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The Methodology of Input – output Tables

by

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1. Introduction

The input-output table and the related computation technique represent merely a method for studying, analysing and planning the production and reproduction process in the national economy. Studies of consumption and final demand must precede the input-output analysis. Therefore, the basic assumptions of input-output analysis are entirely concerned with the nature of the current productive process. This means that in evaluating the efficiency of the input-output analysis as an applied method of analysis and planning, the appropriateness of these basic assumptions must be ascertained. In other words, if it is possible to say that the open static input-output model was developed from statistical table of transactions, it is also quite clear that the table itself cannot be prepared without rules which can only be derived from some theoretical concepts. This gives the reason or, at the same time, the answer to the question why do we study the methodological or conceptual problems of the input-output analysis?

Bearing in mind the variety of aims of the input-output analysis and methods used in achieving these aims, one can say that the aim of the methodological study of the input-output tables is to demonstrate the influence of the input-output theory upon the methods adopted in compiling and constructing statistical tables, and shows not only that the results are necessarily a comprise between the consideration of theory and feasibility, but also that the alternative

methods of arranging the basic data may be desirable.[1] This gives a predominant importance to the methodological study of the input-output analysis.

In the study of the methodology of the input-output tables, one can easily notice that the main characteristic feature of the input-output analysis is the predominance of the government agencies in this activity. The principal reason are the high costs required for assembling the statistical data, compiling the tables and detailed statistical analysis. The important role, which the government must play in interindustry research is desirable for many reasons, because one of the most noticeable results of such research is to point up weakness in existing statistics which only the government is in a position to make good.[2] But this role of government, on the other hand, has deep repercussions on the scientific developments of the input-output analysis. It reveals some tendencies relating to the methodological study, because the main emphasis of government is likely to be on immediate applications rather than on sound methodological development and testing of hypotheses.[3]

1/ United Nations, Problems of Input-Output Tables and Analysis, Series F, No 14, p. 29.

2/ Chenery and Clark, Interindustry Economics, John Wiley and Son, Inc. 1959, USA, p. 196.

3/ Ibid., p. 196.

In theory as well as in practice, the methodological study of input-output technique is of paramount importance in the market economies as well as in the centrally-planned economies. The input-output technique is still considered experimental in most countries. This puts it in a close connection with the statistical practices of the country, i.e. the statistical methods used in measuring the economic totals or variables in the tables. In other words, the input-output technique is based on a simplified general theory of production and reproduction. It is basically a method for analysing and, therefore, planning the social product and national income.

In theory, there are radical differences in the economic concepts and, therefore, in the statistical measurement of social product and national income between the market economies and the centrally-planned economies. These differences are easily reflected in the statistics of social product and national income prepared according to the system of national accounts applied in the market economies and the system of national balances applied in the centrally-planned economies. All these questions will be discussed in detail, in a special study in the future. But what I should like to assert now, is the great significance of these conceptual differences in constructing the input-output tables, in arranging the data, in using the tables for analysing and planning national economy and in doing comparative studies. These differences must be kept in mind when making international comparisons.

In studying the methodology of the input-output tables, I should like to confine the present study to the main problems for two reasons:

i - The input-output technique is still considered experimental in most countries, since in none of them has it been pursued for a long enough period to establish a routine of data collection and analysis.[1/] Accordingly, there are many methodological questions which still demand a more detailed analysis.

ii - Not all methodological questions are of the same significance for all countries and, therefore, demand general solution, but some of them depend to a great extend, on the case of study and the available data.

2. Classification and aggregation

The starting point in any attempt to apply input-output model to a real economy is to divide this economy into sectors. In doing this, we are immediatelly faced with a number of problems, in particular with the question of classification. The real difficulty stands behind the fact that for an economic system there are thousands of different activities. To fit the intricate complexities of a modern

1/ Ibid., p. 183.

industrial economy into sectors, however, requires a substantial amount of aggregation. This represents really a very difficult problem and no definite or satisfactory treatment of it has yet been given.

From the beginning, I should like to lay some stress on the fact that the classification process is completely synonymous with the aggregation process, because classification implies grouping in input-output analysis. Therefore, any aggregation criterion can be easily translated into a criterion for classification of units into sectors. But how should these sectors be formed?

The aggregation problem is, in fact, how sectors or groups of commodities should be formed in the table. In other words, what are the ideal criteria for aggregation? In this respect the notion of homogeneity plays a great role as the basic assumption of input-output analysis. Consequently, I think it useful to throw some light on its concept as an introduction to the aggregation problem.

Roughly, the homogeneity assumption means that each sector produce a single product with a single input-output structure and there is no automatic substitution between the output of different sectors, but a perfect substitution between all the products of

a single sector. The extent to which this homogeneity assumption is valid is really the core of the aggregation problem. This means that the choice of the criteria must be made in the light of a good knowledge of the characteristics of the productive activities being aggregated as well as of the uses of the outputs. This depends basically on the experiences of the staff of technicians who work in constructing the tables practically and on the available data as well.

In theory, the proposed aggregation criteria depend, in principle, on what type of aggregation we have in mind. The distinction between horizontal and vertical aggregation should be made clear : horizontal aggregation involves the aggregation of parallel stages in the process of production, the vertical aggregation involves the aggregation of consecutive stages.1/

Aggregation criteria

Accordingly, there are two main criteria for aggregation.

1- Similar input structure: Units which have a similar input structure should be grouped together even if they have different uses, e.g. cars and tanks.

2- Output proportionality: Units whose output is likely to change in equal proportion should be grouped together. For example, this

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1/ U.N., Problems of Input-Output Tables and Analysis, Series F, No 14, p. 34.

might be true of such consecutive stages of the productive process as the carding, spinning, weaving, and dyeing of textile fabrics. When the successive steps are performed in relatively fixed proportions, such as smelting and refining or spinning and weaving, it is often justifiable to combine them into a single sector.1/

In general, the problematic character of the aggregation question stems principally from the fact that the basic unit of statistical data collection is the establishment. In the real world, the establishment may be a single plant building, with its capital equipment and associated labour force, but it oftenly produces several kinds of products, several secondary products beside its characteristic or principal product. In addition, even if each commodity could be represented by a separate sector, so that both inputs and outputs could be perfectly homogeneous, there would be considerable substitution between sectors.2/

In practice, the empirical applicability of any criterion remains in close connection with the availability of statistical data, the nature of the statistical unit used in industrial statistics and the purposes of study. Accordingly, there is a closer relation between the proposed aggregation criterion for input-output analysis and the adopted statistical unit in the industrial statistics.

1/ Chenery and Clark, Interindustry Economics, John Wiley and Son, Inc., 1969, USA, p. 38.

2/ Op. cit., p. 30.

A statistical unit may be any of the following:[1/]

1- a commodity group

2- an establishment such as a farm, a mine or a factory

3- an activity such as trade or construction, or

4- an institution organizing a branch of economy such as an enterprise or government agency?

In short, if it is true that each one of these statistical units is homogeneous in the sense that there exits a common factor in each one, we cannot say that any of them can satisfy completely the homogeneity concept as it is used in the input-output analysis.

Last and before leaving the subject of aggregation, I should like to lay some stress on the following remarks:

1- There is no ideal criterion for aggregation that can be recommended. The efficiency of any criterion depends specifically upon the purposes of study. In other words, a given aggregation may be valid and efficient for one purpose, but it is not necessary to be so for another purposes, i.e. if the analysis is principally concerned with a few sectors, then other sectors which are only weakly related can often be aggregated without introducing significant errors into the results of analysis.

1/ U.N., Problems of Input-Output Tables and Analysis, Series F, No 14, p. 31.

Strictly speaking, the validity of any actual aggregation can only be determined by reference to the specific uses of the model, since perfect aggregation is never achieved.1/

2- Owing to the fact that the input-output analysis is based on a simplified general theory of production, we can say that similarity of input structure is the best and the most acceptable criterion for aggregation in input-output tables. The study of the interdependences in the productive process is still the main aim of the input-output analysis?

3- The availability of the statistical data represents, practically, the most serious limitation on the system of classification and aggregation. A more detailed classification always provides greater information and, therefore, achieves more homogeneity in sectors. But, on the other hand, the large number of sectors demands a great availability of data, highly qualified technicians, high costs and long period of time for compilation, construction of the table and analytical work.

The great number of sectors cannot, in any way, satisfy the pure homogeneity assumption, but it realizes, at least, a great degree of reality in aggregation. On the other hand, it opens the doors to substitutability. The greater degree of detail, the greater are the costs of preparing the table, and the greater is the likelyhood of substitutability and the prevalence of "external" effects between sectors.2/ Accordingly, the best solution depends, principally, on a reasonable compromise

1/ Chenery and Clark, Interindustry Economics, John Wiley and Son, Inc., 1959, USA, p 38.
2/ Op.cit.,,p. 30.

between all of these contradictory considerations, in the light of statistical potencialities and the purposes of study.

4- Careful study of the classification and aggregation question can help effectively in discovering the shortcomings in the applied system and reveals particular reclassification which improves the homogeneity of input-output technique.

5- Any efficient system of classification and aggregation must consider not only the relations presently axisting within the economy, but also those likely to prevail in the future as a result of technical progress or changes in the productive structure of the society by introducing new industries as a part of an overall programme for growth. This remark has a special significance in the developing economies during the periods of their economic and social growth. The reason is that during the periods of development, and as a result of the growth plan, the economic structure is always subject to radical changes.

3. Valuation of transactions

It is more logical, before handling the subject of valuation of transactions, to determine clearly which transactions are relevant to the input-output table? The input-output model is really a simplified production theory. Its basic aim is to study the interdependence in the current productive system. This fact has a direct effect on the nature of transactions which are relevant to the technique. It means, in

theory, that the trancsaction must be related with the process of production in the period of study. Therefore, there should be no ambiguity about recording transactions between sectors in the table. But practically the problem is not so easy as we can expect.

In practice, the attempt reveals a number of serious difficulties. These difficulties are basically due to the following considerations:

1 - The concept of the productive activities

If it is possible to say that there are two different systems of managing the national economy, the market machanism system and the central-planning system, and each of them has its characteristic ideological concept which reflects the used economic analytical techniques, this makes the conceptual difference of productive activities between the two systems naturally expected and accepted.

This difference in the definition of the productive activities is completely reflected in the study and measurement of social product and national income.

In the market economies, the national product represents all commodities and services produced in the economy during a certain period of time, say, one year, while in the centrally-planned economies it is confined only to material production and the related productive services such as transportations and trade margins. This is because the items of material production embody the newly created value in

themselves. National income, in the centrally planned economies, is created in all the branches of the sphere of material production.1/ All these conceptual differences are clearly reflected in the statistical accounting systems used in both countries; the system of national accounts in market economies and the system of national balances in centrally-planned economies. These differences will be analysed, in detail, in specific a study in the future, to show the relation between input-output analysis and both systems of accounting.

2 - The theoretical framework

It is a matter of fact that the nature of transactions which are relevant to the input-output table depends, to a great extent, upon the theoretical framework and the nature of the problems which the table is designed to fit. Needless to say that the input-output analysis is merely an analytical technique. Therefore, it has a variety of uses and, consequently, a large number of methods which depend upon the case of study and its theoretical framework.

3 - Availability of statistical data

In practice, the availability of the statistical data and their qualification represent one of the most serious limitations to many questions in the input-output field, one of which is the identity of

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1/ Pavlov, G., Problems of the Analysis for Inter-Branch Relationships in the Planned Inter-Branche Balances, Memo. 752, March 1967, INP, Cairo, U.A.R., p. 15.