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REPORT II

TECHNICAL NOTES

PREPARATION OF AN ANALYTICAL SYSTEM FOR THE MEASUREMENT OF ECONOMIC IMPACTS IN APPALACHIA

(Contract No. DACW55-67-C-0016)

Prepared for the

OFFICE OF APPALACHIAN STUDIES
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Washington, D. C.

February 1968

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The Report "An Analytical System for the Measurement of Economic Impacts in Appalachia" which was submitted in accordance with the provisions of Contract No. DA-33017-CIVENG-66-21, is appended hereto.

I

INTRODUCTION

The results of the research under Contract No. DACW55-67-C-0016 were originally presented as photo-copies of computer printouts in a report entitled: An Input-Output Model of Appalachia; Prepared for the Office of Appalachian Studies, U. S. Army Corps of Engineers, by Research and Development Corporation. Volumes 2, 3, and 4 were produced for a limited distribution and it was our intention to issue a volume of technical notes (as Volume I) describing the procedures and data sources. However, this report will serve the dual purpose of technical notes for the above report and as one volume of a two-volume report designed for a wider audience.

This volume of technical notes is one of three types of documents which were produced under the Contract. In addition to the technical notes, there are five computer reports, a sixth report, consisting of Appalachian income multipliers for twelve types of water resource development projects. The remaining output under this contract consists of computer printouts of magnetic type and card records which comprise data files used in the construction of the analytical system. The original intent of the technical notes was to describe procedures and data sources used in the construction of the model and in predicting the effects of water resource activities. However, in addition, examples of the use of the model are presented, as provided for in a modification of the original contract.

The input-output model which is developed in this study is built

up from National input-output coefficients and estimates of interregional trade. The input-output studies of the Office of Business Economics and the Interagency Growth Study provided the technical coefficients. These coefficients were then disaggregated for Appalachia on the basis of information concerning interregional trade in the Appalachian Region. Both surveys and statistical models were employed to estimate interregional trade flows.

Regional input-output coefficients in this study were estimated by disaggregating each National input-output coefficient in the table of direct requirements.[1] For example, let us consider the paper and allied products sector in North Appalachia. Furthermore, let us examine the shipments of chemicals and selected chemical products industries to the paper industry per dollar of output of the paper industry. The 1958 input-output study showed that 3.185 cents' worth of chemicals were used for every dollar of output of the Paper and allied products sector. The National coefficient (.03185) is part of the input data used in our analytical system. The question is asked: Where do paper and allied products manufacturers and other users located in North Appalachia obtain their supplies of chemical and allied products? The same question is asked for each of the other input-output coefficients in the National model. That is, we assume each National input-output coefficient to be applicable to Appalachia and establish a procedure for disaggregating

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[1]The table of direct requirements is similar in concept to the one contained in Table 2 in U. S. Department of Commerce, Survey of Current Business, Vol. 45, No. 9 (September 1965); a description of the actual matrix is provided in Chapter IV.

it according to the regions from which supplies of the particular good or service originate.

A number of procedures were used to estimate the interregional movement of goods and services. Statistical models were used to estimate shipments of manufactured products. These models were fitted with data from the 1963 Census of Transportation. The data which were used showed the volume of shipment from each census region to each other census region. The Census of Transportation also contained information from which it was possible to estimate the average distance over which interregional shipments moved.

Using data from the various publications of the U. S. Bureau of the Census, to which specific references are given below, it was possible to estimate the production of input-output sectors in each of the census regions. It was also possible, using production estimates, statistics contained in the input-output study, data concerning capital requirements of industries and consumption requirements of households, to estimate the use of the products of an input-output sector in a census region. The information for input-output sectors was then aggregated so as to be consistent with information contained for "shipper groups" in the Census of Transportation.

Regression analyses were used to estimate the parameters which related shipments and independent variables: production, use, and distance. Eleven different statistical models were estimated. It was found that adequate estimates of interregional shipments could be made by using a linear-in-logarithms model. Estimates of interregional trade terminating in Appalachia were then made, using the parameters obtained in the statistical analysis phase and values of the independent

variables relating to sub-areas in Appalachia and sub-areas in the rest of the U. S.

This process can be thought of as working backward when compared to the model estimation, which is described above. In this phase, shipments are estimated on the basis of what is known about production in the producing area, use in the consuming area, and the distance between the respective regions. In the statistical estimation, on the other hand, shipments were known, whereas in this latter phase, shipments are estimated. Thus, for each manufacturing sector, we estimated inter-regional shipments, terminating in Appalachia. The proportions of these shipments from each region was then estimated. The National input-output coefficients were then broken down through the use of information about the proportion of shipments originating in North Appalachia, the proportion originating in Central Appalachia, the proportion originating in South Appalachia, and the proportion originating in the rest of the United States.

Surveys were conducted to determine the regions from which business establishments in Appalachia procured supplies of mineral and agricultural products. Surveys were also carried out in order to estimate the proportion of services and trade supplied by businesses within Appalachia. It was necessary to carry out surveys for these types of industries because the 1963 Census of Transportation did not include data from which to estimate the necessary statistical models. These surveys provided information which was consistent with that obtained by use of the statistical models. The information from these surveys was used to break down the appropriate input-output coefficients according to the region from which the goods and services originated.

Therefore, by the techniques described above, a four-region input-output model was developed. This model shows the values of inputs required per dollar output of the purchasing sector. The information is shown for each of the three regions of Appalachia and for the rest of the United States. For example, for columns applicable to Central Appalachia, the model shows the inputs supplied by sectors from North, Central and South Appalachia and the rest of the U. S.

At this point we have what is known as an open interindustry model of Appalachia. In the National model, the household sector is not included in the model. The income flows to the household sector are contained along with non-income charges in the "value added" row. The expenditures of the household sector are shown in "personal consumption expenditures," one of the "final demand" vectors.

In our model, expenditures by the household sector depend upon income payments to the household sector. Income payments, in turn, are generated by shipments to final demand, which includes "exports" from the region, gross private fixed capital formation, and non-local government expenditures. In order to build into the model the relationship between income and expenditures, it was necessary to add an additional row and column to the model.

Estimates of the income payments to households per dollar output of a producing sector were made by the use of unpublished data relating to the 1958 input-output model. Estimates were made of the marginal propensities to consume the products of input-output sectors. These propensities to consume can be thought of as linear non-homogeneous demand functions in which the independent variable is household

income. The estimates of these demand functions are based upon data and relationships appearing in The American Economy to 1975, "The Survey of Consumer Expenditures" of the U. S. Bureau of Labor Statistics, and numerous publications of the U. S. Department of Agriculture, to which specific references are provided below.

This model of Appalachia when confronted with a change in final demand will estimate the resulting changes in industrial output by input-output sectors in each region of Appalachia. Additionally, because of the built-in relationships between income and expenditures, estimates can be made of the increases in personal consumption expenditures and income. Therefore, the model enables us to estimate the direct and indirect incomes which result from changes in final demand. For example, the model can be used to estimate the economic impacts of such changes in final demand as construction of water development projects and changes in government expenditures and the impact of a new manufacturing plant.

II

REPORTS AND THEIR USES

A. Regional Definition

The Appalachian Region was sub-divided into three regions for the purpose of this study. The boundary of each region within Appalachia followed the boundaries of economic sub-regions of the Office of Business Economics.[1] The boundary separating Appalachian parts of states from non-Appalachian parts followed the definition of the Appalachian Regional Commission[2] except in the following case. Twenty counties in northeastern Mississippi were considered to be part of Appalachia for the purpose of this study.[3]

Figure II-1 shows the sub-areas of Appalachia employed in the study. The numbering of the sub-areas in most cases follows OBE's numbering of economic sub-regions, except for the following cases: OBE sub-region 9 is sub-area 11; OBE sub-region 11 is sub-area 9; the counties in Mississippi were designated sub-area 27, whereas there was not an OBE sub-region covering that area and, finally, there is

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[1]U. S., Department of Commerce, Office of Business Economics (Map) Economic Sub-Regions.

[2]U. S. Appalachian Regional Commission (Map), Appalachian Region, 1965.

[3]During the data collection phase of the study the Mississippi counties to be officially included in Appalachia had not been designated.

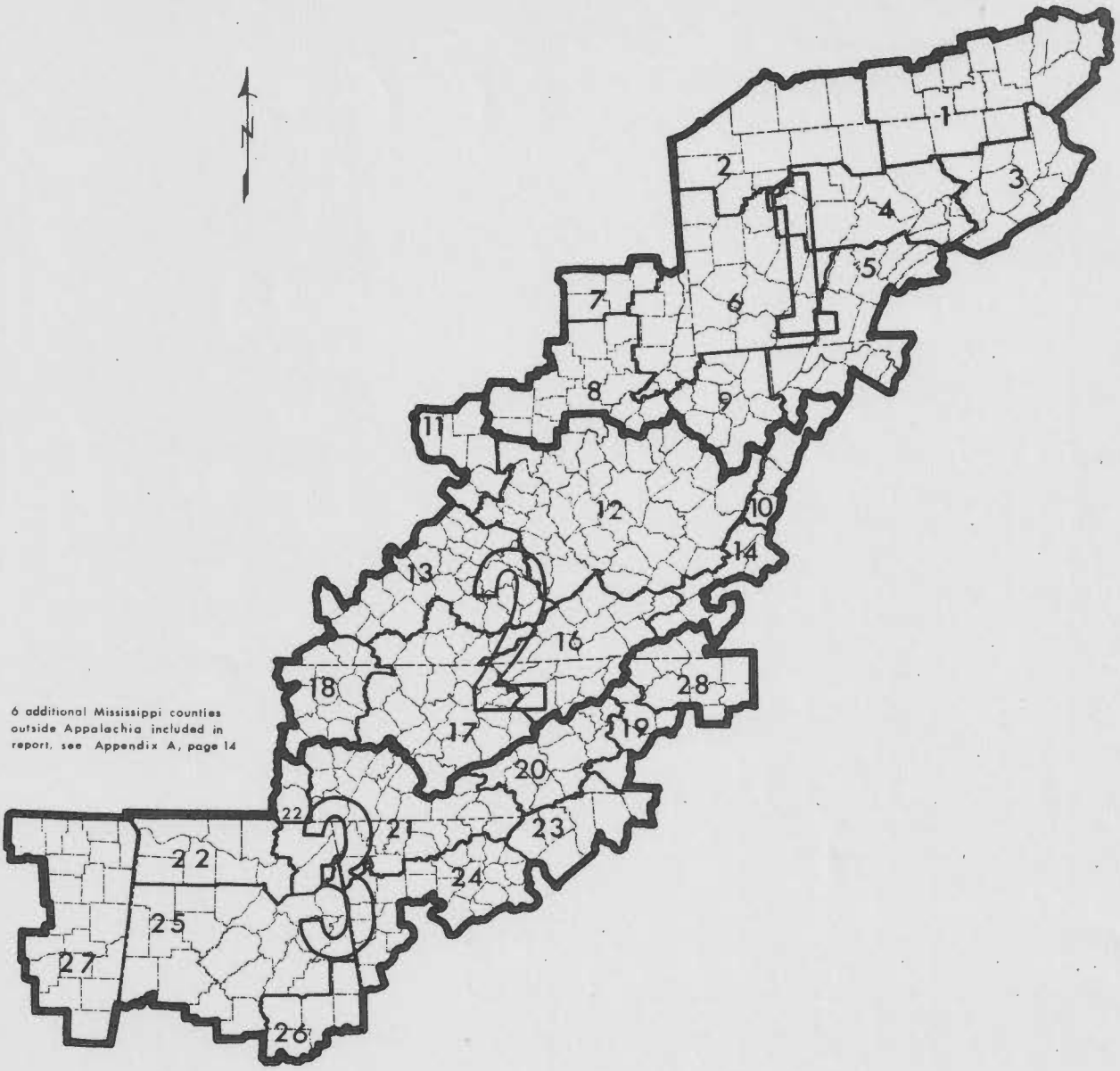
no sub-area 15. Area designated as Economic Area 15 on OBE Map has been changed to 28 on Input-Output map (See Figure II-1, page II-3). This was done to obtain proper sequencing for computer runs. The changes in the designations of regions were necessary because of computer programming considerations.

The three major regions of the study were formed by grouping sub-areas. These three regions, which are roughly the northern, central and southern thirds of Appalachia, are shown by the heavy outlines in Figure II-1, and are numbered.

B. Computer Reports

This section relates to photo copies of computer reports which were originally presented in Volumes 2-4 of An Input-Output Model of Appalachia; Prepared for the Office of Appalachian Studies, U. S. Army Corps of Engineers, by Research and Development Corporation. These reports are reproductions of working materials which were not planned to have wide distribution. The tables were designed for analysts actually working on the study. Additionally, identification numbers and acronyms are employed. Also, indentification numbers of input-output sectors undergo changes from report four to "matrix inversion," because MPS-360, a mathematical programming code,was used to perform the matrix inversion and the numbering was changed to accommodate this system. Therefore, the contents of the reports will be described in greater detail than would usually be provided.

The computer programs which were designed to produce the input-output matrix for Appalachia and the inverse matrix also enabled estimation of other economic variables. These programs were used to develop estimates of production and use of products of input-output sectors 13-64 for sub-areas. They were also used to develop



SUB-AREAS WITHIN APPALACHIA

estimates of trade flows terminating in the Appalachian region. Estimates of production and use by input-output sector and sub-areas are shown in Report One. Estimates of trade flows by input-output sector, sub-area of destination and sub-area of origin are given in Report Two. It is our judgment that it is possible to use Reports One and Two in economic analysis but that they should be considered to be working data and not for publication.

REPORT ONE--"PROD" AND "USAGE" FOR SECTOR XX IN THOUSANDS OF DOLLARS

This set of reports presents estimates of production ("PROD") and use ("USAGE") for each of sectors 13-64. Estimates of production are presented for each of the sub-areas of the study whether within or outside of Appalachia. Estimates of use of the products of each manufacturing input-output sector are presented only for sub-areas within Appalachia because these values only were used in the models for estimating interregional trade terminating in Appalachia. The sub-areas of Appalachia appear in the upper portion of the table. In the lower left corner of the table the heading "SUMPROD" followed by a number appears. This is the value of production in all sub-areas in 1964 approximately equal to the 1964 output (in 1958 dollars) of that sector.

As an example, let us examine Report One for Sector 14, in An Input-Output Model of Appalachia, Vol. 2 of 4, page 2. Sector 14 is Food and kindred products (see Appendix E). Reading the top line, from the left we find the following information: sub-area 1 produces an estimated $274,576,000 worth of Food and kindred products (products of Sector 14); sub-area 1 uses an estimated $320,344,000 worth of Food and kindred products (products of Sector 14). Estimates of production

("PROD") and use ("USAGE") of the products of input-output Sector 14 are given for each sub-area of Appalachia through sub-area 28. The next entries, reading to the right, are estimates of production and use of products of Sector 14 for sub-area 2, etc.

Note that both "PROD" and "USAGE" are zero for sub-area 15. This is the case because tables of Reports One have a position for sub-area 15, although there is no sub-area with this identification number. However, all entries relating to sub-area 15 are zero. This procedure of having a position for sub-area 15 and zero values was also followed in Report Two.

REPORT TWO--NORMALIZED MANUFACTURING SHIPMENT DOLLAR VALUES FOR SECTOR XX

This set of reports presents estimates of the value of shipments terminating in Appalachia. Estimates are provided for shipments of products of each input-output sector, 13-64. Estimates of shipments are shown from each of the seventy-six sub-areas in the U. S. to each of the twenty-seven sub-areas of Appalachia. See the description of Report One above concerning sub-area 15. Values of interregional shipments were computed using the mathematical models, then normalized in order to adjust for overestimates and underestimates. Tables V-1 presents the relationship between "statistical analysis groups" and the models used for particular sectors.

About midway down each page of Report Two, and again at the bottom, the following appears: "RECEIVING SUB-AREA SHIPMENT VALUE " followed by a number. This number is not always equal to "USAGE" for the sub-region, as it should be, because of a programming error. Actually,

all values in the middle of the page are in error and those at the bottom are correct. The programming error which was made was to call for the printing of the wrong character. This error did not affect the calculation made with the models and all values appearing in "REPORT TWO" are correct except for "RECEIVING SUB-AREA SHIPMENT VALUE" in the middle of the page.

REPORT THREE--NORMALIZED DOLLAR AND DECIMAL RATIO SHIPMENT FIGURES FOR SECTOR XX

This set of reports presents the value of interregional trade terminating in Appalachia by regions. The values shown were obtained by grouping estimates of interregional trade by sub-areas, which appeared in Report Two. Estimated values of interregional trade appear in the column headed "DOLLAR." Ratios were then computed which record the proportion of all shipments which terminate in a particular region. These values appear in the column headed "DECIMAL." The decimal ratios by region of origin also appear in APPENDIX B of this report. It was these decimal ratios which were used to compute the coefficients of the interregional input-output model from the National input-output model.

As an example, Report Three for Sector 14 will be discussed. This table appears on an unnumbered page following page 28 in Volume 2 of 4, An Input-Output Model of Appalachia, in the section of this volume containing "REPORT TWO." The first entry of Report Three shows that approximately $752 million worth of Food and kindred products were shipped from Region 1 to Region 1. The next item to the right (.24461) is equal to the value of shipments from Region 1 to Region 1 divided

by all shipments terminating in Region 1. In this case, about 24.5 percent of all shipments terminating in Region 1 originated in Region 1. The second line of the table shows the value of shipments originating in Region 2 and terminating in Region 1 and the ratio of these shipments to total shipments terminating in Region 1. Lines three and four of the table show respectively, values of interregional shipments from Regions 3 and 4 which terminate in Region 1 and corresponding ratios. The table shows that the approximately 1.5, 1.6 and 72.5 percent of shipments of the Food and kindred products sector (Sector 14) originate in Regions 2, 3 and 4, respectively. The next four lines of the table relate to shipments terminating in Region 2, and the bottom four lines relate to shipments terminating in Region 3.

REPORT FOUR--EXPANDED REGIONAL DATA USING ECONOMIC I/O MATRIX

Report Four contains an interregional input-output matrix for Appalachia. The model relates to the three regions of Appalachia and the rest of the U. S. Economic activity of each region is subdivided into eighty-three sectors. The coefficients of the report are called "direct coefficients" and estimate the inputs supplied (by sector and region) per dollar's worth of output of the purchasing sector. There are eighty-three purchasing sectors in each of the three regions of Appalachia, although the model does not contain purchasing sectors for Region 4, "rest of the U. S."

On each page of Report Four there appears the following designation: "FROM AREA X TO AREA Y." Actually, this heading should read, "From Region X to Region Y," with X varying from 1 to 4 and Y varying from 1 to 3.

The general layout of Report Four is shown in Figure II-2.

Figure II-2.--Location of input-output coefficients in Report Four.

Region 1 to Region 1 (Pages 1-10)	Region 1 to Region 2 (Pages 40-49)	Region 1 to Region 3 (Pages 80-89)
Region 2 to Region 1 (Pages 11-19)*	Region 2 to Region 2 (Pages 50-59)	Region 2 to Region 3 (Pages 90-99)
Region 3 to Region 1 (Pages 20-29)	Region 3 to Region 2 (Pages 60-69)	Region 3 to Region 3 (Pages 100-109)
Region 4 to Region 1 (Pages 30-39)	Region 4 to Region 2 (Pages 70-79)	Region 4 to Region 3 (Pages 110-119)

*Note the addition of page 15A.

Page 1 of Report Four presents input-output coefficients for purchasing sectors 1-17. Producing sectors 1-41 in Region 1 are shown on page 1. On page 2 producing sectors 42-83 are shown and the coefficients relate to inputs supplied by sectors 42-83 in Region 1 to purchasing sectors 1-17 in Region 1. Thus, pages 1 and 2 provide the vector of input coefficients from sectors in Region 1 to sectors 1-17 in Region 1. Pages 3 and 4 show input-output coefficients from producing sectors in Region 1 to sectors 18-34 in Region 1; sectors 35-51 are shown on pages 5 and 6, etc.

Input-output coefficients which reflect shipments from industries located in Region 2 to industries located in Region 1 are found on pages 11-19 and on page 15A. On pages 11 and 12 we find coefficients for purchasing sectors 1-17 in Region 1 and for all producing sectors in Region 2. On pages 20 and 21 are presented coefficients which are

again for purchasing sectors 1-17 in Region 1; these coefficients relate to all producing sectors located in Region 3. Similarly, the coefficients for purchasing sectors 1-17 in Region 1 and producing sectors in Region 4, "rest of the U. S.," are found on pages 30 and 31.

The complete vectors of sectors 1-17 in Region 1 can be formed by adjoining the vectors presented on pages 1 and 2, 11 and 12, 20 and 21, and 30 and 31. A similar procedure is followed with each set of vectors until the entire matrix is filled out.

In general, the table is entered by finding the purchasing sector which is desired. Purchasing sectors located in Region 1 are found on pages 1-39. Pages 40-79 contain coefficients relating to purchasing sectors located in Region 2 and pages 80-119 contain coefficients relating to purchasing sectors located in Region 3. Once the appropriate purchasing sector has been located, the producing sectors are located by reference to Figure II-2 and the intersection is found to obtain the specific coefficient. The identification numbers of the producing sectors are shown on the left margin of Report Four. The sector titles and their descriptions appear in Appendix E.

As an example, the input-output coefficients relating to the "Chemicals and selected chemical products" (Sector 27) purchased by "Paper and allied products..." (Sector 24) may be used. Furthermore, the "Paper and allied products . . ." sector to which this example refers is located in Region 3. The relevant input-output coefficients are found on pages 82, 92, 102 and 112 at the intersection of row 27 and column 24. These coefficients show the inputs per dollar's output of the "Paper and allied products . . ." sector in Region 3 from

from "Chemicals . . ." in Region 1: $0.001530;

from "Chemicals . . ." in Region 2: $0.005580;

from "Chemicals . . ." in Region 3: $0.005090; and

from "Chemicals . . ." in Region 4: $0.020290.

MATRIX INVERSION

This report presents the inverse of the following matrix: (I-A); where

I means: an identity matrix of 249 rows and 249 columns.

A means: a matrix of direct requirements coefficients of 249 rows and 249 columns.

Each coefficient of Report Four which relates to producing industries located in Appalachia is a coefficient of A. The coefficients of Report Four which are included in A are found on pages 1-29, 40-69 and 80-109. The other coefficients, which are not included in A relate to "imports" into Appalachia from the rest of the U. S.

Each coefficient of "matrix inversion" shows the direct and indirect requirements of producing sectors required per dollar shipment to final demand of the purchasing sector. Final demand in this model can be thought of as: exports from Appalachia, non-local government expenditures and gross private fixed capital formation.

The format of Report Four and "Matrix Inversion" differs greatly. The reason for this difference is that a mathematical programming code was used to perform the matrix inversion. This mathematical programming code, MPS 360, presented its output in a form which differed from reports 1 - 4.

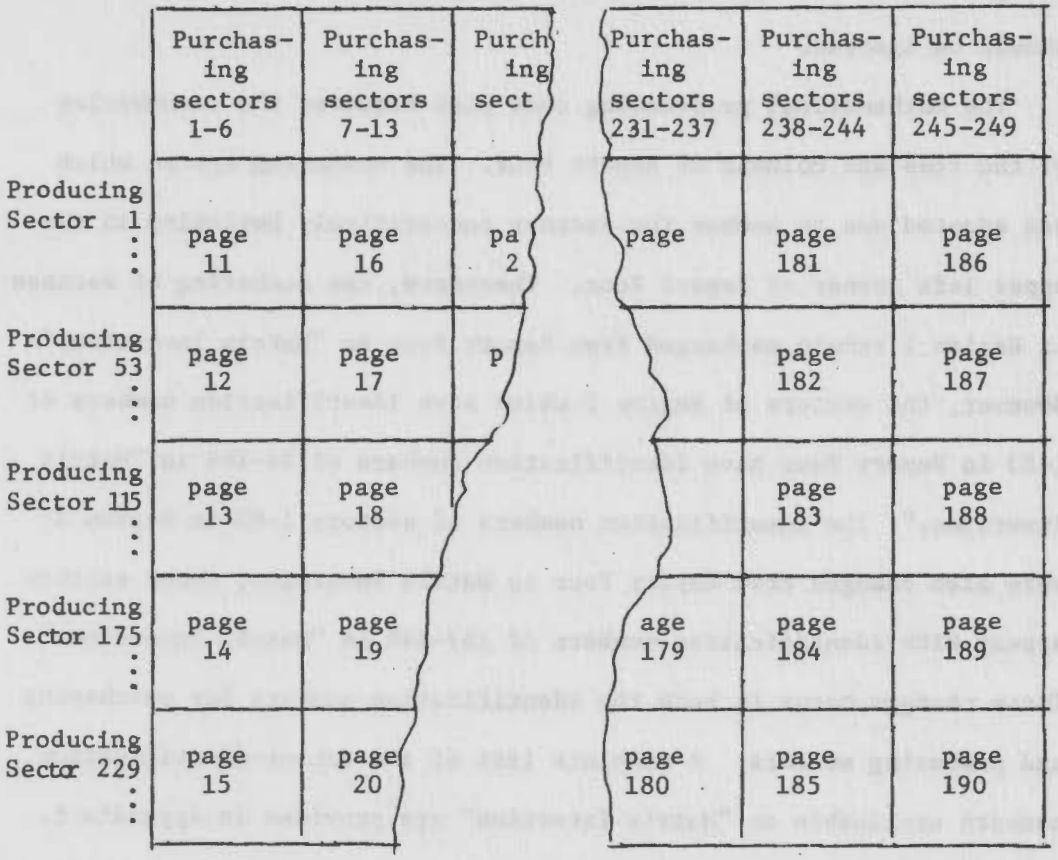
The first row and first column of "MATRIX INVERSION" are titled "OBJ." This row and column refer to what is known as the "objective function" in mathematical programming. However, in this table this designation is not appropriate and both the first row and first column should be ignored.

The mathematical programming code also required the renumbering of the rows and columns of Report Four. The numbering system which was adopted was to number the sectors consecutively beginning in the upper left corner of Report Four. Therefore, the numbering of sectors in Region 1 remain unchanged from Report Four to "Matrix Inversion." However, the sectors of Region 2 which have identification numbers of 1-83 in Report Four have identification numbers of 82-166 in "Matrix Inversion." The identification numbers of sectors 1-83 in Region 3 were also changed from Report Four to Matrix Inversion; these sectors appear with identification numbers of 167-249 in "Matrix Inversion." These changes occur in both the identification numbers for purchasing and producing sectors. A complete list of the sector-identification numbers applicable to "Matrix Inversion" are provided in Appendix E.

All the inverse coefficients relating to purchasing sectors 1-6 are presented on pages 11-15 of "Matrix Inversion." Pages 16-20 present all the coefficients relating to purchasing sectors 7-13, etc. Each page can be thought of as a panel of the complete inverse matrix. Figure II-3 shows how the pages of the inverse would be placed in order to assemble the complete inverse matrix. It is, of course, not necessary to assemble the matrix but it will be helpful to have this diagram in mind when using the table. Actually, there is some minor

variability in the producing sectors contained on the pages shown, but the diagram portrays the general format with sufficient accuracy.

Figure II-3.--Location of inverse coefficients in Matrix Inversion



To enter the table the identification number of the purchasing sector in the appropriate region is first found. The identification numbers of purchasing sectors appear on the top of each page. After finding the appropriate purchasing sector the producing sector is then located on either the left or right margin.

For example, the inverse coefficients for purchasing sector, "Paper and allied products . . ." in Region 3 and producing sector:

"Chemicals . . ." in Regions 1, 2 and 3 will be found. First, from Appendix E we obtain the identification number for the "Paper . . ." sector in Region 3, which is 190. We then find 190 at the top of the page, which first occurs on page 146. All coefficients relating to "Paper . . ." sector in Region 3 are found on pages 146-150. Next, the identification numbers of the "Chemicals . . ." sectors are found by reference to Appendix E: Region 1 -- 27, Region 2 -- 110 and Region 3 -- 193. We find the following inverse coefficients at the appropriate row-column intersections:

row	column	inverse coefficient
27	190	.00239
110	190	.00821
193	190	.00646

The first of the coefficients above relates to Region 1 of Appalachia. It shows that the direct and indirect requirements of chemicals produced in Region 1 would be $0.00293 per dollar of shipment to final demand by the "Paper . . ." sector of Region 3. Similarly, $0.00821 and $0.00646 of chemicals would be required from Regions 2 and 3 per dollar's worth of shipment to final demand by the "Paper . . ." of Region 3.

These values are <u>direct</u> and <u>indirect</u> requirements of chemicals which result from the shipment of a dollar's worth of output to final demand by the "Paper . . ." sector.

The coefficients include the chemicals needed directly in the

manufacture of paper; they include the chemicals needed in the forestry industry which provides the pulpwood; they also include the chemicals needed to produce the chemicals which are required ultimately in both the forestry and paper sectors.

C. IMPACTS OF WATER RESOURCE PROJECTS

The input-output model has the potential for measuring the economic impacts of changes in final demand. One such change in final demand is represented by construction of a water development project. A water development project is considered to be a final demand with respect to the Appalachian Region, because funds used for construction do not depend upon incomes in Appalachia. Other final demands for goods and services from the Appalachian Region are not altered by the project. It can be thought of as an addition to the existing set of final demands applicable to the region.

The impacts of twelve types of water development projects were estimated. These estimates showed the increases in incomes to persons living in all Appalachia which resulted from a project of a given type in a given region. Estimates of the economic impacts are presented for each project as though it was located in each region.

A column vector containing 249 rows was developed which estimated the direct requirements of each type of water development project according to region. The vector was estimated by multiplying the elements of the total direct requirements vector, in Appendix C, by the appropriate coefficients relating to interregional trade, in Appendix B. The worksheets of Appendix D bring together these above-mentioned coefficients (relating to total direct requirements and regional

distribution of products and services used in Appalachia) for the purpose of measuring economic impacts. These worksheets were used in preparing estimates of the economic impacts resulting from water development projects.

The procedure used to estimate the impact of water development projects follows:

a. Transcribe the value from the appropriate table of Appendix C to Column No. 1 of the three worksheets. Worksheets with the heading for Projects in Region 1 are employed in cases where the hypothetical project is assumed to be located in Region 1, etc.

A final demand vector for each region was computed by multiplying Column 1 by Column 2 and placing the product in Column 3. The regional final demand vectors were then multiplied by the sums of coefficients, from the model, which appear in Column 4. The product in Column 5 represents a change in income in Appalachia as the result of the final demand in that input-output sector and in that region. An estimate of the total change in income in Appalachia as the result of the project was found by summing the values in Column 5 for the three appropriate worksheets.

Estimates of economic impacts which would result from water resource development projects are presented in Table II-1. For example, the table shows that an expenditure of $1000 on large earth fill dams in Region 1 would result in an estimated increase in incomes of $806 in all Appalachia. If the project was

located in Region 2, it was estimated that the increase in incomes would be $841 for each $1000 spent on construction. Estimates of the incomes generated by water resource projects varied from $419 per $1,000 of project cost for powerhouse construction in Region 2 to $1,013 per $1,000 of project cost for levee construction in Region 1.

Table II-1.--Estimated income before taxes accruing to persons in Appalachia, per $1000 of project cost by type of project and region.

	Region 1	Region 2	Region 3
	dollars	dollars	dollars
Large earth fill dams	806	841	830
Local flood protection	918	903	900
Large dam and power generating facility	890	875	867
Dredging	925	906	895
Revetments	778	741	697
Miscellaneous	800	781	770
Pile dikes	893	876	850
Rock and concrete dam	688	661	656
Levees	1013	990	979
Medium concrete dams	866	855	852
Small earth fill dams	778	749	748
Powerhouse construction	458	428	419

III

SURVEYS

Mathematical models were constructed for most manufacturing sectors, using data in the 1963 Census of Transportation. For other sectors, however, it was necessary to conduct surveys in order to gather original data from places within Appalachia. The surveys were designed to provide estimates of the proportion of products or services supplied from within Appalachia to business establishments and households in Appalachia, as called for in the design of the analytical model. Surveys were taken to estimate interregional movements of agricultural and mineral products, to determine regions from which services are purchased and to determine where households in Appalachia purchased goods and services.

A. Survey for Estimating Interregional Movements of Agricultural and Mineral Products

The purpose of this survey was to determine the geographical areas where agricultural and mineral products that are used in Appalachia originate.

1. Sampling technique

Information concerning the sources of agricultural and mineral products was obtained from manufacturing plants which used these products in their manufacturing processes. Manufacturing plants using agricultural and mineral products and

their SIC's are shown in Table III-1. A list was then made of the names and addresses of establishments corresponding to these SIC's and which were located in Appalachia; this information was obtained from the most recent industrial directory for each state which was available. A random sample was then drawn from establishments appearing on this list.

Table III-1.--Types of manufacturing establishments surveyed.

SIC Code	Description
2011	Meat Slaughtering Plants
2015	Poultry Dressing Plants
2033	Canned Fruits and Vegetables
2034	Dehydrated foods
2035	Pickled foods
2037	Fresh Frozen Fruit and Vegetables
2041	Flour Mills
2042	Prepared Animal Feeds
2046	Wet Corn Milling
2063	Beet Sugar
2085	Distilled Liquor
2091	Cottonseed oil Mills
2092	Soybean Oil Mills
2093	Vegetable Oils Mills
2111	Cigarettes
2121	Cigars
2131	Chewing and Smoking
2141	Tobacco Steming and Redrying

Table III-1, Continued

SIC Code	Description
2211	Broad woven fabric mills, cotton
2231	Broad woven fabric mills, wool
2281	Yarn spinning mills cotton
2283	Yarn spinning mills wool
2871	Fertilizers
2911	Petroleum refining
3111	Leather Tanning
2819	Industrial inorganic chemicals
3274	Lime
2899	Sales
3211	Flat Glass
3221	Glass Containers
3241	Cement - Hydraulic
3251	Brick and Structural Clay Products
3253	Tile (floor)
3255	Clay Refractories
3259	Structural Clay Products
3312	Blast Furnaces
3321	Grey Iron Foundries
3322	Malleable Iron Foundries
3323	Steel Foundries
3331	Primary smelting and refining of copper
3332	Primary smelting and refining of lead
3333	Primary smelting and refining of zinc
3334	Primary smelting and refining of aluminum
3339	Primary smelting of metals not elsewhere classified
3361	Aluminum castings
3362	Brass, Bronze, Copper
3369	Metals not elsewhere classified

2. Number and geographic pattern of questionnaires taken

Table III-2.--Number of questionnaires taken in the survey for raw materials, by subregions

Sub-Region Number	Number of questionnaires taken
1	48
2	72
3	43
4	44
5	33
6	224
7	9
8	50
9	4
10	5
11	23
12	49
13	10
14	7
15	25
16	23
17	48
18	6
19	32
20	23
21	88
22	45
23	118
24	98
25	84
26	7
Total	1218

3. Questionnaire used

Figure III-3.--

APPALACHIAN ECONOMIC IMPACT STUDY

Conducted For
Office of Appalachian Studies
U. S. Army Corps of Engineers
P. O. Box 1159, 550 Main Street
Cincinnati, Ohio 45201

Survey of Raw Materials

Raw Material_____

Name of firm_____

Address_____

(_____) Major Products_____

Average Number of Employees in 1966_____

Is the headquarters of the firm located at this plant?_____

If not, where is the headquarters?_____

Sources of Raw Material City or Town	State	Percent from each source	Mode of transport

4. Estimation of interregional trade

The purpose of this survey was to obtain estimates of the pattern of interregional trade of agricultural and mineral products. Estimates of the pattern of trade were obtained for each of sectors 1-10. These estimates showed the proportion of the value of a sector's products supplied by each region: Northern Appalachia (Region 1) Central Appalachia (Region 2), Southern Appalachia (Region 3) and the rest of the U. S. (Region 4.)

The following steps were carried out to obtain these estimates:

1. The SIC of the manufacturing establishment was checked to assure consistency with its major products.
2. The establishment was then assigned to the appropriate input-output sector by using sector definitions which appear in Appendix Table E-1. The definitions used for this assignment were consistent with the definitions of sectors of the National input-output study for 1958.
3. The number of employees was recorded.
4. The average output per employee in the U. S. for 1964 for that input-output sector was then recorded.
5. An estimate of the value of output for that establishment was then made by multiplying the number of employed (3. above) times the average output per employee (4. above).
6. The appropriate direct requirements coefficient from the National input-output study for 1958 was then recorded.[1]

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[1] U.S. Department of Commerce, Survey of Current Business, Vol. 45, No. 9 (Sept. 1965), 40-45.

This coefficient would show the value of a producing sector's output required per dollar's worth of the producing sector's output. The coefficient would appear at the intersection of the column corresponding to the sector of the manufacturing establishment and the row corresponding to the particular agricultural or mineral sector for which the estimate is to be made.

7. The value of output of the establishment (5. above) was then multiplied times the appropriate direct requirements coefficient, described in (6. above), to yield an estimate of the total value of products from a particular agricultural or mineral sector used in production.
8. The value of goods supplied by each region was then estimated by multiplying the total value of products from a particular sector times the distribution of these products by region of origin. The distribution of products by region of origin was obtained from the questionnaires.
9. The establishments were then grouped according to regions in which they were located and the values of products terminating in each region of Appalachia were estimated according to region of origin. Subsequent calculations yielded the proportions used in the model.

Appendix Tables B-1 through B-10 show the regional distribution of agricultural products terminating in Appalachia.

B. Survey for Estimating Interregional Flows of Value in Finance, Insurance, Real Estate and Services

The purpose of this survey was to determine where the various services required in Appalachia are produced.

1. Sampling technique

Two-stage sampling was employed in this survey. The first stage was to select at random a county from each subregion. The second stage was to select a number of business firms from the county selected in the first stage. The category of all business establishments was subdivided into two groups: (1) those with 100 employees or less, and (2) those with over 100 employees.

2. Number and geographic pattern of questionnaires taken

Table III-3.--Questionnaires taken in survey for estimating interregional flows of value in finance, insurance, real estate and services, by subregions and counties

Subregion	County/counties	Number of questionnaires taken
1	Otsego, N.Y.	10
2	Cattaraugus,N.Y.	33
3	Luzerne, Pa.	40
4	Clinton, Pa.	9
5	Allegany, Md.	17
6	Onio, W.Va.	40
7	Tuscarawas, O.	40
8	Muskingum, O.	40
9	Brown, Adams, Clermont, O.	20

cont'd on next page

Subregion	County/counties	Number of questionnaires taken
10	Allegheny, Pa.	20
11	Harrison, W. Va.	40
12	Kanawha, W. Va.	40
13	Madison, Ky.	25
14	Alleghany, Va.	--
15	Surry, N. C.	40
16	Washington, Va. Sullivan, Tenn.	40
17	Knox, Tenn.	40
18	Putnam, Tenn.	31
19	Burke, N. C.	38
20	Buncombe, N. C.	40
21	Hamilton, Tenn.	40
22	Lauderdale Colbert, Ala.	40
23	Greenville, S. C.	--
24	Forsyth, Ga.	--
25	Jefferson, Ala.	40
26	Lee, Miss.	26
	Total	749

3. Questionnaire used:

Figure III-2

APPALACHIAN ECONOMIC IMPACT STUDY

Conducted For
Office of Appalachian Studies
U. S. Army Corps of Engineers
P. O. Box 1159, 550 Main Street
Cincinnati, Ohio 45201

Survey of Finance, Insurance, Real Estate and Services

Name of firm_____

Address_____

( ) Major Products_____

Average Number of Employees in 1966_____

Is the headquarters of the firm located at this plant?_____

If not, where is the headquarters?_____

What percent of your expenditures in 1966 for each of the following was spent in areas A, B, and C shown on the accompanying map of the Appalachian Region, and what proportion was spent outside the Appalachian Region? The location of firms providing these services is of primary importance. If your firm has no expenditures in a particular category, write "none."

	A	B	C	Outside
1. Banking charges (including interest paid by you on loans)				
2. Payments to credit and loan agents other than banks				
3. Insurance premiums other than life insurance (give region of home office of insurance companies)				
4. Rental of land and/or buildings				
5. Royalties (including payments for use of patents, licenses, etc., and royalties on the extraction of minerals)				

	A	B	C	Outside
6. Advertising				
7. Consultants				
8. Engineering and Architectural Services				
9. Contributions to business and professional associations, to charity, to political and similar groups.				
10. Expenditures for maintenance and repair construction (according to locations of firms providing these services)				
11. Printing and publishing				
12. Residence of employees (per cent residing in each region during work week)				
13. Shipment of output (per cent of total value of shipments to each region)				
14. If this plant is the headquarters of the corporation, estimate what per cent of the corporate stock is held by persons in each region				

4. Estimation of interregional trade

Information from the questionnaires was used to estimate the region of origin of each type of service. Such a distribution was prepared for each classification of establishments: those with 100 or less employees and those with over 100 employees. Specifically, regional distributions were estimated from the survey for the following expenditures:

Banking

Non-life insurance

Rents

Royalties

Advertising

Estimates were then developed for regions by using data relating to the number of establishments according to size. It was assumed that all industries within a particular size classification had the same regional preference function with respect to a particular expenditure item, for example--banking. This assumption, of course, did not require a further assumption relating to the similarity of input coefficients. The regional preference functions which were estimated at least in part from this survey are shown in Appendix Tables B-70, B-71 and B-73.

Question 14 of the questionnaire was also used to estimate the distribution of dividend-type income.

C. Survey of Households

The purpose of this survey was to determine the geographic pattern of expenditures of persons living in Appalachia.

1. Sampling technique

The method employed was two-stage sampling. In the first stage a county was selected at random. The same county was selected in this survey as in the survey relating to finance, insurance, etc. In the second stage households were selected at random from each of three income groups. The income groups were: under $4,000; $4,000 - 7,499; and $7,500 and over.

2. Number and geographic pattern of questionnaires

Table III-4.--Questionnaires taken in survey of households, by region and county

Sub-Region	County/counties	Number of Questionnaires Taken
1	Oneonta, N.Y.	40
2	Olean, N.Y.	34
3	Wilkes Barre, Pa.	40
4	Clinton, Pa.	16
5	Allegany, Md.	40
6	Onio, W. Va.	40
7	Tuscarawas, O.	40
8	Muskingum, O.	40
9	Brown, Adams Clermont, O.	40
10	Allegheny, Pa.	--
11	Harrison, W. Va.	40

continued on next page

Subregion	County/counties	Number of Questionnaires Taken
12	Kanawha, W. Va.	40
13	Madison, Ky	40
14	Alleghany, Va.	32
15	Surry, N. C.	40
16	Washington, Va. Sullivan, Tenn.	40
17	Knox, Tenn.	--
18	Putnam, Tenn.	40
19	Burke, N. C.	34
20	Buncombe, N. C.	40
21	Hamilton, Tenn.	--
22	Lauderdale Colbert, Ala.	40
23	Greenville, S.C.	--
24	Forsyth, Ga.	27
25	Jefferson, Ala.	40
26	Lee, Miss.	29
	Total	812

3. Questionnaire Used:

Figure III-3

APPALACHIAN ECONOMIC IMPACT STUDY

Conducted For
Office of Appalachian Studies
U. S. Army Corps of Engineers
P. O. Box 1159, 550 Main Street
Cincinnati, Ohio 45201

Survey of
Household Expenditures

Name_____

Address_____

1. How many persons lived in your house or apartment at the end of 1966? (include children but not roomers or boarders) _____
2. How many members of your household work outside the county?_____
   Where?_____
3. Did you make any mail order purchases last year?_____
   If so, how much did you spend on each of the following and from which company did you buy?

Type of Purchase	Amount Spent	Company
Clothing		
Furniture		
Household Appliances		
Any other (specify		

4. Did you shop outside the county in 1966?_____
   Where did you shop?_____

In 1966, what per cent of your expenditures on each of the following were made outside the county? (exclude mail order purchases)

Type of Purchase	Location	Per cent	Location	Percent
Groceries				
Clothing				
Furniture				
Appliances				
Other (specify)				

5. City (cities) where your life insurance (including Veterans) endowment, disability and other personal insurance company(s) is(are) located_____

6. City (cities) where your property insurance company(s) is(are) located_____

7. City (cities) where your hospitalization and other health insurance company(s) is(are) located_____

8. City (cities) where your auto insurance company(s) is located

9. Did you have expenditures for medical care outside the county?_____

What per cent of your total expenditures for medical care were made outside the county in 1966? In which cities were these made?

City	Percent of total expenditures for medical care

10. Do you own your home?_____ If so, where do you send your mortgage payment?_____

If you rent, where do you make or sent your payment?_____

to an individual?_____

to an organization?_____

11. Was anyone in your household away at school during the winter of 1965-1966?_____Where is the school located?_____

What amount was paid by you or sent to him for his support during the school-year 1965-66?

Tuition_____

Room and board_____

Book,s supplies & equipment_____

12. What percent of gifts and contributions were made to persons or organizations outside the county?_____

Where were these persons or institutions located?_____

_____

13. In 1966 how many trips were made by your family outside the county, including vacations?_____

What amount was spent on all trips and vacations?

Place			
Gas			
Public transportation			
Lodging			
Meals and purchased food			
Entertainment			
All expense tours			

14. In which category would the combined income of your household fall? (See attached list)

A. Under $1,000

B. $1,000 - $1,999

C. $2,000 - $2,999

D. $3,000 - $3,999

E. $4,000 - $4,999

F. $5,000 - $5,999

G. $6,000 - $7,499

H. $7,500 - $9,999

I. $10,000 - $14,999

J. $15,000 and over

IV

STATISTICAL MODELS ESTIMATING INTERREGIONAL TRADE

In general, the procedure which was followed was to fit statistical models estimating interregional shipments. In these models, the value of shipments between any two regions was assumed to depend upon production in the shipping region, use in the receiving region and cost of movement. Distance was used as a surrogate variable for transport costs due to insufficient data on transport costs.

Once these models were fitted, they were used to estimate shipments originating in states of the coterminous United States and terminating in Appalachia. Estimates were also made of trade flows originating in one economic sub-region of Appalachia and terminating in another. Estimates of interregional shipments were made for each input-output sector. Thus it was possible to estimate the input-output coefficients of the interregional model from the "direct requirements" table for the United States and the estimates of trade flows.

A. Methodology Employed

In order to fit the desired regression models it was necessary to develop information concerning shipments, production and use of the products of each shipper group by census regions. This information was not readily available. Furthermore, it was necessary that methods of quantifying independent variables for the

statistical analysis be consistent with methods which would be used later to estimate these same variables for the sub-regions of Appalachia. Therefore, a computer program was developed which integrated various data files for the purpose of quantifying these variables. A detailed flow chart relating to this program is given in Chapter VI, under the heading "Statistical Analysis and Data Reduction System." The purpose of the following sections is to describe the sources of basic data files and their use in developing the variables of the regression analysis.

Regression analyses were conducted for twenty-two groups of manufactured products, which will be called statistical analysis groups. A total of ten models were fitted for each statistical analysis group.

B. Models Tested:

The general hypothesis for this problem is that for a given statistical analysis group:

$$S_{gh} = f(P_g, U_h, D_{gh}) \qquad \ldots(VI\text{-}1)$$

where: S_{gh} = the value of shipments of products of the statistical analysis group from region g to region h

P_g = the value of the products of the statistical analysis group produced in region g

U_h = the value of products of the statistical analysis group used in region h

D_{gh} - the geographical distance between region g and region h

The following models were fitted by regression:

$$S_{gh} = a = b\,P_g + c\,U_h + d\,D_{gh} \quad \ldots(IV\text{-}2)$$

$$S_{gh} - a\,P_g^{\,b}\,U_h^{\,c}\,D_{gh}^{\,d} \quad \ldots(IV\text{-}3)$$

$$S_{gh} = \frac{a\,P_g\,U_h}{D_{gh}\,\sum_g P_g} \quad \ldots(IV\text{-}4)$$

$$S_{gh} = a + b\,\frac{P_g}{\sum_g P_g} + c\,U_h + d\,D_{gh} \quad \ldots(IV\text{-}5)$$

$$S_{gh} = a + b\,\frac{P_g}{\sum_g P_g} + c\,\frac{U_h}{\sum_g P_h} + d\,D_{gh} \quad \ldots(IV\text{-}6)$$

$$S_{gh} = a\,\frac{P_g\,U_h}{D_{gh}^{\,b}} \quad \ldots(IV\text{-}7)$$

$$S_{gh} = a\,\frac{P_g\,U_h}{D_{gh}^{\,b\sum_g P_g}} \quad \ldots(IV\text{-}8)$$

$$S_{gh} = a + b\,P_g + c\,P_g^{\,2} + d\,U_h + e\,U_h^{\,2} + f\,D_{gh} + k\,D_{gh}^{\,2} \quad \ldots(IV\text{-}9)$$

$$S_{gh} = a\,\frac{P_g\,U_h}{D_{gh}^{\,2}} \quad \ldots(IV\text{-}10)$$

C. Quantification of Variables

1. Production

Production for a statistical analysis group in a census region was estimated as follows:

a. Employment by census region, and by input-output sector, File "M," multiplied by output per employee for the U.S., File "B," to yield estimates of production by census region and by input-output sector.

b. Input-output sectors within a statistical analysis group, File "R," were then summed, yielding estimates of production by census region and by statistical analysis group, which was required for the regression analysis.

2. Use

Use of products of a "statistical analysis group" is defined to include (1) industrial use on the current account, (2) industrial use on the capital account, and (3) use for personal consumption expenditures.

a. Industrial use--current account

The national input-output model for 1958 presents inter-industry sales and purchases which are recorded on the current account of the purchasing unit. Likewise, the direct requirements table[1] gives the current account purchases per dollar output of the purchasing industry.

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[1] Survey of Current Business, Vol. 45, No. 9 (September 1965), p. 40.

These data can, therefore, be used in estimating the required quantity.

Industrial use--current account for a given input-output sector (in this example, Sector i) and a given census region was computed as follows:

$$\sum_{j=1}^{82} a_{ij} P_j^{(h)}$$

where a_{ij} are the direct requirement coefficients from the input-output matrix, File "G."

$P_j^{(h)}$ is production in input-output Sector j, in Census Region h.[1]

b. Industrial use--capital account

The 1958 input-output study shows the value of shipments to the final demand sector "Gross private fixed capital formation." In other words, the total value of sales on the capital account is recorded by the selling input-output sector. The published input-output study does not show the distribution of sales on the capital account by purchasing input-output sector. However, unpublished information[2] was obtained which presented

---

[1]The method used to estimate production by input-output sector is described in Section IV-C-1.

[2]Data files from the U. S. Bureau of Labor Statistics, Division of Economic Growth.

estimates of 1958 capital flows: the values of purchases on the capital account for each input-output sector by each selling input-output sector. Capital coefficients estimated from these data, and described in File "Z," were used to develope estimates of industrial use--capital account.

The following computational procedure was used to estimate industrial use--capital account for input-output Sector i and Census Region h:

$$\sum_{j=1}^{82} c_{ij} P_j^{(h)}$$

where: c_{ij} are the capital coefficients for 1958 from File "Z"

and $P_j^{(h)}$ is production in input-output Sector j, in Census Region h.[1]

c. Personal consumption expenditures

The final component of total use of products of an input-output sector in a census region is personal consumption expenditures. For each census region estimates of personal consumption expenditures were made by multiplying National average propensities to consume the products of particular input-output sectors (File "D") by the personal income of the census region (File "Q").

---

[1]The method used to estimate production by input-output sector is described in Section IV-C-1.

Estimates of total use of the products of an input-output sector in a census region were made by summing use--current account, use--capital account and personal consumption expenditures. Use was then summed by input-output sector according to input-output sectors contained in a statistical analysis group, File "R," yielding estimates of use by census region and by statistical analysis group which was required for the regression analysis.

3. Shipments

Another of the variables required for the statistical analysis was interregional shipments among census regions. Estimates of the value of shipments in a statistical analysis group were made as follows:

a. For each census region, a percentage distribution of interregional trade flows by census region of destination and shipper group (File "S") was multiplied by tons of shipments originating in a census region.

b. Statistical analysis groups were formed by combining input-output sector using File "R" and the volume of interregional trade flows were obtained for these groups by appropriate summation of shipper group values.

c. A percentage distribution of the tons of shipment by region of destination was then made for the combined shipper groups within a statistical analysis group.

d. This percentage distribution was then multiplied by the production[1] in a statistical analysis group within a

---

[1]The method used to estimate production by input-output sector is described in Section IV-C-1.

census region to yield estimates of the value of trade flows by census region of destination and origin for a statistical analysis group.

4. Distance

The average length of interregional shipments was obtained in miles by dividing the number of ton-miles for each interregional shipment, File "T," by the number of tons for each interregional shipment, File "S."

The distance component used in the 1963 Census of Transportation was calculated by a computer program known as "PICADAD." The distance calculated by this program is an estimate of the straight-line miles between the origin and destination shown on the shipping document, without recognition of the actual route used for the shipment. On the average, railroad short-line and highway direct-route distances exceed calculated straight-line distances by about 24 percent and 21 percent, respectively.

In some cases entries did not appear in one-half or both halves of Table 9. In these cases distances were estimated by first estimating the center of gravity of population in each census region.[1,2] The direct-route highway mileage was then

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[1]Measurements were made by use of the map. U. S., Bureau of the Census, Standard Metropolitan Statistical Areas of the United States and Puerto Rico: 1963.

[2]Population data were obtained from U. S., Bureau of the Budget, Standard Metropolitan Statistical Areas (1961)

estimated between the locations of the centers of population.[1] The direct-route distance was then divided by 1.21 for the purpose of estimating straight-line miles.[2]

D. Data Files

The data files which are referred to in this section are card and tape records which form inputs to the computer system used in the reduction of data for statistical analysis. The complete file is presented where its actual composition would help the reader's understanding or his evaluation of procedures. In most cases, however, the values contained in the records would not contribute to either understanding or evaluation and therefore are not included. Descriptions of data sources and procedures followed in estimating the numerical values are provided.

1. Employment: File "M"

Procedures for estimating employment by input-output sector for census regions and for counties were essentially the same. Therefore, the description below relates to estimating employment for both states and counties. State estimates of employment were used to form the estimates for census regions, needed for the statistical analysis. County estimates relate to estimating interregional trade terminating in Appalachia, which is discussed in Chapter V.

a. General procedures

In general, employment for the purpose of this study

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[1] Rand McNally and Company, Road Atlas (43 rd ed.; Chicago).

[2] 1963 Census of Transportation, p. 2.

is defined as employment other than "administrative and auxiliary" as used in County Business Patterns.[1] The procedure followed in estimating employment was to use published data of the Bureau of the Census which appears in County Business Patterns, 1964, and when needed, the 1963 Census of Manufactures.[2] Employment data were secured for each state in the U. S. and for each county within Appalachia. Employment data for states were secured from County Business Patterns, Table 1-B, "State by Industry, 1964," in the column headed "Number of Employees, mid-March pay period." Employment data for counties were found in Table 2, "Counties; 1964," in the column headed "Number of Employees, mid-March pay period."

In County Business Patterns, the Bureau of the Census classifies employees according to Standard Industrial Classification Codes (SIC). The 2-, 3- and 4-digit SIC Codes were used to construct the sectors of the 1958 Input-Output Study.[3] The Location of Manufacturing Plants, a Special Report of the 1963 Census of Manufactures, lists the number of plants by size-class by 4-digit SIC in each

---

[1] U. S., Bureau of the Census, County Business Patterns, 1964.

[2] U. S., Bureau of the Census, 1963 Census of Manufactures; Location of Manufacturing Plants by Industry, County, and Employment Size.

[3] Survey of Current Business, Vol. 45, No. 9 (September 1965), p. 33.

county in the U. S. The Size of Establishments[1] section of the 1963 Census of Manufactures lists for industries the number of establishments in each employment size-class and lists for industries the total number of employees in each employment size-class.

County Business Patterns includes the following types of employees covered under the Federal Insurance Contributions Act: (1) all covered wage and salary employment of private non-farm employers and of non-profit membership organizations under compulsory coverage; and (2) all employment of religious, charitable, educational and other non-profit organizations covered under the provisions of the Federal Insurance Contributions Act. The following types of employment covered by the Social Security Program, in whole or in part, are excluded from basic tabulations: government employees, self-employed persons, farm workers, and domestic workers reported separately. Also, railroad employment subject to the Railroad Retirement Act and of employment on ocean-borne vessels are not included.

County Business Patterns contains a category of employees called "administrative and auxiliary." These employees are not classified as employed in any particular industry or SIC. Therefore, employees classified as "administrative and auxiliary" were not considered when estimating employment for an input-output sector.

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[1]U. S. Bureau of the Census, 1963 Census of Manufactures; Size of Establishments.

Where employment data are shown in enough detail so that employment can be estimated in input-output sector, the employment data in the appropriate columns in County Business Patterns were grouped according to input-output sectors.

b. Disclosure problems--general

A disclosure problem occurred when the publication of an item would disclose the operation of an individual reporting unit. The Census Bureau withholds publication of an item of this type and a "D" appears in the column headed "Number of Employees, mid-March pay period." However, the number of reporting units in a kind of business and their distribution by employment size-class are not considered a disclosure by the Bureau of the Census. Therefore, these items appear in cases where employment figures are withheld to avoid disclosure.

c. Disclosure problems--establishments with 499 employees or less

The number of reporting units, by employment size-class for a state or county, and the average number of employees per establishment for the U. S. were used to estimate employment for the 2-, 3-, and 4-digit SIC's for the state or county. These estimates, with disclosure problems, were then used with published employment data for 2-, 3-, and 4-digit SIC's to construct estimates of employment by input-output sectors.

d. Disclosure problems--establishments with 500 employees or more

In this case, the SIC of the establishment was found in Location of Manufacturing Plants. This publication had an additional employment size-class of 500-999 whereas County Business Patterns classified all plants with over 500 employees in the size-class: "500 or over." If the establishment was found to have between 500-999 employees, its employment was estimated as the average employment in the size-class 500-999 in the U. S. for that particular industry using data from Size of Establishments. If an establishment had over 999 employees, its employment was estimated as the average size of establishments within that size-class for that particular industry in the U. S.

e. Industries with less than ten reporting units and less than 100 employees

In counties with small populations there were very limited data available in County Business Patterns and sometimes manufacturing employment was not broken down at all by SIC. This occurred because data are not shown separately for any industry which does not have at least 100 employees or ten reporting units in a county. These data for an unpublished industry are included, however, in the totals shown for the broader industry groups. In these cases, industrial classification of establishments from Locations of Manufacturing Plants and the employment totals

for manufacturing from County Business Patterns were used as controls in estimating employment by input-output sector.

f. Reconciliation of estimates

After the published and estimated employment figures were recorded by input-output sector, values for all sectors were summed and reconciled with the published employment totals and sub-totals from County Business Patterns.

When total employment for a state estimated by input-output sectors did not agree with the published total in County Business Patterns, revisions were made in estimates of employment in establishments with over 1000 employees were disclosure problems existed. Revisions of this type were accomplished by determining which large plants were responsible for the discrepancies, through the use of state industrial directories. If the differences still could not be reconciled, employment estimates in all remaining plants with over 1000 employees were revised upward or downward by the same percentage until the employment totals by input-output sectors and the published totals in County Business Patterns were in agreement.

When the total employment for a county, estimated by input-output sectors, did not agree with the published total in County Business Patterns, the procedure followed to correct the differences was essentially the same as for the states. In some cases, however, it was necessary to

revise the estimated employment figures for establishments with less than 1000 employees. This was necessary because published data for counties was not as complete as data for states. Many counties did not have any establishments with over 1000 employees. If this was the case, the estimated employment in smaller establishments was revised upward or downward by the same percentages so that revised employment estimates by input-output sectors totaled the published data of County Business Patterns.

g. Agriculture

Data concerning output of agriculture by type of farm are available for counties and states. Therefore, it is not necessary to use the round-about method for estimating output. Rather, estimates of output can be made directly in 1964 dollars from the 1964 Census of Agriculture. File "M" contains values of output for Sector 1, "Livestock and livestock products" and for Sector 2, "Other agricultural products" adjusted for National consistency. These values are multiplied by "1" in File "B" and therefore are conceptually consistent with estimates of production for other input-output sectors.

2. Output per employee: File "B"

Estimates of output per employee which were used in this study reflect estimates of labor productivity in 1964 and are in 1958 dollars. The number of employees used to form the ratio for a given input-output sector is equal to total number

of employees in the U. S. in that sector other than "administrative and auxiliary" as defined in County Business Patterns 1964.

a. General procedures

In general, the method employed was to obtain output indexes for National input-output sectors (1958 = 100). Estimates of total output for each input-output sector in 1964 were then made by multiplying 1958 output by the 1964 index number. Output deflators for input-output sectors were then employed to obtain estimates of 1964 output in 1958 dollars. The estimate of 1964 output in 1958 dollars was then divided by the number of employees, as was discussed above.

b. Output--1958

The value of output of each input-output sector in the U. S. was obtained from the National input-output study for 1958,[1] Table 1, "Interindustry Transactions, 1958" in the column headed "Total."

c. Output indexes

Output indexes were obtained or constructed for input-output sectors, with 1958 = 100. For most of the input-output sectors, unpublished output indexes were available.[2]

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[1] Survey of Current Business, Vol. 45, No. 9 (September 1965), p. 39.

[2] Data files of Office of Business Economics, U. S. Department of Commerce.

However, output indexes for sectors 1-13 and 74 were not readily available.

Publications of the U. S. Bureau of Mines were used to obtain output indexes for mineral industries.[1] Output indexes for "New construction," Sector 11, were estimated data appearing in Construction Review.[2]

Output indexes were not required for Sector 1, "Livestock and livestock products" or Sector 2, "Other agricultural products," because the value of output[3] in 1964 by census region was used in place of employment (in File "M"). Therefore, the application of the output deflator to these estimates was all that was required.

d. Output deflators

Unpublished implicit price deflators for sectors 14-64, 66, 67, 70-73 and 75-79 were obtained from the Office of Business Economics.[4] Information was also obtained from the Office of Business Economics concerning deflators for electric and gas utilities and for transportation and

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[1] U. S., Bureau of Mines, 1965 Minerals Yearbook; Minerals and Metals, Vol. 1.

U. S., Bureau of Mines, 1964 Minerals Yearbook; Mineral Fuels, Vol. II.

U. S., Bureau of Mines, Index Numbers for the Mining Industry, Information Circular IC - 8275 (1965).

[2] U. S., Department of Commerce, Construction Review.

[3] Estimates of the value of output were obtained from U. S., Bureau of Census, 1964 Census of Agriculture.

[4] From data files of Office of Business Economics, U. S. Department of Commerce.

warehousing. Deflators of the agricultural sectors were developed from indexes of cash receipts from marketings, indexes of physical volume of marketings and indexes of prices received by farmers.[1] Output deflators for sectors 5-10 were obtained from published statistics of the U. S. Bureau of Mines.[2,3] An output deflator for Sector 11, "New construction," was obtained from the composite construction cost index of the U. S. Department of Commerce.[4]

e. Other sectors

Labor productivity for Sector 12, "Maintenance and repair construction," was assumed to be the same as for Sector 11, "New construction," because of a lack of data for making a separate estimate. The Office of Business Economics had no separate indexes for Sector 13, "Ordinance and accessories." Estimates of labor productivity for Sector 60, "Aircraft and parts," were used for Sector 13.

Output indexes and deflators for sectors 3, 4 and 74 were not readily available. Our plan was to use general indexes of output and prices in order to estimate labor

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[1] U. S., Department of Commerce, Office of Business Economics, 1965 Business Statistics, A Supplement to the Survey of Current Business, pp. 14, 38, 39.

[2] Minerals Yearbook 1965, Vol. I, p. 18.

[3] Index Numbers for the Mining Industry, 1965, p. 82.

[4] Business Statistics, 1965, p. 52.

productivity for 1964 in 1958 prices. However, File "B" records for these sectors erroneously showed output per employee as zero. Therefore, in every region, estimates of production in these sectors is zero. Since they are not manufacturing industries, the underestimates in production cause no problem. However, since production of these three sectors is zero we have a slight underestimate of the use of the products of each statistical analysis group in each census region. This underestimate results from an underestimate of "industrial use--current account" and "industrial use--capital account," the computation of which involved production. It is our conclusion that the slight understatement of use would not substantially alter the results of the subsequent statistical analysis.

3. Input-output matrix: File "B"

The "input-output matrix: File 'B'" was developed by linear interpolation--coefficient-by-coefficient from two consistent matrixes (one for 1958 and one for 1970). The objective of this procedure was to estimate National coefficients for 1964.

The "input-output matrix: File 'B'" was developed from the direct requirements table of the 1958 input-output study[1] and a direct requirement matrix for 1970 which was projected by the "Interagency Growth Study."[2] Specifically, a 5-digit

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[1]Tape for the 1958 matrix was obtained from U. S., Department of Commerce, Office of Business Economics.

[2]Card deck for the 1970 matrix was obtained from U. S., Bureau of Labor Statistics, Division of Economic Growth.

rounded coefficients, computed from a total output base were used for the 1958. The card deck for the 1970 matrix contained 7-digit coefficients which were rounded to 5-digits using routines which were developed as part of the study.

Sector identification numbers for the 1970 matrix were the same as those of the 1958 input-output study. The 1970 study is in terms of 1958 prices as were used in the 1958 input-output study. Several minor changes, however, were made by the "Inter-agency Growth Study,"[1] and these changes were followed in this study. Changes were also made in the 1958 matrix to achieve consistency. These changes are as follows:

a. The government grain operations were not considered in the 1970 matrix; therefore, the coefficient in row 2, column 78 was made zero.

b. A definitional change was made in Sector 74, "Research and development." Column 74 of the 1970 matrix reflected only primary research and development. These coefficients in column 74 reflect projected actual purchases per dollar output. In the 1958 matrix all research and development activity, wherever in the private economy it was performed, was transferred into the research and development sector. As a result, the coefficients of the 1958 input-output study reflect both real inputs and transferred research

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[1]Letter from U. S., Bureau of Labor Statistics, Division of Economic Growth.

and development performed by other industries. The coefficients of the 1964 matrix for column 74 equal those for the 1970 matrix.

c. Average propensities to consume: File "D"

Average propensities to consume: File "D" were estimated by dividing U. S. personal consumption expenditures by input-output sector for 1958[1] by U. S. personal income for 1958.[2]

d. Personal income: File "Q"

The records of File "Q," personal income by Census region, were obtained by summing state estimates of personal income for 1964.[3]

e. Composition of statistical analysis groups: File "R"

Each shipper group was defined in terms of input-output sectors by assigning each appropriate manufacturing input-output sector to an appropriate shipper group. This assignment was based upon a comparison of industries contained in respective input-output sectors and shipper groups. The following assignments were made: in the case of Sector 14, "Food and kindred products" and Sector 15, "Tobacco products,"

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[1] Survey of Current Business, Vol. 45, No. 45 (September 1965), p. 39.

[2] U. S., Department of Commerce, National Income and Product Accounts of the United States, 1929-1965; Statistical Tables (August 1966), p. 33.

[3] U. S., Department of Commerce, Survey of Current Business, Vol. 46, No. 4 (April 1966), p. 10.

it was necessary to combine both shipper groups and input-output sectors. This was done for the purpose of obtaining information for shipments, and for production and use at the same level of detail. In this case, interregional shipments of meat and dairy products were known from the 1963 Census of Transportation, whereas methods for estimating "production" by region and "use" by region could not be made by our procedures for this fine a classification. The composition of statistical analysis groups is shown in Table IV-1.

f. Shipments--tons and percentages: File "S"

Records of File "S" were obtained from Table 9 in the 1963 Census of Transportation; Shipper Groups, for respective shipper groups.

g. Shipments--ton-miles and percentages: File "T"

Records of File "T" were obtained from Table 9 in the 1963 Census of Transportation; Shipper Groups, for respective shipper groups.

Table IV-1.--File "R," composition A of statistical analysis groups

Statistical analysis group number	Included shipper group identification number[1]	Included sector identification number[2]
1	1, 2, 3	14, 15
2	4	16, 17, 33, 34
3	5	18, 19
4	6	24, 25
5	7	27, 28
6	8	29, 30
7	9	31
8	10	32
9	11	20, 21
10	12	22, 23, 64
11	13	35, 36
12	14	37
13	15	38
14	16	40
15	17	39, 41, 42
16	18	47, 48, 49
17	19	43, 44, 45, 46, 50, 51, 52
18	20	56, 57
19	21	53, 54, 55, 58
20	22	59
21	23	60, 61
22	24	62, 63

[1]Shipper group identification numbers are from U. S. Bureau of the Census, 1963 Census of Transportation, Vol. TC 63-C1.

[2]Sector identification numbers are from Survey of Current Business, Vol. 45, No. 9 (September 1965), p. 33.

h. Capital coefficients: File "Z"

Capital coefficients are estimates of the quantity of capital goods needed per dollar output of the purchasing industry. They were computed as follows:

$$c_{ij} = \frac{C_{ij}}{X_j} \qquad \ldots(IV\text{-}11)$$

where c_{ij} - the capital coefficient.

C_{ij} = the value of output of Sector i purchased by Sector j and recorded on the capital account.

X_j = the output of Sector j.

Values for C_{ij} were obtained by distributing total gross private fixed capital formation[1] for a given sector over the purchasing sectors. A table showing the percentage distribution of the outputs of capital goods producing sectors was used for this distribution.[2] Values of X_j, of course, were from the 1958 input-output study.[3]

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[1] Survey of Current Business, Vol. 45, No. 9 (September 1965), p. 39.

[2] Worksheets showing the percentage distribution of the output of each category of capital goods were obtained from U. S., Bureau of Labor Statistics, Division of Economic Growth.

[3] Survey of Current Business, Vol. 45, No. 9 (September 1965), pp. 33-49.

E. Statistical Analysis

Multiple regression analysis was used to estimate ten separate equations for each statistical analysis group. Regression analyses were made using BMD Biomedical Computer Programs.[1] On the basis of this analysis, the following model was selected for use in estimating interregional trade for the Appalachian input-output study:

$$S_{gh} = a\, P_g^{\,b}\, U_h^{\,c}\, D_{gh}^{\,d} \qquad \ldots(IV\text{-}12)$$

This model reduces to the following linear model by taking a logarithmic transformation:

$$\ln S_{gh} = \ln a + b \ln P_g + c \ln U_h + d \ln D_{gh}. \qquad \ldots(IV\text{-}13)$$

Table IV-2 presents estimates of the parameters, standard errors of estimate and R^2's for this model

Table IV-2.--Estimates of the parameters, standard errors and R^2, by statistical analysis group.

Statistical analysis groups	ln a	b	c	d	R^2
1	-2.70541	0.88668 (0.17054)	0.83502 (0.18328)	-1.33084 (0.12108)	0.7268
2	-1.72540	1.07914 (0.09722)	0.45306 (0.13659)	-0.98838 (0.14889)	0.7521
3	-5.80508	1.08072 (0.11028)	0.70970 (0.13455)	-0.71710 (0.10371)	0.7369
4	2.08991	0.55755 (0.10011)	0.88455 (0.08780)	-1.44561 (0.07652)	0.8959

continued--

[1] McDonnell Automation Center, Abstracts of Biomedical Computer Programs (October 1966).

Table IV-2, cont'd.

Statistical analysis group	In a	b	c	d	R^2
5	-0.46745	0.62156 (0.12739)	0.79002 (0.11463)	-0.96880 (0.09983)	0.7718
6	2.49475	0.90363 (0.16264)	0.40071 (0.19714)	-1.27109 (0.13768)	0.6964
7	-1.78430	0.90689 (0.19540)	0.56827 (0.30834)	-1.02020 (0.17146)	0.4659
8	-2.24703	0.94862 (0.09314)	0.63695 (0.11230)	-0.85955 (0.09798)	0.7802
9	-6.20102	1.31580 (0.18603)	0.86515 (0.24590)	-1.23438 (0.14848)	0.6185
10	-4.89122	1.26028 (0.14339)	0.64667 (0.15542)	-0.99540 (0.11303)	0.7283
11	3.43606	0.88375 (0.21298)	0.41955 (0.21719)	-1.60250 (0.13109)	0.7252
12	0.07671	1.06404 (0.14345)	0.47871 (0.19347)	-1.36670 (0.18926)	0.7410
13	-4.69651	0.86719 (0.10972)	0.92216 (0.11400)	-0.80982 (0.09756)	0.7462
14	0.59831	0.89518 (0.16809)	0.55853 (0.19081)	-1.18526 (0.12237)	0.6741
15	-3.07975	1.00666 (0.11517)	0.74734 (0.13495)	-1.09211 (0.11363)	0.7692
16	-2.83986	.91157 (0.10082)	0.68252 (0.11950)	-0.81500 (0.11105)	0.7702
17	-8.61260	1.22767 (0.14253)	0.83905 (0.17229)	-0.67622 (0.12045)	0.6986
18	-7.04024	0.99548 (0.06273)	0.80563 (0.08230)	-0.40893 (0.08101)	0.8453
19	-5.03740	1.04515 (0.08973)	0.67856 (0.12065)	-0.67892 (0.10500)	0.7754
20	2.86203	1.05818 (0.10965)	0.28382 (0.16846)	-1.46619 (0.16302)	0.7686
21	-4.84789	0.99477 (0.17396)	0.86783 (0.18247)	-0.88309 (0.13449)	0.5362
22	-5.55751	0.85065 (0.12348)	0.93459 (0.11837)	-0.53728 (0.10405)	0.7691

V

ESTIMATION OF INPUT-OUTPUT COEFFICIENTS, INTERDEPENDENCE COEFFICIENTS AND CONSTRUCTION MULTIPLIERS

In Chapter IV statistical models for estimating interregional trade were discussed. We now turn to the use of the models selected for the purpose of estimating interregional trade in Appalachia. Our method for developing the input-output model for Appalachia calls for information about interregional trade terminating in Appalachia, by input-output sectors. Surveys were made to estimate interregional trade for some sectors. The models will be used to estimate interregional trade in other sectors. A set of sub-areas outside of Appalachia was delineated. Data was then compiled for these sub-areas for the purpose of estimating the independent variables of the model: Production, Use and Distance. Values for the independent variables were inserted into the models and the models were then employed in estimating interregional trade terminating in Appalachia.

A. Sub-areas Outside Appalachia

Figure V-1 shows the sub-areas both within and outside of the Appalachian Region. Non-Appalachian parts of Appalachian states were designated as sub-areas. An entire state was designated as a sub-area in cases where no part of that state was within Appalachia. Only the coterminous U. S. was considered.

B. Quantification of Variables

1. Production

Production for an input-output sector in a sub-region was estimated as follows:

Employment by sub-region (File "A") was multiplied by output per employee in the U. S. for that input-output sector. (This is essentially the same procedure that was used for estimating production in the statistical analysis phase).

2. Use

Use of products of an input-output sector in a sub-region was estimated in essentially the same way as use of products of the "statistical analysis group."

Production of the sub-region by input-output sectors (described in V-A-1) was multiplied by the appropriate coefficients in File "G" and File "Z" to estimate industrial use on the current and capital accounts, respectively. Personal consumption expenditures were estimated by multiplying average propensities to consume (File "D") by personal income in the sub-region (File "C").

3. Distance

In order to estimate interregional distances (File "E") we first estimated the center of population in the sub-region. Straight line distances were then estimated by finding the direct route highway mileage between centers of population and dividing by 1.21.

County population data were employed in estimating centers of population for sub-regions of Appalachia.

County population data were also used for the parts of Appalachian states outside of Appalachia. For other sub-region population data for SMSA's were used to estimate centers of population.[1]

Table V-1.--Models used for estimating trade flows

Statistical analysis Group Identification No.	Input-output Identification No.*
1	14, 15
2	16, 17, 33, 34
3	18, 19
4	24, 25, 26
5	27, 28
6	29, 30
7	31
8	32
9	20, 21
10	22, 23, 64
11	35, 36
12	37
13	38
14	40
15	39, 41, 42
16	47, 48, 49
17	43, 44, 45, 46, 50, 51, 52
18	56, 57
19	53, 54, 55, 58
20	59
21	60, 61
22	62, 63

*Sector Identification Numbers are from Survey of Current Business Vol. 45, No. 9 (September 1965), p. 33.

[1]County population data for 1960 were from Rand McNally Road

C. Computation of Interregion Trade

The models described in Chapter IV and presented in Table IV-2 were used to estimate interregional shipments. Table V-1 specifies the models used to compute interregional trade for each input-output sector.

In general, we have the model:

$$\ln S_{gh} = \ln a + b \ln P_g + e \ln U_h + d \ln D_{gh} \qquad \ldots(V\text{-}1)$$

To compute shipments from sub-area g to sub-area h (S_{gh}), we substitute in (V-1) the following data compiled for sub-areas for a particular input-output sector:[1]

P_g: production, region g

U_h: use, region h

D_{gh}: distance from region g to region h

The appropriate parameters are then substituted from Table IV-2. The value of S_{gh} can then be computed because all the values on the right side of the equation are known. A further discussion relating to the estimation of interregional trade is presented in Section B of Chapter II, especially computer reports 1-3.

Atlas, 43rd Annual Edition.

SMSA population data for 1960 were from U. S. Bureau of the Budget, Standard Metropolitan Statistical Areas.

[1] See the discussion in V-B, above concerning estimation of these variables.

D. Closing the Model

The model of Appalachia differs from the National input-output model and some regional models in that personal consumption expenditures are endogenous. In the National model for 1958 personal consumption expenditures were placed in final demand. In our model, however, we assume that personal consumption expenditures is a function of personal income. Personal income is directly related to the level of final demand. It is, therefore, necessary to construct an input-output model which is consistent with these assumptions and this model is known as a "closed" input-output model. The procedure followed was to develop a closed input-output model for the U. S. from the existing "open" model by the adding of an additional row and column.

The input-output coefficients for the U. S. contained in File "G" provide the open model of the U. S. which was used in this phase of the study.[1] An additional row and column were added to this basic matrix of 82 sectors, square. This additional sector is called personal consumption expenditures (P.C.E.).

1. Personal consumption expenditures row

Coefficients in the personal consumption expenditures row estimate total personal consumption expenditures per dollar output of the sector. These coefficients were formed by first determining the proportion of the value added of each sector which was attributable to personal income.[2] The next step was

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[1]The construction of File "G" is discussed in Chapter IV.

[2]Unpublished data files of Office of Business Economics were used for this purpose.

to multiply that proportion of value added flowing to personal income by the "value added" coefficient for that particular sector found in the direct requirements table of the 1958 input-output study.[1]

Actually, personal income per dollar output was first estimated. This was done by determining for each sector the payments per dollar output in the following categories: wages and salaries, other labor income, proprietors income, rental income, dividends, interest and business transfer payments.

Then, in order to be consistent with the P.C.E. column, which is discussed below, income per dollar output for each sector was converted into the personal consumption expenditures consistent with this level of income. This conversion of income per dollar output into P.C.E. per dollar output took into account the following: personal contributions for social insurance, personal taxes and personal savings. With these adjustments consistency is attained between the P.C.E. column and row.

2. Personal consumption expenditures column

The coefficients of the personal consumption expenditures column show estimates of the marginal propensities to consume by input-output sectors.

They were computed as follows:

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[1] Survey of Current Business, Vol. 45, No. 9, pp. 40-44.

$$P_i = \frac{C_i e_i}{C} \qquad \ldots(V\text{-}2)$$

where: e_i means the elasticity with respect to income for the ith sector.

C_i means P.C.E. for the ith sector.[1]

C means total P.C.E.

P_i means marginal propensity to consume for the ith sector with respect to income.

Elasticities of demand for a sector's output with respect to total personal consumption expenditures were computed from income elasticities derived from consumer surveys.[2] These income elasticities were assumed to apply to all goods or services within a "type of product" category. A weighted average income elasticity of demand then was computed for each input-output sector. The weights used were the values of sales by "type of product" category in producer prices.[3]

The marginal propensities to consume with respect to income were then used to develop marginal propensities to consume with respect to total P.C.E., using the identity:

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[1] Actual values for C_i and C were obtained from Survey of Current Business, Vol. 45, No. 9, p. 39.

[2] Income elasticities are from Clopper Almon, Jr., The American Economy to 1975 (New York: Harper and Row, 1966), pp. 32-38.

[3] Weights were obtained from Nancy W. Simon, "Personal Consumption Expenditures in the 1958 Input-output Study." Survey of Current Business, Vol. 45, No. 10, pp. 7-20.

$$\sum_{i=1}^{83} P_i^* = 1 \qquad \ldots(V\text{-}3)$$

where P_i^* is the marginal propensity to consume the products of the ith sector with respect to total P.C.E. These coefficients formed the P.C.E. column.

Therefore the individual P_i's were adjusted, as follows in order to form the P*'s.

$$P_i^* = \frac{1}{\sum_{i=1}^{83} P_i} \; P_i \qquad \ldots(V\text{-}4)$$

E. Direct Requirements of Water Resource Projects

After the model was constructed it was confronted with specific demand vectors for the purpose of measuring economic impacts of water resource projects. Data were obtained from the files of Resources for the Future which estimated the values of purchases by input-output sectors which were required in water development projects.[1] Specifically, purchases per $1,000 of total project cost and for the purposes of this study these records are called "direct requirements of water resource projects." These values are shown for each of twelve types of projects in Appendix C.

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[1]These data were obtained from Mr. Robert H. Haveman who, along with Mr. Robert M. Steinberg assisted us in interpreting the computer printouts.

The estimates of direct requirements of water development projects were developed by Haveman from raw project data obtained from Division of Productivity and Technological Developments of the U. S. Bureau of Labor Statistics.[1] The raw project data was obtained from the "Reasonable Cost Estimate" for the project prepared by the U. S. Corps of Engineers. Raw project data used to estimate the direct requirements were from the following projects:

Large Earth-fill Dam

Painted Rock Dam	Arizona

Small Earth-fill Dams

Buckhorn Reservoir	Kentucky
Dillon Reservoir (clearing)	Ohio
Mansfield Reservoir	Indiana

Local Flood Protection

Big Dalton Wash Channel	California
Cape Girardeau	Missouri
Woonsocket, Blackstone River	Rhode Island

Pile Dikes

Ackley Bend to Leavenworth Reach, Missouri R.	Kansas
Ashport - Goldust, Mississippi River	Arkansas
Miami to Glasgow Bend, Missouri River	Missouri
Near Bigelow, Arkansas River	Arkansas
New Haven Reach to Weldon Spring Bend, Mo. River	Missouri

Levees

Elk Chute Drainage District	Missouri
Lake Ponchartrain	Louisiana
Near Muscatine, Mississippi River	Iowa
Old Lake	Louisiana
Ripley, Mississippi River	Tennessee
Santa Maria Valley and Bradford Canyon	California
Yazoo River	Mississippi

--cont'd on next page

Revetments

Arkansas River Revetment	Arkansas
Bank Paving, Mississippi River	Missouri, Tennessee Arkansas, Mississippi
Board Revetment, Red River	Louisiana
Cessions to Kempe Bend, Mississippi River	Mississippi, Arkansas, Louisiana
Sacramento River Bank Protection	California

Powerhouse Construction

Beaver Dam Powerhouse	Arkansas

Medium Concrete Dam

Beaver Dam and Reservoir	Arkansas

Lock and Concrete Dam

Columbia Lock and Dam	Alabama

Large Dam and Power Generating Facility

Glen Canyon Dam and Powerhouse	Arizona

Dredging

Anacostia River	District of Columbia
Atlantic Intra-Costal Waterway, Port Royal Sound	South Carolina
Bronx River	New York
Brunswick Harbor	Georgia
Calument-Sag Channel	Illinois
Columbia River between Bonneville and Vancouver	Washington, Oregon
Duxburg Harbor	Massachusetts
Galveston Harbor	Texas
Gulf Intra-Coastal Waterway, Freeport	Texas
Intra-Costal Waterway. Caloosahatchie River to Anclote River	Florida
Mantego to Oregon Inlet	North Carolina
Matagorda Channel, Point Lavaca	Texas
New York Harbor	New York
Philadelphia, Delaware River	Pennsylvania
Sabine-Neches Waterway	Texas

Miscellaneous

Bayou Macon Channel Improvement	Louisiana
Jetties, Gold Beach	Oregon
Outlet Channel, Sardis Dam	Mississippi
Sea Wall Extension, Galveston	Texas

F. Data Files

1. Employment: File "A"

Procedures used in the estimation of Employment in File "A" are described in Chapter IV under the heading "Employment: File 'M'".

2. Output per employee: File "B"

Procedures used in the estimation of output per employee, by input-output sector are described in Chapter IV under the heading "Output per employee: File 'B'".

3. Personal income: File "C"

Estimates of personal income by sub-areas within Appalachia were obtained from the Office of Business Economics.[1] These data were for 1929 - 62, whereas a 1964 estimate of personal income was needed for the model.

An estimate of personal income for 1964 was made by regressing personal income on time, to estimate the parameters. Year 1964 was then substituted into the equation for the purpose of estimating personal income for that year.

Estimates of personal income for complete states were from source documents cited in Chapter IV, "Personal income: File "Q." Estimates of personal income for those parts of states outside Appalachia were made by subtracting estimates of the Appalachian portions from state

---

[1] Specifically the computer printouts were entitled "Personal Incomes, Appalachian Regions, Summary Detail," December 12, 1966.

estimates. Where it was necessary to subdivide personal income in the part of a state outside Appalachia, it was done by assuming per capita income constant among the various portions of the sub-area and using 1960 county population data to develop shares of total personal income in each portion.

4. Average propensities to consume: File "D"

Procedures used in the estimation of output per employee, by input-output sector are described in Chapter IV under the heading of "Average propensities to consume: File "D."

VI

COMPUTER SYSTEM DESIGN

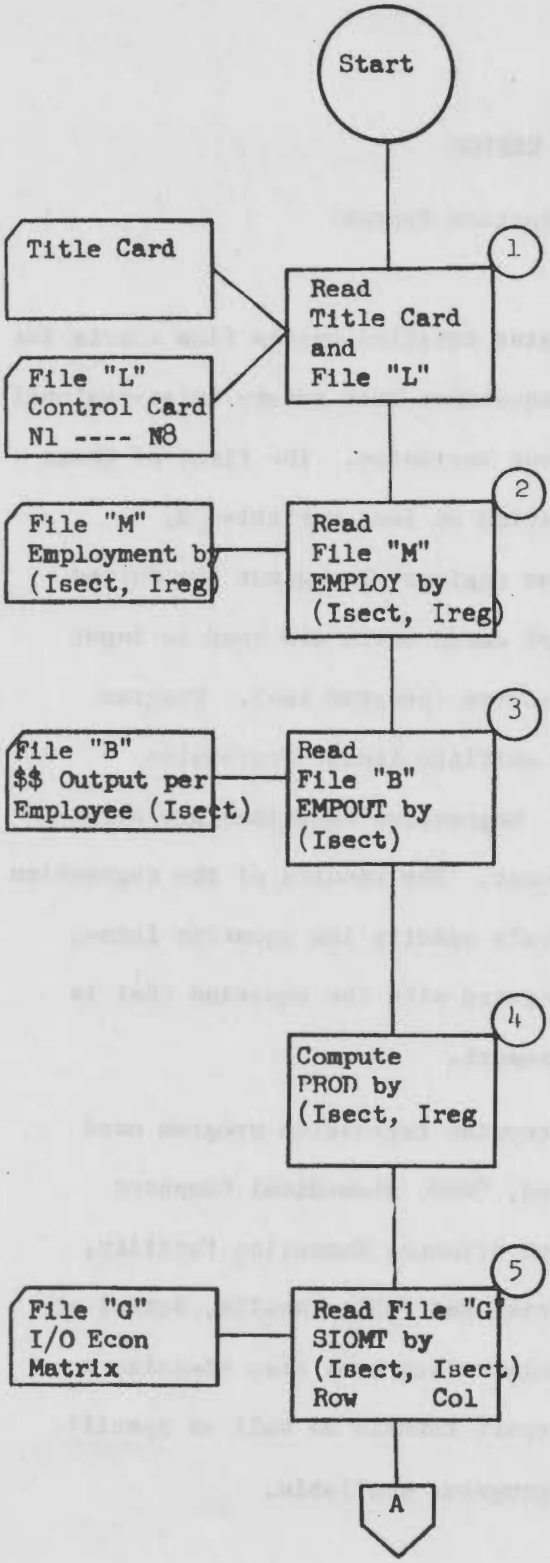
A. Statistical Analysis and Data Reduction System

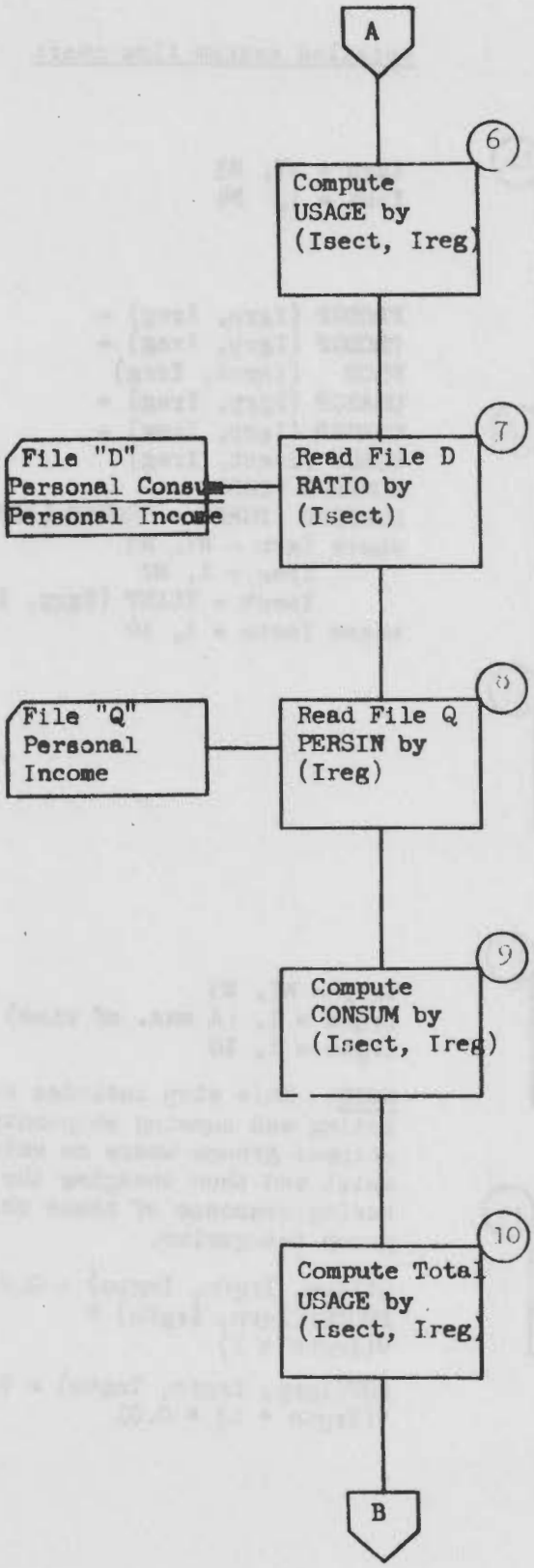
1. General description

This section of the report contains detailed system flow charts for two programs which develop the equations that relate inter-regional shipments to significant dependent variables. The first of these two programs accumulates information on four variables S, PROD, USAGE, and DIST for various regions throughout the United States, and generates a series of cards which are used as input data to a stepwise regression program (program two). Program two then computes a sequence of multiple linear regression equations in a stepwise manner. Regression equations are determined with and without an intercept. The results of the regression analysis are used to quantitatively specify the equation forms, coefficients and exponents associated with the equation that is used by other programs of this report.

A detailed description of the stepwise regression program used is contained in the book entitled, "BMD, Biomedical Computer Programs," prepared by the Health Sciences Computing Facility, Department of Preventative Medicine and Public Health, School of Medicine, University of California. This book also contains a description of typical output report formats as well as specific instructions on how to use the programs available.

2. Detailed system flow chart





Detailed system flow chart

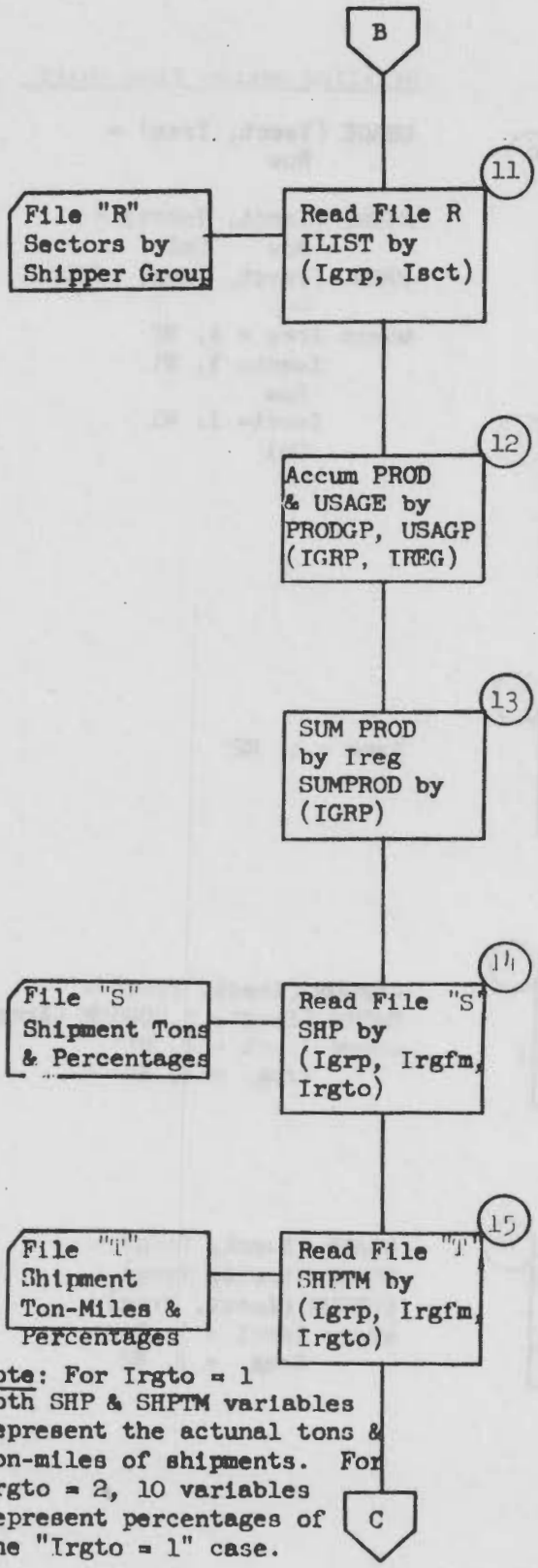
```
USAGE (Isect, Ireg) =
       Row

SIOMT (Isect, Isect) *
       Row     Col
PROD  (Isect, Ireg) + USAGE
       Col
where Ireg = 1, N2
      Isect= 1, N1
       Row
      Isect= 1, N1
       Col
```

```
Ireg = 1, N2
```

```
CONSUM (Isect, Ireg) =
RATIO (Isect) * CONSUM (Ireg)
where Isect = 1, N1
      Ireg  = 1, N2
```

```
USAGE (Isect, Ireg) =
USAGE (Isect, Ireg) +
CONSUM (Isect, Ireg)
where Isect = 1, N1
      Ireg  = 1, N2
```



Note: For Irgto = 1 both SHP & SHPTM variables represent the actunal tons & ton-miles of shipments. For Irgto = 2, 10 variables represent percentages of the "Irgto = 1" case.

Detailed system flow chart

Igrp = N7, N3
Isct = 1, N4

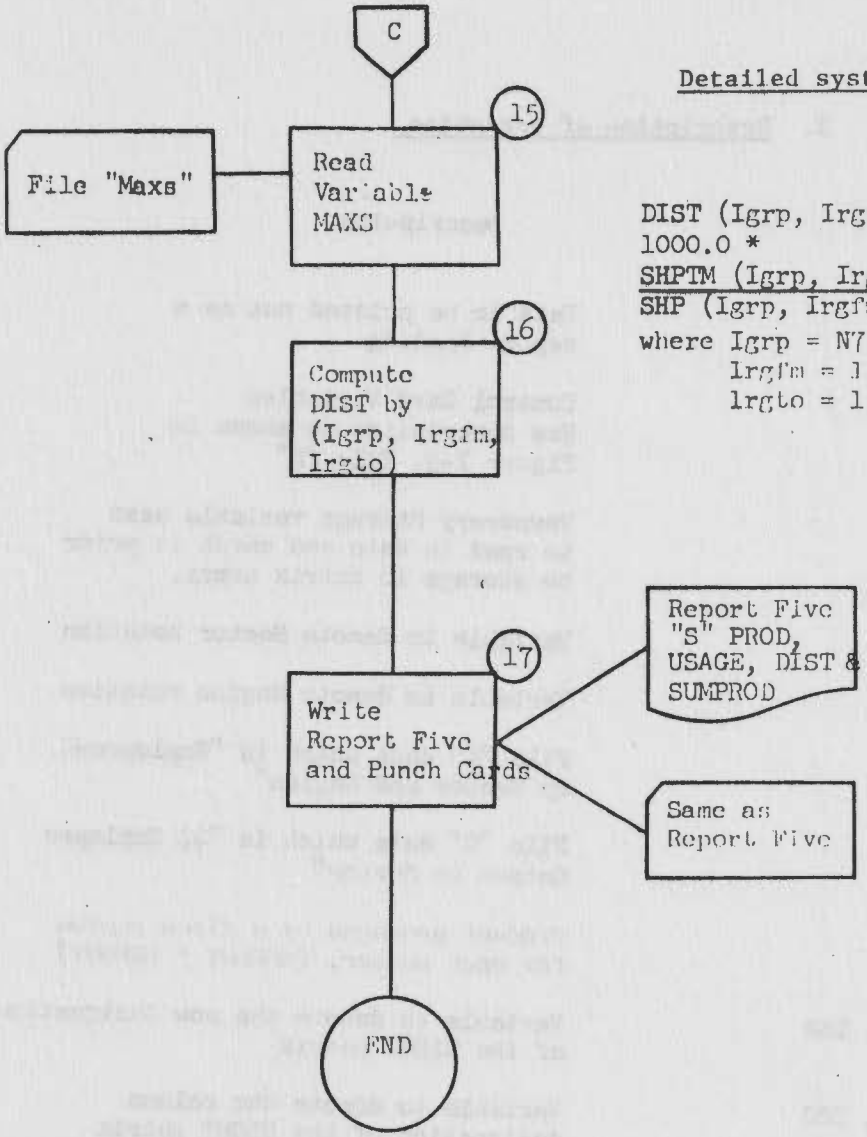
PRODGP (Igrp, Ireg) =
PRODGP (Igrp, Ireg) +
PROD (Isect, Ireg)
USAGGP (Igrp, Ireg) =
USAGGP (Igrp, Ireg) +
USAGE (Isect, Ireg)
SUMPROD (IGRP) =
SUMPROD (IGRP) + PRODGP (IGRR, IREG)
where Igrp = N7, N3
Ireg = 1, N2
Isect = ILIST (Igrp, Isctn)
where Isctn = 1, 10

Igrp = N7, N3
Irgfm = 1, (A max. of nine)
Irgto = 1, 10

NOTE: This step includes computing and summing shipments by shipper groups where no values exist and thus changing the numbering sequence of these shipper group categories.

S(Igrp, Irgfm, Irgto) = 0.01 *
PRODGP(Igrp, Irgfm) *
V(Irgto + 1)

SHP(Igrp, Irgfm, Irgto) = V(1) *
V(Irgto + 1) * 0.01



Detailed system flow chart

DIST (Igrp, Irgfm, Irgto) =
1000.0 *
SHPTM (Igrp, Irgfm, Irgto)
SHP (Igrp, Irgfm, Irgto
where Igrp = N7, N3
Irgfm = 1, MXNM
Irgto = 1, 9

3. Description of variables

Variable	Description
TITLE	Data to be printed out as a report heading
N1 N8	Control Card Variables See description as shown in Figure I-3, File "L"
IS, IR, V	Temporary Storage variable used to read in data and check it prior to storage in matrix array.
ISECT	Variable to denote Sector notation
IREG	Variable to denote Region notation
EMPLOY	File "M" data which is "Employment by Sector and Region"
EMPOUT	File "D" data which is "$/$ Employee Output by Sector"
PROD	Product produced by a given region for each sector. (EMPLOY * EMPOUT)
IROW, IIROW, ISR	Variable to denote the row designation of the SIOMT matrix
ICOL, IICOL, ISC	Variable to denote the column designation of the SIOMT matrix
SIOMT	The interpolated I/O Economic matrix with "N1" rows and columns (Sectors) as outputted by the program in Section III of this report.
USAGE	The product "PROD" being used by each sector, user-region combination. Before Step Nine --- Excluding CONSUM After Step Nine --- Including CONSUM
RATIO	File "D" data which is "Ratio of Personal Income and Personal Consum.

Variable	Description
PERSIN	File "Q" data which is "Personal Income by Region"
CONSUM	That product being consumed by each sector region combination (RATIO * PERSIN)
IGRP	Variable to denote "Shipper Group" designation
ILIST	Variable to indicate what sectors are included in what shipper groups
PRODGP	That product PROD which is produced in a shipper group-region combination
USAGGP	That product USAGE which is used is a shipper group-region combination
SUMPRD	That product PRODGP which is produced by all regions in a shipper group.
S, SHP	That product (tons) which is shipped from one region to another for each shipper group.
SHPTM	That product(ton miles) which is shipped from one region to another for each shipper group
ISP	A variable used to denote which actual "from region numbers" are in which assigned "from region numbers"
MAXS, MXNM	A variable used to denote the maximum number of actual "from region numbers" in a given shipper group shipment data file.
DIST	The distance between two regions for each shipper group (SHPTM/S)

B. Data Reduction-Expanded Matrix Generation System

1. General description

This section of the report contains detailed system flow charts of four integrated programs which perform the necessary computations to develop Reports One, Two, Three, Four and Four-A.

The first program produces Reports One, Two and Three by computing 1) the products being produced (PROD) in each "sub-area" and manufacturing sector in the United States, 2) the products being used (USAGE) in each "sub-area" in Appalachia, 3) the effective distance (DIST) between each usable "sub-area" combination and 4) the shipments (S) between each "sub-area" combination. The shipments (S) are calculated according to the equation form:

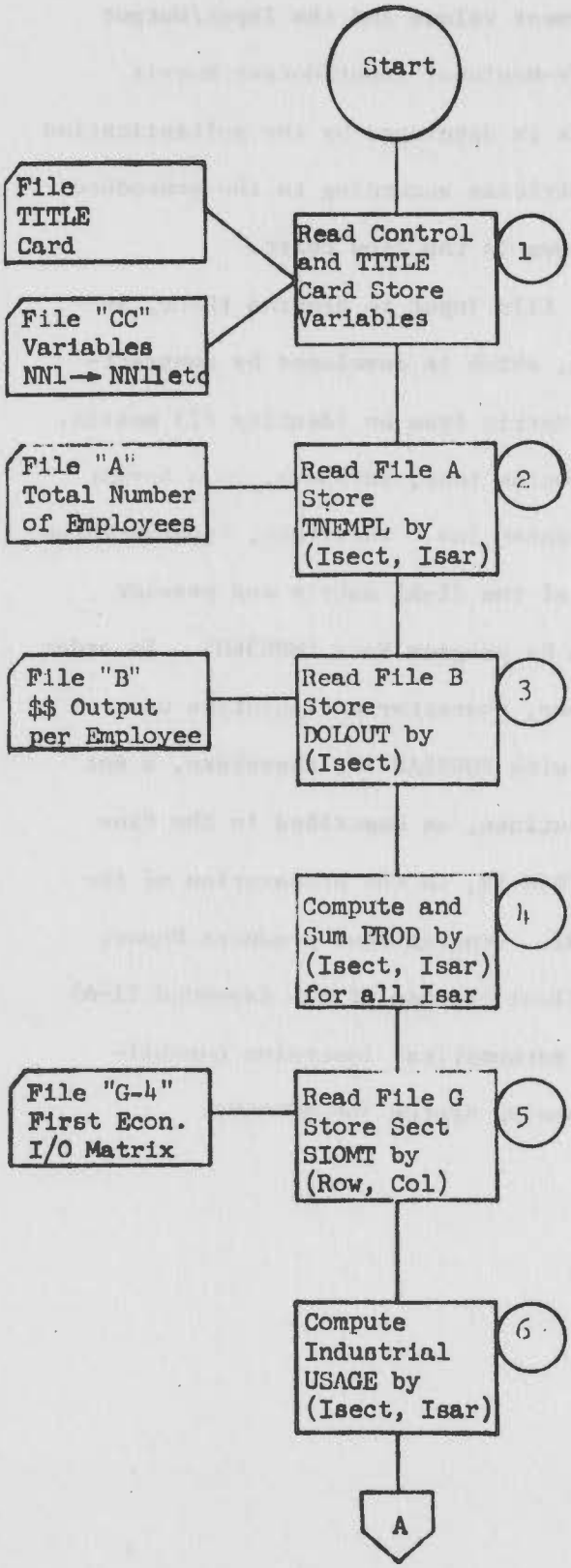
$$S_{g,h} = f(PROD_g, USAGE_h, DIST_{g,h})$$

where g and h are sub-area notations.
Both the detailed equation form and the coefficients and exponents associated with the equation were developed as a result of the programs contained in Section One of this report.

For this problem, the United States is sub-divided into up to 80 sub-areas and 4 regions where up to 30 of these sub-areas and 3 regions are contained in Appalachia. The shipment (S) values are first calculated for each sub-area combination (Report 2) and then accumulated into the proper regional categories (Report 3). These regional shipment (S) values represent the composite shipments of goods by sector between each region.

Program two uses the regional shipment values and the Input/Output Matrix to develop an expanded Inter-Regional Input/Output Matrix (Report Four). The expanded matrix is developed by the multiplication of the two previously mentioned matricies according to the procedure shown in step number twenty-two shown in the flow chart. Program two also develops the tape file input to program three, an expanded (I-A) Input/Output Matrix, which is developed by subtracting the Expanded (A) Input/Output Matrix from an Identity (I) matrix. The (I-A) matrix is required by program four, (MPS360), in a format different from that supplied by program Two. Therefore, Program Three was designed to change the format of the (I-A) matrix and provide additional information as required by program Four (MPS360). In order to develop the input to Program Four, character manipulation was necessary. This is not available with FORTRAN IV; therefore, a set of FORTRAN IV compatible "BEEF" routines, as described in the flow chart were used to supplement FORTRAN IV, in the preparation of the input data to Program Four (MPS360). Program Four produces Report Four-A which contains the mathematical inverse of the Expanded (I-A) Input/Output Matrix, and uses the mathematical inversion capabilities of IBM's Mathematical Programming System 360 MPS360).

2. Detailed System Flow Chart



$1 \leq ISECT \leq NN1 \leq 85$

$1 \leq ISAR \leq NN2 \leq 80$

$1 \leq ISECT \leq NN1 \leq 85$

$PROD(Isect, Isar) = TNEMPL(Isect, Isar) * DOLOUT(Isect)$

$SMPROD(Isect) = \sum_{Isar} PROD(Isect, Isar)$

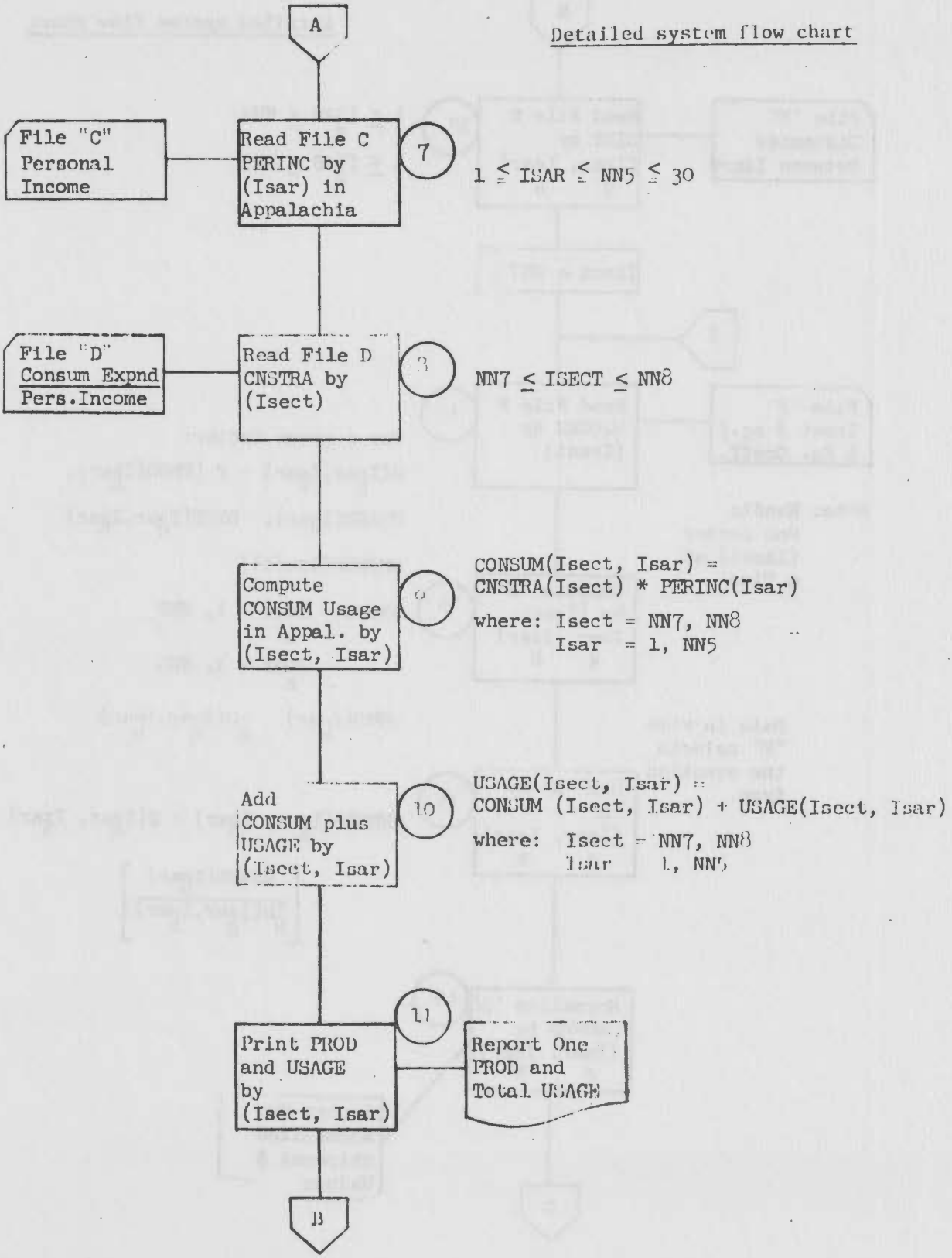
where: ISAR = 1, NN2
ISECT = 1, NN1

$1 \leq ISECT \leq NN1$

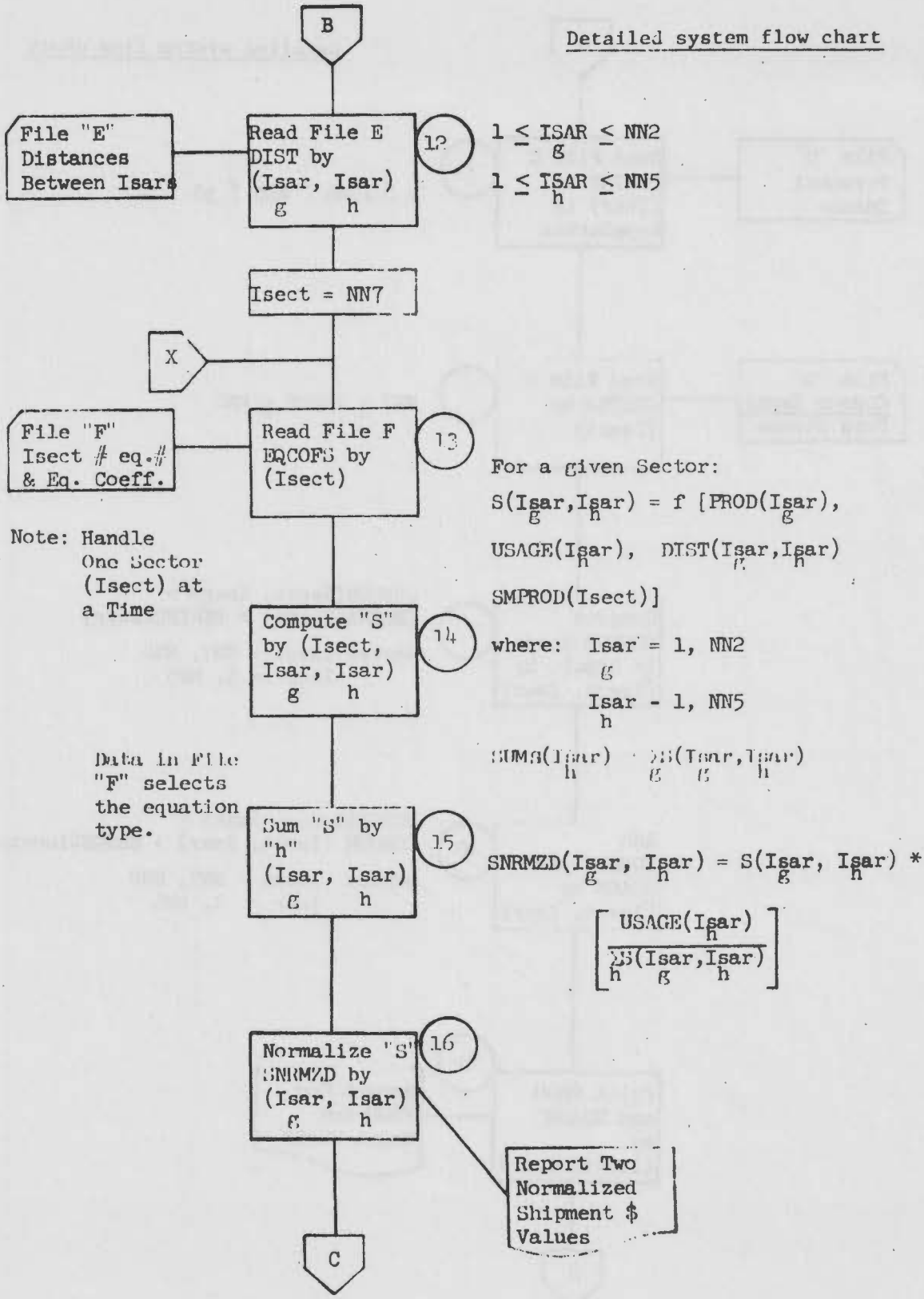
$1 \leq ISAR \leq NN5 \leq 30$

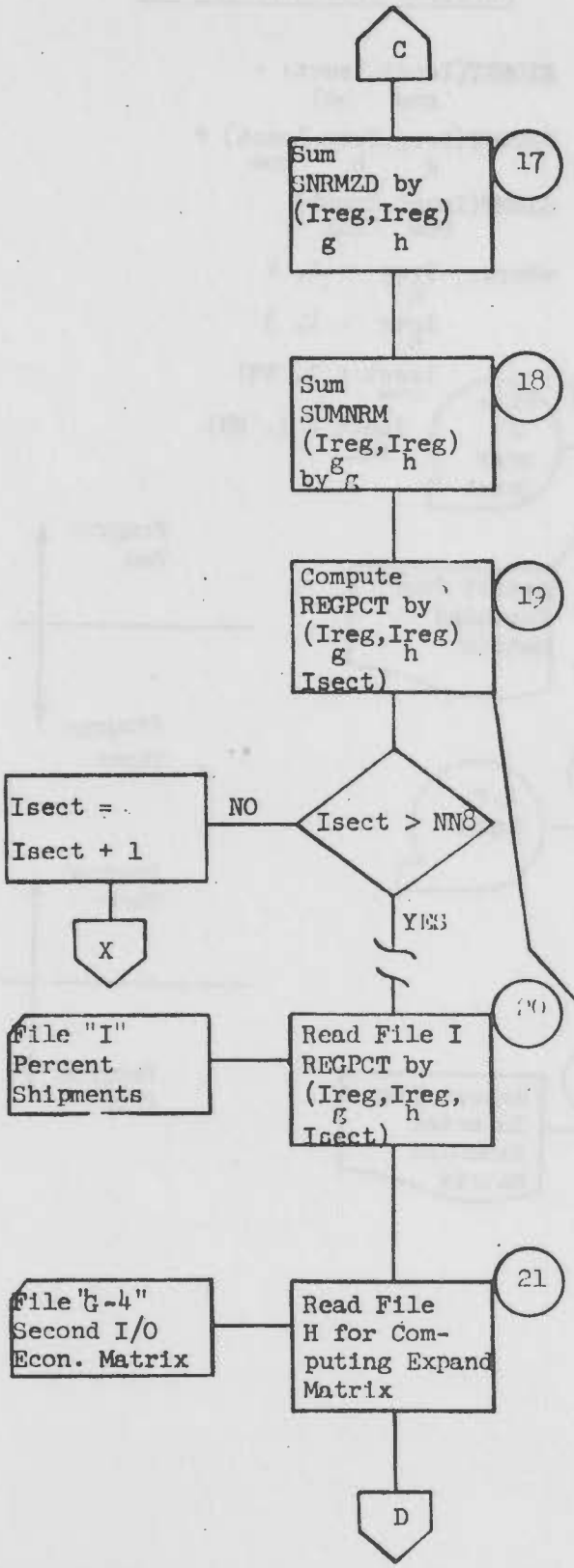
$$USAGE_{Row}(Isect,Isar) = USAGE_{Row}(Isect,Isar) + PROD_{Col}(Isect,Isar) * SIOMT_{Row,Col}(Isect,Isect)$$

where: Isar = 1, NN5
Isect - NN7, NN8
Row
Isect - NN7, NN8
Col


A
File "C"
Personal
Income
Read File C
PERINC by
(Isar) in
Appalachia
7
1 ≤ ISAR ≤ NN5 ≤ 30
File "D"
Consum Expnd
Pers.Income
Read File D
CNSTRA by
(Isect)
8
NN7 ≤ ISECT ≤ NN8
Compute
CONSUM Usage
in Appal. by
(Isect, Isar)
9
CONSUM(Isect, Isar) =
CNSTRA(Isect) * PERINC(Isar)
where: Isect = NN7, NN8
Isar = 1, NN5
Add
CONSUM plus
USAGE by
(Isect, Isar)
10
USAGE(Isect, Isar) =
CONSUM (Isect, Isar) + USAGE(Isect, Isar)
where: Isect = NN7, NN8
Isar = 1, NN5
11
Print PROD
and USAGE
by
(Isect, Isar)
Report One
PROD and
Total USAGE
B

Detailed system flow chart





$$SUMNRM(Ireg_g, Ireg_h) = \sum_h \sum_g SNRMZD(Isar, Isar)$$

where:

$Ireg_h = Ireg_g = 1$ for $g = 1, NN3$

$Ireg_h = Ireg_g = 2$ for $g = (NN3+1), NN4$

$Ireg_h = Ireg_g = 3$ for $g = (NN4+1), NN5$

$Ireg_g = 4$ for $g = (NN5+1), NN6$

$$TSNRM(Ireg_h) = \sum_g SUMNRM(Ireg_g, Ireg_h)$$

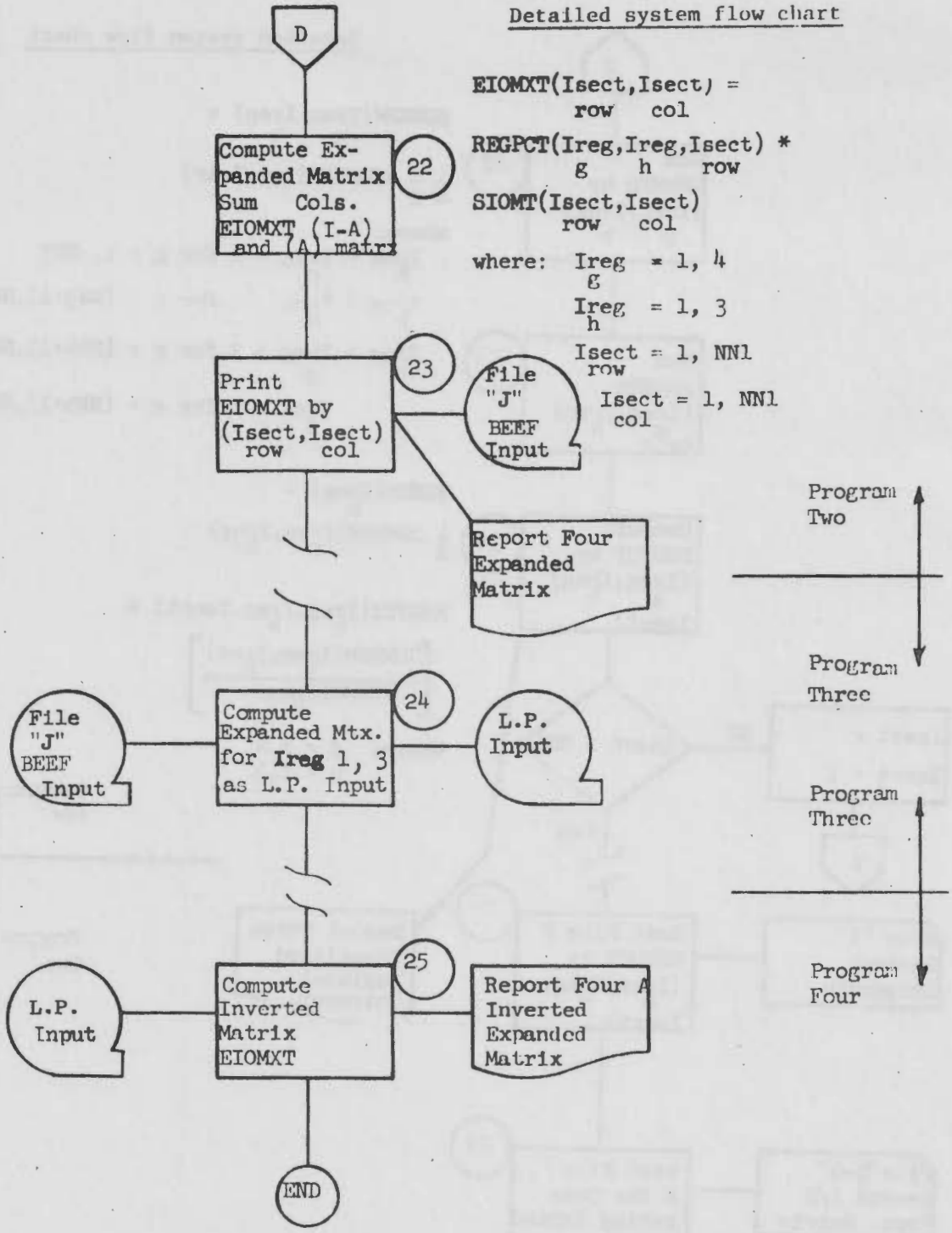
$$REGPCT(Ireg_g, Ireg_h, Isect) = \left[\frac{SUMNRM(Ireg_g, Ireg_h)}{TSNRM(Ireg_h)}\right]$$

where: $g = 1,4$
$h = 1,3$

Program One

Program Two

Detailed system flow chart



3. Description of variables

Variable	Description
TITLE	Data to be printed out as a report heading.
NN1 ⟶ NN11 N1 ⟶ N3	See program listing for detailed description.
ISC, ISA, ISB, TE	Temporary Storage variable used to read in data and check it prior to storage in matrix arrays.
ISECT	Variable used to indicate sector numbers.
ISAR	Variable used to indicate sub-area numbers.
TNEMPL (Prior to Step 4)	File "A" data which is "Total Number of Employees" by sector and sub-area.
DOLOUT	File "B" data which is "$ Output per Employee" by sector.
TNEMPL (After Step 4)	Product of File "A" and File "B" data. That product produces the $ value of product being produced by each producer sub-area, sector combination.
SMPROD	The total product produced by each sector.
SIOMT	The interpolated matrix with "NN1" rows and columns as outputed by the program in Section III of this report.
IIROW, ITCOL ISAR, ISCR, ISCC	Indexing variables used in matrix manipulations.
USAGE	That product used by each sector, user sub-area combination.

Variable	Description
PERINC	File "C" data which is "$$ Personal Income" by sub-area in Appalachia.
CNSTRA	File "D" data which is "Consumer Expenditure Ratio" by sector.
CONSUM	Product of File "C" and File "D". That product produces the $ value of the product being consumed by each sector, user sub-area combination.
NPG, NPAG	Variable to keep track of page numbers by report.
NN51	Variable to keep track of when to stop printing user sub-area data in report one.
SUMPRD	SUMPROD/1000.
DIST	File "E" data which is "Distances Between Sub-Areas" by "From" - "To" sub-area combinations.
SN	Variable to indicate values of coefficients required on equations being used to compute shipments (up to seven allowed).
C2, C3, C4, etc.	C2=SN(2) C3=SN(3) C4=SN(4) etc.
ANTLG	Variable equal to the anti-log of SN(1).
S	Computed Shipment values as well as manually supplied shipment values for each sub-area combination for each sector.

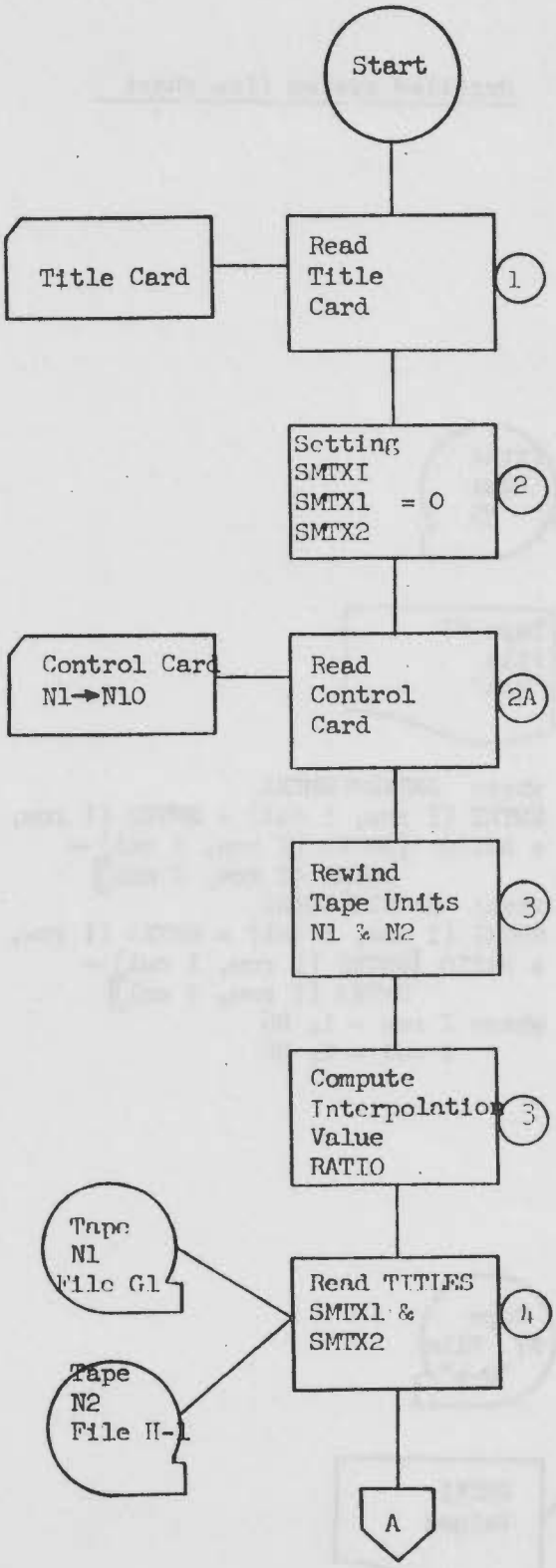
Variable	Description
N(I), I=1,5 NB, NA, NC, ND	Variables used to accumulate values of "S" by regions both as computed and as normalized.
SUMNRM	Variable used to store values of "S" by each region combination for each sector.
TSNRM	The total of SUMNRM shipments going to each region for each sector.
REGPCT	Percentage values of inter-regional shipments. Essentially equal to SUMNRM/TSNRM.

C. Linearly Interpolated Input-Output Matrix

1. General description

The purpose of this routine is to provide an automated means for developing a linearly interpolated matrix from two other matrices, plus providing for updating the input matrices by replacement and the output matrix by addition to the interpolated values.

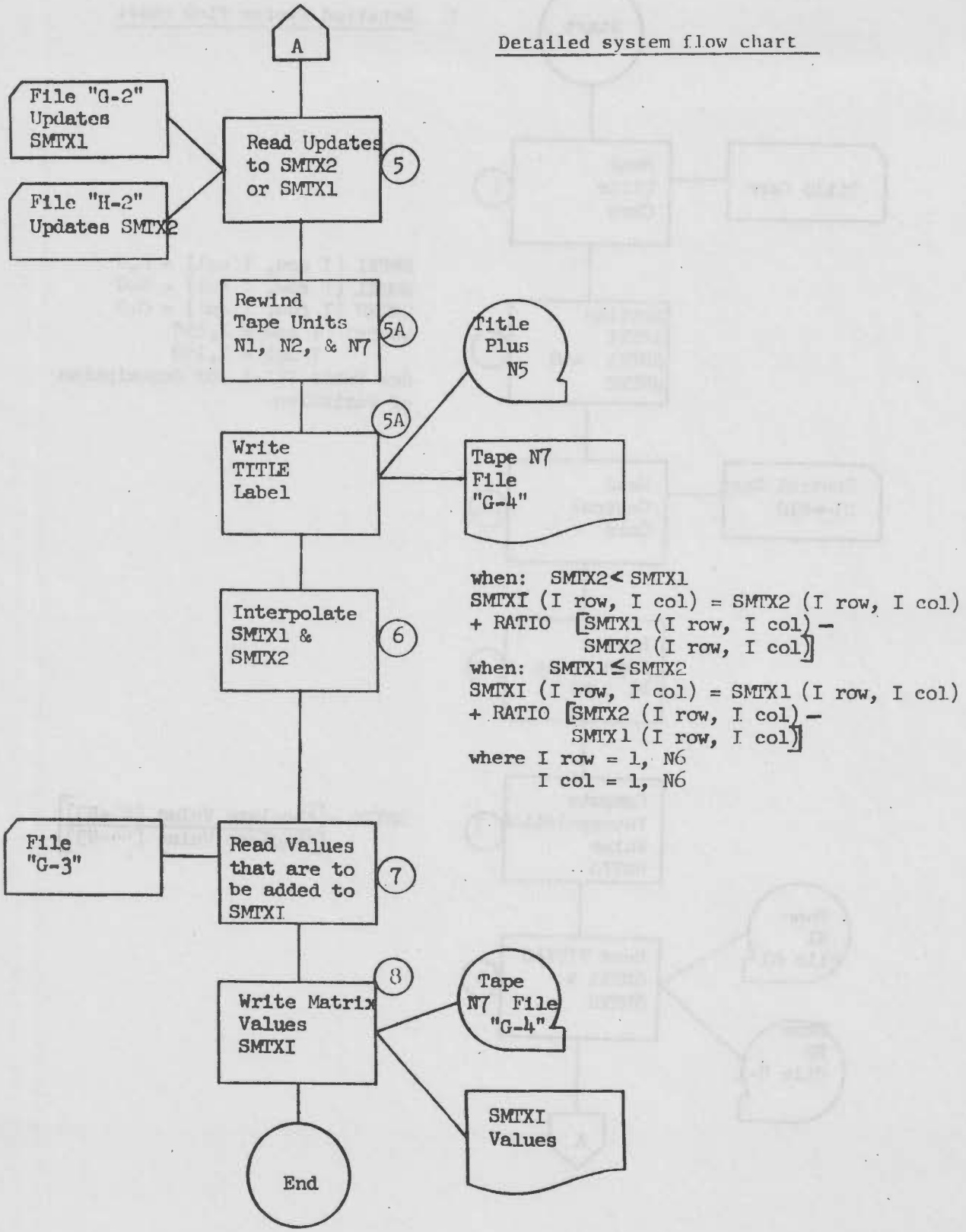
2. Detailed system flow chart



SMTXI (I row, I col) = 0.0
SMTX1 (I row, I col) = 0.0
SMTX2 (I row, I col) = 0.0
where: I row = 1,150
I col = 1,150
See Table III-1 for description of variables

$$RATIO = \left[\frac{\text{Absolute Value } (N5-N3)}{\text{Absolute Value } (N4-N3)}\right]$$

Detailed system flow chart



when: SMTX2 < SMTX1

$$SMTXI(I\ row, I\ col) = SMTX2(I\ row, I\ col) + RATIO\ [SMTX1(I\ row, I\ col) - SMTX2(I\ row, I\ col)]$$

when: SMTX1 ≤ SMTX2

$$SMTXI(I\ row, I\ col) = SMTX1(I\ row, I\ col) + RATIO\ [SMTX2(I\ row, I\ col) - SMTX1(I\ row, I\ col)]$$

where I row = 1, N6
I col = 1, N6

3. Description of variables

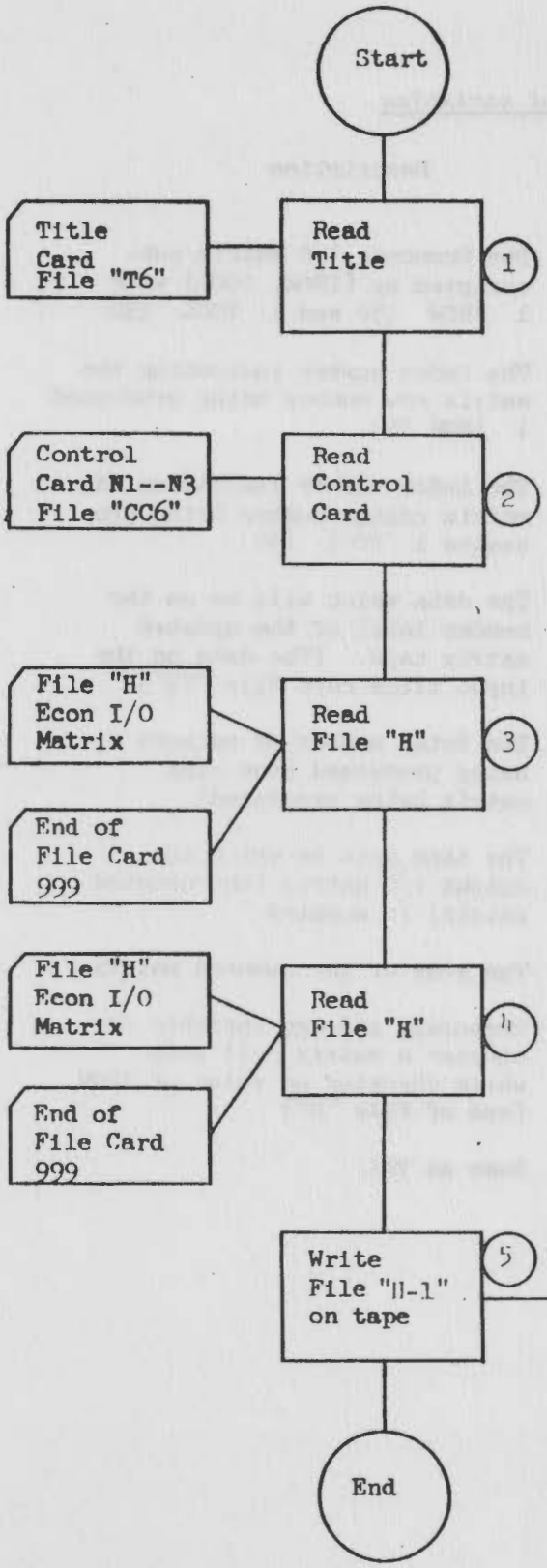
Variable	Description
TITLE	The data which will be on the header label of the interpolated matrix tape.
SMTX1	The input matrix to be updated, (the lowest year), on tape unit N1.
SMTX2	The input matrix to be updated, (the highest year), on tape unit N2.
SMTXI	The interpolated matrix on tape unit N7.
N1 → N8	See program listing for description.
DIFT3	Absolute Difference between N4 and N5.
DIFT1	Absolute Difference between N4 and N3.
DIFT2	Absolute Difference between N5 and N3.
RATIO	DIFT2/DIFT1
IROW	Index variable to indicate the rows of the matrix being processed.
ICOL	Index variable to indicate the columns of the matrix being processed.
V	Temporary storage variable.
K	A variable used to distinguish between cards which have data to update the lowest year matrix and cards which have data to update the highest year matrix.

D. 1970 Input-Output Matrix

1. General description

The purpose of this routine is to provide an automated means for reading the 1970 Economic I/O Card Matrix and loading the data on tape in File "G " or "H" format.

2. Detailed flow chart



N1 = Total number of sectors in matrix
N2 = Tape unit number on which output tape is mounted
N3= Year of resulting tape matrix

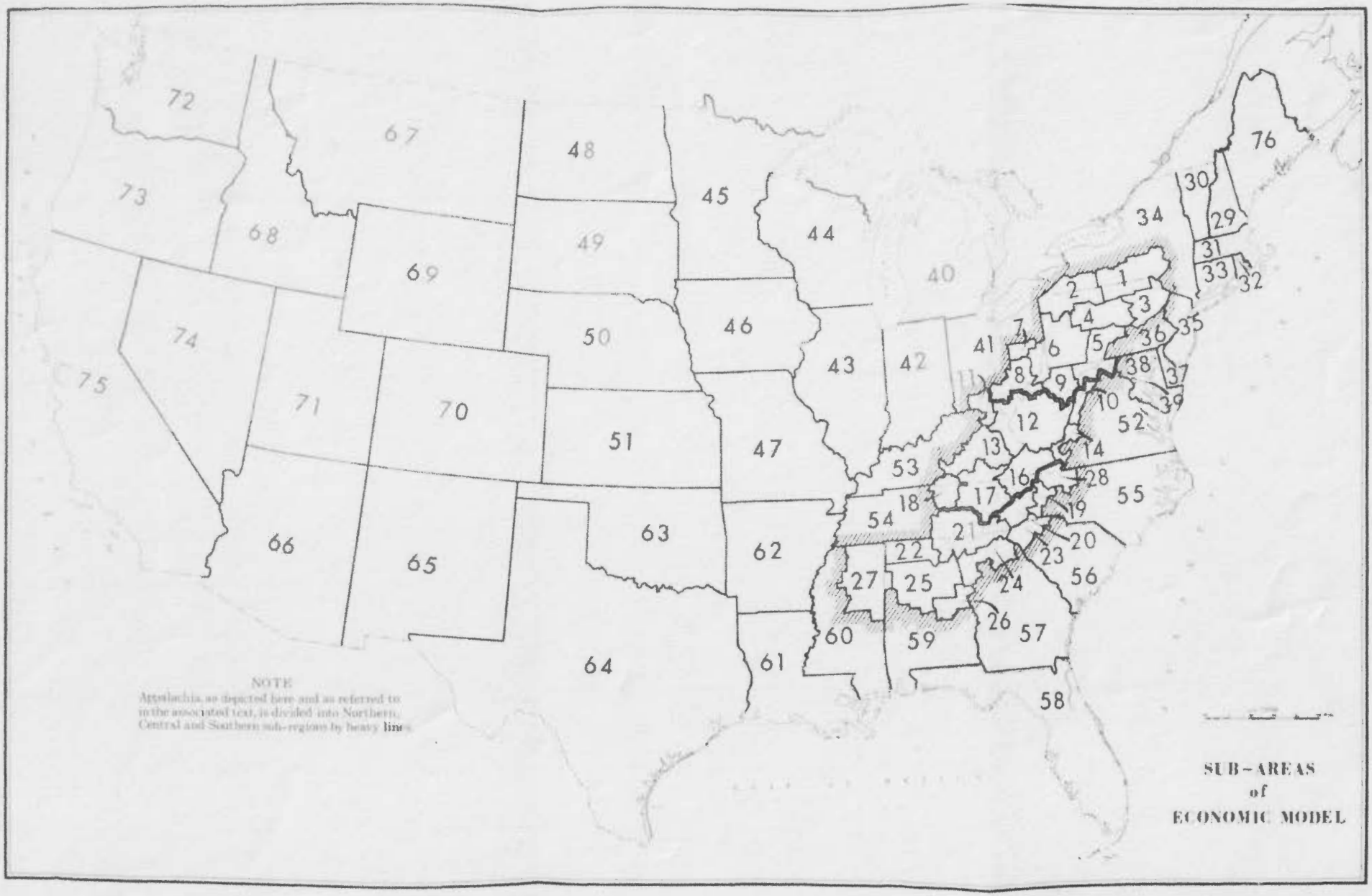
Note: These File "H" Cards have ten values per card

Note: These File "H" cards have one value per card

Note: File "H" is a "N1 by N1" matrix written in 80 col. card format. An 80 col. card image header exists prior to 80 col. card records

3. Description of variables

Variable	Description
SMTXI	The Economic I/O Matrix subscripted by (IROW, ICOL) with 1 IROW 150 and 1 ICOL 150
IROW	The index number indicating the matrix row number being processed 1 IROW 150
ICOL	The index number indicating the matrix column number being processed 1 ICOL 150
TITLE	The data which will be on the header label of the updated matrix tape. (The data on the input title card File "T5")
N1	The total number of sectors being processed (the size matrix being processed)
N2	The tape unit on which the output I/O matrix (the updated matrix) is mounted
N3	The year of the updated matrix
VAL	Temporary storage variable for storage a matrix cell value while checking on value of IROW (end of File "H")
V	Same as VAL


72
67
48
73
68
69
49
45
44
40
76
30
29
34
31
33
32
2
1
3
4
35
36
5
7
6
41
38
37
39
8
9
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52
74
50
46
43
42
11
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75
71
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63
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24
26
57
60
59
64
61
58
NOTE
Appalachia, as depicted here and as referred to in the associated text, is divided into Northern, Central and Southern sub-regions by heavy lines
SUB-AREAS
of
ECONOMIC MODEL

APPENDIX A

COUNTIES INCLUDED IN SUB-REGIONS

Counties in Sub-region 1

County	State
Broome	New York
Chemung	"
Chenango	"
Cortland	"
Delaware	"
Otsego	"
Shuyler	"
Steuben	"
Tioga	"
Tompking	"
Bradford	Pa.
Susquehanna	"
Tioga	"

Counties in Sub-region 2

County	State
Alleghany	New York
Chattaragus	New York
Chautaugua	"
Cranford	Pa.
Erie	"
Forest	"
McKeen	"
Potter	"
Verango	"
Warren	"

Counties in Sub-region 3

County	State
Carbon	Pa.
Columbia	"
Lackawana	"
Luzerne	"
Monroe	"
Pike	"
Schuykill	"
Sullivan	"
Wayne	"
Wyoming	"

Counties in Sub-region 4

County	State
Cameron	Pa.
Centre	"
Clearfield	"
Clinton	"
Elk	"
Jefferson	"
Lycoming	"
Montour	"
Northumberland	"
Snyder	"
Union	"

Counties in Sub-region 5

County	State
Bedford	Pa.
Blair	"
Fulton	"
Huntington	"
Juniata	"
Mifflin	"
Alleghany	Md.
Garrett	"
Washington	"
Berkley	W. Va.
Grant	"
Hampshire	"
Jefferson	"
Mineral	"
Morgan	"

Counties in Sub-region 6

County	State
Alleghany	Pa.
Armstrong	"
Beaver	"
Butler	"
Cambria	"
Clarion	"
Fayette	"
Greene	"
Indiana	"
Lawrence	"
Mercer	"
Somerset	"
Washington	"
Westmoreland	"
Belmont	Ohio
Harrison	"
Jefferson	"
Monroe	"
Brooke	W. Va.
Hanconck	"
Marshall	"
Ohio	"
Pleasant	"
Tyler	"
Wetzel	"

Counties in Sub-region 7

County	State
Carroll	Ohio
Coshocton	"
Holmes	"
Morrow	"
Portage	"
Richland	"
Stark	"
Summit	"
Trumbull	"
Wayne	"
Wyandot	"

Counties in Sub-region 8

County	State
Athens	Ohio
Guernsy	"
Hocking	"
Jackson	"
Morgan	"
Muskingum	"
Noble	"
Perry	"
Pickaway	"
Pike	"
Ross	"
Union	"
Vinton	"
Washington	"
Richie	W. Va.
Wirt	"
Wood	"

Counties in Sub-region 9

County	State
Barbour	W. Va.
Doddridge	"
Harrison	"
Lewis	"
Marion	"
Monongalia	"
Preston	"
Randolph	"
Taylor	"
Tucker	"
Upshur	"

Counties in Sub-region 10

County	State
Hardy	W. Va.
Pendleton	"
Bath	"
Highland	"
Page	"

Counties in Sub-region 11

County	State
Adams	Ohio
Brown	"
Clermont	"
Highland	"
Fleming	Ky.
Lewis	"

Counties in Sub-region 12

County	State	County	State
Boone	W. Va.	Raleigh	W. Va.
Braxton	"	Roane	"
Cabell	"	Summers	"
Calhoun	"	Wayne	"
Caly	"	Webster	"
Fayette	"	Wyoming	"
Greenbriar	"	Gallia	Ohio
Gilmer	"	Lawrence	"
Jackson	"	Meigs	"
Kanawha	"	Scioto	"
Lincoln	"	Boyd	Ky.
Logan	"	Carter	"
McDonald	"	Elliott	"
Mason	"	Floyd	"
Mercer	"	Greenup	"
Mongo	"	Johnson	"
Monroe	"	Lawrence	"
Nicholas	"	Martin	"
Pocahontas	"	Pike	"
Putnam	"	Rowan	"

Counties in Sub-region 13

County	State
Adair	Ky.
Bath	"
Breathitt	"
Casey	"
Clark	"
Clay	"
Estill	"
Garrard	"
Greene	"
Jackson	"
Knott	"
Lee	"
Leslie	"
Letcher	"
Lincoln	"
Madison	"
Magoffin	"
Menifee	"
Montgomery	"
Morgan	"
Owsley	"
Perry	"
Powell	"
Pulaski	"
Rockcastle	"
Russell	"
Wolfe	"

Counties in Sub-region 14

County	State
Alleghany	Va.
Botetourt	"
Craig	"
Floyd	"
Giles	"
Pulaski	"
Wythe	"

Counties in Sub-region 16

County	State
Bland	Va.
Buchanan	"
Dickenson	"
Lee	"
Russell	"
Scott	"
Smithe	"
Tazewell	"
Washington	"
Wise	"
Carter	Tenn.
Greene	"
Hancock	"
Hawkins	"
Johnson	"
Sullivan	"
Unicoi	"
Washington	"

Counties in Sub-region 17

County	State
Bell	Ky.
Harlan	"
Knox	"
Laurel	"
McCreary	"
Wayne	"
Whitely	"
Anderson	Tenn.
Blount	"
Campbell	"
Clairborne	"
Cocke	"
Cumberland	"
Fentress	"
Grainger	"
Hamblen	"
Jefferson	"
Knox	"
Loudon	"
Monroe	"
Morgan	"
Roane	"
Scott	"
Sevier	"
Union	"

Counties in Sub-region 18

County	State
Clinton	Ky.
Cumberland	"
Monroe	"
Clay	Tenn.
DeKalb	"
Jackson	"
Lewis	"
Overton	"
Pickett	"
Putnam	"
Smith	"
White	"
Macon	"

Counties in Sub-region 19

County	State
Alexander	N.C.
Caldwell	"
Rutherford	"
Watuga	"
Burke	"

Counties in Sub-region 20

County	State
Avery	N.C.
Buncombe	"
Haywood	"
Jackson	"
Henderson	"
McDowell	"
Madison	"
Mitchell	"
Swain	"
Transylvania	"
Yancy	"

Counties in Sub-region 21

County	State	County	State
Bledsoe	Tenn.	Dade	Ga.
Bradley	"	Fannin	"
Grundy	"	Gilner	"
Hamilton	"	Gordon	"
Marion	"	Murray	"
McMinn	"	Rabum	"
Meigs	"	Towns	"
Polk	"	Union	"
Rhea	"	Walker	"
Secuatchie	"	Whitfield	"
Van Buren	"	DeKalb	Ala.
Warren	"	Jackson	"
Cherokee	N.C.		
Clay	"		
Graham	"		
Macon	"		
Catoosa	Ga.		
Chattooga	"		

Counties in Sub-region 22

County	State
Coffee	Tenn.
Franklin	"
Colbert	Ala.
Franklin	"
Launderlade	"
Lawrence	"
Limestone	"
Madison	"
Marshall	"
Morgan	"

Counties in Sub-region 23

County	State
Anderson	S.C.
Cherokee	"
Oconee	"
Pickens	"
Greenwood	"
Spartensburg	"
Polk	N.C.

Counties in Sub-region 24

County	State
Banks	Ga.
Barron	"
Bartow	"
Carroll	"
Cherokee	"
Dawson	"
Douglas	"
Floyd	"
Forsythe	"
Franklin	"
Gwinnette	"
Habersham	"
Hall	"
Haralson	"
Jackson	"
Lumpkin	"
Madison	"
Paulding	"
Pickens	"
Polk	"
Stephens	"
White	"

Counties in Sub-region 25

County	State
Bibb	Ala.
Blount	"
Calhoun	"
Cherokee	"
Clinton	"
Clay	"
Cleburne	"
Cullman	"
Etowah	"
Fayette	"
Jefferson	"
Marion	"
St. Clair	"
Shelby	"
Talladega	"
Tuscaloosa	"
Walker	"
Winston	"

Counties in Sub-region 26

County	State
Chambers	Ala.
Coosa	"
Elmore	"
Randolph	"
Tallapoosa	"
Heard	Ga.

Counties in Sub-region 27

County	State
Alcorn	Miss.
Attala	"
Benton	"
Calhoun	"
Chickasaw	"
Choctaw	"
Clay	"
Grenada	"
Itawamba	"
Kemper	"
Lafayette	"
Lee	"
Lowndes	"
Marshall	"
Monroe	"
Montgomery	"
Noxubee	"
Oktibbeha	"
Pontotoc	"
Prentiss	"
Tippah	"
Tishoming	"
Union	"
Webster	"
Winston	"
Yalabusha	"

Counties in Sub-region 28

County	State
Carroll	Va.
Grayson	"
Alleghany	N.C.
Ashe	"
Davie	"
Forsythe	"
Stokes	"
Surry	"
Wilkes	"
Yadkin	"

APPENDIX B

REGIONAL DISTRIBUTION OF THE VALUE OF PRODUCTS AND SERVICES TERMINATING IN APPALACHIA

Appendix Table B-1.--Distribution of the value of products and/or services of Sector 1 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	36.4	0.7	0.0
Region 2	0.0	57.9	0.0
Region 3	0.0	5.9	90.4
Region 4	63.6	35.5	9.6
Total	100.0	100.0	100.0

Appendix Table B-2.--Distribution of the value of products and/or services of Sector 2 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	17.2	0.0	0.0
Region 2	0.0	30.1	0.0
Region 3	0.7	.9	18.5
Region 4	82.1	69.0	81.5
Total	100.0	100.0	100.0

Appendix Table B-3.--Distribution of the value of products and/or services of Sector 3 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-4.--Distribution of the value of products and/or services of Sector 4 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-5.--Distribution of the value of products and/or services of Sector 5 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	0.0	0.0	0.0
Region 2	0.0	0.0	0.0
Region 3	0.0	0.0	8.9
Region 4	100.0	100.0	91.1
Total	100.0	100.0	100.0

Appendix Table B-6.--Distribution of the value of products and/or services of Sector 6 terminating in Appalachia, according to region o of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	0.0	0.0	0.0
Region 2	0.0	0.0	0.0
Region 3	0.0	0.0	23,7
Region 4	100.0	100.0	76.3
Total	100.0	100.0	100.0

Appendix Table B-7.--Distribution of the value of products and/or services of Sector 7 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	94.2	0.0	0.0
Region 2	4.8	100.0	13.8
Region 3	0.0	0.0	81.8
Region 4	1.0	0.0	4.4
Total	100.0	100.0	100.0

Appendix Table B-8.--Distribution of the value of products and/or services of Sector 8 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	73.3	0.0	0.0
Region 2	7.7	10.0	0.0
Region 3	0.0	0.0	0.0
Region 4	19.0	90.0	100.0
Total	100.0	100.0	100.0

Appendix Table B-9.--Distribution of the value of products and/or services of Sector 9 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	84.3	0.0	0.0
Region 2	0.1	94.2	0.0
Region 3	0.0	0.7	93.0
Region 4	15.6	5.1	7.0
Total	.00.0	100.0	100.0

Appendix Table B-10.--Distribution of the value of products and/or services of Sector 10 terminating in Appalachia, according to region of origin, by region of destination

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	7.8	0.0	0.0
Region 2	0.0	15.4	0.0
Region 3	0.0	0.0	35.0
Region 4	92.2	84.6	65.0
Total	100.0	100.0	100.0

Appendix Table B-11.--Distribution of the value of products and/or services of Sector 11 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-12.--Distribution of the value of products and/or services of Sector 12 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-13.--Distribution of the value of products and/or services of Sector 13 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	5.5	1.6	1.1
Region 2	3.0	12.8	3.0
Region 3	2.2	4.1	15.7
Region 4	89.3	81.5	80.2
Total	100.0	100.0	100.0

Appendix Table B-14.--Distribution of the value of products and/or services of Sector 14 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	24.5	5.9	3.0
Region 2	1.4	15.9	3.2
Region 3	1.6	6.8	27.1
Region 4	72.5	71.4	66.7
Total	100.0	100.0	100.0

Appendix Table B-15.--Distribution of the value of products and/or services of Sector 15 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	45.2	5.7	2.4
Region 2	0.0	0.0	0.0
Region 3	9.2	28.4	57.6
Region 4	45.6	65.9	40.0
Total	100.0	100.0	100.0

Appendix Table B-16.--Distribution of the value of products and/or services of Sector 16 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	6.3	0.7	0.4
Region 2	1.1	4.6	1.2
Region 3	18.4	38.4	52.0
Region 4	74.2	56.3	46.4
Total	100.0	100.0	100.0

Appendix Table B-17.--Distribution of the value of products and/or services of Sector 17 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	9.2	1.4	1.3
Region 2	6.9	43.0	16.0
Region 3	4.2	8.6	23.6
Region 4	79.7	47.0	59.1
Total	100.0	100.0	100.0

Appendix Table B-18.--Distribution of the value of products and/or services of Sector 18 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	5.7	2.8	2.1
Region 2	2.0	7.1	4.0
Region 3	5.2	11.6	18.1
Region 4	87.1	78.5	75.8
Total	100.0	100.0	100.0

Appendix Table B-19.--Distribution of the value of products and/or services of Sector 19 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	3.3	1.7	1.3
Region 2	0.6	2.5	1.3
Region 3	2.7	7.7	12.5
Region 4	93.4	88.1	84.9
Total	100.0	100.0	100.0

Appendix Table B-20.--Distribution of the value of products and/or services of Sector 20 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	14.9	2.4	1.2
Region 2	3.1	17.9	3.4
Region 3	2.9	7.6	20.4
Region 4	79.1	72.1	75.0
Total	100.0	100.0	100.0

Appendix Table B-21.--Distribution of the value of products and/or services of Sector 21 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	5.1	1.0	0.5
Region 2	0.0	0.0	0.0
Region 3	0.2	0.5	2.3
Region 4	94.7	98.5	97.2
Total	100.0	100.0	100.0

Appendix Table B-22.--Distribution of the value of products and/or services of Sector 22 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	10.1	2.3	1.6
Region 2	3.1	13.7	6.4
Region 3	7.6	15.6	23.8
Region 4	79.2	68.4	68.2
Total	100.0	100.0	100.0

Appendix Table B-23.--Distribution of the value of products and/or services of Sector 23 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	31.9	13.8	10.6
Region 2	0.7	5.7	2.5
Region 3	0.7	2.6	7.0
Region 4	66.7	77.9	79.9
Total	100.0	100.0	100.0

Appendix Table B-24.--Distribution of the value of products and/or services of Sector 24 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	40.4	11.2	4.6
Region 2	1.3	23.7	4.3
Region 3	1.9	13.1	39.4
Region 4	56.4	52.0	51.7
Total	100.0	100.0	100.0

Appendix Table B-25.--Distribution of the value of products and/or services of Sector 25 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	35.6	8.3	4.6
Region 2	1.5	25.4	5.5
Region 3	1.3	6.2	25.4
Region 4	61.6	60.1	64.5
Total	100.0	100.0	100.0

Appendix Table B-26.--Distribution of the value of products and/or services of Sector 26 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	37.1	7.6	4.0
Region 2	2.2	30.5	5.4
Region 3	1.5	8.0	36.5
Region 4	59.2	53.9	54.1
Total	100.0	100.0	100.0

Appendix Table B-27.--Distribution of the value of products and/or services of Sector 27 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	19.9	6.4	4.7
Region 2	10.5	38.0	17.2
Region 3	2.3	4.9	15.7
Region 4	67.3	50.7	62.4
Total	100.0	100.0	100.0

Appendix Table B-28.--Distribution of the value of products and/or services of Sector 28 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	27.7	9.2	7.1
Region 2	8.7	35.5	16.4
Region 3	5.7	16.5	33.0
Region 4	57.9	38.8	43.5
Total	100.0	100.0	100.0

Appendix Table B-29.--Distribution of the value of products and/or services of Sector 29 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	7.9	2.2	1.6
Region 2	0.7	7.8	4.0
Region 3	0.6	3.2	10.8
Region 4	90.8	86.8	83.6
Total	100.0	100.0	100.0

Appendix Table B-30.--Distribution of the value of products and/or services of Sector 30 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	13.5	4.9	3.1
Region 2	0.0	0.0	0.0
Region 3	0.3	1.7	8.1
Region 4	86.2	93.4	88.8
Total	100.0	100.0	100.0

Appendix Table B-31.--Distribution of the value of products and/or services of Sector 31 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	17.0	5.3	3.6
Region 2	2.0	11.6	2.2
Region 3	0.4	1.0	4.9
Region 4	80.6	82.1	89.3
Total	100.0	100.0	100.0

Appendix Table B-32.--Distribution of the value of products and/or services of Sector 32 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	10.8	5.5	4.2
Region 2	0.5	2.4	1.3
Region 3	1.8	5.5	13.4
Region 4	86.9	86.6	81.1
Total	100.0	100.0	100.0

Appendix Table B-33.--Distribution of the value of products and/or services of Sector 33 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	20.7	6.0	5.6
Region 2	1.9	15.9	6.3
Region 3	0.6	2.7	9.3
Region 4	76.8	75.4	78.8
Total	100.0	100.0	100.0

Appendix Table B-34.--Distribution of the value of products and/or services of Sector 34 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	19.0	8.4	6.2
Region 2	1.1	5.4	1.6
Region 3	0.9	2.9	7.8
Region 4	79.0	83.3	84.4
Total	100.0	100.0	100.0

Appendix Table B-35.--Distribution of the value of products and/or services of Sector 35 terminating in Appalachia, according to region of orgini, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	70.4	21.0	14.4
Region 2	1.5	32.9	5.8
Region 3	0.6	8.6	32.6
Region 4	27.5	37.5	47.2
Total	100.0	100.0	100.0

Appendix Table B-36.--Distribution of the value of products and/or services of Sector 36 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	52.7	12.2	5.0
Region 2	1.9	37.5	5.3
Region 3	0.9	6.3	46.7
Region 4	44.5	44.0	43.0
Total	100.0	100.0	100.0

Appendix Table B-37.--Distribution of the value of products and/or services of Sector 37 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	64.1	24.4	10.8
Region 2	0.8	18.3	1.7
Region 3	0.7	4.9	55.0
Region 4	34.4	52.4	32.5
Total	100.0	100.0	100.0

Appendix Table B-38.--Distribution of the value of products and/or services of Sector 38 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	20.3	8.5	6.9
Region 2	4.3	20.9	8.3
Region 3	2.0	4.9	16.7
Region 4	73.4	65.7	68.1
Total	100.0	100.0	100.0

Appendix Table B-39.—Distribution of the value of products and/or services of Sector 39 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	21.7	9.9	6.6
Region 2	0.0	0.0	0.0
Region 3	0.2	0.9	3.0
Region 4	78.1	89.2	90.4
Total	100.0	100.0	100.0

Appendix Table B-40.--Distribution of the value of products and/or services of Sector 40 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	29.0	10.4	5.2
Region 2	0.4	4.7	1.0
Region 3	1.7	7.3	31.3
Region 4	68.9	77.6	62.5
Total	100.0	100.0	100.0

Appendix Table B-41.--Distribution of the value of products and/or services of Sector 41 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	15.7	6.2	4.5
Region 2	0.3	1.3	0.7
Region 3	0.4	1.8	8.5
Region 4	83.6	90.7	86.3
Total	100.0	100.0	100.0

Appendix Table B-42.--Distribution of the value of products and/or services of Sector 42 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	20.0	7.6	5.3
Region 2	0.8	6.9	2.7
Region 3	0.8	3.3	14.9
Region 4	78.4	82.2	77.1
Total	100.0	100.0	100.0

Appendix Table B-43.--Distribution of the value of products and/or services of Sector 43 terminating in Appalachia, according to region of origin by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	27.0	16.7	13.2
Region 2	0.0	0.0	0.0
Region 3	0.0	0.0	0.0
Region 4	73.0	83.3	86.8
Total	100.0	100.0	100.0

Appendix Table B-44.--Distribution of the value of products and/or services of Sector 44 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	0.4	0.2	0.1
Region 2	0.2	0.5	0.2
Region 3	0.6	1.0	2.4
Region 4	98.8	98.3	97.3
Total	100.0	100.0	100.0

Appendix Table B-45.--Distribution of the value of products and/or services of Sector 45 termination in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	7.4	3.8	2.7
Region 2	0.5	1.4	0.4
Region 3	0.2	0.4	1.1
Region 4	91.9	94.4	95.8
Total	100.0	100.0	100.0

Appendix Table B-46.--Distribution of the value of products and/or services of Sector 46 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	7.9	4.3	3.6
Region 2	0.5	2.0	1.1
Region 3	1.4	2.9	7.3
Region 4	90.2	90.8	88.0
Total	100.0	100.0	100.0

Appendix Table B-47.00Distribution of the value of products and/or services of Sector 47 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	14.1	7.0	5.6
Region 2	0.0	0.3	0.2
Region 3	0.4	1.1	2.4
Region 4	85.5	91.6	91.8
Total	100.0	100.0	100.0

Appendix Table B-48.--Distribution of the value of products and/or services of Sector 48 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	9.9	4.5	3.6
Region 2	0.1	0.8	0.4
Region 3	3.1	9.3	18.3
Region 4	86.9	85.4	77.7
Total	100.0	100.0	100.0

Appendix Table B-49.--Distribution of the value of products and/or services of Sector 49 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	22.4	11.4	9.3
Region 2	0.2	1.0	0.9
Region 3	0.5	1.4	4.0
Region 4	76.9	86.2	85.8
Total	100.0	100.0	100.0

Appendix Table B-50.--Distribution of the value of products and/or services of Sector 50 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	3.7	1.9	1.5
Region 2	0.2	0.6	0.3
Region 3	0.6	1.2	2.2
Region 4	95.5	96.3	96.0
Total	100.0	100.0	100.0

Appendix Table B-51.--Distribution of the value of products and/or services of Sector 51 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	19.3	7.9	7.8
Region 2	0.0	0.0	0.0
Region 3	0.1	0.3	0.3
Region 4	80.6	91.8	91.9
Total	100.0	100.0	100.0

Appendix Table B-52.--Distribution of the value of products and/or services of Sector 52 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	5.1	2.4	2.1
Region 2	0.1	0.3	0.2
Region 3	0.5	1.2	2.0
Region 4	94.3	96.1	95.7
Total	100.0	100.0	100.0

Appendix Table B-53.--Distribution of the value of products and/or services of Sector 53 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	16.7	10.1	8.0
Region 2	0.0	0.2	0.1
Region 3	1.4	3.2	5.6
Region 4	81.9	86.5	86.3
Total	100.0	100.0	100.0

Appendix Table B-54.--Distribution of the value of products and/or services of Sector 54 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	1.4	0.6	0.5
Region 2	0.1	0.2	0.2
Region 3	3.3	6.7	11.9
Region 4	95.2	92.5	87.4
Total	100.0	100.0	100.0

Appendix Table B-55.--Distribution of the value of products and/or services of Sector 55 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	13.2	8.6	7.1
Region 2	1.0	3.1	2.2
Region 3	1.1	3.1	5.4
Region 4	84.7	85.2	85.3
Total	100.0	100.0	100.0

Appendix Table B-56.--Distribution of the value of products and/or services of Sector 56 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	5.9	4.4	3.9
Region 2	1.2	2.7	1.9
Region 3	2.4	3.9	4.6
Region 4	90.5	89.0	89.6
Total	100.0	100.0	100.0

Appendix Table B-57.--Distribution of the value of products and/or services of Sector 57 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	17.5	11.9	11.6
Region 2	0.9	2.2	1.5
Region 3	1.4	2.8	3.4
Region 4	80.2	83.1	83.5
Total	100.0	100.0	100.0

Appendix Table B-58,--Distribution of the value of products and/or services of Sector 58 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	6.1	2.4	2.2
Region 2	0.0	0.0	0.0
Region 3	1.2	2.2	5.5
Region 4	92.7	95.4	92.3
Total	100.0	100.0	100.0

Appendix Table B-59.—Distribution of the value of products and/or services of Sector 59 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	30.3	5.5	4.2
Region 2	0.3	6.3	1.2
Region 3	0.1	0.7	9.9
Region 4	69.3	87.5	84.7
Total	100.0	100.0	100.0

Appendix Table B-60.--Distribution of the value of products and/or services of Sector 60 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	11.9	3.0	2.0
Region 2	0.0	0.0	0.0
Region 3	0.8	2.2	8.6
Region 4	87.3	94.8	89.4
Total	100.0	100.0	100.0

Appendix Table B-61.--Distribution of the value of products and/or services of Sector 61 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	29.4	13.0	8.8
Region 2	0.7	3.9	1.0
Region 3	0.6	1.6	7.6
Region 4	69.3	81.5	82.6
Total	100.0	100.0	100.0

Appendix Table B-62.--Distribution of the value of products and/or services of Sector 62 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	12.1	716	6.5
Region 2	1.2	3.5	2.3
Region 3	0.9	1.8	2.8
Region 4	85.8	87.1	88.4
Total	100.0	100.0	100.0

Appendix Table B-63.--Distribution of the value of products and/or services of Sector 63 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	7.5	4.8	4.4
Region 2	0.4	1.2	0.6
Region 3	1.0	2.5	2.9
Region 4	91.1	91.5	92.1
Total	100.0	100.0	100.0

Appendix Table B-64.--Distribution of the value of products and/or services of Sector 64 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	7.6	3.7	2.8
Region 2	0.2	1.6	0.7
Region 3	0.5	2.0	5.9
Region 4	91.7	92.7	90.6
Total	100.0	100.0	100.0

Appendix Table B-65.--Distribution of the value of products and/or services of Sector 65 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	63.7	0.8	0.0
Region 2	0.0	25.8	0.0
Region 3	0.0	0.0	10.1
Region 4	36.3	73.4	89.9
Total	100.0	100.0	100.0

Appendix Table B-66.--Distribution of the value of products and/or services of Sector 66 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-67.--Distribution of the value of products and/or services of Sector 67 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-68.--Distribution of the value of products and/or services of Sector 68 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-69.--Distribution of the value of products and/or services of Sector 69 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	97.0	0.1	0.0
Region 2	0.1	96.3	0.0
Region 3	0.0	0.0	96.9
Region 4	2.9	3.6	3.1
Total	100.0	100.0	100.0

Appendix Table B-70.--Distribution of the value of products and/or services of Sector 70 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	34.7	4.6	0.1
Region 2	0.3	25.0	0.3
Region 3	0.1	0.4	29.1
Region 4	64.9	70.0	70.5
Total	100.0	100.0	100.0

Appendix Table B-71.--Distribution of the value of products and/or services of Sector 71 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	63.9	6.2	0.0
Region 2	4.5	79.5	0.0
Region 3	0.0	0.1	78.1
Region 4	31.6	14.2	21.9
Total	100.0	100.0	100.0

Appendix Table B-72.--Distribution of the value of products and/or services of Sector 72 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	20.8	2.0	0.0
Region 2	4.0	33.6	0.5
Region 3	0.0	0.0	23.4
Region 4	75.2	64.4	76.1
Total	100.0	100.0	100.0

Appendix Table B-73.--Distribution of the value of products and/or services of Sector 73 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-74.--Distribution of the value of products and/or services of Sector 74 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	0.0	0.0	0.0
Region 2	0.0	0.0	0.0
Region 3	0.0	0.0	0.0
Region 4	100.0	100.0	100.0
Total	100.0	100.0	100.0

Appendix Table B-75.--Distribution of the value of products and/or services of Sector 75 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-76.--Distribution of the value of products and/or services of Sector 76 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-77.--Distribution of the value of products and/or services of Sector 77 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	98.9	0.0	0.0
Region 2	0.0	97.1	0.0
Region 3	0.0	0.2	97.6
Region 4	1.1	2.7	2.4
Total	100.0	100.0	100.0

Appendix Table B-78.--Distribution of the value of products and/or services of Sector 78 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	0.0	0.0	0.0
Region 2	0.0	0.0	0.0
Region 3	0.0	0.0	0.0
Region 4	100.0	100.0	100.0
Total	100.0	100.0	100.0

Appendix Table B-79.--Distribution of the value of products and/or services of Sector 79 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-80.--Distribution of the value of products and/or services of Sector 80 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	0.0	0.0	0.0
Region 2	0.0	0.0	0.0
Region 3	0.0	0.0	0.0
Region 4	100.0	100.0	100.0
Total	100.0	100.0	100.0

Appendix Table B-81.--Distribution of the value of products and/or services of Sector 81 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-82.--Distribution of the value of products and/or services of Sector 82 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	100.0	0.0	0.0
Region 2	0.0	100.0	0.0
Region 3	0.0	0.0	100.0
Region 4	0.0	0.0	0.0
Total	100.0	100.0	100.0

Appendix Table B-83.--Distribution of the value of products and/or services of Sector 83 terminating in Appalachia, according to region of origin, by region of destination.

Region of origin	Region of destination		
	Region 1	Region 2	Region 3
	per cent	per cent	per cent
Region 1	98.8	0.0	0.1
Region 2	0.0	98.5	0.0
Region 3	0.0	0.0	98.6
Region 4	1.2	1.5	1.3
Total	100.0	100.0	100.0

APPENDIX C

DIRECT REQUIREMENTS OF WATER RESOURCE DEVELOPMENT PROJECTS

Appendix Table C-1.--Value of goods and services required for construction of large earth fill dam projects by input-output sector per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	.12
2	.18	45	103.61
3		46	3.84
4		47	.38
5		48	
6		49	9.53
7		50	.08
8		51	
9	.24	52	.60
10		53	1.24
11		54	
12		55	.70
13		56	.26
14		57	
15		58	
16		59	76.65
17	.22	60	
18		61	
19		62	.02
20	7.82	63	
21	.02	64	.01
22	.02	65	15.52
23		66	2.02
24		67	
25		68	2.79
26		69	114.90
27	17.21	70	8.09
28		71	3.90
29	.17	72	
30	.19	73	
31	69.87	74	
32	10.09	75	4.91
33		76	
34		77	1.08
35	.01	78	
36	14.10	79	.25
37	1.19	80	
38	.46	81	4.18
39		82	.26
40	51.04	83	466.88
41			
42	5.35	Total	$ 1,000.00
43			

Appendix Table C-2.--Value of goods and services required for construction of local flood protection projects by input-output sector, per $1,000 of project cost

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	
2	.28	45	41.00
3		46	
4		47	.20
5		48	.07
6		49	2.84
7		50	
8		51	
9	40.97	52	
10		53	.54
11		54	.54
12		55	.13
13		56	
14		57	
15		58	.05
16		59	21.23
17	.01	60	
18		61	.01
19	.32	62	.15
20	11.52	63	
21		64	.09
22		65	38.33
23	.04	66	2.02
24		67	
25		68	2.79
26		69	81.74
27	2.63	70	8.09
28	.11	71	3.90
29	.57	72	
30	.08	73	
31	24.31	74	
32	7.27	75	4.91
33		76	
34		77	1.08
35		78	
36	68.53	79	.25
37	4.64	80	
38	.31	81	4.18
39		82	.26
40	112.91	83	498.41
41	.09		
42	12.63	Total	$ 1,000.00
43			

Appendix Table C-3.--Value of goods and services required for construction of large dam and power generating projects by input-output sector, per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	
2		45	44.35
3		46	2.42
4		47	2.43
5		48	.14
6		49	2.12
7		50	
8		51	.80
9	41.08	52	2.43
10		53	45.22
11		54	
12		55	
13		56	.85
14		57	
15		58	
16		59	3.87
17	.16	60	
18		61	1.63
19		62	1.72
20	5.74	63	
21		64	.01
22		65	39.20
23	.44	66	2.02
24	.78	67	
25		68	2.79
26	.14	69	61.47
27	6.66	70	8.09
28		71	3.90
29		72	
30	.06	73	
31	11.15	74	
32	6.97	75	4.91
33		76	
34		77	1.08
35		78	
36	59.87	79	.25
37	31.51	80	
38	3.26	81	4.18
39		82	.26
40	70.82	83	485.74
41	.15		
42	6.18	Total	$ 1,000.00
43	33.15		

Appendix Table C-4.--Value of goods and services required for dredging projects by input-output sector, per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	
2		45	31.93
3		46	
4		47	.09
5		48	
6		49	.50
7		50	
8		51	
9	.01	52	
10		53	
11		54	
12		55	.47
13		56	
14		57	
15		58	
16		59	1.23
17	.84	60	
18		61	149.76
19		62	.19
20	.06	63	
21		64	
22		65	16.89
23		66	2.02
24		67	
25		68	3.00
26		69	55.71
27	13.57	70	8.09
28	1.08	71	3.90
29		72	
30		73	
31	87.11	74	
32		75	4.91
33		76	
34		77	1.08
35		78	
36		79	.25
37	44.14	80	
38	.68	81	4.18
39		82	.26
40	.56	83	546.80
41			
42	20.69	Total	$1,000.00
43			

Appendix Table C-5.--Value of goods and services required for construction of revetments projects by input-output sector, per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	
2		45	19.75
3		46	
4		47	
5		48	
6		49	.05
7		50	
8		51	
9	303.79	52	
10		53	
11		54	
12		55	
13		56	
14		57	
15		58	
16		59	4.48
17		60	
18		61	15.52
19		62	
20	45.54	63	
21		64	
22		65	193.26
23		66	2.02
24		67	
25		68	2.79
26		69	72.81
27		70	8.09
28		71	3.90
29		72	
30		73	
31	41.81	74	
32	3.18	75	4.91
33		76	
34		77	1.08
35		78	
36	.23	79	.25
37	1.75	80	
38	1.76	81	4.18
39		82	.26
40	.20	83	259.74
41			
42	8.65	Total	$1,000.00
43			

Appendix Table C-6.--Value of goods and services required for construction of miscellaneous projects by input-output sector, per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	.01
2	1.12	45	107.28
3		46	
4		47	
5		48	.16
6		49	9.21
7		50	
8		51	.97
9	22.66	52	
10		53	
11		54	
12		55	.27
13		56	
14		57	
15		58	
16		59	49.57
17		60	
18		61	.81
19		62	.16
20	20.47	63	
21		64	.27
22		65	34.72
23		66	2.02
24		67	
25		68	1.85
26		69	106.16
27	24.00	70	8.09
28	.09	71	3.90
29	.03	72	
30	.11	73	
31	84.15	74	
32	12.22	75	4.91
33		76	
34		77	1.08
35		78	
36	54.16	79	.25
37	36.18	80	
38		81	4.18
39		82	.26
40	.28	83	403.31
41			
42	5.00	Total	$1,000.00
43	.09		

Appendix Table C-7.--Value of goods and services required for construction of pile dike projects by input-output sector, per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	
2		45	60.18
3		46	
4		47	
5		48	
6		49	6.32
7		50	
8		51	.56
9	121.50	52	
10		53	
11		54	
12		55	
13		56	
14		57	
15		58	
16		59	8.85
17		60	
18		61	37.99
19		62	
20	55.21	63	
21		64	
22		65	88.20
23		66	2.02
24		67	
25		68	2.79
26		69	69.15
27	14.47	70	8.09
28		71	3.90
29		72	
30		73	
31	28.49	74	
32	3.96	75	4.91
33		76	
34		77	1.08
35		78	
36		79	.25
37	4.15	80	
38		81	4.18
39		82	.26
40		83	457.22
41			
42	16.27	Total	$1,000.00
43			

Appendix Table C-8.--Value of goods and services required for construction of rock and concrete dam projects by input-output sector, per $1,000 of project cost

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	.05
2	.97	45	109.06
3		46	29.82
4		47	.18
5		48	.40
6		49	9.60
7		50	11.66
8		51	.78
9	65.89	52	
10		53	6.05
11		54	
12		55	12.93
13		56	
14		57	
15		58	
16		59	11.94
17		60	
18		61	9.22
19	.01	62	
20	4.52	63	
21		64	
22		65	61.13
23		66	2.02
24		67	
25		68	1.13
26		69	99.04
27	1.28	70	8.09
28		71	3.90
29	.65	72	
30	1.08	73	
31	13.47	74	
32	3.97	75	4.91
33		76	
34	.01	77	1.08
35		78	
36	120.13	79	.25
37	65.33	80	
38	1.52	81	4.18
39		82	.26
40	43.98	83	276.67
41	2.53		
42	5.51	Total	$ 1,000.00
43	4.80		

Appendix Table C-9.--Value of goods and services required for construction of levees projects by input-output sector, per $1,000 of project cost

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	.26
2	.25	45	71.66
3		46	
4		47	
5		48	.02
6		49	.59
7		50	
8		51	.06
9	72.69	52	
10		53	.23
11		54	
12		55	.02
13		56	
14		57	
15		58	
16		59	9.56
17		60	
18		61	13.03
19		62	
20	1.14	63	
21		64	.05
22		65	53.75
23		66	2.02
24		67	
25		68	2.79
26		69	55.67
27	1.42	70	8.09
28		71	3.90
29		72	
30	.02	73	
31	77.42	74	
32	11.14	75	4.91
33		76	
34		77	1.08
35		78	
36	.61	79	.25
37	1.44	80	
38	.03	81	4.18
39		82	.26
40	5.33	83	591.03
41			
42	5.10	Total	$1,000.00
43			

Appendix Table C-10.--Value of goods and services required for construction of medium concrete dams projects by input-output sector per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	.08
2	.06	45	83.59
3		46	24.46
4		47	2.30
5		48	.01
6		49	9.06
7		50	.51
8		51	
9	1.57	52	8.84
10		53	2.77
11		54	
12		55	
13		56	
14		57	
15		58	
16	2.09	59	16.71
17	.12	60	
18		61	3.81
19	.39	62	.27
20	5.17	63	
21		64	.02
22		65	18.86
23		66	2.02
24	.01	67	
25	.29	68	16.64
26		69	83.63
27	8.51	70	8.09
28		71	3.90
29		72	
30	1.23	73	
31	4.94	74	
32	1.97	75	4.91
33		76	
34		77	1.08
35		78	
36	94.42	79	.25
37	27.85	80	
38	4.94	81	4.18
39		82	.26
40	77.70	83	466.56
41			
42	4.82	Total	$ 1,000.00
43	1.17		

Appendix Table C-11.--Value of goods and services required for construction of small earth fill dams projects by input-output sector per $1,000 of project cost.

Input-output sector	Value of goods and services	Input-output sector	Value of goods and services
	dollars		dollars
1		44	.02
2	.91	45	150.87
3		46	2.25
4		47	.51
5		48	.45
6		49	10.15
7		50	.25
8		51	
9	23.69	52	
10		53	1.05
11		54	
12		55	.79
13		56	
14		57	
15		58	
16		59	75.03
17		60	
18		61	
19		62	.02
20	5.78	63	
21		64	.01
22		65	31.28
23		66	2.02
24		67	
25		68	2.79
26		69	116.46
27	47.82	70	8.09
28		71	3.90
29		72	
30	.09	73	
31	56.34	74	
32	7.41	75	4.91
33		76	
34		77	1.08
35		78	
36	9.77	79	.25
37	3.27	80	
38	.23	81	4.18
39		82	.26
40	26.42	83	396.81
41	.18		
42	4.66	Total	$ 1,000.00
43			

APPENDIX D

WORK SHEETS FOR COMPUTING DIRECT AND INDIRECT CHANGES IN INCOMES IN APPALACHIA

Appendix Figure D-1.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 1, Final Demand for Region 1, Sectors 1-40.

Input-output sector	Total Final Demand	Decimal Reg. 1 to Reg1 Sec. 1-40	Final demand for Region 1 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
1		.36360		.46549	
2		.17220		.63994	
3		1.00000		.48608	
4		1.00000		.52485	
5		.00020		.39325	
6		--		.39386	
7		.94170		.72796	
8		.73340		.68931	
9		.84270		.62604	
10		.07770		.59591	
11		1.00000		.48045	
12		1.00000		.57075	
13		.05539		.35452	
14		.24461		.37820	
15		.45231		.21571	
16		.06293		.37390	
17		.09225		.35969	
18		.05644		.44718	
19		.03353		.32721	
20		.14896		.44900	
21		.05077		.45058	
22		.10146		.53820	
23		.31865		.58251	
24		.40398		.42302	
25		.35614		.44660	
26		.37094		.61927	
27		.19913		.43078	
28		.27654		.42645	
29		.07906		.51323	
30		.13500		.49987	
31		.16976		.46228	
32		.10788		.50547	
33		.20722		.37066	
34		.18997		.51414	
35		.70359		.58017	
36		.52693		.57354	
37		.64157		.56186	
38		.20274		.36328	
39		.21671		.41813	
40		.28962		.46923	

Appendix Figure D-1, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 1 to Reg 1 Sec. 41-83	Final demand for Region 1 Col. 1 x Col. 2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.15692		.49494	
42		.19969		.48819	
43		.26953		.50292	
44		.00416		.47482	
45		.07427		.54407	
46		.07887		.47333	
47		.14106		.57843	
48		.09945		.53489	
49		.22352		.54268	
50		.03749		.60318	
51		.19278		.62961	
52		.05096		.44977	
53		.16689		.60896	
54		.01417		.50899	
55		.13140		.55948	
56		.05877		.50566	
57		.17545		.57015	
58		.06088		.49007	
59		.30296		.36992	
60		.11887		.43444	
61		.29421		.44785	
62		.12083		.55557	
63		.07465		.64122	
64		.07625		.53156	
65		.63710		.68490	
66		1.00000		.75720	
67		1.00000		.76055	
68		1.00000		.60508	
69		.96990		.83251	
70		.34730		.50551	
71		.63890		.73786	
72		.20780		.71388	
73		1.00000		.68522	
74		0.		.09165	
75		1.00000		.39781	
76		1.00000		.70719	
77		.98850		.87998	
78		00.		.52000	
79		1.00000		.58993	
80		0.		--	
81		1.00000		.29331	
82		1.00000		.19469	
83		.98771		1.45055	

Appendix Figure D-2.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 1, Final Demand for Region 2, Sectors 1-40.

Input-output sector	Total Final Demand	Decimal Reg. 2 to Reg 1 Sec. 1-40	Final demand for Region 2 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec.41-83	Change in income in Appalachia Col. 3 x Col. 4
1		0.0		.51490	
2		0.0		.66809	
3		0.0		.50783	
4		0.0		.58259	
5		0.0		.37529	
6		0.0		.38430	
7		0.04790		.73075	
8		0.07720		.68906	
9		0.00110		.62399	
10		0.0		.57977	
11		0.0		.46807	
12		0.0		.56532	
13		0.03011		.34732	
14		0.01451		.41686	
15		0.0		.22419	
16		0.01128		.41859	
17		0.06873		.39438	
18		0.02028		.47975	
19		0.00595		.37163	
20		0.03092		.45232	
21		0.0		.45169	
22		0.03140		.54198	
23		0.00664		.57231	
24		0.01301		.42419	
25		0.01505		.44927	
26		0.02229		.63183	
27		0.10470		.43818	
28		0.08670		.44899	
29		0.00688		.52181	
30		0.0		.52209	
31		0.02080		.20987	
32		0.00544		.52944	
33		0.01898		.37352	
34		0.01108		.51974	
35		0.01536		.57737	
36		0.01870		.56687	
37		0.00813		.52363	
38		0.04342		.36654	
39		0.0		.42849	
40		0.00448		.43941	

Appendix Figure D-2, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 2 to Reg 1 Sec. 41-83	Final demand for Region 2 Col. 1 x Col.	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		0.00255		.46894	
42		0.00767		.46501	
43		0.0		.48150	
44		0.00237		.45056	
45		0.00460		.51833	
46		0.00561		.45242	
47		0.00040		.56408	
48		0.00122		.52107	
49		0.00225		.52261	
50		0.00167		.59463	
51		0.0		.61977	
52		0.00090		.43674	
53		0.00043		.60115	
54		0.00062		.49671	
55		0.01029		.55157	
56		0.01170		.50176	
57		0.00889		.56890	
58		0.0		.48574	
59		0.00340		.33517	
60		0.0		.42539	
61		0.00699		.42450	
62		0.01234		.55079	
63		0.00440		.64642	
64		0.00186		.53440	
65		0.0		.67076	
66		0.0		.76433	
67		0.0		.76721	
68		0.0		.56338	
69		0.00070		.84185	
70		0.00290		.51051	
71		0.04460		.74630	
72		0.03970		.72374	
73		0.0		.69822	
74		0.0		.09164	
75		0.0		.38618	
76		0.0		.71672	
77		0.0		.89285	
78		0.0		.47867	
79		0.0		.58476	
80		0.0			
81		0.0		.20913	
82		0.0		.21769	
83		0.00005		1.46727	

Appendix Figure D-3.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 1, Final Demand for Region 3 Sectors 1-40.

Input-output sector	Total Final Demand	Decimal Reg. 3 to Reg 1 Sec. 1-40	Final demand for Region 3 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec.41-83	Change in income in Appalachia Col. 3 x Col. 4
1		--		.50859	
2		.00660		.65871	
3		--		.49524	
4		--		.56413	
5		--		.36145	
6		--		.39239	
7		--		.71291	
8		--		.66647	
9		--		.61440	
10		--		.56926	
11		--		.46816	
12		--		.56190	
13		.02146		.34541	
14		.01616		.43648	
15		.09239		.21556	
16		.18432		.41565	
17		.04250		.38889	
18		.05227		.48581	
19		.02681		.38234	
20		.02945		.43385	
21		.00190		.44098	
22		.07562		.53760	
23		.00725		.57075	
24		.01935		.41295	
25		.01242		.43921	
26		.01531		.61904	
27		.02325		.42068	
28		.05738		.42232	
29		.00562		.50669	
30		.00266		.49814	
31		.00362		.16534	
32		.01780		.51307	
33		.00610		.36182	
34		.00878		.51075	
35		.00650		.56072	
36		.00916		.55158	
37		.00666		.53744	
38		.01991		.36500	
39		.00166		.46483	
40		.01709		.45832	

Appendix Figure D-3, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 3 to Reg 1 Sec. 41-83	Final demand for Region 3 Col. 1 x Col. 2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.00432		.48370	
42		.00807		.47920	
43		--		.48358	
44		.00609		.45894	
45		.00246		.52791	
46		.01374		.45892	
47		.00373		.56483	
48		.03047		.52537	
49		.00474		.52721	
50		.00585		.59368	
51		.00089		.61253	
52		.00549		.44029	
53		.01340		.59669	
54		.03297		.49957	
55		.01134		.54875	
56		.02402		.49389	
57		.01406		.55880	
58		.01182		.48149	
59		.00122		.34214	
60		.00849		.42687	
61		.00626		.43121	
62		.00890		.54414	
63		.00968		.63256	
64		.00495		.52810	
65		--		.65305	
66		--		.75341	
67		--		.75245	
68		--		.54871	
69		--		.82717	
70		.00140		.49724	
71		.00020		.73517	
72		--		.70947	
73		--		.68579	
74		--		.08851	
75		--		.38127	
76		--		.70321	
77		--		.87674	
78		--		.45354	
79		--		.57403	
80		--			
81		--		.16048	
82		--		.21682	
83		.00002		1.44741	

Appendix Figure D-4.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 2, Final Demand for Region 1, Sectors 1-40

Input-output sector	Total Final Demand	Decimal Reg. 1 to Reg 2 Sec. 1-40	Final demand for Region 1 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec.41-83	Change in income in Appalachia Col. 3 x Col. 4
1		.00680		.46549	
2		--		.63994	
3		--		.48608	
4		--		.52485	
5		--		.39325	
6		--		.39386	
7		--		.72796	
8		--		.68931	
9		--		.62604	
10		--		.59591	
11		--		.48045	
12		--		.57075	
13		.01577		.35452	
14		.05916		.37820	
15		.05743		.21571	
16		.00664		.37390	
17		.01475		.35969	
18		.02764		.44718	
19		.01746		.32721	
20		.02447		.44900	
21		.01019		.45058	
22		.02256		.53820	
23		.13760		.58251	
24		.11248		.42302	
25		.08355		.44660	
26		.07625		.61927	
27		.06399		.43078	
28		.09191		.42645	
29		.02189		.51323	
30		.04865		.49987	
31		.05345		.46228	
32		.05503		.50547	
33		.05996		.37066	
34		.08436		.51414	
35		.21015		.58017	
36		.12187		.57354	
37		.24443		.56186	
38		.08468		.36328	
39		.09910		.47813	
40		.10404		.46923	

Appendix Figure D-4, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 1 to Reg 2 Sec. 41-83	Final demand for Region 1 Col. 1 x Col.	Sum inverse coefficients 2 rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.06202		.49494	
42		.07591		.48819	
43		.16732		.50292	
44		.00175		.47482	
45		.03790		.54407	
46		.04334		.47333	
47		.07041		.57843	
48		.04524		.53489	
49		.11371		.54268	
50		.01946		.60318	
51		.07942		.62961	
52		.02425		.44977	
53		.10149		.60896	
54		.00597		.50899	
55		.08589		.55948	
56		.04400		.50566	
57		.11900		.57015	
58		.02384		.49007	
59		.05479		.36992	
60		.03010		.43444	
61		.13037		.44785	
62		.07627		.55557	
63		.04773		.64122	
64		.03701		.53156	
65		.00810		.68490	
66		--		.75720	
67		--		.76055	
68		--		.60508	
69		.00060		.83251	
70		.04550		.50551	
71		.06230		.73786	
72		.01980		.71388	
73		--		.68522	
74		--		.09165	
75		--		.39781	
76		--		.70719	
77		--		.87998	
78		--		.52000	
79		--		.58993	
80		--			
81		--		.29331	
82		--		.19469	
83		.00012		1.45055	

Appendix Figure D-5.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 2, Final Demand for Region 2, Sectors 1-40

Input-output sector	Total Final Demand	Decimal Reg. 2 to Reg 2 Sec. 1-40	Final demand for Region 2 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec.41-83	Change in income in Appalachia Col. 3 x Col. 4
1		.57850		.51490	
2		.30190		.66809	
3		1.00000		.50783	
4		1.00000		.58259	
5		0.		.37529	
6		0.		.38430	
7		1.00000		.73075	
8		.10000		.68906	
9		.94160		.62399	
10		.15420		.57977	
11		1.00000		.46807	
12		1.00000		.56532	
13		.12754		.34732	
14		.15918		.41686	
15		0.		.22419	
16		.04597		.41859	
17		.42980		.39438	
18		.07075		.47975	
19		.02492		.37163	
20		.17878		.45232	
21		0.		.45169	
22		.13747		.54198	
23		.05755		.57231	
24		.23721		.42419	
25		.25414		.44927	
26		.30480		.63183	
27		.38036		.43818	
28		.35499		.44899	
29		.07830		.52181	
30		0.		.52209	
31		.11559		.20987	
32		.02392		.52944	
33		.15884		.37352	
34		.05381		.51974	
35		.32914		.57737	
36		.37475		.56687	
37		.18269		.52363	
38		.20900		.36654	
39		0.		.42849	
40		.04727		.43941	

Appendix Figure D-5, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 2 to Reg 2 Sec. 41-83	Final demand for Region 2 Col. 1 x Col. 2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.01304		.46894	
42		.06861		.46501	
43		0.		.48150	
44		.00479		.45056	
45		.01415		.51833	
46		.02038		.45242	
47		.00248		.56408	
48		.00795		.52107	
49		.00966		.52261	
50		.00551		.59463	
51		0.		.61977	
52		.00337		.43674	
53		.00154		.60115	
54		.00215		.49671	
55		.03103		.55157	
56		.02678		.50176	
57		.02238		.56890	
58		0.		.48574	
59		.06289		.33517	
60		0.		.42539	
61		.03883		.42450	
62		.03469		.55079	
63		.01190		.64642	
64		.01602		.53440	
65		.02750		.67076	
66		1.00000		.76433	
67		1.00000		.76721	
68		1.00000		.56338	
69		.96300		.84185	
70		.25010		.51051	
71		.79490		.74630	
72		.33650		.72374	
73		1.00000		.69822	
74		0.0		.09164	
75		1.00000		.38618	
76		1.00000		.71672	
77		.97060		.89285	
78		0.		.47867	
79		1.00000		.58476	
80		0.			
81		1.00000		.20913	
82		1.00000		.21769	
83		.98501		1.46727	

Appendix Figure D-6.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 2, Final Demand for Region 3, Sectors 1-40

Input-output sector	Total Final Demand	Decimal Reg. 3 to Reg 2 Sec. 1-40	Final demand for Region 3 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec.41-83	Change in income in Appalachia Col. 3 x Col. 4
1		.05930		.50859	
2		.00870		.65871	
3		--		.49524	
4		--		.56413	
5		--		.36145	
6		--		.39239	
7		--		.71291	
8		--		.66647	
9		.00710		.61440	
10		--		.56926	
11		--		.46816	
12		--		.56190	
13		.04139		.34541	
14		.06812		.43648	
15		.28367		.21556	
16		.38397		.41565	
17		.08573		.38889	
18		.11630		.48581	
19		.07696		.38234	
20		.07607		.43385	
21		.00479		.44098	
22		.15576		.53760	
23		.02624		.57075	
24		.13057		.41295	
25		.06170		.43921	
26		.07979		.61904	
27		.04901		.42068	
28		.16471		.42232	
29		.03240		.50669	
30		.01705		.49814	
31		.00979		.16534	
32		.05455		.51307	
33		.02742		.36182	
34		.02888		.51075	
35		.08553		.56072	
36		.06282		.55158	
37		.04919		.53744	
38		.04914		.36500	
39		.00857		.46483	
40		.07304		.45832	

Appendix Figure D-6, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 3 to Reg 2 Sec. 41-83	Final demand for Region 3 Col. 1 x Col.	Sum inverse coefficients 2 rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.01774		.48370	
42		.03289		.47920	
43		--		.48358	
44		.01057		.45894	
45		.00390		.52791	
46		.02885		.45892	
47		.01113		.56483	
48		.09318		.52537	
49		.01441		.52721	
50		.01175		.59368	
51		.00244		.61253	
52		.01148		.44029	
53		.03159		.59669	
54		.06691		.49957	
55		.03131		.54875	
56		.03949		.49389	
57		.02781		.55880	
58		.02170		.48149	
59		.00676		.34214	
60		.02181		.42687	
61		.01634		.43121	
62		.01762		.54414	
63		.02476		.63256	
64		.01964		.52810	
65		--		.65305	
66		--		.75341	
67		--		.75245	
68		--		.54871	
69		--		.82717	
70		.00440		.49724	
71		.00050		.73517	
72		--		.70947	
73		--		.68579	
74		--		.08851	
75		--		.38127	
76		--		.70321	
77		.00210		.87674	
78		--		.45354	
79		--		.57403	
80		--			
81		--		.16048	
82		--		.21682	
83		.00042		1.44741	

Appendix Figure D-7.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 3, Final Demand for Region 1, Sectors 1-40

Input-output sector	Total Final Demand	Decimal Reg.1 to Reg 3 Sec. 1-40	Final demand for Region 1 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec.41-83	Change in income in Appalachia Col. 3 x Col. 4
1		--		.46549	
2		--		.63994	
3		--		.48608	
4		--		.52485	
5		--		.39325	
6		--		.39386	
7		--		.72796	
8		--		.68931	
9		--		.62604	
10		--		.59591	
11		--		.48045	
12		--		.57075	
13		.01141		.35452	
14		.02953		.37820	
15		.02389		.21571	
16		.00384		.37390	
17	500	.01293	6.00	.35969	2.00
18		.02080		.44718	
19		.01353		.32721	
20		.01215		.44900	
21		.00469		.45058	
22		.01621		.53820	
23		.10607		.58251	
24		.04623		.42302	
25		.04600		.44660	
26		.03964		.61927	
27		.04712		.43078	
28		.07113		.42645	
29		.01579		.51323	
30		.03114		.49987	
31		.03588		.46228	
32		.04247		.50547	
33		.05547		.37066	
34		.06267		.51414	
35		.14391		.58017	
36		.05013		.57354	
37		.10813		.56186	
38		.06866		.36328	
39		.06629		.47813	
40		.05200		.46923	

Appendix Figure D-7, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 1 to Reg 3 Sec. 41-83	Final demand for Region 1 Col. 1 x Col. 2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.04525		.49494	
42		.05326		.48819	
43		.13158		.50292	
44		.00137		.47482	
45		.02665		.54407	
46		.03624		.47333	
47		.05649		.57843	
48		.03594		.53489	
49		.09349		.54268	
50		.01484		.60318	
51		.07844		.62961	
52		.02130		.44977	
53		.08007		.60896	
54		.00531		.50899	
55		.07092		.55948	
56		.03909		.50566	
57		.11629		.57015	
58		.02157		.49007	
59		.04234		.36992	
60		.02030		.43444	
61		.08771		.44785	
62		.06475		.55557	
63		.04440		.64122	
64		.02819		.53156	
65		--		.68490	
66		--		.75720	
67		--		.76055	
68		--		.60508	
69		--		.83251	
70		.00130		.50551	
71		--		.73786	
72		--		.71388	
73		--		.68522	
74		--		.09165	
75		--		.39781	
76		--		.70719	
77		--		.87998	
78		--		.52000	
79		--		.58993	
80		--			
81		--		.29331	
82		--		.19469	
83		.00077		1.45055	

Appendix Figure D-8.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 3, Final Demand for Region 2, Sectors 1-40

Input-output sector	Total Final Demand	Decimal Reg. 2 to Reg 3 Sec. 1-40	Final demand for Region 2 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
1		--		.51490	
2		--		.66809	
3		--		.50783	
4		--		.58259	
5		--		.37529	
6		--		.38430	
7		.13820		.73075	
8		--		.68906	
9		--		.62399	
10		--		.57977	
11		--		.46807	
12		--		.56532	
13		.03048		.34732	
14		.03199		.41686	
15		--		.22419	
16		.01196		.41859	
17	5.00	.16025	80.12	.39438	31.00
18		.04043		.47975	
19		.01325		.37163	
20		.03349		.45232	
21		--		.45169	
22		.06440		.54198	
23		.02540		.57231	
24		.04330		.42419	
25		.05518		.44927	
26		.05363		.63183	
27		.17162		.43818	
28		.16391		.44899	
29		.04024		.52181	
30		--		.52209	
31		.02253		.20987	
32		.01274		.52944	
33		.06335		.37352	
34		.01578		.51974	
35		.05852		.57737	
36		.05324		.56687	
37		.01713		.52363	
38		.08295		.36654	
39		--		.42849	
40		.00972		.43941	

Appendix Figure D-8, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 2 to Reg 3 Sec. 41-83	Final demand for Region 2 Col. 1 x Col. 2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.00678		.46894	
42		.02754		.46501	
43		--		.48150	
44		.00192		.45056	
45		.00447		.51833	
46		.01128		.45242	
47		.00156		.56408	
48		.00401		.52107	
49		.00851		.52261	
50		.00302		.59463	
51		--		.61977	
52		.00216		.43674	
53		.00099		.60115	
54		.00149		.49671	
55		.02200		.55157	
56		.01946		.50176	
57		.01465		.56890	
58		--		.48574	
59		.01201		.33517	
60		--		.42539	
61		.01034		.42450	
62		.02348		.55079	
63		.00583		.64642	
64		.00695		.53440	
65		--		.67076	
66		--		.76433	
67		--		.76721	
68		--		.56338	
69		.00030		.84185	
70		.00280		.51051	
71		--		.74630	
72		.00540		.72374	
73		--		.69822	
74		--		.09164	
75		---		.38618	
76		--		.71672	
77		--		.89285	
78		--		.47867	
79		--		.58476	
80		--			
81		--		.20913	
82		--		.21769	
83		.00047		1.46727	

Appendix Figure D-9.--Work sheets for computing direct and indirect income changes in Appalachia for projects in Region 3, Final Demand for Region 3, Sectors 1-40

Input-output sector	Total Final Demand	Decimal Reg. 3 to Reg 3 Sec. 1-40	Final demand for Region 3 Col.1 x Col.2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
1		.90430		.50859	
2		.18450		.65871	
3		1.00000		.49524	
4		1.00000		.56413	
5		.08860		.36145	
6		.23650		.39239	
7		.81780		.71291	
8		--		.66647	
9		.93050		.61440	
10		.34970		.56926	
11		1.00000		.46816	
12		1.00000		.56190	
13		.15686		.34541	
14		.27139		.43648	
15		.57560		.21566	
16		.51994		.41565	
17		.23576		.38889	
18		.18056		.48581	
19		.12455		.38234	
20		.20418		.43385	
21		.02291		.44098	
22		.23777		.53760	
23		.06990		.57075	
24		.39428		.41295	
25		.25432		.43921	
26		.36558		.61904	
27		.15679		.42068	
28		.32963		.42232	
29		.10757		.50669	
30		.08112		.49814	
31		.04855		.16534	
32		.13359		.51307	
33		.09312		.36182	
34		.07760		.51075	
35		.32569		.56072	
36		.46709		.55158	
37		.55004		.53744	
38		.16710		.36500	
39		.02984		.46483	
40		.31278		.45832	

Appendix Figure D-9, continued--Sectors 41-83

Input-output sector	Total Final Demand	Decimal Reg. 3 to Reg 3 Sec. 41-83	Final demand for Region 3 Col. 1 x Col. 2	Sum inverse coefficients rows 83, 166 249, Sec. 41-83	Change in income in Appalachia Col. 3 x Col. 4
41		.08475		.48370	
42		.14852		.47920	
43		--		.48358	
44		.02378		.45894	
45		.01053		.52791	
46		.07301		.45892	
47		.02436		.56483	
48		.18262		.52537	
49		.04047		.52721	
50		.02247		.59368	
51		.00297		.61253	
52		.02021		.44029	
53		.05567		.59669	
54		.11915		.49957	
55		.05421		.54875	
56		.04572		.49389	
57		.03354		.55880	
58		.05528		.48149	
59		.09850		.34214	
60		.08586		.42687	
61		.07560		.43121	
62		.02787		.54414	
63		.02865		.63256	
64		.05909		.52810	
65		.10090		.65305	
66		1.00000		.75341	
67		1.00000		.75245	
68		1.00000		.54871	
69		.96840		.82717	
70		.29100		.49724	
71		.78130		.73517	
72		.23370		.70947	
73		1.00000		.68579	
74		--		.08851	
75		1.00000		.38127	
76		1.00000		.70321	
77		.97550		.87674	
78		--		.45354	
79		1.00000		.57403	
80		--			
81		1.00000		.16048	
82		1.00000		.21682	
83		.98613		1.44741	

APPENDIX E

SECTOR NUMBERING

Appendix Table E-1.--Sector numbering for Report Four and Matrix Inversion.

Report Four	Matrix inversion			Title	Related SIC codes 1957 edition
	Reg. 1	Reg. 2	Reg. 3		
1	1	84	167	Livestock & livestock products	013,pt.014, 0193,pt.02, pt.0729
2	2	85	168	Other agricultural products	011,012,pt. 014,0192, 0199,pt.02
3	3	86	169	Forestry & fishery products	074,081,082, 084,086, 091
4	4	87	170	Agricultural, foresty & fisheries services	071,0723,pt. 0729,085, 098
5	5	88	171	Iron & ferroalloy ores minint	1011,106
6	6	89	172	Nonferrous metal ores mining	102,103,104, 105,108, 109
7	7	90	173	Coal mining	11,12
8	8	91	174	Crude petroleum & natural gas	1311, 1321
9	9	92	175	Stone & clay mining & quarrying	141,142,144, 145,148, 149
10	10	93	176	Chemical & fertilizer mineral mining	147
11	11	94	177	New construction	138,pt.15,pt. 16,pt.17, pt.6561
12	12	95	178	Maintenance & repair construction	pt.15,pt.16, pt.17
13	13	96	179	Ordnance & accessories	19
14	14	97	180	Food & kindred products	20
15	15	98	181	Tobacco manufactures	21

cont'd.

Appendix Table E-1 continued--

Report Four	Matrix inversion			Title	Related SIC codes 1957 edition
	Reg. 1	Reg. 2	Reg. 3		
16	16	99	182	Broad & narrow fabrics, yarn & thread mills	221,222,223 224,226, 228.
17	17	100	183	Misc. textile goods & floor coverings	227,229
18	18	101	184	Apparel	225,23(excluding 239), 3992
19	19	102	185	Misc. fabricated textile products	239
20	20	103	186	Lumber & wood products, except containers	24(excluding 244)
21	21	104	187	Wooden containers	244
22	22	105	188	Household furniture	251
23	23	106	189	Other furniture & fixtures	25 (excluding 251)
24	24	107	190	Paper & allied products, except containers & boxes	26(excluding 265)
25	25	108	191	Paperboard containers & boxes	265
26	26	109	192	Printing & publishing	27
27	27	110	193	Chemicals & selected chemical products	281(exclud. alumina pt. of 2819), 286,287, 289
28	28	111	194	Plastics & synthetic materials	282
29	29	112	195	Drugs, cleaning, & toilet preparations	283,284
30	30	113	196	Paints & allied products	285

cont'd.

Appendix Table E-1 continued--

Report Four	Matrix inversion			Title	Related SIC codes 1957 edition
	Reg. 1	Reg. 2	Reg. 3		
31	31	114	197	Petroleum refining & related industries	29
32	32	115	198	Rubber & misc. plastics products	30
33	33	116	199	Leather tanning & industrial leather products	311,312
34	34	117	200	Footwear & other leather products	31(excluding 311,312)
35	35	118	201	Glass & glass products	321,322,323
36	36	119	202	Stone & clay products	324,325,326, 327,328, 329
37	37	120	203	Primary iron & steel manufacturing	331,332,3391, 3399
38	38	121	204	Primary nonferous metals manufacturing	2819(alumina only),333, 334,335, 336,3392
39	39	122	205	Metal containers	3411,3491
40	40	12β	206	Heating, plumbing & fabricated structural metal products	343,344.
41	41	124	207	Screw machine products, bolts, nuts, etc. & metal stamping	345,346
42	42	125	208	Other fabricated metal products	342,347,348, 349(exclud. 3491)
43	43	126	209	Engines & turbines	351
44	44	127	210	Farm machinery & equipment	352
45	45	128	211	Construction, mining, oil field machinery & equipment	3531,3532, 3533

cont'd.

Appendix Table E-1 continued--

Report Four	Matrix inversion			Title	Related SIC codes 1957 edition
	Reg. 1	Reg. 2	Reg. 3		
46	46	129	212	Materials handling machinery & equipment	3534,3535, 3536,3537
47	47	130	213	Metalworking machinery & equip.	354
48	48	131	214	Special industry mach. & equip.	555
49	49	132	215	General industrial mach. & equip.	556
50	50	133	216	Machine shop products	359
51	51	134	217	Office, computing & accounting machines	357
52	52	135	218	Service industry machines	358
53	53	136	219	Electric transmission & distribution equip., & electrical industrial apparatus	361,362
54	54	137	220	Household appliances	363
55	55	138	221	Electric lighting & wiring equip.	364
56	56	139	222	Radio, television, & communication equipment	365,366
57	57	140	223	Electronic components & accessories	367
58	58	141	224	Misc. electrical machinery, equipment & supplies	369
59	59	142	225	Motor vehicles & equipment	371
60	60	143	226	Aircraft & parts	372
61	61	144	227	Other transportation equipment	373,374,375 379
62	62	145	228	Professional, scientific, & controlling instruments & sup.	381,382,384, 387
63	63	146	229	Optical, ophthalmic, & photographic equip. & supplies	383,385,386

cont'd.

Appendix Table E-1 continued--

Report Four	Matrix inversion			Title	Related SIC codes 1957 edition
	Reg. 1	Reg. 2	Reg. 3		
64	64	147	230	Misc. manufacturing	39(excluding 3992)
65	65	148	231	Transportation & warehousing	40,41,42,44, 45,46,47
66	66	149	232	Communications, except radio & television broadcasting	481,482,489
67	67	150	233	Radio & T.V. broadcasting	483
68	68	151	234	Electric, gas, water, & sanitary services	49
69	69	152	235	Wholesale & retail trade	50(excluding manufacturers sales offices), 52,53,54, 55,56,57, 58,59,pt. 7399
70	70	153	236	Finance & insurance	60,61,62,63, 64,66,67
71	71	154	237	Real estate & rental	65(excluding 6541 & pt. 6561)
72	72	155	238	Hotels & lodging places; personal & repair services, except automobile repair	70,72,76(exclud. 7694 & 7699)
73	73	156	239	Business services	6541,73(exclud.7361, 7391,& pt. 7399),7694, 7699,81,89 (exclud. 8921)
74	74	157	240	Research & development	--

cont'd.

Appendix Table E-1 continued--

Report Four	Matrix inversion			Title	Related SIC codes 1957 edition
	Reg. 1	Reg. 2	Reg. 3		
75	75	158	241	Automobile repair & services	75
76	76	159	242	Amusements	78,79
77	77	160	243	Medical, educational services & nonprofit organizations	0722,7361,80, 82,84,86, 8921
78	78	161	244	Federal Government enterprises	--
79	79	162	245	State & local government enterprises	--
80	80	163	246	Gross imports of goods & services	--
81	81	164	247	Business travel, entertainment & gifts	--
82	82	165	248	Office supplies	--
83	83	166	249	Personal consumption expenditures	--

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