012	.00042	.00129	.00022	.00039	.00022
08	Rubber & plastic	.00208	.00928	.00391	.00413	.01040	.00500	.00177	.00381
09	Chemicals	.04842	.05298	.02119	.01836	.01685	.04021	.01050	.00814
10	Oil refineries	1.05461	.01413	.00934	.00708	.00525	.02013	.00732	.03582
11	Glass & ceramics	.00784	1.19093	.02381	.01885	.02348	.12343	.00403	.00251
12	Basic metals	.00339	.00516	1.09393	.11670	.04125	.03040	.00212	.00289
13	Metal products	.01565	.01370	.02076	1.04988	.03785	.07897	.00369	.00382
14	Machinery & appliances	.01228	.01897	.02783	.05224	1.16030	.04181	.02704	.03741
15	Construction & housing	.00060	.00069	.00083	.00046	.00059	1.00068	.00252	.00281
16	Services	.14491	.20144	.18193	.14066	.15903	.23462	1.25479	.18345
17	Transportation	.10235	.11369	.08427	.04640	.03871	.08026	.03953	1.10950
	Totals	1.61678	1.72967	1.52703	1.49582	1.54011	1.78114	1.42226	1.42028

Table 14. UN (P) transform (inverse matrix)

		01	02	03	04	05	06	07	08	09
01	Agriculture	1.47310	.34480	.00683	.08334	.06791	.00948	.03978	.01346	.01339
02	Food	.17342	1.24256	.00741	.01737	.01365	.01084	.07710	.01492	.03031
03	Mining	.02976	.01491	1.07972	.00934	.01106	.01386	.00754	.02276	.04229
04	Textiles & apparel	.01544	.01120	.00706	1.74211	.03996	.01784	.07601	.13393	.01162
05	Wood & carpentry	.01710	.01357	.01140	.00808	1.31893	.06661	.02064	.01197	.01034
06	Paper & publishing	.03763	.05887	.03101	.04907	.03988	1.43613	.05477	.08522	.06122
07	Leather products	.00074	.00035	.00038	.00536	.00118	.00054	1.31878	.00290	.00031
08	Rubber & plastic	.01739	.01268	.01527	.10122	.02537	.02126	.06214	1.16193	.03892
09	Chemicals	.09909	.04332	.04018	.06008	.03855	.05530	.06165	.33344	1.27972
10	Oil refineries	.06259	.02659	.02555	.01360	.01651	.01744	.01016	.02871	.05117
11	Glass & ceramics	.00973	.01736	.01729	.00624	.01614	.00754	.00870	.01671	.01713
12	Basic metals	.02678	.03183	.05011	.01782	.05636	.02193	.01609	.03707	.05504
13	Metal products	.02728	.05151	.02473	.01353	.04436	.02145	.01975	.03429	.03792
14	Machinery & appliances	.06378	.04383	.10391	.05731	.04715	.04422	.03196	.05800	.04575
15	Construction & housing	.04146	.03520	.02079	.01481	.01247	.01922	.01092	.01862	.01426
16	Services	.30370	.18843	.28446	.17352	.12484	.18777	.12935	.18345	.18037
17	Transportation	.06004	.06445	.05990	.04074	.04804	.04516	.02975	.05278	.04481
	Totals	2.45903	2.20146	1.78600	2.41354	1.92236	1.99659	1.97509	2.21010	1.93457

Table 14. Continued

		10	11	12	13	14	15	16	17
01	Agriculture	.00481	.00623	.00472	.00454	.00619	.01211	.02727	.00738
02	Food	.00638	.00678	.00536	.00446	.00576	.00666	.02920	.00953
03	Mining	.36513	.05933	.07598	.02926	.01905	.02835	.01962	.02771
04	Textiles & apparel	.00472	.01109	.00794	.00906	.02189	.00843	.01421	.00782
05	Wood & carpentry	.00668	.02275	.00833	.01803	.02027	.10295	.01648	.01130
06	Paper & publishing	.02702	.09037	.02649	.03381	.04078	.03368	.09597	.02483
07	Leather products	.00023	.00046	.00029	.00068	.00222	.00042	.00097	.00050
08	Rubber & plastic	.00970	.02652	.01417	.01534	.03757	.01472	.01111	.01524
09	Chemicals	.06677	.06810	.03408	.03125	.03667	.04790	.02845	.02038
10	Oil refineries	1.08933	.02270	.01785	.01484	.01333	.02993	.02146	.06891
11	Glass & ceramics	.01029	1.12865	.02060	.01755	.02309	.07455	.01105	.00806
12	Basic metals	.03227	.03145	1.36473	.43724	.22116	.13537	.03463	.03358
13	Metal products	.03525	.02842	.04683	1.09119	.08870	.12812	.02439	.02078
14	Machinery & appliances	.05233	.04905	.07943	.12699	1.39381	.09587	.10637	.10931
15	Construction & housing	.01601	.01433	.01965	.01366	.01753	1.01417	.07711	.06492
16	Services	.17518	.16796	.17607	.14682	.17840	.18115	1.32329	.18788
17	Transportation	.07318	.06879	.05981	.04042	.03743	.04772	.04347	1.08164
	Totals	1.97528	1.80298	1.96233	2.03514	2.16385	1.196210	1.88505	1.69977

Table 15. "D" transform (inverse matrix)

		01	02	03	04	05	06	07	08	09
01	Agriculture	1.47280	.92915	.00706	.22387	.34392	.02729	.13591	.02803	.04857
02	Food	.06427	1.24249	.00284	.01731	.02561	.01156	.09777	.01153	.04077
03	Mining	.02910	.03826	1.07972	.02430	.05426	.03859	.02488	.04584	.14847
04	Textiles & apparel	.00578	.01118	.00271	1.74213	.07524	.01910	.09667	.10379	.01568
05	Wood & carpentry	.00361	.00676	.00232	.00430	1.31903	.03789	.01390	.00493	.00742
06	Paper & publishing	.01321	.05493	.01113	.04585	.07018	1.43614	.06303	.06163	.07715
07	Leather products	.00021	.00027	.00011	.00423	.00172	.00045	1.31883	.00176	.00033
08	Rubber & plastic	.00844	.01629	.00758	.13076	.06178	.02941	.10214	1.16203	.06783
09	Chemicals	.02745	.03189	.01145	.04451	.05379	.04387	.05807	.19135	1.27967
10	Oil refineries	.02171	.02450	.00912	.01262	.02889	.01732	.01198	.02065	.06413
11	Glass & ceramics	.00401	.01702	.00674	.00641	.03093	.99820	.01121	.01314	.02344
12	Basic metals	.00871	.02538	.01589	.01478	.08768	.01936	.01685	.02369	.06124
13	Metal products	.00803	.03791	.00712	.01021	.06268	.01720	.01877	.01988	.03831
14	Machinery & appliances	.02550	.04560	.04224	.06060	.09398	.05004	.04292	.04748	.06525
15	Construction & housing	.01516	.02016	.00608	.01174	.01859	.01565	.01021	.01097	.01449
16	Services	.25848	.42629	.24873	.39439	.53513	.45722	.37392	.32301	.55341
17	Transportation	.03117	.08884	.03185	.05636	.12510	.06684	.05288	.05656	.08361
	Totals	1.99764	3.01692	1.49269	2.80437	2.98851	2.29613	2.45194	2.12617	2.58977

Table 15. Continued

		10	11	12	13	14	15	16	17
01	Agriculture	.01392	.01649	.01536	.01630	.01574	.04277	.03222	.01435
02	Food	.00685	.00666	.00649	.00594	.00544	.00873	.01281	.00687
03	Mining	1.02385	.15196	.23956	.10157	.04693	.09690	.02245	.05211
04	Textiles & apparel	.00509	.01091	.00963	.01210	.02069	.01107	.00626	.00566
05	Wood & carpentry	.00381	.01191	.00536	.01277	.01018	.07186	.00385	.00433
06	Paper & publishing	.02735	.08311	.02997	.04215	.03605	.04133	.03945	.01678
07	Leather products	.00020	.00036	.00028	.00073	.00165	.00043	.00033	.00028
08	Rubber & plastic	.01351	.03375	.02220	.02644	.04593	.02498	.00632	.01424
09	Chemicals	.05332	.04973	.03061	.03091	.02573	.04662	.00928	.01091
10	Oil refineries	1.08934	.02075	.02008	.01839	.01171	.03650	.00876	.04622
11	Glass & ceramics	.01125	1.12857	.02530	.02376	.02218	.09937	.00493	.00591
12	Basic metals	.02869	.02557	1.36461	.48147	.17281	.14676	.01258	.02004
13	Metal products	.02845	.02097	.04250	1.09120	.06294	.12610	.00804	.01126
14	Machinery & appliances	.05963	.05109	.10175	.17924	1.39411	.13315	.04947	.08355
15	Construction & housing	.01312	.01075	.01813	.01388	.01264	1.01422	.02581	.03570
16	Services	.42940	.37633	.48495	.44563	.38396	.54103	1.32349	.30889
17	Transportation	.10906	.09366	.10027	.07461	.04902	.08668	.02646	1.08161
	Totals	2.91684	2.09257	2.51705	2.57709	2.31771	2.52850	1.59251	1.71871

Table 16. UN (T) transform (inverse matrix)

		01	02	03	04	05	06	07	08	09
01	Agriculture	1.27333	.44968	.00724	.05685	.06260	.01006	.02218	.00601	.01077
02	Food	.05036	1.17490	.00468	.00482	.00516	.00773	.02784	.00381	.01658
03	Mining	.00213	.00222	1.02551	.00078	.00116	.00337	.00062	.00198	.00820
04	Textiles & apparel	.00754	.01210	.00624	1.63819	.03985	.02396	.05390	.08901	.00819
05	Wood & carpentry	.00361	.00593	.00582	.00186	1.19847	.05489	.00718	.00258	.00422
06	Paper & publishing	.00576	.02420	.01201	.01000	.01158	1.24051	.01116	.01573	.01986
07	Leather products	.00046	.00040	.00044	.00549	.00149	.00094	1.32438	.00243	.00025
08	Rubber & plastic	.00215	.00358	.00447	.02058	.00633	.00789	.01175	1.02989	.01099
09	Chemicals	.03108	.02481	.02724	.01534	.01763	.04486	.01965	.12753	1.19302
10	Oil refineries	.01781	.01478	.01720	.00385	.00753	.01279	.00274	.00797	.02865
11	Glass & ceramics	.00321	.02247	.02212	.00284	.01639	.00873	.00539	.00968	.01848
12	Basic metals	.00065	.00264	.00492	.00051	.00502	.00189	.00057	.00148	.00527
13	Metal products	.00349	.02354	.00821	.00177	.01507	.00896	.00393	.00623	.01321
14	Machinery & appliances	.00640	.00952	.02696	.00776	.00834	.01233	.00381	.00633	.00837
15	Construction & housing	.00109	.00113	.00104	.00037	.00042	.00106	.00023	.00039	.00050
16	Services	.14469	.19320	.33151	.10304	.09708	.24509	.07202	.08923	.15830
17	Transportation	.03731	.10073	.09444	.03279	.05506	.07987	.02198	.03614	.05269
	Totals	1.59107	2.06583	1.60005	1.90684	1.54918	1.76493	1.58933	1.43642	1.55755

Table 16. Continued

		10	11	12	13	14	15	16	17
01	Agriculture	.00191	.00884	.00350	.00443	.00414	.01350	.02597	.00514
02	Food	.00167	.00340	.00241	.00244	.00223	.00404	.01653	.00432
03	Mining	.06858	.01535	.01850	.00300	.00149	.00655	.00362	.00286
04	Textiles & apparel	.00171	.00901	.00603	.00975	.01821	.00752	.01412	.00510
05	Wood & carpentry	.00095	.01205	.00274	.01499	.00933	.08802	.00404	.00190
06	Paper & publishing	.00453	.03141	.00747	.01503	.01102	.01432	.03400	.00618
07	Leather products	.00011	.00054	.00023	.00126	.00296	.00050	.00133	.00044
08	Rubber & plastic	.00103	.00739	.00318	.00482	.00935	.00454	.00224	.00315
09	Chemicals	.02555	.04904	.01697	.02087	.01366	.03759	.01341	.00602
10	Oil refineries	1.03442	.01251	.00869	.00941	.00511	.02244	.01110	.03483
11	Glass & ceramics	.00437	1.16664	.02105	.02350	.02189	.13097	.00542	.00194
12	Basic metals	.00113	.00245	1.05024	.09142	.02292	.01905	.00146	.00123
13	Metal products	.00762	.00970	.01566	1.05644	.03066	.07154	.00407	.00246
14	Machinery & appliances	.00425	.00969	.01492	.04120	1.09487	.02649	.02288	.02006
15	Construction & housing	.00034	.00058	.00072	.00056	.00055	1.00070	.00326	.00232
16	Services	.07387	.15226	.14437	.15773	.13321	.21676	1.31800	.14635
17	Transportation	.05591	.09181	.07122	.05384	.03374	.07732	.05328	1.09323
	Totals	1.28795	1.57457	1.38790	1.51072	1.41534	1.74185	1.53473	1.33753

Table 17. UN (PT) transform (inverse matrix)

		01	02	03	04	05	06	07	08	09
01	Agriculture	1.27344	.27521	.00713	.03468	.02781	.00594	.01202	.00417	.00568
02	Food	.08276	1.17500	.00756	.00433	.00377	.00748	.02472	.00433	.01428
03	Mining	.00218	.00138	1.02551	.00049	.00053	.00202	.00034	.00140	.00437
04	Textiles & apparel	.01236	.01209	.01007	1.63819	.02905	.02314	.04781	.10113	.00705
05	Wood & carpentry	.01236	.01209	.01007	1.63819	.02905	.02314	.04781	.10113	.00705
06	Paper & publishing	.00814	.00313	.01288	.00255	1.19844	.07279	.00873	.00401	.00498
07	Leather products	.00038	.00044	.00080	.00619	.00123	.00103	1.32438	.00312	.00025
08	Rubber & plastic	.00310	.00315	.00634	.01810	.00405	.00671	.00917	1.02989	.00334
09	Chemicals	.05980	.02898	.05106	.01784	.01494	.05038	.02025	.16834	1.19302
10	Oil refineries	.03033	.01537	.02879	.00399	.00570	.01284	.00252	.00941	.02559
11	Glass & ceramics	.00523	.02228	.03541	.00281	.01185	.00837	.00474	.01092	.01578
12	Basic metals	.00118	.00290	.00874	.00057	.00402	.00201	.00056	.00186	.00499
13	Metal products	.00662	.02716	.01530	.00204	.01269	.01000	.00403	.00818	.01313
14	Machinery & appliances	.01022	.00926	.04232	.00754	.00592	.01159	.00328	.00700	.00701
15	Construction & housing	.00206	.00130	.00191	.00042	.00035	.00118	.00024	.00051	.00050
16	Services	.15749	.12811	.35471	.06841	.04691	.15710	.04238	.06727	.09039
17	Transportation	.05204	.08557	.12947	.02787	.03413	.06565	.01658	.03491	.03857
	Totals	1.71761	1.32135	1.75805	1.84688	1.41015	1.67874	1.53199	1.47495	1.45162

Table 17. Continued

		10	11	12	13	14	15	16	17
01	Agriculture	.00112	.00543	.00194	.00234	.00259	.00719	.02389	.00369
02	Food	.00161	.00343	.00219	.00214	.00229	.00353	.02495	.00509
03	Mining	.04094	.00960	.01042	.00161	.00094	.00354	.00338	.00209
04	Textiles & apparel	.00164	.00907	.00547	.00844	.01873	.00656	.02129	.00601
05	Wood & carpentry	.00126	.01667	.00341	.01781	.01315	.10537	.00835	.00309
06	Paper & publishing	.00448	.03276	.00702	.01345	.01171	.01293	.05304	.00752
07	Leather products	.00012	.00060	.00024	.00124	.00344	.00049	.00227	.00059
08	Rubber & plastic	.00087	.00655	.00254	.00368	.00847	.00349	.00297	.00326
09	Chemicals	.02859	.04791	.01790	.02097	.01631	.03811	.02349	.00823
10	Oil refineries	1.03442	.01309	.00819	.00845	.00545	.02031	.01737	.04252
11	Glass & ceramics	.00419	1.16664	.01898	.02019	.02232	.11342	.00811	.00227
12	Basic metals	.00120	.00272	1.05024	.08712	.02592	.01829	.00243	.00160
13	Metal products	.00848	.01129	.01644	1.05645	.03640	.07211	.00710	.00335
14	Machinery & appliances	.00399	.00950	.01319	.03469	1.09487	.02250	.03355	.02295
15	Construction & housing	.00038	.00067	.00075	.00056	.00064	1.00070	.00564	.00313
16	Services	.04720	.10172	.08704	.09054	.09084	.12549	1.31799	.11416
17	Transportation	.04578	.07867	.05499	.03962	.02948	.05737	.06826	1.09323
	Totals	1.22627	1.51631	1.30095	1.40930	1.38355	1.61140	1.62408	1.32278

VITA

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Candidate for the Degree of

Master of Science

Thesis: A Study of Input-Output Adjustments

Major Field: Economics

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