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General Explanations of the 200 Sector Tables: The 1947 Interindustry Relations Study

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GENERAL EXPLANATIONS
of the
200 SECTOR TABLES:



**The 1947 Interindustry
Relations Study**

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1953

UNITED STATES DEPARTMENT OF LABOR
Martin P. Durkin - Secretary

BUREAU OF LABOR STATISTICS
Ewan Clague - Commissioner

The 1947 Interindustry Relations Study

The Study of Interindustry Relations for 1947 is a comprehensive analysis of the transactions relationships among the separate industries of the United States in that year. For purposes of this study, the United States economy was subdivided into about 500 separate sectors or activities, the majority of which correspond with conventional industry classifications. A detailed statistical analysis was carried out for each sector of the purchases from and sales to all sectors in 1947, and the results were reconciled within a general framework of national production and consumption data.

This study was made as a part of a continuing inter-agency program directed primarily toward the improvement of industrial mobilization analysis. It was financed jointly by the United States Air Force, the National Security Resources Board, and the United States Department of Labor. The study was carried on for several years by the Division of Interindustry Economics of the Bureau of Labor Statistics, U. S. Department of Labor, under the general direction of W. Duane Evans, Chief of the Division, and Marvin Hoffenberg, Assistant Chief. Jack Alterman, Sidney A. Jaffe, Philip M. Ritz, and (for a shorter period) Sam H. Schurr were responsible for major parts of the study. Important contributions were made by many members of the staff.

The funds assigned to this project were intended to provide information needed for industrial mobilization applications. However, because the methodology and results of the study are of wider interest, the Bureau of Labor Statistics is undertaking with limited resources some documentation of the study for general use.

The plans for publication include general statements on concepts and procedures applicable to the entire study; methodological reports referring to major economic areas, such as manufacturing, mining, and agriculture; and detailed reports for specific sectors or industries giving the basic statistical findings of the study.

The accompanying report provides a general explanation of the 200-sector interindustry tables, published in October 1952. Insofar as the basic concepts and procedures employed in the 1947 Interindustry Relations Study affect the understanding of these tables, they too are described. These explanations are equally applicable to the methodology and procedures which were followed in documenting the detailed industry studies (i.e., on a 450 to 500-sector basis) from which the 200-sector tables were developed.

GENERAL EXPLANATIONS

of the

200 SECTOR TABLES:

The 1947 Interindustry Relations Study

Report No. 33

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June 1953

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The 1947 Interindustry Relations Study

Introduction

Basic raw material output, intermediate production, distribution, and ultimate consumption throughout the national economy are linked together in a maze of interdependences. Many industries operate largely or even primarily to supply goods and services needed by other industries, whose products in turn may pass through many stages before emerging from the processing system as a finished product in the hands of an ultimate consumer. The production of synthetic rubber, for example, is determined largely by the volume of tires and other important rubber-using items being produced. The number of tires required is to a great extent determined by the number of tire-using vehicles in production. Going further, the number of such vehicles produced is related directly to the demand for them by individuals, business concerns, governments, foreign buyers, etc. One may go further in the other direction by considering the industrial chemicals purchased by the synthetic rubber plant, the grains used by the industrial chemical plant, and the different items the farmer uses to raise his grain crops, among them trucks and farm vehicles using rubber tires.

Such examples illustrate the relationships that together form an immense and intricate structural network linking the output in any one industry with the output of all other industries. Insofar as these relations grow out of technological ties or settled customs, they may be expected to remain relatively stable and to provide some basis for anticipating the effects of a major change in production requirements in one segment of the national economy upon all other segments.

It can be presumed, therefore, that the production levels of all industries in the processing system will be affected by a change in the demands of households, government, foreign countries, or investors for the product of a particular sector. However, the large number of sectors and the complexity of their interrelationships in a highly developed economy such as that of the United States make it almost impossible to trace quantitatively the direct and indirect impact of any change in a single autonomous (or final demand) sector or in the complete set without some consistent, systematic form of organization and measure. The interindustry relations approach brings the mass of structural interconnections into a formal and consistent framework within which the complete impact upon each industrial sector may be computed systematically.

^{1/} Prepared in the Bureau's Division of Interindustry Economics by Philip M. Ritz and Gabriel G. Rudney. Some of the material included has been adapted from other published material prepared in the Division.

The three enclosed tables summarize the findings of the Bureau of Labor Statistics' Interindustry Relations Study for the year 1947. ^{2/} They reflect different aspects of the transactions relations for that year among approximately 200 industrial sectors of the continental United States. Table I - Interindustry Flow of Goods and Services by Industry of Origin and Destination--is a so-called "transactions" table, which records the distribution of the total supply (both domestic and foreign) of the products and services associated with each sector. In recording this distribution of output--along the rows--the table automatically provides a distribution--in the columns--of the purchases by each sector from other sectors. The transactions data are converted, after a few adjustments to a limited number of sectors, into a table of input coefficients, table II - Direct Purchases Per Million Dollars of Output. This table portrays the "processing" sectors of the 1947 economy in terms of their direct unit requirements from each other. Table III - Direct and Indirect Requirements Per Million Dollars of Final Demand--is the most abstract of the tables. It is derived from table II by mathematical techniques ^{3/} and describes more completely the internal demand structure of the economy by linking production in each of the "processing" sectors with end-product deliveries of each to sectors outside the processing system, i.e., to final demand sectors.

The three tables and their relationship with each other are discussed below. Part A of the technical appendix following provides a brief explanation of the theoretical framework of the interindustry relations system. Part B provides a discussion of the basic concepts and research methods of the 1947 study. Part C describes briefly some of the problems faced in using the tables and suggests readings which should be helpful to those who wish to pursue the subject further. Attachments to the technical appendix include information on the method of aggregation by which the 200-sector tables were developed from the more detailed data available in the Bureau of Labor Statistics on a 450- to 500-sector basis. The relationships of both the 200-sector and the 450- to 500-sector classification systems with the Standard Industrial Classification (SIC) system and, where applicable, with the 1947 Census of Manufactures industrial delineations are also indicated. Also included are a table showing the relation of each sector's primary output to gross domestic output (as defined) and a discussion of the problem of byproducts and waste products (scrap) as handled in the 200-sector tables.

Table I - Interindustry Flow of Goods and Services
by Industry of Origin and Destination

This table shows in summary form the distribution of the value of all output in continental United States for 1947 both by industry of origin and industry of destination. For this purpose, the entire economy

^{2/} Preliminary findings published in the autumn of 1951 were presented in similar tables but on a more aggregative 50-sector basis.

^{3/} See technical appendix, part A, for further explanation.

is divided into some 200 sectors. The data for these sectors represent aggregations of data prepared initially in better than 450-industry detail.

The row entries

The entries in each row in the table list in producer's prices the dollar amount of a designated industry's output consumed in 1947 by itself and each of the other sectors of the economy. The last entry in a row represents the gross domestic output of the industry (see explanation of gross domestic output later).

For illustrative purposes consider the first row, referring to the meat animals and products industry, which had a 1947 gross output of \$9,801.7 million. The first entry (col. 1) in this row indicates that the industry itself purchased \$937.7 million worth of the total production, mostly for feeding and breeding. This entry, representing an "intra-industry" transaction, illustrates the fact that each designated industry may be composed of a large number of separate enterprises, any of which may sell to or purchase from another.

Continuing along the row, meat packing and wholesale poultry (col. 21) was by far the largest purchaser of meat animals and products with \$8,099.0 million worth. Over \$38 million was purchased by miscellaneous food products (col. 26), and so on. Almost \$47 million, in the form of hides, went to a special stockpile of byproducts (col. 267), since specific byproduct allocations to purchasing industries are explicitly omitted from the regular distributions (see discussion of waste products and byproducts in the technical appendix, attachment 3). Exports to foreign countries (col. 225) exceeded \$13 million. The Federal Government (col. 215) took \$5.7 million and State and local governments (col. 220) \$1.4 million. Over \$21 million was sold to gross private capital formation (col. 205), in the form of horses and mules newly entering the work animal class.

The entries appearing in the four inventory columns may need special explanation, particularly since this presentation differs from previous ones, e.g., the 50-sector chart published in the autumn of 1951. In the present chart, depletions appear as negative entries in the inventory column rather than as positive row entries. For example, the inventory change within the meat animals and products sector (row 1) of holdings of its own products amounted to a net depletion of \$574.1 million in 1947. This shows as a negative entry in column 236. Of course there is no entry in column 235, which shows net increases in inventory for the producing sector. Meat animals and products held outside the producing industry showed both inventory depletions and gains. Those sectors which had only stock gains showed an inventory increase total of \$69.7 million (col. 230). Those sectors which had only decreases showed a depletion total of \$175.5 million.

Inventory depletions, which represent output of a previous period, are distributed along with current production by the allocations in each row. Similarly, competitive imports are added to current domestic supply and distributed to users of output in identical fashion. However, the sum of all allocations adds, properly, to gross (current) domestic output (col. 999) because of the negative entries in the competitive imports column (no. 226) and the stock depletion columns. For the first sector, competitive imports amounted to \$338.1 millions and depletions, as noted above, amounted to about \$750 millions. Thus, over a billion dollars worth of product in addition to gross domestic output was distributed to users.

Continuing the discussion of row 1, it will be noted that households (col. 200) consumed nearly \$1,070 million dollars worth of the output of the meat animals and products sector. This figure is comprised almost entirely of farm-slaughtered livestock which has been either consumed on the farm or sold directly to other final consumers.

The above discussion of row 1 can be extended similarly to all the other rows of table I.

The column entries

It is readily seen that the first entry in each row represents the shipments of the corresponding sector to the meat animals and products industry (col. 1). It follows that the first column is a summary of the 1947 purchasing pattern of this sector.

The first entry in the column is, of course, the aforementioned intra-industry transaction. The major purchases of the sector were grains for feed bought from the food grains and feed crops sector (row 4), amounting to over \$3,840 million; prepared feeds from the grain mill products sector (row 24), totaling over \$314 million; milk fed to calves from the farm dairy products sector (row 3), amounting to \$130 million; and potatoes and sweet potatoes for feed from the vegetables and fruits sector (row 8), amounting to about \$80 million; and so on for other product-producing industries.

The large purchases of transportation, amounting to about \$110 million and \$185 million from railroads (row 169) and trucking (row 170), respectively, should be noted. Large purchases were made also from wholesale trade (row 176) and retail trade (row 177), amounting to \$76 million and over \$140 million, respectively. These transportation and trade costs and some others appeared as margin items on materials purchased for production purposes by the meat animals and products industry.

The rental amount (row 183) of over \$191 million represents gross rent paid for rented land and service buildings. Costs for maintenance construction (row 212), applicable to owned service buildings alone, amounted to \$10.5 million. Over \$136 million worth of byproduct items (oilseed cake and meal, and animal oil byproduct feeds) were purchased from the special stockpile sector (row 267). As mentioned above, allocations of byproducts from the specific producing industries to actual consuming sectors are not shown directly.

Payments to the Federal Government (row 215) and to State and local governments (row 220) amounted to \$40.5 million and \$94 million respectively. Such payments are in the form of excise taxes on materials and services purchased, corporate income taxes, special licenses, etc. The large household entry (row 200) of over \$3,270 million includes wage and salary payments, entrepreneurial net income, interest payments, and depreciation charges. Since the total output of the meat animals and products sector refers to productive activities, the outlays appearing in the first column are those expenditure items incurred in the process of production. The expenditures of ranchers and farmers as consumers are not included in this sector; they appear as part of the household column.

The outlays of the other sectors in 1947 may be traced similarly by examining their respective columns. In general, then, the distribution of the products or services of any one industry to each of the others may be traced by reading the entries along its row, and its purchases from other industries by reading down its column.

The sectors have been divided into two groups. The first 190 (through sector 192, since 165 and 166 are blank) may be considered the "processing" or "intermediate" sectors--for each of these the gross output and gross outlay totals are identical. This is equivalent to saying, in an accounting sense, that current outlays, with allowance for profits and inventory change, are equal to current receipts. The same is true for the next seven sectors, which are somewhat special in nature in that, though they are similar to processing sectors, they appear more for purposes of presentation than because of their structural interconnections with true processing sectors. (Each of these will be discussed later.)

The remaining sectors are called the "autonomous" or "final demand" sectors. Their columns may be looked upon as end-product deliveries and their rows as factor payments plus other charges against end-product or final demand. Gross receipt and outlay totals are not equal for these sectors individually, but for the autonomous sectors collectively there is a balance. This is roughly equivalent to saying, in a gross national product sense, that factor payments (value added) for productive activities plus tax payments and certain other charges are equal to the sum of consumer expenditures, net investment (including net change in stocks and net foreign balance), and government expenditures. With minor adjustments for

statistical and conceptual differences, the gross national product may be derived from these figures--on the product side from the columns and on the factor payment side from the rows.

Basic transactions concepts

All entries in table I are in producer's (rather than purchaser's) values. For example, the \$9,801.7 million output of meat animals and products (row 1, col. 999) is the value at the sales level of the producing industry, i.e., before the addition of any marketing charges on the sale of that output. The entries for transportation (rows 169-171 and 173-175) and trade (rows 177 and 178) in the first column represent the marketing charges added to the producer's values of goods purchased by the meat animals and products sector. Correspondingly, the marketing charges on sales of products of the meat animals sector appear in the input structure of the sectors purchasing these products as part of their total payments for transportation and trade margins. A similar situation exists with respect to excise taxes on goods and services. This margin item appears in the input structure of the purchasing sector as a portion of the Federal Government entry (row 215) and the State and local government entry (row 220).

The output totals are on a gross (rather than net) basis. This means that "sales" by an industry to itself are included. In some instances these intra-industry "sales", as well as others, may include imputations for nonmonetary transactions. Thus the output of the food grains and feed crops sector (no. 4) includes the imputed value of grains produced on the farms and kept for seed by the same farmer. It further includes an imputation for the value of corn fed to hogs on the farm where grown. This latter transaction represents part of the total in the cell appearing at the intersection of row 4 and column 1. The reason for the inclusion of this transaction is that the output total for the sector includes all corn (and wheat, barley, rye, etc.) grown in 1947 by farmers, no matter whether kept for their own use or sold to others. In general only those transactions which clearly correspond with normal market movement of goods from one production stage to another are represented in the industry totals. Others, such as the intermediate fresh meat which eventually becomes cured meat or the crude vegetable oil which is usually refined in the same plant, are generally excluded.

As indicated above, the distribution along any row includes the supply of an industry's product beyond the production by the primary industry. Included are:

(1) Current production

- (a) of all products produced by the primary industry (including its secondary production), and
- (b) of products primary to the industry but produced as secondary products by other domestic industries (this includes any other transfers-in from such industries);

(2) Imports of competitive products (including shipments to continental United States from noncontiguous territories);

(3) Inventory depletions of products primary to the industry, wherever held.

Thus the total distributed supply of an industry's products might exceed the gross domestic output of that industry, as defined. However, negative entries appearing toward the end of the row, representing the sector's respective totals for competitive imports and inventory depletions, compensate for such excess and thus make the row total identical with gross domestic output. Manifestly, the total for the column, gross domestic outlays, is the sum of purchases of goods and services required for current domestic productive activities.

Transportation and trade sectors

The output of the transportation sectors (nos. 169-175) and the trade sectors (nos. 176 and 177) is, in general, the gross margin added to commodities in the process of distribution to users. The disposition of the output of these industries appears in the table as the transportation and trade charges attached to the commodities that each industry purchases. Of course, the outputs of the several transportation industries are not limited to the above services, for they include also the carrying of passengers and mails, overseas freight and other services. The remaining marketing charge, in the form of government excise taxes, has been discussed above.

Final demand sectors

The new and maintenance construction sectors, which themselves are composed of numerous subsectors, appear in the nonautonomous portion of table I for presentation purposes alone. They are omitted from the remaining tables (II and III) because they are treated in effect, as autonomous sectors. This manner of handling reflects the general recognition in social accounting circles that the relationship between the output of construction, whether it be new or maintenance, and the output of purchasing sectors in the rest of the economy is difficult of expression in terms of

structural coefficients. Moreover, there is fairly general agreement that decisions on levels of construction are essentially autonomous in nature, especially since they often tend to be unrelated to current production. More often they are related to current investment decisions, which are clearly autonomous in this context.

The maintenance construction sector (row 212) shows allocations to practically every processing sector. These represent current maintenance costs for each sector, excluding those costs which may have been paid as part of rent and hence assumed by the real estate and rentals sector (col. 183) in its rental activities. This situation exists also for the household sector (row 200), which paid only a small amount of such maintenance charges, representing those few maintenance costs assumed directly by tenants. The allocations to the two government sectors represent public maintenance costs that have been specifically separated from public new construction, even though the government accounts may treat both as current expenditures.

The output of new construction (row 211) was allocated to three sectors--the two government sectors (cols. 215 and 220) purchased all new public construction and gross private capital formation (col. 205) took all new private construction. The other allocations to gross private capital formation ^{4/} were mainly the value of producer's durable equipment. There were, however, some special allocations to gross private capital formation, such as the one from the real estate and rentals industry (row 183) referring to charges involved in existing real property transactions.

The treatment of foreign countries is somewhat special in that imports classed as "competitive" were transferred to the related domestic industry and distributed from the latter, whereas imports classed as "noncompetitive" were assigned as direct inputs to the industry using the item. The noncompetitive imports row (no. 225) records the distribution of such imports to purchasing sectors at foreign port value. The competitive imports column (no. 226) records, at domestic port (landed) value in the rows of counterpart domestic industries, the counter-balancing negative entries required to maintain consistency with the domestic output control total. Two entries in this column need especial mention. The positive entry of \$206.2 million for the overseas transportation sector (row 172) represents the difference between the (positive) amount needed to balance the

^{4/} The existence of a gross private capital formation sector is indicative of the exclusive adherence to current account transactions in the development of interindustry input relationships. Items which are normally capitalized by an industry are allocated to autonomous sectors, such as gross private capital formation, which purchase investment items. See part B of the technical appendix for further discussion of capital and current account transactions.

overseas freight charges included in the landed value of the commodities appearing in the competitive imports column and the (negative) amount which would otherwise represent the competitive import of ocean freight (foreign vessels carrying goods to the United States). Similarly the negative \$58 million entry in the banking, finance, and insurance sector (row 181) is the sum of two such entries, with the competitive import amount (negative) exceeding in absolute value the total of insurance on ocean freight included in the landed value of commodities. The export column (no. 225) includes all listed exports and such invisibles as foreign purchases of United States ocean and air transportation, royalty payments for U. S. motion pictures sent abroad, insurance payments by foreigners, and income on U. S. investments abroad.

The two government rows (nos. 215 and 220) show essentially estimates of the amounts of taxes, postage, and other miscellaneous payments to government by the various sectors. Activities of government, such as government printing activities, government-owned hospitals, and public schools, which closely parallel those of a private sector, have been excluded from the government rows and included in the appropriate industrial sector. The government columns (215 and 220) show outlays to other sectors for supplies, equipment, wages and salaries, etc. These outlays include expenditures for capital items (equipment) of government-owned hospitals, schools, and similar institutions, even though the activity may have been defined elsewhere.

The household row (no. 200) is in large measure composed of payments made to individuals by other sectors. It was defined to include all wages and salaries, interest payments, depreciation charges, payments for entrepreneurial services, contributions, and various other minor income payments. The household column (no. 200) shows for the most part individual or consumer outlays for the varied goods and services offered by other sectors. As indicated previously, the rental figure (row 183) in the household column includes rental payments by consumers and imputed rentals for owner-occupied dwellings. It further includes estimates for certain other costs of owner-occupants, such as fuels used for heating. Other elements of the household column, not normally considered as consumer expenditures, include such items as travel and entertainment expenses by business and cash bank service charges to business. These items, of course, could have been subtracted from the household column and assigned to the appropriate industrial sectors as inputs. However, it is believed that the structural coefficients which would then maintain would be somewhat less reliable, for there is apparently no constant relationship between these expenditures by a sector and its value of output. In addition, it is usually simpler, for analytic applications, to determine bills of goods that reflect total purchases by both business and persons for some of the elements involved, such as total eating and drinking receipts and total transportation expenditures.

Processing sectors excluded from structural coefficients

The processing sector portion of table I includes three "dummy" industries. The two waste products sectors (nos. 265 and 266) provide for convenient distribution of both metal and nonmetal waste materials, which are supplied from a wide variety of sources and shipped to numerous destinations. The stockpile of byproducts (sector 267) has similar demonstrative value, though the reason for its existence results more from requirements of analytic application rather than ease of distribution. Both the waste products and byproducts sectors were set up primarily to free the allocations of each sector from transactions which are generally incidental to the major output of the sector. This is important in the establishment of structural interrelationships (input coefficients) and their consequent analytic use. When either waste products or byproducts form a large part of the output of a sector, there is the danger that inclusion of these items in output allocations and resulting coefficients would, in analytic applications involving stipulated bills of goods, lead to production requirements from a sector (brought on by other sectors' requirements for either waste products or byproducts) that might be completely inconsistent with the requirements for the major products of the sector. Thus, unless hides, a byproduct of the meat packing industry (row 21), are specifically excluded from the input coefficient relating meat packing with leather tanning (col. 67), it is possible that a large demand for leather goods and the commensurate demand for hides would call for production by the meat packing industry far beyond its normal requirements for supplying meat. At the same time, there exists a reasonably constant proportion which relates the production of hides with that of meat. Requirements for hides which deviate from the base period (1947) proportion would not be evident in the total derived production of the meat packing industry, and hence it would be impossible to determine the composition of the derived production requirements. The methods by which byproduct determinations can be made consistently are described in the following discussion of table II and in attachment 3 to the technical appendix.

It will be noted that two other sectors appear in the group associated with processing sectors but are excluded from the structural coefficients of table II. Small arms (no. 951) and small arms ammunition (no. 961) appear in table I for tabular completeness rather than analytic usefulness. In the year 1947 these industries were very small and the end-product demand was essentially for civilian goods. However, any analytic problem requiring a build-up of arms and ammunition for defense purposes would naturally require a more current investigation of the industry. Most contemplated uses of this 200-sector chart would involve separate stipulation in the bills of goods (final demand or autonomous sectors) of military end-products, rather than use of coefficients determined for an essentially different

peace-time industry. For this reason these sectors do not appear in table II.

Table II - Direct Purchases Per Million Dollars of Output

This table may be interpreted as showing in simple form the unit ^{5/} cost structure for each intermediate sector in 1947 in terms of its direct purchases from other processing sectors. For this purpose, the processing segment of the economy was divided into 190 sectors. The table was derived from the transactions data of the first table after some modifications.

First, the following nonautonomous sectors of table 1,

Small Arms	951
Small Arms Ammunition	961
New Construction	211
Maintenance Construction	212

were arbitrarily designated as autonomous and hence were explicitly excluded from the structural interrelationships of table II.

In addition, there were the special adjustments for waste products and byproducts. These were merely operational devices for preventing requirements for waste products and byproducts from entering the structural interrelationships used to determine production requirements of producing industries. These adjustments consisted of dropping out the following rows and columns of table I:

Waste Products, Metal	265
Waste Products, Nonmetal	266
Stockpile of Byproducts	267

and making an appropriate adjustment in the diagonal (intra-industry) entry of each affected producing industry by adding to it the amounts appearing in columns 265-267 for each. For example, the \$46.7 million worth of hides allocated by the meat animals industry (row 1) to the stockpile of byproducts (col. 267) was omitted from that column and added to the intra-industry entry (col. 1), raising that entry from \$937.7 million to \$984.4 million. If, for control purposes, it were desired to keep the column totals the same, a counter-balancing negative entry amounting to \$46.7 million could then be made in the household row (200) of the meat animals column. This, of course, is not relevant if one is concerned only with deriving the input coefficients of table II. Similar adjustments were carried out for each entry in the three columns listed above.

The data of table II are multiples (by one million) of ratios calculated directly from the data of table I after the adjustments described above. The ratios were computed by dividing all column entries for each intermediate sector by the respective gross domestic output levels (col. or row 999). The denominator in each case refers, of course, to domestic production during the year; inventory depletions and competitive imports are

^{5/} In units of a million dollars.

negative entries in the row distribution to compensate for the allocation of total supply. As mentioned before, the production figure is gross in the sense that intra-industry transactions are included.

Thus, for example, total internal transactions (including byproducts) within the meat animals and products industry—\$984.4 million (row 1, col. 1 of the earlier table)—divided by the industry's gross domestic output, \$9,801.7 million, yields 0.1004315 on a per unit basis, or \$100,432 per million dollars of output, the entry at row 1 and column 1 of the present table. The sales of the food grains and feed crop industry to meat animals—\$3,840.7 million (row 4, col. 1 of the previous table)—divided by \$9,801.7 million gives 0.391844 or, per million dollars of meat animal output, \$391,844, the entry at row 4 and column 1 of the present table. The other ratios may be derived similarly.

The cost structure of each sector per million dollars of output in 1947 may then be observed by reading down the sector columns. In column 21, for example, each million dollars worth of meat packing and wholesale poultry required large purchases from the meat animals and products sector totaling \$729,244; from the poultry and eggs sector, \$26,775; from establishments within the meat packing industry itself, \$49,714; etc. Further down the same column are recorded purchases per million dollars of output of \$4,500 for animal oils, \$5,415 for tin cans, \$1,351 for refrigeration equipment parts, \$1,594 for electric light and power, and so on. Other columns provide similar information for the other sectors.

Users of these data are cautioned that the ratios reflect only the cost and price structures prevailing in 1947 for the industries as defined for this particular study. Thus product mix factors, the inclusion of secondary products, the fact that originally undistributed items have been allocated somewhat arbitrarily, and other factors make it inadvisable to draw conclusions from the coefficients without first being familiar with the composition of the industries. The BLS Industry Classification Manual for the 1947 Interindustry Relations Study, June 6, 1952 (revised March 20, 1953), generally distributed with the interindustry tables, will be helpful. The individual industry reports, which are in process of being made available to the public, will provide more complete information. At present, however, only a few of these reports are available.

Table III - Direct and Indirect Requirements Per
Million Dollars of Final Demand

This table ^{6/} is the last in a series of three which reflect different aspects of the transaction relations among industrial sectors during the year 1947. While based on figures from the first table, "Interindustry Flow of Goods and Services by Industry of Origin and Destination," it is computed more directly from the second table, "Direct Purchases Per Million Dollars of Output."

Table III is of special interest since it shows the combined direct and indirect requirements placed on all sectors by the delivery outside the processing system of a million dollars of output from each sector. For example, it shows that the amount of electric power required in 1947 to support the delivery of a million dollars worth of plastics materials outside the processing system (i.e., to final demand sectors) was substantially more than that indicated by the direct purchase requirements of table II. Part of this resulted from the fact that the plastics materials industry purchased from numerous industries which themselves used a fair amount of electric power. More specifically, this industry had sizeable purchases from industrial organic chemicals, which industry had fairly large direct inputs of electric power and of other products (such as its own intra-industry purchases and various inorganic chemicals) which used electric power. Other more remote ways in which electric light and power production was related to the output of plastics materials may be found. Table III summarizes all these supply connections, direct and indirect, among the sectors, expressing them in terms of requirements per million dollars of finished goods delivery from each sector. Thus, the entry in row 50, column 167, indicates that \$18,870 of electric light and power's domestic output was directly or indirectly required in 1947 per million dollars of deliveries outside the processing system of products of the plastics materials industry.

The processing system is here defined to include only the activities of sectors shown in table II. The term "deliveries outside the processing system" refers to sales to sectors excluded from this table (households, investors, foreign buyers, government, etc.) of goods to be used as purchased rather than processed further.

The meaning of table III may be illustrated more precisely by reference to table II. Note there that 1947 production of a million dollars of output by the meat packing and wholesale poultry industry (col. 21) was accompanied by \$49,714 of intrasector transactions

^{6/} Table III is presented here because of its general usefulness in considering problems involving input coefficients not too different from those of table II. However, it is somewhat special in nature in that it was computed for use in connection with specific industrial mobilization problems.

(row 21, col. 21). 7/ Since such consumption is required within the sector, then delivery outside of the processing system of a million dollars of meat packing and wholesale poultry products required at least \$1,049,714 gross domestic output by that sector. Note that per million dollars of meat packing, \$729,244 was purchased from the meat animals and products industry (row 1), \$26,775 from the poultry and eggs industry (row 2), \$881 from the farm dairy products industry (row 3), and so on down the column.

One may conclude that in 1947 the delivery of a million dollars worth of meat packing products and wholesale poultry outside the processing system required gross domestic production of at least \$1,049,714 from the meat packing industry, \$765,498 from the meat animals industry ($\$729,244 \times 1.049714$), \$28,106 from the poultry and eggs industry ($\$26,775 \times 1.049714$), \$925 from the farm dairy products industry ($\$881 \times 1.049714$), and so on.

To extend the chain of inference, note now column 1 of table II which shows the unit cost structure of the meat animals and products industry. Per million dollars of output of this sector, there were \$100,432 of intrasector transactions (row 1, col. 1), and there were purchases of \$13,260 from farm dairy products (row 3), \$391,844 from food grains and feed crops (row 4), and so on.

One may now make the critical assumption that these purchases were made by establishments in the meat animals industry in order to carry out their function of supplying their markets, and that a pro rata share of the purchases may properly be attributed to the demand for meat animals by each of the other sectors. On this basis, the \$765,498 of meat animals generated by \$1 million of end-product deliveries by the meat packing industry entailed in turn additional gross output of \$76,881 in the meat animals industry ($\$765,498 \times 0.100432$), \$12 in the farm dairy products industry ($\$925 \times 0.013260$), and so on.

Totaling the figures, it may now be concluded that delivery outside of the processing industry of a million dollars worth of meat packing products and wholesale poultry required on the average, in 1947, gross output of at least \$842,379 from meat animals ($\$765,498 + \$76,881$), \$937 from farm dairy products ($\$925 + \12), and so on.

7/ In this discussion and that following, any reference to an intrasector allocation may be looked upon as if no byproduct or waste product items have been included in the transaction. Since the interpretation of byproduct and waste product inclusion within such allocations is unrelated to the general discussion of indirect effects as effectuated by the calculations which led to table III, these items are left for later discussion in the technical appendix.

Proceeding step by step in this way, and including all the sectors in the calculations, one could slowly build up a table of the total requirements on all sectors entailed by deliveries outside of the processing system from any sector. This method of measurement of total requirements on all sectors induced by deliveries outside of the processing system from each sector would be extremely laborious and certainly inefficient in terms of application of clerical time. Fortunately, the measuring procedure can be shortened.

Table III shows the results of a systematic, simultaneous, and complete set of appropriate computations; they were carried through by means of a very high speed electronic digital computer. Technically, table I may be called the transactions matrix; table II, the input coefficient matrix; and this table, the transposed inverse of the difference between an identity matrix and the input coefficient matrix. The text above outlines verbally a much-used iterative method for the solution of the implied system of equations, but actual computations were carried through by direct methods. The discussion in part A of the technical appendix to these general explanations indicates the mathematical system which is used.

Each row in table III shows the gross output in 1947 required directly and indirectly from each sector to support the delivery outside the processing system of \$1 million by the sector named at the beginning of the row. For example, in row 1, delivery of \$1 million of meat animals and products required a total gross domestic output of \$1,112,549 from the meat animals and products sector (col. 1), \$110 from the poultry and eggs sector (col. 2), \$14,929 from farm dairy products (col. 3), \$499,869 from the food grains and feed crops industry (col. 4), and varying amounts from all sectors. To give other examples, the entry in row 64, column 62, indicates that \$170,996 of petroleum products were required directly and indirectly per million dollars of end-product deliveries by the paving and roofing materials industry. The entry in row 65, column 30, shows that \$246,219 of output of the spinning, weaving, and dyeing industry was required directly and indirectly per million dollars of end-product deliveries by the tire and inner tubes industry.

As the table stands, all entries are related to deliveries outside the processing system rather than to total production. To illustrate, the external delivery of \$1 million by the motor vehicles industry (row 145) required \$1,376,157 gross production (or a multiple of 1.376157) by that same industry (row and column 145). Similarly the steel works and rolling mills industry (col. 79) provided \$141,543 of its products to meet this motor vehicle demand. One may conclude, then, that $\$141,543/1.376157$ of steel works and rolling mills production, or \$102,854, was required directly and indirectly per \$1 million of motor vehicle production. The other entries in the table may be adjusted similarly to refer to production rather than external end-product deliveries by dividing all entries in each row by the entry at the intersection with the corresponding column (e.g., divide the row 1 entries by the column 1 entry of row 1, and so on).

Note also that all figures refer to gross output (including intrasector transactions) rather than net output (referring only to transactions with other sectors). The figures may be adjusted to exclude intrasector transfers by multiplying each by one minus the unit equivalent (per dollar rather than per million dollars) of the entry at the intersection of the corresponding row and column in table II. Thus each entry in column 145 would be multiplied by one minus 0.268605, or .731395. The adjusted entry for row 145 and column 145 would be \$1,376,157 x .731395, or \$1,006,514. This may be interpreted as showing that external delivery of \$1 million of meat animals would require \$1,006,514 output from the sector net of all intrasector transfers. Since the latter are excluded, the excess of \$6,514 over \$1 million represents the "feedback" effects on itself of motor vehicle purchases from other sectors.

If adjustments to a net output concept and to a production level rather than external deliveries basis are both to be applied, the former must be carried through first and the latter based on its results.

Each column in table III shows the gross output from a single sector required directly and indirectly per \$1 million of deliveries outside the processing system by each of the sectors. The entries in the first column, for example, reflect the dependence of meat animal production on the demand for its own product, for poultry and eggs, for farm dairy products, etc.

The entries in column 6 show that substantial production of tobacco is required by only a few processing industries' demands. Other columns may be interpreted similarly. In fact, the entries in columns 180 (Hotels), 190 (Motion Pictures) and 192 (Nonprofit Institutions) indicate that the production of these sectors moves almost entirely to the ultimate consumer directly rather than through other processing channels.

The operational significance of table III may be shown simply. If a set of specified end-product deliveries is applied to the entries in any given column, the sum of the cross-products will show the total gross domestic output required from that sector to support the stipulated deliveries from the processing system. In effect, this will represent the "set-aside" against the sector's gross output implied by the stipulated deliveries--the amount preempted by this expression of purpose, and hence not available for other uses. Similarly, the specified deliveries may be applied to each of the columns in turn to give the total deliveries from each sector of the economy. These production levels are the basic results of the use of the interindustry technique when applied to production models.

Concluding Remarks

The above discussion has provided only broad outlines of the interindustry relations system and its associated economywide tables. The application of the interindustry technique to analytical problems concerning the economy entails much more than mere availability of the general solution shown in table III. It is necessary to fully understand the composition of each of the industrial sectors and to have some idea of the reliability of the data. It is further necessary to have intimate knowledge of the requirements for establishing bills of goods for future years. The following technical appendix gives some of the information needed for these purposes and indicates a number of difficulties that may be encountered. It would be impractical in this type of document to give a full discussion of all the problems that might be faced and their possible solutions. This can come only with a long period of close familiarity with the entire area of investigation and the resultant understanding, first, of the empirical and conceptual problems encountered in gathering and organizing the data, and second, of the theoretical questions needing answers before analysis can be properly applied and understood.

General Explanations of the 200-Sector Tables

TECHNICAL APPENDIX

A. The Theoretical System

The interindustry relations system and its operational features may be explained more precisely by representing it as a determinate system of simultaneous linear equations. The economy is regarded as made up of $(n + 1)$ sectors. For n of these (the intermediate or processing sectors) it is supposed that structural interconnections (technical or input coefficients) can be established. The remaining sector, called the autonomous sector, has components explicitly defined, not in terms of structural relationships with the interindustry network, but in the sense of making independent and autonomous final demands upon the processing system.

Production during some stated period for one of the intermediate sectors, say the i -th, may be represented by the symbol X_i . Some of this production, X_{ia} , may be required for direct delivery to the autonomous sector; other amounts may go to any of the intermediate sectors. The balance between supply and demand may be represented as follows:

$$(1) \quad X_i = X_{ia} + X_{i1} + X_{i2} + X_{i3} + \dots + X_{ij} + \dots + X_{in}$$

The amount delivered to the autonomous sector represents shipments of finished goods or services for use without further processing or incorporation into other processes. The remaining items, X_{i1} , X_{i2} , ... X_{ij} , represent deliveries of materials, components, or services by the i -th sector to each of the intermediate sectors of the economy to the extent needed to maintain their productive activities.

For schematic presentation purposes, the basic supply-demand relations of the economic system are expressed simply (though slightly rearranged) in the form of a square array or "input-output" table in which the rows represent the distribution of output by producing sectors.

		Purchasing Sectors					Final Demand	Total Output
		1	2	... j ...	n			
Producing Sectors	1	X_{11}	X_{12}	... X_{1j} ...	X_{1n}	X_{1a}	X_1	
	2	X_{21}	X_{22}	... X_{2j} ...	X_{2n}	X_{2a}	X_2	
	
	
	
	i	X_{i1}	X_{i2}	... X_{ij} ...	X_{in}	X_{ia}	X_i	
	
	
	n	X_{n1}	X_{n2}	... X_{nj} ...	X_{nn}	X_{na}	X_n	
	Charges Against Final Demand		X_{a1}	X_{a2}	... X_{aj} ...	X_{an}	X_{aa}	X_a
Total Outlays		X_1	X_2	... X_j ...	X_n	X_a		

The enclosed table I - "Interindustry Flow of Goods and Services by Industry of Origin and Destination" is in this form and delineates about 200 sectors. About 190 of these are regular intermediate (processing) sectors, although for presentation purposes an additional seven appear in the nonautonomous segment of the table. All of the transactions are measured in 1947 dollars. Reading across the rows of the table, the entries first record shipments or sales to nonautonomous (producing, distributive, and service) sectors. Further on are shown the sales to the autonomous sectors (ultimate consumers). Typically, these entries in the autonomous sectors' columns represent purchases (by consumers, investors, government, and foreign countries) of items which are used without further processing within the system. The right hand margin merely records the total of the industry's transactions with other industries and itself. This sum of the distributed output along the row is defined as the gross domestic output of the industry. For this chart, gross domestic output is the base for the determination of input coefficients, rather than the gross output concept (including competitive imports) used for other presentations.

Each entry in any row is also an entry in a column, i.e., the output of each sector appears automatically as an input into another sector. Each column records the purchases of the j-th industry from each of the other industries and, in addition, the charges against the autonomous sector (final demand), such as labor costs, taxes, depreciation, profits, and similar items. The balance of a sector's inputs with its gross output may be thus represented as follows:

$$(1a) \quad X_{1j} + X_{2j} + X_{3j} + \dots + X_{ij} + \dots + X_{nj} + X_{aj} = X_j$$

The first n figures show the outlays for goods and services required by an industry to carry on its activities. The next entry (with subscript aj) corresponds to the sum of the several entries near the bottom of each column--wage and salary payments, other payments to individuals, tax payments to governments, and payments for noncompetitive imports. The bottom margins record total outlays. Total receipts and total outlays are equal for any nonautonomous industry. This is not so for any of the final demand sectors, but for the autonomous sector collectively there is a similar balance, or identity. This is roughly equivalent to saying that in the gross national product sense, total charges against final demand are identical with final demand itself, which is the sum of consumer expenditures, investment (including change in stocks and net foreign balance), and government expenditures.

Thus, by use of the transactions table, the multitudinous product and service flows of the entire economy are summarized within a consistent framework which also has operational significance. This table, which is really a summary of the results of exhaustive empirical research, becomes the base from which further analysis of the structural interrelationships of the economy may proceed systematically.

Given the summary of transactions for the economy, in order to proceed for operational purposes, it is necessary to make the critical assumption that the amount of production delivered by one industry to a second nonautonomous sector will be exclusively a function of the production level of the second sector. This may be represented as follows:

$$(2) \quad X_{ij} = F_{ij} (X_j)$$

With this assumption, the previous supply demand identity takes the form:

$$(3) \quad X_i = X_{ia} + F_{i1} (X_1) + F_{i2} (X_2) + \dots + F_{ij} (X_j) + \dots + F_{in} (X_n)$$

Loose restrictions may be placed on the form of the interrelation functions-- that they are nondecreasing (an industry requires at least as much of every input when its production level increases), and single-valued (for obvious reasons).

There are strong a priori reasons for supposing near-proportionality for many if not most of these functions over a reasonable, if limited, period of time. For these reasons and for others related to the empirical foundation of these parameters and the computational problems which arise with other assumptions, proportionality between an industry's inputs and its output is assumed for this system. This may be represented as follows:

(4) $X_{1j} = a_{1j}X_j$

The technical or input coefficient a_{1j} expresses the direct output requirements imposed on the 1-th industry per unit of output of the j-th industry. The original balance between supply and demand in (3) may then be expressed as follows:

(5) $X_1 = X_{1a} + a_{11}X_1 + a_{12}X_2 + \dots + a_{1n}X_n$, or

(5a) $X_{1a} = -a_{11}X_1 - a_{12}X_2 - \dots + (1-a_{11})X_1 - \dots - a_{1j}X_j - \dots - a_{1n}X_n$

The interindustry relations of the economy may then be expressed as a system of n simultaneous linear equations.

$$\begin{aligned}
 X_{1a} &= (1-a_{11})X_1 - a_{12}X_2 - a_{13}X_3 \dots - a_{1n}X_n \\
 X_{2a} &= -a_{21}X_1 + (1-a_{22})X_2 - a_{23}X_3 \dots - a_{2n}X_n \\
 (6) \quad X_{3a} &= -a_{31}X_1 - a_{32}X_2 + (1-a_{33})X_3 \dots - a_{3n}X_n \\
 &\dots\dots\dots \\
 X_{na} &= -a_{n1}X_1 - a_{n2}X_2 - a_{n3}X_3 \dots + (1-a_{nn})X_n
 \end{aligned}$$

The parameters (a_{ij}) of the interindustry system may be conveniently displayed in an array or matrix form with n rows and n columns.

		Purchasing Sector				
		1	2	3	...	n
Producing Sector	1	a_{11}	a_{12}	a_{13}	...	a_{1n}
	2	a_{21}	a_{22}	a_{23}	...	a_{2n}
	3	a_{31}	a_{32}	a_{33}	...	a_{3n}

	n	a_{n1}	a_{n2}	a_{n3}	...	a_{nn}

The appended table II-- "Direct Purchases Per Million Dollars of Output"--is very similar to the above except that each entry has been multiplied by one million, i.e., six zeroes have been added. This table shows in simple form the unit cost structure for each of the nonautonomous sectors in 1947 in terms of its direct purchases from other processing sectors. The table, a 190 x 190 matrix, is derived from the summary transactions data shown in the first table after slight modifications (explained above in the text).

The computed ratios (or input coefficients) were obtained by dividing all column entries for each intermediate sector by the gross domestic output level for that sector and multiplying each ratio by one million. The denominator in each case refers to domestic production during 1947; i.e., inventory depletions (production of earlier years) and competitive imports (foreign supply) have been excluded from output by means of the negative entries in the row distributions of table I. Domestic production is gross in the sense that intra-sector transactions are included.

Given a stipulated pattern of end-product deliveries or bill of goods (X_{ia}), which is represented as the column on the left-hand side of the n simultaneous equations shown above, and given the empirically determined parameters (a_{ij}) of the system, it is possible to compute the required production levels (X_1, X_2, \dots, X_n), or total impact of the bill of goods on each of the intermediate sectors.

However, if the system is broken down into a large number of sectors (resulting in a large number of equations and unknowns), the computation of a numerical solution becomes involved and burdensome. Most important, however, the solution provides only that single set of production levels for the intermediate sectors which is consistent with the stipulated end-product requirements; a solution for

another pattern of end-product deliveries would require another complete set of computational operations and no savings will have accrued because of the solution of the first problem. Thus a series of problems could be long and extremely time-consuming.

A mathematical shortcut can, however, be applied to this problem, i.e., a general solution to the system of equations can be secured by inverting a matrix very similar to that showing the system's parameters. The matrix to be inverted is as follows:

$$\begin{bmatrix} (1-a_{11}) & -a_{12} & -a_{13} & \dots & -a_{1n} \\ -a_{21} & (1-a_{22}) & -a_{23} & \dots & -a_{2n} \\ -a_{31} & -a_{32} & (1-a_{33}) & \dots & -a_{3n} \\ \dots & \dots & \dots & \dots & \dots \\ -a_{n1} & -a_{n2} & -a_{n3} & \dots & (1-a_{nn}) \end{bmatrix}$$

The above matrix is an identity matrix minus the input coefficient matrix and can be represented simply as $(I-A)^{-1}$; it will itself be an $n \times n$ matrix, but the coefficients will be somewhat different in nature. Furthermore, there will be an entry in practically every cell.

The above may be represented by the following solution of the initial set of equations (6) which represented the interindustry system:

$$(7) \quad \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ \dots \\ X_n \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & b_{13} & \dots & b_{1n} \\ b_{21} & b_{22} & b_{23} & \dots & b_{2n} \\ b_{31} & b_{32} & b_{33} & \dots & b_{3n} \\ \dots & \dots & \dots & \dots & \dots \\ b_{n1} & b_{n2} & b_{n3} & \dots & b_{nn} \end{bmatrix} \cdot \begin{bmatrix} X_{1a} \\ X_{2a} \\ X_{3a} \\ \dots \\ X_{na} \end{bmatrix}$$

where b_{ij} are the elements of a matrix which is the reciprocal of the previous matrix $(I-A)$, X_{ia} are elements of a column vector representing stipulated bills of goods, and X_i are elements of a column vector representing production levels consistent with the bills of goods and the structural coefficients.

Interchange of the rows and columns of the above b_{ij} matrix produces a transposed matrix of the type shown in the enclosed table III - "Direct and Indirect Requirements Per Million Dollars of Final Demand." The only basic difference is that the entries in table III represent multiples by one million of such coefficients for the 1947 economy. The

interchange of rows and columns was for computational and interpretational convenience, i.e., the bill of goods may be set up in columnar fashion alongside any column and by simple cross-multiplication and summation the total requirements upon an industry may be readily determined. Total requirements upon all industries may be determined, of course, by applying this procedure to each column. The entries along a row, on the other hand, represent requirements, both direct and indirect, upon each industry in the row consistent with delivering a unit of the specified column industry's production to the final demand sectors. Table III, of course, shows those requirements per million dollars of deliveries to final demand. Thus, an entry in row i , column j shows by how much the production level of the j -th industry would change if the level of end-product deliveries by the i -th industry changes by one million dollars (the remainder of end-product deliveries by other industries remaining unchanged).

B. The 1947 Study--Concepts and Methods

The method of economic analysis known as the interindustry relations technique ^{8/} may proceed directly from the enclosed tables by application of stipulated bills of goods to the columns in table III.

The gathering and organizing of the immense volume of quantitative information which made up the 1947 interindustry study was undertaken by the Bureau of Labor Statistics at the request of the National Security Resources Board and the Department of the Air Force. Their interest was in the mobilization planning aspects of interindustry models. Subsequent to the initial work in late 1949, a number of other agencies have participated in the interindustry relations program of the Federal Government. Their participation has been under the general monitorship of a group in the Office of Statistical Standards, United States Bureau of the Budget. However, much of the work by these other agencies was not relevant to the development of the 1947 Interindustry Relations Study; hence the discussion does not extend to their work.

The individual industry studies which, together with the interindustry tables and a substantial volume of associated material, make up the 1947 Interindustry Relations Study have been reworked

^{8/} Also commonly known as the input-output technique in the terminology associated with Leontief's work. See his Structure of American Economy, 1919-1939 (New York, Oxford University Press, 1951), Part II. Also see Leontief and others, Studies in the Structure of the American Economy (New York, Oxford University Press, 1953).

several times since original preparation but, except for a few in the construction and chemical sectors, are not yet generally available. Additional reports are expected to be released as funds permit. The general procedures which were followed in each broad area of the economy (Agriculture, Mining, Manufacturing, Services, Trade, Transportation, Construction, Government, Foreign Trade, other Final Demand areas) have been made available to the Conference on Research in Income and Wealth, October 1952. A limited number of copies of the preliminary reports covering each of these areas are available upon request to the Bureau of Labor Statistics, Division of Interindustry Economics. These latter reports will be revised and made generally available with the publication of Volume 18 of the Conference proceedings. A more general discussion of the procedural aspects of the entire project is available in the May 1952 issue of the Review of Economics and Statistics, entitled "The Interindustry Relations Study for 1947."

The industry studies are important for a number of reasons beyond their intrinsic worth in depicting the input and output structures of each sector. They are necessary for the understanding of analytic problems, both in the formulation process and the interpretation of results, e.g., production models involving stipulated end-product deliveries. They are valuable as a take-off point for revisions of coefficients or for making complete new studies for later years. Assuming these uses, the ensuing discussion concentrates on the methods used and the procedures followed in putting together the industry studies which were summarized in the transactions chart, table I. These studies distinguish better than 450 sectors of the domestic economy. Additional data exist in organized fashion which can readily separate some of these sectors to provide detail for some 500 sectors.

Period of study. For obvious reasons, the study data must almost necessarily be compiled for a calendar year rather than some other period. It is also preferable to have a recent year with not too many abnormalities in the various transactions. The year 1947 was the inevitable current choice because it was the latest year for which a complete Census of Manufactures was available. Fortunately the year met the other requirements reasonably. However, the selection of a specific time period for the study does not limit data research to that year exclusively. When data for 1947 were not readily available, recorded information for other years was investigated and used as a guide in establishing the distribution of production or the details of material requirements for 1947.

Sources. The numerous secondary sources used in the preparation of the industry studies extended over almost all statistical data pertaining to the U. S. economy, including published information of government agencies, trade associations, private research agencies, etc. and many technical texts published by individuals as well. In summary, most materials came from the Bureau of the Census of the United States Department of Commerce and other specialized government statistical agencies. Basic data on manufacturing industries were derived from the Census of Manufactures: 1947.

The 1948 Census of Business provided statistics and information on business structure of trade and many service industries. Mining data were based largely on published material in the Minerals Yearbook, United States Department of the Interior, Bureau of Mines. Basic agricultural figures were obtained from Agricultural Statistics, 1949 and 1950, United States Department of Agriculture, and from dozens of other publications emanating from the Bureaus; transportation data came mostly from Interstate Commerce Commission publications. Essential foreign trade figures were obtained from Summary of Foreign Commerce of the United States, January - December 1947, Bureau of the Census, and Balance of International Payments of the United States, 1946-1948, United States Department of Commerce. Estimates of Federal Government purchases were derived from the annual budget statements of the Bureau of the Budget and the Combined Statement of Receipts, Expenditures, and Balances of the U. S. Government, United States Treasury Department; State and local government data were acquired from financial statistics published by the Government Division, Bureau of the Census. Data on the utility industries were obtained from Federal Communications Commission and Federal Power Commission publications, and so on.

Basic published statistics were supplemented by data from a wide variety of unpublished documents and confidential information provided by business groups and establishments. In some cases the BLS analysis of such unpublished information assumed the character of major research projects. In several instances it was necessary to resort to primary information. Such was the case for several construction sectors, for which field surveys were conducted on a sample basis. A very important sample survey was a large-scale study with the help of the Census Bureau of the input structure of most of the industries in the machinery and metal fabricating areas.

Other valuable sources of information were special compilations and tabulations by other agencies on the request of BLS. For example, several special tabulations of 1947 foreign trade data by the Census Bureau were indispensable in the development of the foreign trade sectors of the study. A project conducted by the Bureau of Agricultural Economics for the use of BLS provided a summary of practically all the relevant agricultural information in both the published and unpublished file material of the Department of Agriculture. Data gleaned from these materials were supplemented by consultation with area and commodity experts in the Department so as to provide a fairly extensive interindustry chart for agriculture vis-à-vis the rest of the economy, though additional detail was also provided.

Taken together, the industry tabulations provide an evaluation of the existing national statistical information system. They constitute effectively a single tabulation, with a logical framework and a uniform set of industry classifications, within which most

national economic statistics are incorporated. Inconsistencies, redundancies, gaps, and weaknesses in the statistical information representing the national economy become readily apparent under these circumstances.

Classification. The system of classification employed in the 1947 study is that which provides the greatest possible degree of detail--as many as 500 sectors--subject to the type and amount of data that can be reasonably obtained. The sector detail employed approximates the 4-digit level of the Standard Industrial Classification for most of the manufacturing area, with broader aggregation for nonmanufacturing activities, and special commodity type classifications for agriculture and mining.

In establishing an interindustry classification system, a sector may be defined as (1) a commodity or group of commodities, (2) a group of establishments having in common certain characteristics (such as production of similar commodities, use of the same principal raw material, or possession of similar types of equipment), (3) an activity (such as the activity of providing new residential construction), or (4) a defined process (such as sand casting of metals).

Data availability considerations made it virtually necessary to adhere to an establishment classification for manufacturing industries. This form of classification has been adopted where practical in many service areas in the 1947 study, but data problems in other areas have made some departures necessary or desirable. The agricultural sectors, for example, represent a commodity classification. Construction, for which proper establishment reports are lacking, is classified on an activity basis. Trade activities, where identified, have been brought together on a functional basis into two aggregate sectors, wholesale and retail trade. Other categories, such as government, foreign trade, households, etc. have very special definitions that are designed primarily for making the sector classifications consistent with each other and with definitions commonly adopted in other social accounting systems.

Valuation of production. The 1947 study concerns itself with the "real" flow of goods and services. For example, money flows representing transfers of money for financial claims or for previously existing assets are excluded. Monetary values are used in the study only because of their convenience as a "numeraire" to record production and its allocations. Dollar estimates may be given physical significance by regarding them as representative of the physical amounts transacted in 1947 valued at the average prices prevailing during the year.

Production may be measured in terms of either producer's value or purchaser's value. Between the two lie such margin or spread items as rail, inland water, truck, air, and pipeline transportation costs, warehousing and storage charges, wholesale and retail trade margins, and Federal and State and local government excise taxes. These items are specifically identified in the study's basic tabulations, in which source materials were assembled

and estimates made in terms of both producer's and purchaser's values, fulfilling an essential procedural requirement for reconciling a complete set of 500 sector accounts.

In the published transactions table, however, all entries are in producer's values. More specifically, all output distributions along the sector rows of the table consist of allocations valued f.o.b. shipper; thus output (row) totals are exclusive of marketing costs. Correspondingly, each consuming industry pays the distributive sectors for services in bringing needed commodities to it. For example, the total value of wholesale trade margins on all commodities consumed by an industry is entered as the wholesale trade row item in that industry's column; retail trade margins, rail transportation costs, and other distributive costs are entered similarly as row items in that industry's column.

In the main, the output of the distributive industries is the margin added to commodities in the process of distribution to users. Total outputs of the wholesale trade and retail trade industries are consequently equal to the total volume of trade margins in the economy. Of course, the outputs of some distributive industries are not limited to the above-mentioned services but include the value of other non-margin services, such as the carrying of passengers and mail by the transportation industries.

Significantly, outlays by the distributive industries themselves are for commodities and services used only in the operation of their basic productive function, e.g., gasoline purchased by the trucking industry for use in its own vehicles as contrasted with the gasoline carried as freight.

Current and capital account transactions. An accounting of an industry's transactions might very well include both its current account and capital outlays. Under such conditions a transactions matrix would include representations of both types of outlays. Gross investment expenditures would therefore be included in each industry's cost structure and reflected in its input coefficients. However, since there is no a priori reason to expect stability (in the sense of a proportionate relationship) between output and investment expenditures, input ratios which include capital outlays would not have served the primary purpose of the 1947 study, namely, the determination of structural relationships between industries. Therefore, transactions among the intermediate sectors of the study were limited to current account flows only.

However, an analysis of capital transactions is still necessary, since all productive activities were encompassed in the study. A simple method was used in the 1947 study to record capital outlays. All capital transactions were aggregated in the exogenous portion of the table either in the gross private capital formation column or the

government columns. The first indicates private purchases of new plant and equipment. Public purchases of new plant and equipment are included among the input entries of the government sectors. (See later discussion of autonomous sectors in the 1947 interindustry relations study for more complete discussion of handling of capital goods.)

Secondary products. The type of data available for manufacturing industries from the Census of Manufactures made it necessary to adhere to an industrial classification based upon establishment units. The fact that a single establishment may have produced a wide variety of products complicated this type of classification for interindustry purposes. Each establishment was classified in the industry where its principal commodities were, by definition, primary. However, an establishment could have produced "secondary" commodities that were outside the commodity scope of the industry in which it is classified.

Conceptually, there was no reason why secondary products could not have been allocated from producing industries and charged to consuming industries in the same way as primary products of the same establishments. However, this would have been difficult operationally, because much of the information describing the cost structure of industries and transactions between sectors was based on commodity use, not on the industry classification of producing establishments. In translating such commodity information on costs of a particular industry to a classification by producing industries, no determination could be made of the amount obtained from the industry where the commodity was a primary product and the amount obtained as secondary products from other industries. An arbitrary pro-rata division by means of the amounts produced in each industry would have been extremely tedious. Therefore, it was decided to proceed by considering all products of the same kind as comprising one common pool from which allocations to industries consuming that product could be made.

The secondary product problem was resolved procedurally by use of a transfer device. Secondary products were transferred from the industries where they were actually produced to industries where such products were considered primary and then distributed through this channel. In this procedure the secondary product transfer was treated as if it were a "sale" by the industry of actual production to the primary industry, with a further "sale" by the primary industry to the consuming industry. The value of secondary products was therefore counted twice, i.e., in the output of both the producing sector and the primary sector to which transferred.

For presentation purposes, sectors of the 500-industry classification system were aggregated to form smaller summary tables. In such reductions many secondary product designations became primary in the more aggregative sectors; many secondary transfers then become irrelevant and unnecessary. Thus, primary and secondary product designations are strictly a function of the level of sector aggregation; the more aggregative the classification system, the fewer the secondary products. Appendix C of the Industry Classification Manual accompanying the tables, described in

attachment 1 to this technical appendix, illustrates this fact in that the sum of domestic "transfers-in" for an EM sector is not always the sum of those for the component I-O sectors.

Waste products and byproducts. In the basic tabulations of interindustry transactions, waste products of manufacturing industries were included in their output levels and distributed to consuming industries along with regular production. Similarly, allocations of byproducts to consuming industries were indistinguishable from the allocation of principal products of industries. The term "byproducts" is used here in the sense that production of such items follows as a consequence of the production of the principal products of an industry. They were considered specifically only when they were a significant part of an industry's total output.

However, in the table of interindustry transactions presented here, scrap and byproducts are specifically identified by introducing into the array three dummy industries, "Waste Products, Metal", "Waste Products, Nonmetal", and "Stockpile of Byproducts". Under these circumstances, waste product deliveries are not made to specific consuming industries but flow to either of the two special waste product sectors (columns); by the same device, byproduct deliveries flow to the special byproduct stockpile (column). It should be noted that flows of waste products and byproducts are those going outside of the producing industries. As shown, the consuming industries purchase waste products and byproducts from these special sectors (rows) instead of from actual producing industries.

For the special purpose matrix of input coefficients, table II, waste products and byproducts were explicitly eliminated from the array. This adjustment has been described fully in preceding sections and in attachment 3 to this technical appendix.

Autonomous sectors. For analytical purposes, the interindustry network is developed as an open system which requires the explicit designation of specific sectors--generally personal consumption expenditures, domestic investment, government purchases, and exports or net foreign investment--as autonomously determined or independent of the basic structural relationships of the economy. No assumption of input stability for these sectors is required. Other sectors of the economy may, for special purposes, be arbitrarily designated as autonomous also. (See interpretation of table II.)

The characteristics of the autonomous sectors are in most cases unique. They will be described in turn, since any inherent definitional restrictions must be adhered to if stipulated final demands are to be operationally consistent with interindustry techniques..

Foreign trade. A foreign trade sector is required in the inter-industry study in order to compensate for the restricting factor of geographical coverage. This sector provides a means whereby domestic sectors can balance their inputs with their outputs, by giving them a place to record purchases from and sales to areas beyond the continental United States economy. The foreign trade sector is defined as transactions between two economies--the economy of the rest of the world, as one aggregate, and the continental United States economy, as comprised of a number of sectors. Foreign trade's input is identical with continental United States exports; its output is identical with continental United States imports.

In general, foreign trade transactions are limited to the exchange of currently produced goods and services for other goods and services or for money. For purposes of the present study, the foreign trade sector also included (net) unilateral transactions--transactions for which there were no tangible compensations. In general, however, adherence to the above principle resulted in circumscribing or even eliminating many foreign trade transactions which are normally thought pertinent. Capital flows--long and short term--and changes in gold stock were omitted from the foreign trade sector. Exports of used items were likewise omitted, except for the distributive charges incurred in selling and transporting them to the port of exportation. Imported used items, however, were included since they were in effect "new" to the United States economy. 9/

For the interindustry study, foreign trade's output was classified into two general categories--competitive and noncompetitive imports. Competitive imports were defined to include imported products or services which were similar in nature and/or highly substitutable for products or services produced commercially in continental United States. Noncompetitive imports comprised those imported products or services for which there were no similar or closely substitutable products or services produced in continental United States. Imports considered to be competitive to domestically produced products included such items as natural rubber and bananas, the former being substitutable for synthetic rubber and the latter for domestic fruits. Examples of noncompetitive imports included green coffee beans, cacao beans, tea, jute burlap, and manila hemp. In addition, noncompetitive imports were defined so as to include net private and net government unilaterals abroad, United States personal expenditures in foreign countries, and payments, principally by the Federal Government and by the ocean transportation industry, for goods and services received in foreign countries.

Competitive and noncompetitive imports were subjected to different allocation procedures. Competitive imports were allocated in a transfer sense to domestic industries producing comparable primary products. Such imports were treated as an addition to both the input and the output of the comparable industries via transfers similar to those described for secondary

9/ The basic criterion for defining output (i.e., current productive activity) was inapplicable in this case.

products (but see below for special handling in enclosed table I). Non-competitive imports were treated like primary products, i.e., they were distributed directly to sectors which used them in their production processes.

In table I, the output (row) of foreign trade includes only noncompetitive imports, and the inputs consist of two columns, one showing competitive imports as negative inputs and the other showing continental United States exports. Such treatment of competitive imports makes it possible for total output to refer to the domestic industry's output only and at the same time permits that industry to fulfill all requirements for the products involved. The competitive import entries are valued in terms of domestic port value, which comprises foreign port value, international transportation and insurance costs, and United States duty, if any. Noncompetitive imports are shown in terms of foreign port value. The necessary duty, if any, international transportation, and insurance costs are shown as inputs into the industries purchasing noncompetitive imports--from the Federal Government, transportation, and insurance industries, respectively. Thus these charges appear to be margin items for noncompetitive imports though they are actually part of the landed (domestic port) values for noncompetitive imports, but due to the peculiarities of handling this part of the foreign trade sector are distributed individually. It should be noted that the international transportation and insurance costs associated with noncompetitive imports appear in the intermediate portion of table I and duties, if applicable, in the autonomous portion.

The foreign trade sector's inputs are entered in the United States exports column at producer's values. The necessary trade margin and transportation costs incurred in bringing commodities to the point of exportation are charged to foreign trade by the relevant distributive industries.

Government. Government was divided into two separate sectors, Federal Government and State and local governments. The Federal Government sector was defined to cover the general activities of Government relating to the domestic economy as well as to foreign countries and also included many financial activities of the Government corporations; i.e., Commodity Credit Corporation, Reconstruction Finance Corporation, Federal Deposit Insurance Corporation, and others. However, industrial activities of Government corporations were excluded from the Federal Government sector and were included in the most closely related intermediate industries. These included operations of the TVA fertilizer plant, the RFC tin smelting and synthetic rubber plants, and the Government Printing Office. The State and local governments sector included all local bodies--States, cities, counties, townships, and special districts (except school districts, which were covered in the education industry).

The government outputs (rows) represent total revenues—tax and nontax receipts on current account. Corporate income tax receipts were estimated on an accrual basis; other tax receipts on a collection basis. Corporate income tax receipts were allocated to the industries legally liable for payment except for the prorated tax liability resulting from interest income, which was allocated to households, since interest was treated in the present study as an output of households. Excise taxes, including general sales taxes, were handled as margin items, i.e., they were allocated to industries purchasing products or services upon which these taxes applied, rather than to industries legally responsible for payment. Customs duties associated with competitive imports were allocated to the comparable domestic producing industry while customs duties associated with noncompetitive imports were allocated to the using industries. This treatment of duties is consistent with the competitive and noncompetitive import allocation procedures described in the discussion of the foreign trade sector.

The government columns show expenditures for goods and services and include purchases of capital goods and transfer payments. All public new and maintenance construction (including force account) was treated as purchases of these activities from the respective construction sectors rather than purchases of the items entering construction costs; e.g., materials, services, wages and salaries. Similarly, government expenditures for health and education were treated as purchases of these activities from the hospital and education industries rather than as purchases of individual cost items pertaining to such activities. However, purchases of equipment pertaining to government activities, such as that used in public construction, and in operation of public hospitals and schools, were charged to the government account. Government interest payments (except payments to social insurance funds) and unilaterals were handled on a net basis. Government payments of interest to social insurance funds and contributions to such funds were considered as real costs to government for services rendered and were therefore included in intragovernment transactions. They were considered to be wage supplements in the same sense as employer contributions to social insurance. The intragovernment transactions also included payments of one government sector to another, such as Federal grants-in-aid to the States.

Gross private capital formation. The inputs into the gross private capital formation sector represent outlays for goods and services charged by business to capital account. In general, such outlays were for new plant and equipment. However, where applicable, other costs of acquiring capital assets were also charged to this sector.

The outlay for new plants is shown in table I by the construction input into gross capital formation; it refers only to new private construction. 10/ Outlays for equipment comprise most of the other inputs into the gross private capital formation sector; these were estimated by procedures closely following those used by the Department of Commerce in estimating its producers' durable equipment series. However, the scope of the gross capital formation sector in the interindustry analysis was broadened to include outlays for labor and certain materials charged to capital account (where identifiable--such as installation of telephone equipment), receipts of title abstract companies, commissions on transfers of real property, the value of work done in motion picture production, architectural and engineering fees not included in current construction costs, research and development work by aircraft companies, and trade margins on sales of second-hand equipment. 11/

Outlays for capital equipment charged to current account were not included in the gross private capital formation sector, but were included in the nonautonomous or endogenous part of the table and, wherever identifiable, charged to the individual industry incurring such outlays. 12/

Though there is no distinct output total or distribution which corresponds exactly with the gross private capital formation column, there is a related row which may be looked upon as an offset--capital consumption by business, as measured in terms of depreciation and other capital consumption allowances. Thus, the entries along the respective row would be the depreciation and other capital consumption allowances chargeable to the various individual industries. Net investment would be derived as the difference between the column and the row totals. However, this row does not appear explicitly in the 200-sector tables because data on depreciation and other capital consumption allowances applicable to individual industries were not readily available at the time the tables

10/ New public construction appears as an input to the government sectors as does public maintenance construction. No distinction was made here between force account and contract construction. Oil and gas well drilling has been included as part of the outlay for construction. Outlays for private maintenance construction, however, are shown in the intermediate portion of table I and, as such, were distributed to the industries that incurred these expenditures.

11/ Margins on sales of second-hand passenger cars and trucks allocated to business are also included in the producers' durable equipment estimates of the Department of Commerce.

12/ In the past, the Department of Commerce included capital expenditures charged to current account as part of producers' durable equipment. However, their new producers' durable equipment estimate, not yet released, excludes such outlays.

were prepared; therefore, no attempt was made to segregate such charges from various others included in the aggregate household charge for each industry. Consequently, these capital consumption allowances appear as part of the general residual included in each industry's household row entry in table I.

Inventory change. The inventory changes in table I refer to finished products only and are differentiated as between depletions and additions, and within each category, as between those relating to the "producing industry" and those relating to "all other sectors." The inventory values shown for the "producing industry" are on a net basis, i.e., for any industry a value appears either in the additions column or in the depletions column, but not in both. Inventory changes shown for "all other sectors" are on a gross basis, i.e., values can appear in both the additions and depletions columns of an industry. The additions (or depletions) represent the sum of all such changes on an individual commodity basis for large industrial categories such as farms, manufacturers, wholesale trade, retail trade, and government. Each important commodity group was netted within the industrial category, e.g., the net increase in mill stocks of wheat or the net decrease in wholesale trade's stocks of potatoes was determined. In table III the aggregates representing inventory additions are shown as positive entries and those representing inventory depletions appear as negative entries. The net inventory change for the products of any industry can be derived by summing the respective entries in all four inventory columns.

An alternative presentation would have been to show inventory depletions as positive entries in corresponding rows rather than as negative entries in the indicated columns. Under such a procedure the sum of all entries for an industry would have exceeded the current year gross output of the industry by the corresponding value of inventory depletions. The advantage of the present procedure is that the sum of all entries for an industry yields that gross output figure for each industry which is the denominator for calculation of input coefficients.

Inventory data underlying the values in this table are for the most part expressed in terms of book value, except as they relate to agriculture, wholesale trade, and retail trade. In these latter areas an attempt was made to revalue the respective inventories in terms of average 1947 prices. Theoretically, an inventory revaluation should have been carried through for all industries, but because of the difficulties of setting up appropriate price deflators and making appropriate adjustments to industry control totals and general lack of data, this was considered not feasible.

Households. The household column is comprised mostly of personal consumption expenditures, including those of farm households for personal living requirements, and cost of direct personal taxes. Food produced and consumed on farms was included but not the costs of farm operations. Householders' purchases of dwelling units for their own occupancy were not included here; these transactions were treated as business investment and allocated to gross private capital formation. Some expenditures by individuals in connection with their business activities were included, such as hand tools purchased by carpenters. Expenses of individuals for travel related to their business activities were for the most part also included. Since the individual cell entries were expressed in producer's values, transportation costs, trade margins, and excise taxes relating to household purchases of goods and services were shown as direct payments by households to the sectors producing these distributive cost items. Sales taxes were treated in the same manner as excise taxes, except that those sales taxes reported as part of operating costs in trade were shown as tax payments by trade and were subsequently covered in household payments to trade. Household purchases of second-hand items were shown only to the extent of the gross trade margins involved.

Rental payments covered both rents paid by tenants and imputed rents of homeowners. Tenant paid rents included contract rent plus utilities (heat, light, etc.) not included in such contracts; they differed from the space rent concept used by the Department of Commerce in its consumption expenditures series in that the latter excluded all costs for utilities. For consistency imputed rentals were treated identically, e.g., the imputation included the corresponding items. Practically all maintenance of residential buildings was charged as a cost to the rental industry and not to households. The small outlay for maintenance shown in the household column represented actual maintenance outlays by tenants not appearing as costs to the rental industry.

The household row represents essentially all charges against final demand, except payments to foreign trade (noncompetitive imports) and payments to government (all taxes, including income taxes). The charges can be segregated into factor charges and nonfactor charges. The factor charges consist of wages and salaries, employer contributions to private pension plans, royalties, interest, entrepreneurial income, and corporate profits (after taxes). The nonfactor charges consist of transfer payments (including contributions and gifts), depreciation and amortization, capital outlays charged to current expense, losses and accidental damage to fixed capital (uninsured), business travel and entertainment (including reimbursement for personal car use), banking service cash charges to business, and claim payments (primarily nonlife insurance), and are mostly business cost items which are not considered as payments to individuals. These items were included in the household row for a variety of reasons. Capital

consumption charges, which might properly belong in a gross private capital formation row, were included in households because of the difficulties of segregating these charges for each individual industry from the total charges against the final product of that industry. Business travel and entertainment charges were included here to offset allocations to households on the product side, which included purchases by individuals of transportation and entertainment for business uses. Banking service cash charges to business were included here to offset the allocation to households of the portion of banking output (services) applicable to business. Claim payments included here refer mostly to nonlife insurance claims paid to individuals as well as most nonlife insurance claims paid to business. These items appear in the nonlife insurance column, being a charge to that industry from households.

Transfer payments, included in households as noted earlier, were part of the household entry for the industry where such payments originated. Thus, government transfer payments are part of the household entries in the government columns. Government subsidies are also included in the household entries in the government columns. This means that the profits of the receiving industries had to be adjusted to exclude subsidies. Otherwise, the outlays of those industries would have exceeded the corresponding revenues derived from the sale of their products. The accounts could then have been balanced only by adding the subsidies to the outputs of the respective industries and showing government buying the additional outputs. This procedure would have led to two serious defects. First, the net income of the respective industries would not have been consistent with the market prices of their outputs; this situation could lead to serious difficulties in applications of the interindustry relations system to problems of price analysis and similar nonproduction models. Secondly, the usefulness of currently constructed production indexes would have been impaired for comparative purposes since the output definitions would have been inconsistent unless subsidy proportions remained constant. A more serious practical problem was that many agricultural subsidies could not be identified readily with a product.

The payments represented by the household row correspond, in the main, to national income adjusted to exclude employers' payments of payroll taxes and corporate income taxes, and to include capital consumption allowances, individuals' receipts of insurance claims, and bad debt allowances.

Total gross output and gross outlays. A row total of a conventional interindustry array (but not of the enclosed 200-sector table of transactions) normally represents the value of current shipments, plus gross

additions to inventories, of the commodities and services allocated by that sector. It covers, for the most general case, the following items: (1) commodities shipped by plants classified within the industry—both primary and secondary products; (2) primary products of the industry produced elsewhere; (3) scrap sales, contract and commission work, and electric energy sales and receipts for other activities of the producing industry; (4) competitive imports at domestic port or landed value; (5) additions to the producing industry's inventories of finished products; and (6) depletions of the inventories of the producing industry's products held elsewhere.

The interpretation of the column totals is similar to that of the row totals. The column total covers all costs consistent with the gross output and other items included in the row total, including inventory depletions of the products of the industry wherever held, domestic transfers-in, and the domestic port value (landed value) of competitive and noncompetitive imports.

The row and column totals for the enclosed table I are somewhat different from the conventional array (such as the 50-sector tables), in that these totals represent gross domestic output on a current basis. This was accomplished, of course, by inserting noncompetitive imports and depletions as negative columnar entries. The algebraic sum of each row, then, is the output total used for calculating the input coefficients of table II. Note that a similar set of tables (I, II, and correspondingly, III) could be developed to represent gross output on a domestic plus competitive imports (or currently produced supply) basis by adding competitive imports as a row and thus eliminating them as a negative column. Inventory depletions could be treated similarly, but they are rarely included in output for any type of analysis.

The sum at the lower right-hand corner of the array which indicates aggregate equality between all rows and columns of table I has only limited significance. It represents a measure of total transactions of the economy for a specifically defined schematic portrayal of the economy, namely, that shown by table I. The more detailed the table, the larger is this value; the more aggregative the table, the smaller is the value. Obviously, such a grand sum, standing by itself, is meaningless as a measure of actual transactions in the economy during 1947.

Unallocated. As an industry's output was allocated to consuming sectors, some residual portion, in most cases, could not be assigned in any reasonable manner. In order to account statistically for all output, this

residual was distributed to the "Unallocated Sector." As the identified expenditures by each industry were summed and compared with control totals on costs, it was likewise necessary to compensate for gaps in knowledge (or in estimating ability) by specifying a purchase of a lump sum of materials and services from this unallocated sector. The sector is a residual not only of products left unallocated in a physical sense, but also of statistical discrepancies within the study resulting from variations in pricing and inadequacies of the revaluation procedures.

For certain analytical uses of the interindustry tables it was considered advisable that the unallocated flows be completely distributed. Retention of the unallocated sector, either in the endogenous or exogenous portion of the matrix, could cause pervasive distortions in the analytical results. It was felt that better results could be obtained where unallocated flows had been completely distributed, even though the techniques might be based almost entirely on crude judgment estimates. In a number of instances, some fairly firm negative inferences could be drawn—that is, while the sectors to which the unallocated production of a given industry should be distributed are not known, at least some of the sectors to which it should not go could be reasonably determined. The attached transactions table (I), which includes no unallocated amounts in either row or column, represents the results of such a procedure for eliminating the undistributed items in their entirety.

C. Problems in the Use of Interindustry Relations Tables

The operational significance of table III—"Direct and Indirect Requirements Per Million Dollars of Final Demand"—has been explained in earlier parts of this paper, particularly in part A of this technical appendix. The use of the general solution in table III for analytic problems assumes that the relations implicit in the table are a fair approximation of those which maintain for other years not too distant from 1947. This assumption is probably valid for problems which allow a fair margin of error in the results. Other statements in part A indicate that table II—"Direct Purchases Per Million Dollars of Output"—can be used directly for a specific solution to a problem involving a given bill of goods. The direct use of a table of input coefficients (rather than of inverse coefficients) is usually advisable when the problem under consideration is of such a nature as to demand projection of a fair number of coefficients into future year situations. This problem will be discussed immediately below, but most of the remaining discussion will refer to use of the table of inverse coefficients (table III).

Revised coefficients

For certain important problems in which substantially precise answers for each industry's production levels are needed, it is generally advisable to re-examine the input coefficients and provide new ones wherever substantial change is indicated for the period under consideration. These new coefficients may take the form of either more current relationships or projected ones. It will usually be worthwhile to consider these changes carefully and to apply considerable effort toward a thorough revision, even if only good judgment is used in place of data in some instances.

Once the coefficients have been revised, it is an imposing problem to consider the necessary adjustments of the inverse matrix (table III) to correspond with the changes in the input coefficients (table II revised to incorporate the new coefficients). In general it is much more simple to calculate a new inverse. This, however, is not practical for the user of these tables who does not have large-scale electronic computing equipment at his disposal. Hence the best procedure is to calculate a specific solution (rather than a general one) by using the revised table II. Ordinary tabulating equipment currently available can accommodate such a specific solution in reasonable time.

Application of bills of goods

Whether the problem to be solved involves the use of a general solution (table III) or requires a specific solution (using table II), it is necessary that an independent variable be specified before production levels can be determined. This independent variable may take the form of either a complete bill of goods covering all autonomous sectors or a partial bill of goods covering one or more of such sectors. No matter which is to be used, it is necessary to emphasize the great care and effort which must be taken, in order to counteract any assumption that simple possession of the 1947 tables leads to quick and easy solutions for important problems.

Applications of bills of goods to table III for solution of important problems for periods other than 1947 will provide results in terms of output requirements for the given period from the domestic economy only. This follows from the structure of the enclosed tables in that the output totals which were used as the denominators for calculation of coefficients (in table II) represented such current period domestic output during 1947. However, the expected competitive imports and inventory depletions for years under consideration in a contemplated bill of

goods cannot be ignored. The supplies from foreign sources and from past years enter into the supplying of requirements for materials. Thus, these items must be specified in advance in an analytic problem in order to be consistent with the coefficients in the tables (II and III) and the interpretation of answers in the fashion indicated by the structure of the transactions table (I). Competitive imports and all inventory depletions should be shown as negative entries for the appropriate producing sectors in any bill of goods determination. The analyst familiar with national income accounts will recognize this procedure as essentially similar to stating foreign trade in the bill of goods on a "net foreign investment" ^{13/} basis (exports minus competitive imports) and inventories on a "net domestic investment" basis (increases less depletions).

Detailed final demand stipulations

For most problems seeking the detailed production requirements brought about by a complete set of final demands the following items will need prior stipulation:

1. Foreign Trade
 - a. U. S. Exports
 - b. U. S. Competitive Imports at Domestic Port Value
(negative final demands)

Derivation of detailed requirements from the domestic economy will necessitate appropriate initial entries in the final demands for exports and imports by producing industry. Non-competitive imports, which have no counterpart domestic industry, will not make final demands upon the economy and are excluded. However, separate calculations of both noncompetitive imports and other items entering into the balance of payments may be desirable in order to reconcile with any balance of payments totals which may have been projected for the period in the original preparation of economic magnitudes for assistance as controls.

2. Construction
 - a. New
 - b. Maintenance

Construction will be best represented as designated final demands upon its first-order inputs (as in columns 211 and 212 of table I). Thus the bill of goods will contain stipulated deliveries by industries which produce building materials and

^{13/} It is not exactly the same, for "net foreign investment" includes various other adjustments for items (such as noncompetitive imports) which are not specified in the bill of goods.

construction services. The construction sectors are generally specified autonomously because of the general independence from sector production levels exhibited by construction trends and because of the variegated composition of the construction activity. The numerous subsectors of construction should normally be estimated separately in projecting a construction bill of goods, but this cannot be done without separate data on each, such as is available in the project files. Use of the 1947 input structures for total new construction and total maintenance construction automatically implies 1947 weights for each of the subsectors.

3. Gross Private Capital Formation

This sector's composition has been explained in some detail in part B of this technical appendix. The most important components are producers' durable equipment items, such as those appearing in gross national product series. The "sale" of new private construction to this sector, as in table I, will not be needed, since the construction bill of goods will automatically provide for it. Part B indicated numerous items appearing in this sector which are not normally classed with producers' durable equipment.

4. Federal Government

and

5. State and Local Governments

These sectors are most simply treated like construction in that final demand is represented by first-order inputs (such as those in columns 215 and 220 of table I), which can be projected to future years by movements of control totals. This automatically maintains the 1947 proportions of the various subactivities of these sectors. This assumption is probably not too unreasonable for most State and local activities and for the nondefense portion of Federal Government, but serious distortion can arise by not separately considering defense expenditures. For similar reasons, it is usually advisable to consider the construction activities of both sectors as part of the construction sector. Thus the allocation of construction to the government sectors, as in table I, need not be considered in the bill of goods.

6. Household Expenditures (column 200)

The composition of this sector is very similar to that of the consumer expenditure series in the gross national product accounts. The discussion in part B above went more fully into the additional items appearing in households. These must be considered, of course, in developing a proper bill of goods for this sector.

7. Inventory Change

Table I indicates four different subsectors bearing on inventory change for any producing sector. In developing a bill of goods it is not necessary to consider each, for all that is required is the sum total for each row. This sector is probably the most difficult to project into future years, for assumptions often need be made which prejudge production levels before such levels are determined. This usually requires extensive investigation into the history of each commodity-producing sector and further consideration of the general economic conditions assumed in the model as they affect this essentially dynamic element of the economy.

8. Small Arms and Small Arms Ammunition

These sectors need no special discussion except to indicate the importance of separately estimating military end-products as part of the bill of goods in models which refer to years in which military requirements are important. Prior discussion indicated why these sectors appeared in table I and not in tables II and III.

Partial bills of goods

The discussion up to this point has been concerned with application to table III of a complete set of projected final demands. One of the operational requirements has been the designation for each producing sector of negative final demands representing competitive imports and inventory depletions. To illustrate, the following holds for any industry: Total final demand equals the sum of demands by households, by government, for exports, etc., minus the sum of competitive imports and all stock depletions. The application of a complete set of such demand totals to table III will yield current domestic production requirements by each producing industry consistent with the final demands.

It is often desirable to determine the impact of an individual final demand sector upon the economy's production. For instance, the steel or copper production requirements consistent with a certain standard of consumption expenditures is important information in itself. Similarly, it might be important to know the effect of a proposed export program upon the domestic economy.

Unfortunately, the present composition of table III (and, of course, tables I and II) is not amenable to definitive answers of questions such as the type posed. If a single final demand sector is stipulated in a manner conceptually equivalent with the final demand expressions in table I, its demands upon the productive mechanism of the economy will be met partially by current domestic production and partially by competitive imports and stock depletions. In other words, whatever the stipulation of competitive imports and stock depletions for the year under consideration might have been, the results for a single final demand sector would have been consequently affected.

Other presentations of interindustry relations data have been more amenable to the securing of proper results for less than complete bills of goods. The 50-sector tables 14/ released in late 1951 were of this nature, i.e., the gross output figure used as the denominator for calculation of coefficients included competitive imports. The BLS expects to have shortly 200-sector tables, similar in nature to the 50-sector tables, which will be adjusted to include competitive imports in the gross output totals. It is not certain whether such tables will be made available in published form.

Problems of classification, valuation, and pricing

The specification of bills of goods for interindustry relations production models is essentially a data problem. Typically the economic, political, social, and other assumptions implicit in the model are evaluated in terms of well-known economic magnitudes such as gross national product. It is then necessary to consider the specific levels of bills of goods which will be consistent with these magnitudes. Available statistical series from government and private sources can be used, but

14/ The tables and the use of them for problems involving both complete or partial bills of goods are given in: W. D. Evans and M. Hoffenberg, "The Interindustry Relations Study for 1947," The Review of Economics and Statistics, May 1952, Cambridge, Mass.: Harvard University Press, pp. 127 ff.

they have to be considered carefully from the viewpoint of correspondence with interindustry classification systems. They further require adjustment of prices to levels consistent with those in the 1947 transactions chart (table I) in order to make use of table III (or table II) for solutions.

There are other problems relating to valuation of certain types of imputed transactions, the handling of certain transactions which are unique to interindustry tables, the treatment of different types of sales by the same industry, and a host of others, many of which have been indicated elsewhere in this report. Since a complete discussion of these problems is beyond the scope of this presentation, the reader is referred to several other publications for details. The Evans-Hoffenberg article in the May 1952 issue of The Review of Economics and Statistics, and a paper they presented at the October 1952 Conference on Research in Income and Wealth, entitled "The Uses of Interindustry Relations Data and Methods" will be useful. Other BLS papers presented at the Conference will be useful also, particularly those on final demand areas. These include:

- S. A. Jaffe—Final Demand Sectors of the 1947 Interindustry Relations Study
- I. H. Licht—The Government Sector
- M. Weitzman and P. M. Ritz—Foreign Trade in the 1947 Interindustry Study
- D. I. Siskind—Construction in the 1947 Interindustry Study
- S. Netreba—The Development of the Bill of Goods for Interindustry Analysis

Other problems in the use of the interindustry tables

The prior discussion has been concerned entirely with production models depending upon the stipulation of a bill of goods. The serious problems raised with respect to revision of coefficients and developing final demand estimates consistent in concept and quality with the coefficients are real enough, but they were mentioned mainly to emphasize the importance of maintaining high standards in developing all the material that is needed to implement the solution of a problem. No mention was made of the feasibility tests which should be applied to the results of a problem for proper interpretation and understanding. As a minimum it is necessary to develop proper production indexes for judging whether the production requirements resulting from an analytic application are consistent with existing production levels or whether additional capacity need be developed. Another facet of the results which needs consideration

as to feasibility is the set of implied employment levels consistent with production requirements. This generally requires the development of indexes of employment, productivity, and working hours to allow comparison of implied employment with current and projected employment.

The present discussion has referred to problems that are faced in periods of mobilization planning—periods which are generally inflationary. The approach can contribute also for solution of problems during periods of unemployment. For example, during a recession or with one in the offing, it might be urged that the government undertake a public works program to increase employment or that it decrease taxes to stimulate business. The interindustry relations analysis could help trace the differential effect upon various economic sectors of such policies and thus provide information which the authorities could consider in deciding upon suitable implementation. The technique could help decide which of alternative policies would be most favorable for increasing or maintaining employment, consumption, or investment and, of course, all three.

The reader is referred to the two articles by Evans and Hoffenberg previously mentioned for a more extensive discussion of areas of use and inferences which can be made from the interindustry tables and methods.

Attachment 1 to Technical Appendix

The interindustry classification system

The 200-sector tables herein discussed represent a condensation of more detailed data available in the Bureau of Labor Statistics on a 450- to 500-sector basis. Because of the difficult presentation problems, tables incorporating such detail will probably never be published. However, the classification system showing the link between the two systems is available from the BLS in a classification manual, which is herein incorporated by reference. This manual, entitled: "Industrial Classification Manual for the 1947 Interindustry Relations Study," shows, in addition, the relation of each sector to the industrial delineations of the SIC and, where applicable, of the 1947 Census of Manufactures. It includes a set of attached appendices describing:

- (A) the general source of the control totals for each sector;
- (B) the detailed listing of charges against final demand;
- (C) salient output totals, including transfers-in;
- (D) short verbal descriptions of each industry; and
- (E) comparisons of control totals for I-O manufacturing sectors with totals for corresponding sectors in the Census of Manufactures: 1947, Vol. II.

Some of the output totals in appendix C of the classification manual and some of the verbal descriptions in appendix D of that manual do not accord exactly with those for the industries appearing in the enclosed 200-sector tables. The differences are generally due to the fact that the data appearing in the tables represent an earlier stage of both data refinement and specification of industry composition.

It will be noted that the gross output totals for EM sectors are usually less than the sum of the separate gross output totals for the I-O industries included. The differences are equal to the sum of competitive imports transferred in to the I-O sectors and "fictitious" domestic transfers-in; i.e., some portion of the secondary products of an I-O industry was primary to the EM industry in which it was included and hence the gross output of the combined (EM) industry had to be reduced to eliminate the double counting.

Attachment 2 to this technical appendix gives the output totals appearing in table I and the transfers-in and transfers-out that correspond with these levels.

Attachment 2 to Technical Appendix

Transfers in relation to gross domestic output

The following table gives a series of important totals useful in understanding the composition of the industries appearing in table I enclosed. Included in addition to gross domestic output (col. 1) are transfers-in (col. 2), gross output less transfers-in (col. 3), transfers-out (col. 4), and gross output less transfers-out (col. 5).

Knowledge of transfers-in and transfers-out helps in the interpretation of the various allocations of table I. Thus gross output less transfers-in accords closely with the basic source, such as the Census of Manufactures: 1947, used in establishing the output of the primary industry. On the other hand, gross output less transfers-out gives, in effect, the total supply of primary product. This also can be compared with the Census of Manufactures: 1947, (Standard Table 6 in Vol. II). It indicates also the extent to which the distribution along a row in table I might be due to direct allocations rather than indirect. It gives similar indications with respect to column entries in table I and the extent of transfers-in as a percentage of gross output.

Gross output and transfers in the 200-sector tables

(In millions)

EM No.	Industry	Gross domestic output (1)	Transfers-in (2)	Gross output less transfers-in (3)	Transfers-out (4)	Gross output less transfers-out (5)
1	Meat animals and products ...	\$9,801.7	...	same	...	same
2	Poultry and eggs	3,864.0	...	"	...	"
3	Farm dairy products	5,062.9	...	"	...	"
4	Food and feed grains	11,004.2	...	"	...	"
5	Cotton	2,222.7	...	"	...	"
6	Tobacco	884.1	...	"	...	"
7	Oil-bearing crops	1,060.6	...	"	...	"
8	Vegetables and fruits	4,012.5	...	"	\$133.1	\$3,879.4
9	All other agricultural	1,953.7	...	"	...	same
10	Fisheries, hunting, and trapping	404.7	...	"	...	"
11	Iron ore mining	323.9	...	"	...	"
12	Copper mining	292.2	...	"	2.7	289.5
13	Lead and zinc mining	180.5	...	"	...	same
14	Bauxite mining	8.5	...	"	...	"
15	Other metal mining	77.8	...	"	...	"
16	Coal mining	3,036.4	...	"	...	"
17	Crude petroleum and natural gas	4,157.4	...	"	86.4	4,071.0
18	Stone, sand, clay, and abrasives	633.6	\$1.6	\$632.0	0.1	633.5
19	Sulfur	85.2	...	same	...	same
20	Other nonmetallic minerals ..	167.0	2.7	164.3	32.0	135.0
21	Meat packing and poultry	11,106.1	93.4	11,012.7	373.5	10,732.6
22	Processed dairy products	3,646.7	35.3	3,611.4	31.8	3,614.9
23	Canning and preserving	2,725.3	251.8	2,473.5	89.0	2,636.3
24	Grain mill products	5,344.1	88.6	5,255.5	100.6	5,243.5
25	Bakery products	3,352.1	7.0	3,345.1	35.8	3,316.3
26	Miscellaneous food products .	6,633.2	246.7	6,386.5	401.0	6,232.2
27	Sugar	1,180.4	1.1	1,179.3	3.2	1,177.2
28	Alcoholic beverages	2,724.7	16.3	2,708.4	19.9	2,704.8
29	Tobacco manufactures	2,565.4	1.2	2,564.2	7.4	2,558.0
30	Spinning, weaving, and dyeing	8,096.1	62.7	8,033.4	303.6	7,792.5
31	Special textile products	821.9	22.4	799.5	21.5	800.4
32	Jute, linen, cordage, twine .	254.9	28.4	226.5	30.4	224.5
33	Canvas products	97.4	6.4	91.0	7.6	89.8
34	Apparel	11,334.5	18.3	11,316.2	14.4	11,320.1
35	House furnishings, etc.	1,805.6	308.0	1,497.6	145.0	1,660.6

Gross output and transfers in the 200-sector tables — Continued

(In millions)						
EM No.	Industry	Gross domestic output	Transfers-in	Gross output less transfers-in	Transfers-out	Gross output less transfers-out
		(1)	(2)	(3)	(4)	(5)
36	Logging	\$856.7	\$41.1	\$815.6	...	\$856.7
37	Sawmills, planing and veneer mills	3,199.4	47.0	3,152.4	\$136.4	3,063.0
38	Plywood	275.5	10.7	264.8	14.1	261.4
39	Fabricated wood products	1,003.1	42.9	960.2	82.3	920.8
40	Wood containers and cooperage	588.0	65.8	522.2	16.4	571.6
41	Wood furniture	1,464.3	105.2	1,359.1	52.3	1,412.0
42	Metal furniture	874.8	79.3	795.5	99.2	775.6
43	Partitions, screens, shades, etc.	568.8	54.4	514.4	69.8	499.0
44	Pulp mills	945.0	...	945.0	10.0	935.0
45	Paper and board mills	2,823.3	...	2,823.3	5.1	2,818.2
46	Converted paper products	3,404.0	83.7	3,320.3	76.2	3,327.8
47	Printing and publishing	6,552.2	10.3	6,541.9	337.5	6,214.7
48	Industrial inorganic chemicals	1,094.3	161.7	932.6	99.3	995.0
49	Industrial organic chemicals	1,672.3	202.3	1,470.0	262.4	1,409.9
50	Plastics materials	592.2	101.0	491.2	53.9	538.3
51	Synthetic rubber	253.2	27.9	225.3	7.6	245.6
52	Synthetic fiber	726.5	20.4	706.1	21.1	705.4
53	Explosives and fireworks	158.8	2.3	156.5	18.4	140.4
54	Drugs and medicines	1,269.7	59.4	1,210.3	97.2	1,172.5
55	Soap and related products ...	1,533.4	151.3	1,382.1	138.0	1,395.4
56	Paints and allied products ..	1,627.0	57.4	1,569.6	69.2	1,557.8
57	Gum and wood chemicals	157.1	5.8	151.3	17.7	139.4
58	Fertilizers	522.8	7.4	515.4	25.9	496.9
59	Vegetable oils	1,912.6	233.3	1,679.3	58.5	1,854.1
60	Animal oils	775.5	351.5	424.0	41.5	734.0
61	Miscellaneous chemical industries	1,639.9	325.8	1,314.1	162.8	1,477.1
62	Petroleum products	7,572.7	99.5	7,473.2	65.2	7,507.5
63	Coke and products	1,170.8	24.6	1,146.2	16.4	1,154.4
64	Paving and roofing materials	405.4	14.9	390.5	14.4	391.0
65	Tires and inner tubes	1,664.6	76.3	1,588.3	158.2	1,506.4

Gross output and transfers in the 200-sector tables -- Continued

(In millions)						
EM No.	Industry	Gross domestic output	Transfers-in	Gross output less transfers-in	Transfers-out	Gross output less transfers-out
		(1)	(2)	(3)	(4)	(5)
66	Miscellaneous rubber products.	\$1,334.1	\$151.2	\$1,182.9	\$142.8	\$1,191.3
67	Leather tanning and finishing.	1,075.2	3.4	1,071.8	21.4	1,053.8
68	Other leather products	537.1	17.6	519.5	13.4	523.7
69	Footwear (excluding rubber) ..	2,113.9	13.0	2,100.9	7.6	2,106.3
70	Glass	1,152.4	31.9	1,120.5	7.7	1,144.7
71	Cement	410.6	0.2	410.4	2.3	408.3
72	Structural clay products	387.9	11.5	376.4	10.9	377.0
73	Pottery and related products..	314.8	9.0	305.8	11.1	303.7
74	Concrete and plaster products..	625.4	14.3	611.1	10.9	614.5
75	Abrasive products	262.0	34.6	227.4	16.0	246.0
76	Asbestos products	363.3	36.0	327.3	76.1	287.2
77	Other miscellaneous nonmetallic minerals	256.3	23.3	233.0	13.8	242.5
78	Blast furnaces	1,881.2	6.7	1,874.5	29.3	1,851.9
79	Steel works and rolling mills..	7,700.3	23.2	7,677.1	693.8	7,006.5
80	Iron foundries	1,532.5	169.0	1,363.5	108.4	1,424.1
81	Steel foundries	489.9	73.9	416.0	48.9	441.0
82	Primary copper	1,072.5	16.8	1,055.7	47.8	1,024.7
83	Copper rolling and drawing ...	1,334.3	59.6	1,274.7	113.7	1,220.6
84	Primary lead	357.6	30.3	327.3	82.4	275.2
85	Primary zinc	256.1	37.0	219.1	21.6	234.5
86	Primary nonferrous metals, n.e.c.	100.7	21.2	79.5	.5	100.2
87	Nonferrous metal rolling, n.e.c.	201.2	10.0	191.2	36.4	164.8
88	Primary aluminum	284.6	124.0	160.6	...	284.6
89	Aluminum rolling and drawing..	439.9	14.4	425.5	16.8	423.1
90	Secondary nonferrous metals ..	849.9	118.0	731.9	242.5	607.4
91	Nonferrous foundries	610.7	46.0	564.7	33.8	576.9
92	Iron and steel forgings	473.1	102.3	370.8	29.0	444.1
93	Tin cans and other tin ware ..	694.9	8.6	686.3	29.0	665.9
94	Cutlery	151.6	8.7	142.9	9.6	142.0
95	Tools and general hardware ...	480.3	43.9	436.4	60.7	419.6
96	Hardware, n.e.c.	635.8	51.5	584.3	99.9	535.9
97	Metal plumbing and vitreous fixtures	412.0	42.4	369.6	48.1	363.9
98	Heating equipment	1,419.2	156.1	1,263.1	168.2	1,251.0
99	Structural metal products	1,649.2	147.1	1,502.1	168.3	1,480.9
100	Boiler shop products and pipe.	964.1	140.0	824.1	158.3	805.8

Gross output and transfers in the 200-sector tables -- Continued

		(In millions)				
EM No.	Industry	Gross domestic output	Transfers-in	Gross output less transfers-in	Transfers-out	Gross output less transfers-out
		(1)	(2)	(3)	(4)	(5)
101	Metal stampings	\$1,394.7	\$221.3	\$1,173.4	\$179.7	\$1,215.0
102	Metal coating and engraving ..	248.4	...	248.4	6.9	241.5
103	Lighting fixtures	526.5	48.6	477.9	148.2	378.3
104	Fabricated wire products	882.0	378.0	504.0	64.2	817.8
105	Metal barrels, drums, etc. ...	203.2	29.2	174.0	28.3	174.9
106	Tubes and foils	88.8	6.9	81.9	3.8	85.0
107	Miscellaneous fabricated metal products	147.6	44.7	102.9	7.5	140.1
108	Steel springs	128.0	38.0	90.0	51.2	76.8
109	Nuts, bolts, and screw machine products	774.7	83.7	691.0	50.8	723.9
110	Steam engines and turbines ...	157.5	26.9	130.6	18.8	138.7
111	Internal combustion engines ..	815.0	128.0	687.6	166.7	648.9
112	Farm and industrial tractors..	1,143.0	71.4	1,071.6	175.9	967.1
113	Farm equipment	970.6	65.0	905.6	94.4	876.2
114	Construction and mining machinery	1,100.6	164.3	936.3	129.5	971.1
115	Oil-field machinery and tools.	316.3	22.7	293.6	34.6	281.7
116	Machine tools and metal working	1,134.6	104.2	1,030.4	158.2	976.4
117	Cutting tools, jigs, etc.	765.1	134.9	630.2	55.6	709.5
118	Special industrial machinery..	2,014.7	207.9	1,806.8	157.8	1,856.9
119	Pumps and compressors	658.7	97.0	561.7	105.0	553.7
120	Elevators and conveyors	410.7	56.1	354.6	57.7	353.0
121	Blowers and fans	171.0	28.0	143.0	32.7	138.3
122	Power transmission equipment..	500.4	60.4	440.0	90.2	410.2
123	Industrial machinery, n.e.c. .	549.1	115.2	433.9	84.4	464.7
124	Commercial machines and equipment, n.e.c.	1,038.9	59.5	979.4	100.8	938.1
125	Refrigeration equipment	1,489.1	94.7	1,394.4	169.0	1,320.1
126	Valves and fittings	705.0	55.3	649.7	122.2	582.8
127	Ball and roller bearings	387.0	12.6	374.4	50.7	336.3
128	Machine shops	459.6	42.1	417.5	126.6	333.0
129	Wiring devices and graphite ..	512.1	57.2	454.9	54.1	458.0
130	Electrical measuring instruments	186.7	30.9	155.8	24.0	162.7
131	Motors and generators	1,094.5	68.2	1,026.3	164.4	930.1
132	Transformers	391.3	28.3	363.0	50.4	340.9
133	Electrical control apparatus..	701.0	66.1	634.9	53.3	647.7
134	Electrical welding apparatus..	246.0	66.0	180.0	18.7	227.3
135	Electrical appliances	1,525.4	212.6	1,312.8	121.6	1,403.8

Gross output and transfers in the 200-sector tables -- Continued

(In millions)

EM No.	Industry	Gross domestic output (1)	Transfers-in (2)	Gross output less transfers-in (3)	Transfers-out (4)	Gross output less transfers-out (5)
136	Insulated wire and cable	\$1,008.7	\$63.6	\$945.1	\$105.1	\$903.6
137	Engine electrical equipment ...	387.0	30.5	356.5	174.7	212.3
138	Electric lamps	307.3	9.1	298.2	28.0	279.3
139	Radio and related products	1,619.7	52.4	1,567.3	94.7	1,525.0
140	Tubes	134.8	5.6	129.2	6.8	128.0
141	Communications equipment	778.2	18.6	759.6	50.4	727.8
142	Storage batteries	300.7	...	300.7	208.9	91.8
143	Primary batteries	86.8	1.0	85.8	7.8	79.0
144	X-ray apparatus	64.3	4.1	60.2	2.8	61.5
145	Motor vehicles	12,519.7	1,027.0	11,492.7	262.6	12,257.1
146	Truck trailers	164.0	16.4	147.6	11.9	152.1
147	Auto trailers	138.3	1.7	136.6	.6	137.7
148	Aircraft and parts	1,604.9	48.2	1,556.7	22.4	1,582.5
149	Ships and boats	932.0	11.6	920.4	21.2	910.8
150	Locomotives	423.0	65.8	357.2	5.9	417.1
151	Railroad equipment	793.4	23.6	769.8	25.7	767.7
152	Motorcycles and bicycles	247.7	35.8	211.9	21.9	225.8
153	Instruments, etc.	574.1	65.4	508.7	44.4	529.7
154	Optical, ophthalmic and photographic equipment	624.5	18.3	606.2	24.3	600.2
155	Medical and dental instruments, and supplies	393.3	22.6	370.7	45.1	348.2
156	Watches and clocks	397.9	9.8	388.1	24.3	373.6
157	Jewelry and silverware	762.9	19.4	743.5	32.5	730.4
158	Musical instruments and parts ..	127.4	8.2	119.2	4.2	123.2
159	Toys and sporting goods	599.7	50.8	548.9	38.7	561.0
160	Office supplies	299.8	14.9	284.9	118.5	181.3
161	Plastic products	545.3	40.8	504.5	63.7	481.6
162	Cork products	39.2	8.9	30.3	3.4	35.8
163	Motion picture production	461.7	...	461.7	4.9	456.8
164	Miscellaneous manufactured products	2,063.5	543.3	1,520.2	231.1	1,832.4
265	Waste products and metal	406.8	406.8	406.8
266	Waste products, nonmetal	192.4	192.4	192.4
167	Electric light and power	4,436.5	45.5	4,391.0	...	4,436.5
168	Natural, manufactured, and mixed gas	1,751.0	12.5	1,738.5	10.1	1,740.9
169	Railroads	9,959.0	79.7	9,879.3	136.6	9,822.4
170	Trucking	3,932.1	15.4	3,916.7	...	3,932.1

Gross output and transfers in the 200-sector tables -- Continued

(In millions)

EM No.	Industry	Gross domestic output	Transfers-in	Gross output less transfers-in	Transfers-out	Gross output less transfers-out
		(1)	(2)	(3)	(4)	(5)
171	Warehousing and storage	\$541.2	\$25.4	\$515.8	\$59.2	\$482.0
172	Overseas transportation	2,055.4	...	same	...	same
173	Other water transportation	1,030.0	...	"	...	"
174	Air transportation	783.8	...	"	3.0	780.8
175	Pipeline transportation	358.3	...	"	1.4	356.9
176	Wholesale trade	16,101.8	...	"	...	same
177	Retail trade	25,658.3	...	"	37.3	25,621.0
178	Local and highway transportation	3,240.6	...	"	44.3	3,196.3
179	Telephone and telegraph	2,758.4	...	"	...	same
180	Eating and drinking	13,268.5	95.7	13,172.8	...	13,268.5
181	Banking, finance, and insurance	12,669.9	...	same	...	same
182	Hotels	1,388.3	...	"	...	"
183	Real estate and rentals	28,932.4	34.1	28,898.3	...	28,932.4
184	Laundries and dry cleaning	2,017.6	...	same	...	same
185	Other personal services	2,406.2	...	"	63.6	2,342.6
186	Advertising, including radio ..	3,810.5	267.8	3,542.7	...	3,810.5
187	Business services	1,297.3	...	same	41.4	1,255.9
188	Auto repair services	3,952.2	...	"	...	same
189	Other repair services	1,550.0	...	"	...	"
190	Motion pictures, etc.	2,944.3	...	"	...	"
191	Medical, dental, etc.	8,946.7	...	"	...	"
192	Nonprofit institutions	7,335.6	...	"	...	"

Attachment 3 to Technical Appendix

Handling of waste products and byproducts in the 200-sector tables

Waste products and byproducts have been given special treatment in the enclosed interindustry tables. The discussion of table I indicates that both identifiable waste products and important byproducts have been placed in special rows and columns rather than included with other allocations from producing to actual consuming sectors. In table II the waste product and byproduct rows and columns have been eliminated; the combined amounts for each producing sector have been treated as if they were part of the intra-industry cell in table I and hence appear as part of the corresponding input coefficient in table II. The analytic reason for this adjustment has been stated several times, but there is a related operational reason, extending to the use of table III, which needs clarification. Elimination of waste product and byproduct allocations from structural interconnections between producing and consuming industries clearly prevents these items from affecting requirements for the major output of the producing sector. It remains necessary, however, to account for these items as part of output, since they are significant in the interpretation of analytic results.

There were two available alternatives for handling this problem. The first was to include the waste product and byproduct amounts in the bill of goods and thus eliminate them entirely from the coefficients. This meant that these items would have had to be estimated exogenously in any analytic problem. This would have been both time-consuming and difficult, for many of the estimates, particularly those of byproducts, indicated, and properly so, a proportionate relationship with total output. Effectively, this meant that it would be necessary to estimate the dependent variable before deciding on the independent variable. It was decided that a simple method of accomplishing this was to use the other ready alternative—consider the allocations as part of intra-industry transfers. This approach automatically related the waste product and byproduct amounts to total output in the same proportion as the base period. Also the problem of indirect effects was essentially eliminated.

With this procedure incorporated into the coefficients of table III, it is a very simple matter to interpret waste product and byproduct production requirements resulting from the application of stipulated bills of goods. One merely needs to consider the output for each sector and apply the 1947 proportion of waste products and byproducts to gross output to arrive at the amounts of each available during the projected period. The base period allocations of these items can then be used for assistance in determining whether the supply of these items is consistent with the requirements for them. In any event the entire problem becomes a side-calculation which can be simply and yet consistently considered in relation to the output determinations of the analytic model.

The number of waste product allocations inherent in table I are too many to present in this appendix. It may be worthwhile to indicate, however, the amount and specific allocations of byproducts which have been gathered into the special byproducts column. This information will allow the user either to reconstruct a 1947 table with byproducts included in the allocations or to use the base period relations for interpreting analytic projections. The 1947 detail follows:

Byproduct allocations in the 200-sector tables

Sector number		Product	Value (in thousands)
Producing	Receiving		
1	67	Farm hides	\$46,658
5	1	Cottonseed	\$7,873
	3	"	7,874
	58	"	207
	59	"	290,900
	225	"	601
	230	"	47,819
		Total	355,274
21	67	Packers' hides	441,449
	225	" "	22,081
		Total	463,530
59	30	Cotton linters	341
	31	" "	11,175
	32	" "	4,448
	44	" "	24,332
	45	" "	2,607
	225	" "	7,102
		Total	50,005
59	1	Byproduct cake and meal	124,848
	2	" " " "	18,159
	3	" " " "	62,994
	24	" " " "	247,914
	58	" " " "	2,374
	215	" " " "	5,764
	225	" " " "	14,928
		Total	476,981
60	1	Animal oil byproduct feeds	3,348
	24	" " " "	116,313
	55	" " " "	6,062
	58	" " " "	7,173
	61	" " " "	665
	225	" " " "	3,477
		Total	137,038
63	78	Coke oven gas	853
	79	" " "	47,554
	80	" " "	851
	81	" " "	275
	82	" " "	13
	83	" " "	811
	87	" " "	97
	89	" " "	175
	90	" " "	117

Byproduct allocations in the 200-sector tables--Continued

Sector number		Product	Value	
Producing	Receiving		(in thousands)	
63	91	Coke oven gas--Continued	\$640	
	92	" " "	263	
	136	" " "	203	
	168	" " "	63,207	
		Total		\$115,059
78	63	Blast furnace gas	6,546	
	79	" " "	41,743	
	80	" " "	747	
	81	" " "	241	
	82	" " "	11	
	83	" " "	712	
	87	" " "	85	
	89	" " "	153	
	90	" " "	102	
	91	" " "	562	
	92	" " "	231	
	136	" " "	179	
	168	" " "	864	
		Total		52,176
78	64	Slag	78	
	74	"	587	
	77	"	3,600	
	210	"	2,137	
		Total		6,402
82	90	Gold	24,494	
	230	"	13,473	
		Total		37,967
84	90	Gold		24,406
82	90	Silver	10,865	
	230	"	11,400	
		Total		22,355
84	90	Silver	10,865	
	230	"	20,530	
		Total		31,395