

Application of Input-Output Analysis in Pakistan

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The input-output analysis or the study of inter-industry relations, which Professor Leontief pioneered in the United States in the early thirties, has increasingly occupied the minds of practical economists all over the world. Today a body of literature—both theoretical and empirical—has grown up around the basic ideas developed by Leontief, which entitles the input-output analysis to be treated as a separate branch of economics. Yet, the theory is not new to economists. It is, in fact, a theory in the general equilibrium tradition which Quesnay started with the publication of his "*Tableau Economique*" and which Walras presented in a more abstract form.

The basic idea of the input-output approach, viz. that the output of every industry is used either as an input by other industries (and itself) or for satisfying final demands, is not difficult to understand. The input-output analysis treats the economy as a system of mutually inter-dependent industries—a flow of goods and services linking all industries. It studies the production relations between various sectors of the economy and tries to determine and apply the operational constants of the economic system.

One of the earliest applications of the inter-industry approach was in the field of industrial mobilization during and immediately after World War II. The war effort has to be planned in terms of battleships, aircrafts, tanks, munitions and other military supplies which are in the nature of end-products. Yet in order to produce these a number of supporting activities such as steel, rubber, aluminium and other materials and, in fact, the output of almost every industry have to be ensured. The inter-industry approach translates the projected deliveries of end-products into the levels of all supporting activities which they imply and is a powerful device to check the mutual consistency of the two sets of outputs.

In recent years, this technique has also been applied to the solution of problems relating to planned economic development. The analogy of the war effort is perfect as some countries are treating the problem of economic development on a "war footing". The analogy is correct also in the technical sense. For both military and civilian purposes, planning involves necessarily a statement of desired level and composition of finished product deliveries. As a tool of planning for economic development the input-output approach can be used to estimate the output levels of each individual sector consistent with a given bill of goods which the

* This is the summary of a paper read at the All-Pakistan Economic Conference held at Chittagong, 23-26 May, 1960. The paper itself will shortly be published by the Institute as a monograph incorporating some of the results of the Institute's work in inter-sectoral relations and planning.

community may desire to consume.

There are many directions in which the Leontief static input-output model can be extended. By taking into account the capital requirements of each sector and translating them into the extra productive capacity which will be generated by investments, the model can be rendered dynamic and attain a time dimension. Important as this extension may be, we have not included it in the scope of this paper at this stage.

Another possible extension of the model is to give it a regional dimension. The inter-industry approach is based on a division of the economy into homogeneous industrial sectors. This objective can be attained more approximately if each industry is divided on a regional basis also. Techniques of production differ as much from industry to industry as from region to region. Inter-regional input-output analysis, by taking into account regional differences, gives a very clear picture of regional and national economic balance. In an economy like Pakistan's where regional differences are pronounced it is natural that these problems should be relevant to discussions of national economic planning.

Two main inter-regional input-output models have been empirically tested so far. One is associated with the name of Prof. Leontief¹ and the other with that of Prof. Moses.² Our objective in this paper is to present the two models so that their basic structural and behaviouristic assumptions become clear and comparable. Two main devices have been used to achieve this. The first is diagrammatic, i.e. representation of the two models by pipe-diagrams. The second is conceptual. By treating the total demand for a commodity in a region, or in the nation as a whole, as a separate industrial sector the assumptions of the model can be understood much more clearly.

The Leontief model divides the economy into two types of industries, viz. regionally-balanced and nationally-balanced industries. A regionally-balanced industry is one whose production and consumption are confined within a region, i.e. no inter-regional trade takes place in the goods and services produced by such an industry. A typical industry of this type is the construction industry. A nationally-balanced industry is defined by Leontief as one in which inter-regional trade takes place and the proportions in which each region contributes to the total national demand or national pool of the products of such an industry are fixed.

The Moses model does not make any *a priori* division of the economy into different categories of industries. It does, however, make the assumption that each region buys a fixed proportion of its total regional demand for the products of an industry from other regions (and from itself).

There is one further assumption which is common to both the models, and in fact, to all input-output models. The assumption is that every industry in each region requires the products of another industry (and its own) in a fixed proportion to its output. Thus if the level of an industry's output increases, its demand for the products of other industries will rise proportionately. This assumption is based on technical considerations.

We have examined the distinctive assumptions of the two models and have

¹ W. Leontief, "Studies in the Structure of the American Economy," 1953.

² L. Moses, "Inter-Regional Input-Output Analysis", *American Economic Review*, December, 1955.

shown that the Leontief model is a special case of the Moses model, if certain restrictive assumptions are made in the latter.

The Moses model is also capable of incorporating other restrictive assumptions about inter-regional trading patterns. For instance, there may be some industries whose production is confined to one region only while other regions import all their requirements of that particular industry's products from that particular region.

A typical industry of this type in a two-region model for Pakistan may be jute manufactures. We shall call such an industry a "regional monopoly". For the rest of the industries trading co-efficients may be assumed to vary as in the Moses case and these may have to be computed for each region.

The extreme flexibility of the Moses model is a great advantage to the analyst who wants to avoid putting all industries into the Leontief strait-jacket of nationally- and regionally-balanced industries. The practical implementation of the model will consist primarily of categorising industries according to their assumed trading patterns. The four main categories will be (1) regionally balanced industries, (2) nationally-balanced industries, (3) regional monopoly industries and (4) "Moses industries".

The logic of dividing Pakistan's economy into two regions for purposes of input-output analysis is, perhaps, stronger than would be the case for any other country. For in no other country are the geographical boundaries so nearly co-terminous with the economic boundaries. No two regions of a country, perhaps, differ as widely in production practices and consumption patterns as East and West Pakistan. There are, of course, many such differences within each region and the model can gain considerably in analytical sharpness if each region were further divided into smaller sub-regions. A multi-region model is one of the directions in which the present study can be extended.

The application of any analytical model is, of course, directly dependent on the availability of basic data, if it is to have any empirical content. As far as is known no attempt has so far been made to construct an input-output table, regional or national, for Pakistan. The Planning Commission has in the past stated that the technique is "not helpful in the present stage of statistical information in the country."* Yet, as many as three (perhaps more) input-output tables have been constructed in India, which shared almost the same statistical heritage as Pakistan at the time of Partition. The bulk of statistics, especially in agriculture, industry, mining and in relation to households and external trade is of roughly the same quality in both countries. Some of the information made available in the reports of the National Income Committee and the National Sample Survey of India may also be used, in the absence of more reliable data specific to Pakistan.

Recently some new statistical data have become available which should lessen our skepticism about the feasibility of the proposed undertaking. The Ministry of Labour has published the results of a Survey of Manpower for the year 1955 in both regions bringing up-to-date the 1951 Census information on the occupational distribution and strength of the working force. A Census of Manufacturers is now available in full detail for the calendar years 1954 and 1957. The Census gives separate figures for East and West Pakistan for each industry and its scope is somewhat greater than that of Indian Census of Manufacturing Industries. An

* National Planning Board, Government of Pakistan, *The First Five Year Plan*, December, 1957, p. 79.

extensive survey of large and small-scale industries in Karachi has recently been undertaken at the Institute of Development Economics and its results can be used. Moreover, a Census of Agriculture is presently under way and some of its results may soon be available; this may prove to be of great help in giving a firm footing to estimates of the cost structure of agriculture. Regarding household expenditures two surveys have been conducted on the family budgets of industrial workers and middle class commercial and government employees in 1954-55 for the whole country. The first and second rounds of the National Sample Survey have collected some information on the expenditure of rural households.

A model of this nature can hope to give satisfactory results as an analytical tool only in so far as it is based on reliable data. The difficulties in regard to the availability of basic data are immense and cannot be emphasised too strongly. However, perfection in economic statistics can never be achieved and the economist and the statistician must sometimes rely as heavily on their ingenuity and judgment as on the available data. An experiment of this kind, apart from its intrinsic value as an analytical tool, can also serve the vital purpose of pointing out the direction in which future research should be carried and the improvements which can be made in the basic data.