Input-Output Analysis

Prof.Wassily W Leontief introduced input-output analysis technique in 1951. Input means that objects or a material, which is demanded by the entrepreneur or producer for the purpose of production and output, is the result or outcome of the productive effort. Thus input is that object which is purchased with a view to use it in an enterprise where as the output is things made and sold by the entrepreneur. Thus the input is the expenditure of the firm and out put is its income.

In short input-output analysis is a technique for analyzing inter industry relations and interdependence in the entire economy because input on one industry is the output of other. The major share of the economic activity is involved in the production of intermediate goods or inputs, goods that are output for one industry but are again employed as input for further production by another industry. In this way it is a cyclical process following incessantly among many industries. In short it can be said that in an input-output analysis, in a state of perfect equilibrium, the monetary value of the total output of an economy must be equal to the monetary value of all the inputs and outputs pf all the industry taken together.

Main Features of the Input-output Analysis

Main features of the input-output analysis are

1. The analysis applies to an economy that is in equilibrium and economy with partial equilibrium falls outside its sphere.
2. This technique bears no relationship with demand analysis because its sole function is to analyse and consider the technical problems of the production.
3. This analysis is based on empirical study.
4. Input output analysis has two parts first, constructing an input-output table and second making systematic use of the input-output model.

Assumptions

The following assumptions are made by Prof. Leontief before the analysis

1. The economy is in perfect equilibrium
2. the total economy can be divided into two sectors-the inter industry sector and the final demand sector, each sector can be further sub-divided.
3. Every industry produces only one commodity and no two products are produced jointly.
4. The total output of any one industry is used as an input by some other industry or by the final demand sector.
5. Production follows the law of constant returns to scale.
6. The level of the technological progress remains constant in the economic field, because of which the input coefficients remain constant.
7. There are no external economies and diseconomies of production.

Leontief's Statistic Model

Leontief's analysis is based on the assumptions outlined above. In this economy, it is presumed that the output of one industry is an input for another. Consequently, there are clear inter-industry relationships and interdependencies in the economy because of these inter-relationships the total demand and supply of the economy are in equilibrium. This can be explained with the following example

Suppose there is three-sector economy. Among these agriculture and industry combine to form the inter industry sector while the house hold sector is the final demand sector. The following table provides a simplified form of this economy.

Table 1:-Input-Output Table

(Rs in crores)

Sector	Input to Agriculture	Input to Industry	Final Demand	Total output or Total Revenue
Agriculture	25	175	50	250
Industry	40	20	60	120
House hold	10	40	0	50
Total input or Total cost	75	235	110	420

In the above table the total output of the three sector is shown in rows and their inputs in columns. The total of the first raw is 250 crores out of which 50 units are used for final consumption and the remaining output become the input of the other two sectors (175 to industry and 25 to agriculture). Similar is the case of industry. A column wise study will reveal the cost structure of these sectors. The first column is concerned with the cost-structure or inputs of agriculture. Agricultural output worth Rs.250 crores is made possible by the use of units worth Rs. 25, 40 and 10 crores respectively from each of the three sectors. The zero finger in the third column indicates the fact that the household sector is a simply spending sector that does not sell anything to itself.

In general the above table can be written as follows

Table-2:-Input-Output Table

		Purchasing Sector			
Selling Sector		S1	S2	Final Demand	Total output
	S1	x_{11}	x_{12}	D_1	X_1
	S2	x_{21}	x_{22}	D_2	X_2
	S3	x_{31}	x_{32}	0	X_3

where $X_1 = x_{11} + x_{12} + D_1$, $X_2 = x_{21} + x_{22} + D_2$, $X_3 = x_{31} + x_{32}$.

Technological Coefficient

Technological Coefficient is defined as $a_{ij} = \frac{x_{ij}}{X_j}$, where x_{ij} is the that part of output of i^{th} industry which is consumed by j^{th} industry and X_j is the total out pt of the j^{th} industry.

The matrix $A = [a_{ij}]$ of the technological coefficient is called technological matrix. The technological matrix of the above example is given as follows

Table 3:-Technoloical Matrix

(Rs in crores)

Sector	Input to Agriculture	Input to Industry	Final Demand (F)	Total output (G)
Agriculture	$\frac{25}{250} = 0.10$	$\frac{175}{120} = 1.46$	50	250
Industry	$\frac{40}{250} = 0.16$	$\frac{20}{120} = 0.17$	60	120
House hold	$\frac{10}{250} = 0.04$	$\frac{40}{120} = 0.16$	0	50

Final Demand

An industry sells input to other industries, consumers, governments etc of which the sales to the consumers government etc. are not used further production. So they are called final demand.

Let $F = \begin{bmatrix} D_1 \\ \vdots \\ D_n \end{bmatrix}$ be the final demand, $G = \begin{bmatrix} X_1 \\ \vdots \\ X_n \end{bmatrix}$ be the gross output and $A = [a_{ij}]$ be the technological matrix then the Leontief input-output statistical model is given by
$G = (I-A)^{-1} F$. So $F = (I-A)G$. Where I is the identity of matrix of order n.

Eg:-

If the technological matrix of two sectors is $A = \begin{bmatrix} 0.1 & 0.3 \\ 0 & 0.2 \end{bmatrix}$ and if the final demand of each sector are 350 find the gross out put of each sector.

$(I-A) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 0.1 & 0.3 \\ 0 & 0.2 \end{bmatrix} = \begin{bmatrix} 0.9 & -0.3 \\ 0 & 0.8 \end{bmatrix}$, $|I-A| = 0.72$ and $(I-A)^{-1} = \begin{bmatrix} 1.11 & 0.41 \\ 0 & 1.25 \end{bmatrix}$

$G = (I-A)^{-1} F = \begin{bmatrix} 1.11 & 0.41 \\ 0 & 1.25 \end{bmatrix} \begin{bmatrix} 350 \\ 350 \end{bmatrix} = \begin{bmatrix} 532 \\ 437.5 \end{bmatrix}$ So the Gross out put of the two sectors are 532 and 437.5.