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produces, with only few changes—primarily the insertion of depreciation allowances—an estimate of saving which fits perfectly into the national income and product account and can be used as a check upon the direct estimate of aggregate saving which is inherent in the national income and product account, viz, the difference between current income and current expenditure. While that residual estimate of saving is by its very nature indivisible, the measurement of saving derived from the flow-of-funds statement has the great advantage from the point of view of economic analysis of showing the various forms of saving and dissaving. Tables A-13 and 14 in appendix A exemplify this integration.

CHAPTER XIII. INPUT-OUTPUT TABLES

1. THE NATURE OF INPUT-OUTPUT TABLES

An input-output table is, so far as the form of presentation goes, a table which shows the flows of commodities and services—represented by their money value—during a given period (usually 1 year) between a number of sectors, here generally called industries (whence the alternative name of “interindustry analysis”) into which the economy is divided. Each entry, or cell, identifies the value of commodities supplied by one and received by another “industry”—the term being used for any aggregation of economic units or even production processes within a firm or plant. An input-output table thus is a complete from-whom-to-whom breakdown of all commodity and service flows within the Nation and between the Nation and foreign countries. Since as a rule the classification of economic units into industries is the same for suppliers and recipients of goods and services the input-output table generally has the same number of rows and columns and hence the form which is called in algebra a square matrix. Input-output tables vary in size from an aggregative table distinguishing less than 20 supplying and receiving industries, and hence having less than 400 cells, to very detailed documents with over 400 industries and more than 160,000 cells, many of which, of course, may be empty.

Input-output tables may be regarded as simply an alternative form of presenting commodity and service flows within a system of national accounts and are so treated in chapter V and appendix A. In that capacity they provide a powerful check on the completeness and compatibility of much of the information used in building up national product and income estimates.

In practice, however, input-output tables have been developed primarily for a second, more ambitious purpose; namely, to serve, together with auxiliary information such as prices and technological data, as a tool of decision making in public policy and private investment planning by business enterprises. This use of input-output analysis is called economic or mathematical programming. For this purpose input-output coefficients and production functions are derived from the input-output data by the mathematical process known as matrix inversion, which requires modern high-speed calculating machines if the number of industries distinguished is substantial.

Input-output tables may depict a closed or an open system. In a closed system all industries are assumed to be completely interdependent and their inputs and outputs to be functionally related. For ex-

ample, consumer households may be considered to constitute one industry having consumer goods and services as input, producing labor as output. In an open system, input-output analysis regards some industries as being related to the other industries in the economy, but not functionally dependent upon them. Hence, in this case consumer goods and services and/or producer goods, Government services and exports are regarded as final uses or output, i. e., autonomously determined by factors outside the input-output system. Labor and management services are regarded as original inputs, but not as produced by a household industry within the system. Also the construction of plants and the production of producers' goods has been usually regarded as final output of investment goods—autonomously determined—even though in a truly dynamic model investment goods should be regarded as input for future output and hence as an integral part of the mutually interdependent input-output system. Thus, the tables in their present open system form answer primarily the question: What output of raw materials and semimanufactured goods is needed to produce a given volume of final output; or what output of the various industries would be needed to meet an assumed demand for final goods and services, a magnitude which is either identical with or can be derived from gross national product. This links the input-output tables with the national income and product accounts.

2. HISTORICAL BACKGROUND

(a) *United States*

Input-output tables for the United States were first presented in 1941 in W. W. Leontief's work, *The Structure of the American Economy, 1919-1929*. During World War II the use of the input-output technique for analysis of war production plans was considered but did not materialize. However, in 1941 the Bureau of Labor Statistics requested Wassily Leontief to construct an input-output table for 1939 which was used in connection with the analysis of postwar economic problems. This input-output table divided the economy into 96 sectors which were later aggregated into 42 sectors.⁸⁵

After the war, mathematicians and economists developed methods for economic (or mathematical) programing. In order to test the economic feasibility of various strategic plans, an up-to-date input-output table for the American economy was required. The National Security Resources Board, the Bureau of Labor Statistics, and primarily the Air Force, supplied funds for the construction of a comprehensive input-output table for the year 1947. This table was constructed by the Bureau of Labor Statistics in cooperation with a number of Federal agencies and some university research organizations. The 1947 table was based on data for more than 400 industries which were then consolidated into about 200 industries.⁸⁶ The testing of the usefulness of such an input-output table for mobilization planning was discontinued in 1953 before the testing program was completed.

⁸⁵ The aggregated table is described in *Full Employment Patterns, 1950* * * *, appendix A (Bureau of Labor Statistics, May 1946): it is also reprinted as table 24 of W. W. Leontief, *The Structure of the American Economy*, 2d edition, 1951.

⁸⁶ For a brief description, see W. D. Evans and M. Hoffenberg, *The Interindustry Relations Study for 1947, The Review of Economics and Statistics*, May 1952. For details see *Input-Output Analysis: An Appraisal, Studies in Income and Wealth*, vol. 18, 1955, and the accompanying *Input-Output Analysis Technical Supplement*, National Bureau of Economic Research, 1954.

The input-output studies in the United States were conducted relatively independently of the national accounting work, at least administratively. National account data (especially gross national product) were used for making the economic projection of final demand. Input-output coefficients then provided the means for relating the input and output of various industries to the stipulated final demand of future years. However, the work was done essentially outside the National Income Division, primarily by the Bureau of Labor Statistics and in the Department of Defense.

(b) *Abroad*⁸⁷

One or more input-output tables now exist for the following countries: The United Kingdom, Norway, Denmark, the Netherlands, Italy, Canada, and Japan. Discussion of plans for input-output work is also taking place in Sweden, France, and Yugoslavia. In those countries where there is a central statistical office (such as Norway, Denmark, the Netherlands, and Canada) the input-output work forms an integral part of the country's unified statistical system and has developed to a considerable extent as a byproduct of the national accounts. The latter is true even in countries where statistics are not centralized administratively.

In putting together any input-output table, there are alternative ways of classifying and tracing the flows of goods and services throughout the economy. The criteria chosen in setting up the accounts, however, are not neutral in terms of their economic implications. In most of the above countries where foreign trade is extremely important, the success or failure of an input-output table and its analytical uses may well rest on the estimators' ability to portray realistically imports and exports, e. g., to distinguish between the so-called competitive and noncompetitive imports. Where foreign trade is of crucial importance for the economy, it is not adequate to treat imports and exports in the somewhat arbitrary manner as done in the United States.

3. POSSIBLE APPLICATION OF INPUT-OUTPUT TABLES

Input-output studies are still in an experimental stage. Therefore, statements about the usefulness of these tabulations must to some extent be of a speculative nature. Nevertheless, more can be said today than a decade ago when the first large scale attempt at developing an input-output table was initiated.

(a) *National defense and survival planning*

As mentioned earlier, the 1947 input-output table was developed primarily for the purpose of testing the economic feasibility of various mobilization programs. At that time the problem was: What amount and what kind of war material production would be economically feasible if the United States productive capacity over a period of presumably several years had to be converted from a peacetime to a full war mobilization basis? This question arose out of World War II experience. Input-output tables would be of great usefulness for examining this kind of problem.

However, military strategy has since been adapted to the use of atomic weapons. Today a major war may be decided by weapons in

⁸⁷ See *Input-Output Tables: Recent Experience in Western Europe*, in *United Nations, Economic Bulletin for Europe*, May 1956.

existence rather than by an economic potential for developing a munitions industry. Therefore economic feasibility studies for defense planning, though still important, are no longer of the same significance that was attributed to them on the basis of World War II experience.

Nevertheless, representatives of the Office of Defense Mobilization and the Defense Department have pointed out the importance of input-output analysis in connection with planning for postattack survival and possible bomb damage analysis. The question here would be: How could the economy best adjust to dislocation and destruction of parts of its productive capacity? To deal with these problems would require a finer statistical breakdown by products and regions than is required for general purpose tabulations. However, the availability of a general input-output table would greatly facilitate such analysis and improve programing efforts for national defense and survival planning.

(b) Other Government purposes

The Government participates in long range investment planning in the field of resource development such as water supply, energy supply and land reclamation. In other fields the Government is involved in long range planning through its conservation policies. In appraising the future use of resources national accounts projections are a primary tool.

Input-output tables can be quite useful for identifying individual industries or key products within the projected national aggregates. They can also be of use in the examination of specific problems of economic policy—such as in the examination of the impact of foreign aid or of changes in tariff policy on the domestic economy. In such a situation input-output tables would help trace the impact of the foreign aid program not only on industries directly affected but also on those activities indirectly affected by foreign aid shipments or by imports.⁸⁸ The input-output approach could also be used to help measure the economic impacts on various industries and activities of a change in general government policy—e. g., to indicate what would be the effect of a program of military disarmament on various sectors in the economy.

(c) Business investment programing and market analysis

A growing number of corporations are engaged in long term investment planning which, in many instances, involves a four step approach:

- (1) Projecting gross national product and its major components.
- (2) Projecting the market for particular lines of products within these gross national product aggregates.
- (3) Determining the share of the market the particular firm uses as a target for planning purposes.
- (4) Determining the investment program which should enable the firm to reach its target.

In making the transition from the first to the second step an input-output analysis can be very helpful to business decision makers. It

⁸⁸ See *The Foreign Aid Programs and the United States Economy*, a study by the National Planning Association prepared for the Special Committee of the Senate To Study the Foreign Aid Program, No. 9, 85th Cong., 1st sess. (March 1957).

permits businessmen to estimate the increase in output for particular industries (or products) which would be in accord with the posited increase in final demand (gross national product broken down by end products).

In this way business is aided not only with regard to its market analysis outlook, but also with regard to its investment plans. Many competent analysts have pointed out that this kind of analysis is not only useful for business from the aspect of sustained profitability, but that it also introduces a factor into the economic system which will tend to promote balanced economic growth. Its availability and use will make possible what has been called a dynamic market analysis, that is, an appraisal of future markets within the frame of reference of a growing economy. We believe that the Government should assist this development by the supply of the proper statistical tools.

A number of larger firms employ their own economic analysis staffs competent to make use of input-output tables for purposes of investment planning and market analysis. Increasingly, consulting firms are concerning themselves with this kind of work on a contract basis. The input-output technique could be put to widespread use by a great number of middle sized firms through recourse to the modern computing equipment available to those consulting firms.

(d) Input-output tables as a check on statistical accuracy

Basically, an input-output table is an arrangement of statistical information within a certain accounting framework. It can be used, as indicated above, for identifying gaps and inconsistencies in that information. For that purpose, summary tables with a limited number of industry sectors could indicate where additional statistical information is needed. In general, this purpose should be regarded as a byproduct, rather than as a primary objective of input-output tables. Nevertheless, the preparation of input-output tables, together with the other systems of national accounting, can serve as an integrating force in economic statistics, particularly since the emphasis of the input-output approach is real products and services as contrasted with monetary flows and income transactions of the other major national accounting techniques. This possibility is not entirely theoretical. It was the work on the 1947 input-output table which pointed possibly more conclusively than anything else to shortcomings of the current construction statistics and gave impetus to the drive for improving these statistics which is still underway and which the committee has endorsed in chapter XI, section 2.c.

4. POSSIBILITIES AND LIMITATIONS OF INPUT-OUTPUT TABULATIONS

We recognize that after about 15 years experience here and abroad input-output statistics are beyond the pilot study stage. Nevertheless, they are still of an experimental nature.

One may envisage at some future time that there might be developed an accounting system which would automatically yield the information needed for a comprehensive continuous census of industrial and business activities, and would thus at the same time provide the raw statistical material for the national income and product accounts, for flow-of-funds statements and for interindustry flows of products and services. Information would proceed from the busi-

ness unit directly to the final summarization in national accounts and input-output tabulations. With the prospect for wider use of electronic bookkeeping and processing equipment, such an outlook may be visionary but not utopian. (See also ch. XV.)

For a considerable time to come, however, we have to resign ourselves to the fact that there will not be a steady flow of the required information from firms and households for use in final national accounts. Particularly, the information provided by business firms in the census and the other basic statistics sources will not be in a form which can be directly used for input-output tabulations. Estimates and adaptations from available statistical information must still be made which can be used for the input-output tables. Particularly, the census information with respect to the relationship of capital equipment to production is very scanty, to say the least, a deficiency which makes it difficult to place the input-output tables on a dynamic basis.

The construction of a comprehensive interindustry table is a major statistical undertaking which can be done only once every few years. In spite of the fact that the censuses do not yield all needed information, they still remain the basic source of data. Therefore, the input-output tables should be constructed preferably for years for which major economic censuses, particularly the census of manufacturing industry, are undertaken.

However, it is possible to keep such an input-output table up-to-date by patch-up work for a limited period. For example, the 1947 table has been revised up to 1952 by modifying input-output coefficients where substantial changes in technology or substitution in the use of raw materials have occurred.

We have already suggested that the Government's general input-output work should be of the nature of general purpose estimates. These estimates are based primarily on the census information which uses the "establishment" as a statistical unit. The breakdown by industries should be fine enough to achieve a satisfactory degree of homogeneity within each industrial group. But it should not be so fine that the output of many establishments would belong to several industry groups, thereby requiring extensive splitting of inputs. A 400 to 500 industry breakdown appears to be the maximum compatible with this principle.

For specific purposes, particularly for purposes of postattack survival planning and vulnerability analysis, special tabulations may be required. These may necessitate even more detailed information and in crucial areas may identify input-output relationships for individual products and industrial processes. A general purpose tabulation can only provide a frame of reference for such special analyses.

5. RECOMMENDATIONS

The committee feels that input-output work should be considered as an important aspect of the national accounting system.

(a) We recommend that an abbreviated interindustry table be constructed on the basis of 1954 census data.

(b) A fairly detailed input-output table should be constructed on the basis of the 1958 economic censuses. This committee is not in a position to make a recommendation as to the exact detail that would

represent the best compromise between the needs of the users and the unavoidable financial limitations. In formulating the schedules for the 1958 censuses, consideration should be given to questions which would give information needed for the input-output tabulations. For example, information is needed regarding value added estimates for the trade sector. For manufacturing establishments a more inclusive listing of the various input materials consumed in the production process would be useful, and more detailed information regarding capital equipment would be desirable. It is also recommended that the census provide more information on the sales of specific products from manufacturing industries, using the same method as that developed for the 1954 Census of Manufactures. The cost of gathering specific statistical information (e. g., on advertising, insurance, etc.) may be too high to be included in a complete census tabulation. In this case, consideration should be given to collecting such data periodically on a sample basis as part of the census annual survey of manufactures. This kind of information would fill some of the statistical gaps in constructing a 1958 input-output table.

(c) Experimental work on capital-output coefficients and on regional breakdowns of input-output tables should be encouraged. (See discussion in ch. XIV, sec. c.) As far as possible such exploratory work should be carried outside the Federal Government.

(d) A simplified annual input-output table is included in the integrated system of national economic accounts outlined in chapter V (table A-6).

CHAPTER XIV. NATIONAL BALANCE SHEET

1. THE FUNCTION OF BALANCE SHEETS AND THEIR PRESENT STATUS WITHIN THE SYSTEM OF NATIONAL ACCOUNTS

While the United States has had an official annual estimate of national income for a quarter of a century, no steps have yet been taken toward establishing the national balance sheet as a regular feature of our official national economic accounts. This may come as a surprise to businessmen, and even to laymen only vaguely familiar with accounting, since balance sheets and income accounts are usually regarded as the two primary and complementary parts of a system of accounts. Indeed, in the balance-sheet field there has been definite retrogression in marked contrast to the rapid advances made in the last few decades in the national income and product accounts. Up to the 1920's, long before official or unofficial national income estimates became a regular feature, an estimate of national wealth constituted part of our decennial census. It was prepared for the last time for the year 1922.⁸⁹ In this field work even outside of the Federal Government is now so rare that we are limited to 1 continuous and reasonably up-to-date set of national wealth estimates and 1 set of national balance sheets for half a dozen benchmark dates since the turn of the century, and both these attempts have become available only recently.⁹⁰

⁸⁹ National Wealth and Income, Federal Trade Commission, 1926.

⁹⁰ R. W. Goldsmith, *A Study of Saving in the United States*, vol. III, pt. I, Princeton University Press, 1956; see also *Thirty-Seventh Annual Report of National Bureau of Economic Research, Inc.*, pp. 34-36.