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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.

transactions relevant to the table. The available statistical information plays a large role in constructing the table and in compiling the data. For example, the transaction-in-kind such as fodder, the consumption of farm products by farm families must be recorded in input-output table, but the lack of statistics in most countries may prevent it. In this respect, the degree of economic development of the society plays a decisive role. Anyway, the subject can be put, generally, like this:

a - All the productive transactions which have a direct bearing on current production are included.

b - All purely financial transactions such as loans, sales and purchases of securities are excluded.

Now the question is : What is the price which can be used in evaluation ? First of all, we must notice that the sales of sector are not necessarily equivalent the inputs from the first sector to the second one. This note must be clear from the outset, because some references in input-output field prefer to write sales and purchases instead of inputs and outputs. Adjustments in data concerning sales and purchases must be made to take account of changes in stocks.1/ Thus we can write:

1/ U.N., Problems of Input-Output Tables and Analysis, Series F, No 14, p. 37.

Inputs = purchases ± Changes in stocks

Output = sales ± Changes in stocks

In general, there are, as it is evident from table /2.1/, two pricing systems for the valation of transactions. The input-output table may be valued either in producer's or in purchaser's price. The difference between the two prices are the marketing costs which include such items as transportation costs, trade margins and net indirect taxes. Consequently, the two pricing systems are alternative methods of distributing these services among the other sectors of the economy.1/

In a producer's prices system, each industry is treated as paying the transportion costs and trade margins on all its purchases of inputs, with the value of these services lumped together as purchases from the trade and transportation industries. Thus its output as well as its other inputs are stated at F.O.B. prices. In a purchaser's prices system, on the other hand, each industry is treated as paying the transportation costs and trade margins on all its sales of output, with the "presumably different" value of these services lumped together as purchases from the trade and transportation industries. Thus its output as well as its other inputs are stated at delivered prices.2/

1/ Chenery and Clark, Interindustry Economics, John Wiley and Son, Inc. 1959, USA, p. 141.

2/ Ibid., p. 141

In comparing between the two pricing systems we can say that the data about input-output flows in purchaser's prices are relatively obtainable. This makes input-output tables valued in purchaser's prices acceptable for certain uses. But, on the other hand, it needs detailed data on the margins paid by each sector which makes it only applicable in the countries having fairelly complete statistics. Furthermore, the purchaser's price system suffers from many disadvantages.

Firstly, the same use values are purchased for different prices, e.g. for the purposes of productive consumption the products are sold without the turnover tax, while for personal or collective consumption they are sold including the turnover tax.1/

Secondly, the output control total /row total/ for each sector includes the marketing costs which makes technical coefficients unstable for any change in marketing costs.

Thirdly, under this system, all marketing costs are counted twice, in the value of output of the producing industry and as inputs to that industry from the marketing cost sectors.2/

1/ Spevacek, Some problems of Workingout and Utilization in planning the Structural Balances/ Input-Output Tables/ in CSSR, Memo 643, INP, Cairo, April, 1966, p. 26.

2/ U.N., Problems of Input-Output Tables and Analysis, Series F, p.38

Table /2.1/

Country	Producer's prices	Purchaser's prices	Other price concepts
Austria	x		
Belgium	x		
Bulgaria	x		
Canada	x		
Czechoslovakia	x	x	
Denmark	x		
Finland	x		
France			Producer's prices for intermediate transactions, purchaser's prices for final deliveries.
Hungary	x		
Italy	x		
Netherlands	x[a/]		
Norway	x	x	Accounts are kept in both price systems but producer's prices are applied in analytical uses.
Poland	x		
Soviet Union		x	
Spain	x		
Sweden	x	x	Also at producer's prices separately for home-produced and imported supplies
United Kingdom	x		Producer's prices including in certain cases, transport cost paid by the producing sector.
United States	x[b/]		
West Germany	x		Producer's prices, incl. transport cost paid by the producing sector in the matrix of 1954-1958.
Yugoslavia	x		

a/ Including sales taxes etc., for 1959 also a table at producer's prices has been computed excluding taxes on products sold.

b/ Manufacture's excise taxes are uncluded in producer's prices in the 1958 table.

Source: U.N., Economic Bulletin for Europe, Vol. 16, No. 2, 1964, p. 21.

In short, the producer's price system is, for the above mentioned considerations, more preferable than the purchaser's price system. But it must be quite clear that the availability of data plays a decisive role in this respect.

4. Net or gross sector output

One of the most important decision in constructing and compiling input-output tables is the choice between net or gross sector output. It has a deep repercussion on the table itself as a convenient tool of analysing the intraindustry transactions within the sectors. On the other hand, it reflects another difference in the methods of calculation of the control totals of outputs and inputs between market economies and centrally-planned economies.

The problem arises originally when some input-output tables exclude the Intra-industry transactions. This means that all cells on the main diagonal of input-output table are blank. This method is justified on the ground that the value of the diagonal element is dependent on the number of establishments within the industry or sector and, on the other hand, on the use of the establishment method in calculating the value of production of industry. Therefore, we can, for some particular purposes, easily omit all the transactions on the main diagonal of the table without influencing the table as a whole.

Generally, we can say, that this method is quite acceptable under the assumption of commodity technology in production and also when each industry or sector produces only its characteristic commodity. But this is not the case in the real world. Consequently, the gross output or the gross output and import of similar commodities is the more convenient control total for rows and columns. This is quite reasonable, especially when a sector or industry consists of many establishments.

Gross output is defined as the sum of the value of all output of the statistical units produced during the period in question, the value of goods shipped in the same condition as purchased, the value of industrial services rendered to other units, and changes in the stock of goods in process.[1/] In addition, intermediate input control totals which are often established are the total value of cost of materials. The value added, too, are usually available from industrial censuses.

Examining the methods used in calculating gross output of sectors we can easily note another important difference between the market economies and the centrally-planned economies.

1/ Ibid., p. 69.

The manufacturing sectors of input-output tables prepared in the most market economy countries are based upon establishment data/ The only exception being in Japan, which use the commodity approach/ while most of centrally-planned economies use the enterprise as the basic statistical unit.[1] But in some of centrally-planned economies, e.g. in Czechoslovakia, some changes in methods of calculating have been made.

"In industry, the so called enterprise method is used for calculation of the value of the social product. According to this method only a value of production which has not left the border of enterprise and has been entered in an economic turnover of a country may be included in the value of social product. The value of production which has been circulated and has been consumed inside the interprise /for example, among different establishments and workshops/ can not be in the gross value of industrial production.[2] The only exception made in this concept is the inclusion of capital goods produced and consumed in the same enterprise.

Now, and as a result of some practical difficulties which are stem from the absence of the concrete definition of what called border of enterprise, the enterprise method is replaced by the branch method.

1/ Ibid., p. 69.
2/ Spevacek V., Some Problems of Workingout and Utilization in Planning the Structural Balances/Input-Output Tables/ in CSSR, Memo 643, INP, Cairo, April 1966, p. 23.

"The new method of calculation of the value of production, the so-called branch method, being introduced at present in Czechoslovakia and the next statistical table containing about 450 branches of the national economy, will be calculated according to the branch method. The branch method reflects the flows of goods among the different branches of the national economy as they have been defined by the unified classification of production, irrespective if these flows take place inside the enterprise or among different enterprise".1/

At last, there is one thing which must be permanently affirmed. It is very necessary from the view point of national economic planning to attain a consistency between the value figures of the input-output table and those of the national accounts and balances. This can only be achieved by using the same method for valuation and calculation of transactions in all of them; input-output table, national accounts and material balances.

5. Foreign trade

One of the most important uses of input-output technique is the planning of foreign trade, especially in the economies in which foreign trade is relatively significant. In such economies foreign trade activities play a large role in the creation of the social product and national income. Consequently, the planning of the foreign

1/ Ibid., p. 24.

trade sector is one of the most important spheres of comprehensive planning and represents, therefore, a significant part of the comprehensive national plan, especially in the less developed economies.

In the less developed economies; as it is known, the foreign trade sector is one of the most important sectors in the creation of the social product and national income because there is no developed industrial structure. This makes these less developed economies depend significantly on the advanced economies in getting their needs of industrial goods for their production of raw materials. On the other hand; most of these less developed economies are, now, adopting one type or another of development programmes which makes them also basically depend on these advanced economies in getting its needs of capital and technical requirements.

In addition, foreign trade activity plays also an important role in the creation of the social product and of national income in some of the advanced economies such like in Italy, Japan and Czechoslovakia.

In general, the great importance of foreign trade planning is quite evident because of its direct connection with the planning of investment, production, consumption and prices. Thus, the efficiency of foreign trade planning plays a decisive role in comprehensive planning systems and their efficiency as well.

Analysis and planning of foreign trade must be made by analysing its two elements or sides, imports and exports. Input-output technique is really one of the most efficient techniques which can be effectively used in this respect. This recommended analysis can be done on two steps; /i/the treatment of imports and exports in the input-output table, and /ii/ the valuation of imports and exports.

/i/ The treatment of imports and exports

The real problem in the treatment of imports and exports is connected with the recording of imports rather than exports in the table. While there is nearly a universal method in recording exports, there are, on the other hand, several alternative methods for recording imports, each of which is dependent on the theoretical framework of the table, the available data and on the relative significance of the problem under study.

Exports enter nearly all interindustry models as an autonomous final demand, since the main factors influencing them stem from foreign countries rather than from the domestic economy.[1/] In other words, that part of the output of a given sector which is exported is entered in a final demand column. This means that in the open model, in which exports are exogenously determined, exports are recorded separately in

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1/ Chenery and Clark, Interindustry Economics, John Wiley and Son, Inc., USA, 1959, p. 153.

a special column as a final demand sector. Consequently; exports can be projected like any sector of final demand.

This can be done by using income-elasticity and price-elasiticity deduced from a time-series data and the assumed developments in the national income and relative prices in foreign countries. Conventional techniques of analysing export demands may well be satisfactory to classify exports both by commodity group and by receiving country, and then to estimate income-elasticities and price-elasticities from the time-series data.1/

But the most reasonable question to ask here is: Is the assumption that exports are determined exogeneously realistic? In answering that question I would like to make some considerations which are of a paramount significance in foreign trade planning.

Frist of all, it is true that exports depend largely upon demand trends abroad, which may be regarded as a virtually exogeneous elemet, but, on the other hand, this does not reject that exports depend on the following factors:

1- the general price level and the relative prices within the country,

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1/ Ibid., p. 153.

2- the international relative prices,

3- the imports via its repercussions on incomes abroad and via its determination of exports directly, as in the case of bilateral trading agreements.

Generally, the treatment of exports as an exogeneous final demand sector can be accepted, but a detailed analysis, on the basis of multicollinearity, keeps the more convenient base of any comprehensive study of exports as a first essential step in the foreign trade planning.

In contrary to exports, imports depend basically upon domestic factors and, therefore, are treated as a derived demand in most input-output tables. Derived demand means that they are, to a great extent, proportionally related to the volume of domestic production.

Keeping this in mind, the convenient treatment of imports demands the necessary distinction between complementary and competitive imports. This distinction can be made according to the nature and the different functions of imports. It is natural, as we have seen, that some raw materials, which may be very essential as inputs for the domestic industries, are available only through import, even though they can be produced by domestic industries. This can arise for one of two reasons: either the quantity that can be produced domestically is limited, or

there is none because of the availability of some or all materials of production, or simply that the country finds it, according to the relative costs of production, much cheaper to import than to produce these products. All of these products can be looked as complementary inputs and, consequently, the best treatment for them is as proportional inputs into the appropriate using industries.

On the other hand, there are imports which can be produced domestically or, in other words, which are similar to products produced in some domestic industries. These imports which can be called competitive can not be treated as the previous ones, because their volume does not proportionately depend on the output of domestic industries.

A competing import can be defined as a commodity which is a good substitute for some domestically produced commodity. Clearly, the interpretation of the term a good substitute is a matter of judgement. A non-competing/complementary/import is one for which there is no domestic counterpart. 1/

As long as there is no problem in handling the complementary imports, the real problem lies behind the recording of competitive imports.

1/ U.N., Problems of Input-Output Tables and Analysis, Series F, No. 14, p. 50.

The complementary imports can easily be handled like any other input. It is simpler to distribute noncompetitive imports directly to the consuming industries, and if there is no particular interest in individual commodities, they can even be lumped in a single import row.[1/] This is quite acceptable, because the input coefficients formed by its flow will be quite stable in the sense that they do not suffer from the substitution of the domestic production.

In connection with competitive imports, there are several alternative possibilities for treatment. These alternative possibilities can be stated as follows:

i- The first possibility is to allocate all cometitive imports whether final or intermediate, in a single row, to the consuming sector or industry. This possibility is not acceptable because of the instability of the technical coefficients as a result of substitution between imported materials and those domestically produced. Futhermore, the imports of the intermediate materials are completely excluded from the first quadrant of the table which shows the mutual relationships among the productive sectors of the national economy. This is really the main disadvantage of this method because it is very necessary, from the point of view of foreign trade planning, to recognize the competitive imports which were consummed in the different sectors or industries.

1/ Chenery and Clark, Interindustry Economics, John Wiley and Son. Inc., USA, 1959, p. 142.

ii - The second possibility is to distribute the competitive imports along the rows of the corresponding domestic sector. It is quite clear that this method achieves the stability of technical coefficients which makes them more convenients for economic projection and planning. All intermediate flows thus consist of domestic product plus competing imports, and the total of the latter are entered as a negative column in the final bill of goods.[1] By this method we can entirely avoid the use of input coefficients for competitive imports.

iii - The third possibility is that all imported goods/ included complementary/ can be distinguished both by industry of origin and by industry of destination. This is equivalent to the preparation of two tables one for domestic flows and one for imported products.[2] This method may be most favourable for its flexibility; more information about import substitution in particutar elements can be accurately incorporated in the table.

Thus the domestic flow matrix can be constantly revised, so that the problem of substitutability can be minimized.[3] But needless to say, the applicability of this method depends, to a great extent, on the availability of data.

1/ Op. cit., p. 52.
2/ Ibid., p. 53.
3/ Ibid., p. 53.

/ii/- The valuation of imports and exports

It is of great significance, from the outset, to emphasize the importance of the valuation system of foreign trade activities in foreign trade projections and planning in particular and in comprehensive national planning in general. This is because of the existence of several margins such as freight charges, insurance charges, import duties and export subsidiaries, which influence the value of imports and exports and, consequently, the value of technical coefficients of imports.

Generally, there are, as we have already seen, two price systems in foreign trade literature, C.I.F. price system and F.O.B. system. The C.I.F. price comprises three items:[1/]

1- the foreign port value

2- freight charges to the domestic port of the country

3- insurance charges.

The F.O.B. price at the port of embarkation consists of:

1- The producer's value

2- The various marketing consts neceasry to get the goods to the port.

In valuing imports and exports we must keep in mind some basic considerations, two of which are:

1/ U.N., Problems of Input-Output Tables and Analysis, Series F, No 14, p. 53.

1- the valuation system used in the table as a whole, i.e. the producer's or purchaser's price system, and

2- the method adopted for recording competitive imports in the table.

Practically, while the F.O.B. price is used in evaluating exports, the domestic port value is often prefered to value imports. The domestic port value comprises the C.I.F. price plus all the import duties levied by the domestic government on imports for one purpose or another.

Generally, under the domestic port value system of valuation of imports and also under the producer's price system of valuation of all the domestic product flows, the imports can be treated in following manner:

1- The domestic port value of competing imports of type "i" consumed by domestic industry "j" is entered in the cell at the intersection of row "i" and column "J"

2- The costs incurred in transferring the imports from domestic port to point of consumption are treated in exactly the same way as the costs incurred in transferring a domestic product from the producer to the purchaser according to the producer's pricessystem; i.e. the trade and transport margins are entered as inputs to industry "j".[1/]

1/ Ibid., p. 54.

The domestic port value contains, as we have seen, baside, the foreign port value other international margins as freight charges, insurance charges, and import duties, but it does not contain the margin items associated with the transfer of the imports from the domestic port to the consuming industry. the real disadvantage of the domestic port price less in the inclusion of those international margins, the natural consequence being the instability in the table as a result of the overestimation of imports. But in general, the domestic port price is often considered preferable for valuing imports for many reasons:

1- its comparability with the domestic products valued at producer's prices.

2- it can be easily calculated by obtaining C.I.F. price from the statistics of customs which are always available, plus import duties.

6. Substitution in input-output table

The input-output analysis, as we know, is based on a more simplified theory of production. It is an amenable technique, but on the other hand, it is more simple and crude. The role of prices remains suppressed, technical coefficients depict the state of production ex-post, making it less suitable for futre uses.[1/] In reality, the main default of the input-output technique is the absence of substitution among the different inputs used in production of a commodity or a group of commodities. The model

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1/ Abdul Quayum, Lectures on Production Theory and Techniques, INP, UAR, 1965, p. 108.

constructs discrets production function under different sets of assumptions, i.e. linear relationship between inputs and outputs.

"Because of the non-substitution assumption, the general production function of the form

$$X_j = f (X_{1j}, X_{2j}, \ldots\ldots X_{nj}) \qquad /2.15/$$

takes the form of minimum requirements for each input:

$$X_j \leqslant X_{ij} / a_{ij} \qquad (i = 1, 2, \ldots, n) \qquad /2.16/$$

Equqtion /2.16/ states that a minimum amount of each input is required for a given output. The output is therefore fixed by whichever limit is reached first. Actually, no more than the limitational amount of any input would be used, and the partial relation between each input and output reduced to the equality:1/

$$X_{ij} = a_{ij} X_j$$

This gives us a brief idea on how the production function is treated in the general input-output model. The inputs are related with the outputs through constant technical coefficients, a_{ij}; i.e. constant returns to scale and no substitution among inputs. The absence of substitution among inputs might be explained on one of two grounds: either

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1/ Chenery and Clark, Interindustry Economics, 1959, p. 39.

/i/ the technology is such that no substitution is possible or /ii/ relative prices do not change, so that it is not efficient to alter input proportions regardless of the shape of the production function.[1]

To show the extent to which these two grounds are valid, I think it useful to analyse the two crucial assumptions about the techniques and the inputs which play a great role in the development of the theory of production. These two assumptions can be explained briefly as follows:

i- The continuity of the function. It is always assumed that the production function is a continuous one, i.e. the techniques are continuously variable, which means that the inputs can be combined in any proportion we desire in producing the output. Is this true? In reality this is not always true. The techniques or processes of production are not continuously variable, i.e. the inputs cannot be combined in any proportion desired to produce a certain output.[2] In this respect, it is very necessary to distinguish between the variability in the combination of the commodity inputs and the variability in the combination of the basic factors of production, labour and capital. Here, we can easily decide that the variability in the combination of the basic factors of production is likely to be much greater, but not continuous or perfect, than in the combination of inputs in producing

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1/ Ibid., p. 39.
2/ Abdul Quayum, Lectures on Production Theory and Techniques, INP, UAR, 1959, p. 1.

the final outputs. Accordingly, leontief in his original formulation relied primarily on the assumption that the technology is such that no substitution is possible. He argued that a large proportion of what economists usually call substitution was due to use of large aggregates, such as "consumption" in which a change in the proportion of automobiles and foodstuffs consumed, for example, would cause a change in the proportions of inputs of labour and capital used. This type of substitution is eliminated by the use of a finer sector breakdown.[1] This makes the problem now how to get a finer sector breakdown. This is, as we have seen, before a matter of judgements.

ii- The divisibility of inputs. It is also always assumed in theory that inputs are continuously divisible. Generally, this is not a wholly realistic assumption, particularly, in the case of non-divisible inputs such a fixed assets and management or organization. The assumption of divisibility as regards commodity inputs is largely realistic, but very tough problems are faced in connection with the non-divisibility of the factors of production.[2] This duces the importance of the changes in the relative prices of factors, but there are both theoretical and empirical grounds for expecting relative prices to be fairly stable, a part

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1/ Op.cit., p. 39

2/ Abdul Quayum, Lectures on Production Theory and Techniques, INP, UAR, 1959, p. 2.

Generally, the establishments are aggregated or grouped according to the characteristic product. All the establishments which are producing the same characteristic or primary product are classified or aggregated together with the sector bearing its name. But the real problem lies behing the inclusion of the secondary products in the output of same sectors, while there are other sectors that produce them principally and they bear their name. The natural result is that the demand created for one product will appear to lead to an increase in the output of other products in the sectors. This causes some disturbances for the planning of production and can also cause, after certain limit, a partial overproduction crises in some branches of economy. Furthermore, the inclusion of secondary products is really an explicit violation of the homogeneity assumption. The input structure of secondary products is always not the same for the primary or characteristic products and, therefore, it is very difficult to divide the total inputs used in producing of several products.

On the other hand, there is no unique technique of producing one product. This makes the technical coefficients of the same product depend basically upon whether the product is produced as a characteristic or as a secondary product. The adopted technique in both cases is often not the same and, therefore, the input structure is different.

Accordingly, the more logical and natural task is to rule out production of a given product in more than one sector. Otherwise it would be impossible to predict which sector would satisfy demand requirements for that and, consequently, to plan production and consumption.

In addition, this satisfies the homogeneity assumption of sectors and makes calculations more reliable for the purposes of projection and planning. To do this we should need to know the input structure of each sector, with a specification of the inputs which come into each product whether principal or secondary. Needless to say, this depends wholly upon the availability of data and the use of commodity as a fundamental statistical unit in industrial censuses. These data are still lacking in most of the countries.

Anyway, we can demonstrate all the alternative possibilities for handling the secondary products as follows:

1- The rearrangement of secondary products; this can be done by transferring the secondary products from the sectors in which they are actually produced to these sectors in which they are primary; i.e. by subtracting each secondary product from the output of the original establishment and adding it to the sector or industry for which it is primary; simultaneously, an appropriate portion of the inputs of the original establishment must be also transferred to that industry's input structure. This transfer of input can be done in the light of the primary industry's input structure. This is based upon the assumption of a commodity technology which means that the technological processes depend completely on the nature of the commodity produced and therefore the input structure of secondary products in many sectors or industries is the same as the input structure of the sector

in which they are primarily produced. In brief, this means a complete shift to the commodity classification and aggregation. Regardless of the defaults of a commodity technology assumption, the transference of the secondary products can easily be done if the necessary data are available. Products are transferred from the producing sector "A" to sector "B" by means of a positive entry in the row for "A" and the column for "B" with an off setting negative entry in the diagonal element of B. 1/

2- As a result of using establishment as a fundamental statistical unit in industrial statistics in most of the countries, the simplest treatment of the secondary products is to keep all of them in the output of the original sector or industry. It is clear that this solution is based upon the acceptance of the industry technology assumption which means that every industry has its own technology, determined by its principal product; in other words all commodities, whether principal or subsidiary, produced in one industry are made by the same process and therefore require the same input structure. 2/ It is quite evident that this solution is not acceptable because of the absurdity of the industry technology assumption. Furthermore, it violates explicitly the assumption of homogeneity of the sector or industries, which makes it inadequate for projection and planning.

1/ Ibid., P. 43.

2/ U.N., Problems of Input-Output Tables and Analysis, Series F, No. 14, p. 40.

No doubt the first solution is, in reality, the best and the more plausible one. Keeping in mind that the availability of data and the nature of the statistical unit represent a more serious limitation in the choice between the two solutions. In addition, the efficiency of any method is something that can be tested only by experience and in the light of gained experiences.

8. Taxes

Taxes represent, in general, one of the main topics of methodological study of input-output tables. Its significance stems basically from its close connection with the degree of growth of society, economic structure, tax structure and its stability. Taxes are of great importance specifically in the developing economies which depend, to a great extent, upon the indirect taxes as a financial source for the development programmes. In this case indirect taxes and subsidies represent a considerable part in the value of inputs and outputs under the purchaser's price system. Consequently, they affect the derived input coefficients. In addition, the problems are more significant when the tax structure is unstable.

In this respect it is necessary to distinguish between direct taxes which are levied on primary factor services and indirect taxes which are levied on current production and consumption. Direct taxes, i.e. taxes levied on factor services are usually not distinguished in input-output tables, since the value of services before taxation is entered on the table .[1/] But the handling of the net indirect taxes,

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1/ U.N., **Problems of Input-Output Tables** and Analysis, Series F, No. 14, p. 40.

i.e. indirect taxes minus subsidies, depends wholly upon the price system used in the table.

Therefore there are three cases or possibilities for handling net indirect taxes. First, under the producer's price system net indirect taxes are generally entered in a special primary input row and the column of the purchasing sector or industry, i.e. the entry in the primary row records the total value of all indirect taxes levied on the inputs to the sector. Second, under the purchaser's price system, indirect taxes, like the other margin items, are shown as inputs to the producing industry.[1/] In this case, the net indirect taxes are treated in the same method as marketing costs such as transportation costs and trade margins. Third, under the market price system, i.e. producer's prices plus net indirect taxes, the row total of each sector represents the value of the sector output including the value of indirect taxes levied on that output. In order that the column sum of total costs could balance the raw sum of total output, the value of taxes levied on the sector's output must be entered again as part of the input of total industry. Furthermore, each intermediate entry in the column indludes the value of the net indirect taxes levied on each input to that sector.[2/]

To appraise the three cases or possibilities, it is quite evident that the first treatment is more preferable. It is of paramount importance to separate the tax margin from the price before computing the technical coefficient matrix to avoid the effects of

1/ Ibid., p. 40.

2/ Ibid., p. 40, 41

taxes on the coefficients and, on the other hand, to preserve the pure technical concept of these coefficients. This is highly necessary in the case of an unstable tax structure. The input technical coefficients based on such an unstable tax structure would be unreliable in projection and planning.

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