

Input-Output Transactions Table 2004-05

Central Statistical Organization is constructing Input-Output Transactions Table (IOTT), consistent with National Accounts Statistics (NAS) since 1968-69. The first table was jointly constructed by the CSO and the Planning Commission. Since then the tables have been constructed for the years 1973-74, 1978-79, 1983-84, 1989-90, 1993-94, 1998-99 and 2003-04. The table for the year 2003-04 has been constructed in collaboration with India Development Foundation (IDF). The table for the year 2004-05 is constructed by the IDF. The table for the year 2004-05 has been constructed by the IDF. This was required by the Ministry of Industry, this will serve as a base for the Producer's Price Index to be prepared with 2004-05 as base year.

The report is divided into 3 sections. This section gives the basic approach adopted for the compilation of IOTT and other important issues. Next section deals with the concepts involved in the construction of IOTT. Third section deals with the methodology and data sources required and the problems faced in the construction of IOTT.

This IOTT consists of 130 sectors. The sector classification is the same as of the corresponding table for the year 2003-04. The list of sectors along with their composition is given in Appendix I. Detailed 130 sectors absorption (commodity x industry) matrix and the commodity x commodity table under industry technology assumption are given in the Table I and Table II respectively. The absorption matrix gives the inter-industry transactions in value terms at factor cost presented in the form of commodity x industry matrix where columns represent the industry and rows the group of commodities which are the principal products of the corresponding industries. Each row of the matrix shows in the relevant columns, the deliveries of the total output of the commodities to the different industries for intermediate consumption and final use. The entries read down industry columns give the commodity inputs of raw materials and services, which are used to produce outputs of particular industries. The column entries at the bottom of the table give net indirect taxes (NIT) (indirect taxes- subsidies) on the inputs and the primary inputs (income from use of labour and capital), i.e., Gross Value Added (GVA). In the commodity x commodity table the rows as well as columns represents group of commodities which are the principal products of the industries.

The first 37 sectors in the sector classification represent primary production, the next 68 sectors relate to manufacturing industries and remaining 25 sectors deal with the construction, electricity, water supply, different modes of transport and other services sectors. The final uses have been distinguished under 6 categories (i) private final consumption expenditure (ii) government final consumption expenditure (iii) gross fixed capital formation (iv) change in stocks (v) exports and (vi) imports. All the entries in the IOTT are at factor cost. First the table is prepared at purchaser's prices i.e. at the prices in which the actual transactions take place. The entries at factor cost are arrived at by removing the components of trade and transport margins and net indirect taxes. These are shown in separate rows in the table. The row of indirect taxes depicts the taxes paid by the industries on intermediate inputs used in the process of production of industry's output.

Concepts Relating to IOTT

In this section we discuss the concepts relating and definitions used for compilation of tables and the problems associated with their construction. An I-O table also called transactions table or inter-industry table or flow matrix- shows the flows of goods and services from each branch (called sector) of the economy to different branches of the economy over a specified period of time, usually a year. For producing the output in any branch of the economy, different types of raw material inputs and capital equipment, along with labour, are required. The outputs produced may be distributed either for

intermediate use (that is, as input for further production of goods and services by other branches) or for private or public consumption, private or public investment, or exports). An I-O table provides a systematic description of this interdependence among different branches in the economy. The table may also be regarded as a disaggregation of the production accounts in a national accounting system

To construct an I-O table, the economy is divided into a number of homogeneous sectors, each of which is represented in the table by a row and a column. The row corresponding to the sector gives the use pattern of the total supply of the sector, while the column gives the details of the inputs absorbed by the sector. The entry into the cell of the i th row and j th column is the quantity of output of sector i consumed as input by sector j , and its generally denoted by X_{ij} . The output of sector j is denoted as X_j .

The input-output table consists of four quadrants. The first quadrant gives the distribution of that part of the output, which is absorbed by the producing sectors of the economy. This quadrant is the most important and largest part of the table. The second quadrant gives the consumption by the final consumers. Its components are the private consumption expenditure, government current expenditure, gross fixed capital formation, changes in inventories, imports with negative sign and exports. If the imports are shown as a column with negative entries, then the imports by final consumers will be shown along with other domestically produced goods. Quadrants I and II together allocate the total output of each sector in the economy. The third quadrant consists of the primary inputs utilised by the different producing sectors. The primary inputs consist of the factor payments to labour and capital, indirect taxes, depreciation, etc. Quadrant I and III together show the total inputs used in production by each sector of the economy. The fourth quadrant records the primary inputs into final demand sectors; some typical entries such as income of government employees, domestic services and aggregate of final demand vectors, can be shown in this quadrant, but it must be observed that this fourth quadrant is generally omitted from the I-O table.

A schematic arrangement of the input-output table is given below: -

Consuming Sectors					
	1	2	...	n	
Producing sectors					Final demand
1	X_{11}	X_{12}	...	X_{1n}	F_1
2	X_{21}	X_{22}	...	X_{2n}	F_2
:					
N	X_{n1}	X_{n2}	...	X_{nn}	F_n
Primary inputs					Output
	V_{11}	V_{21}	...	V_{1n}	$V_{1, n+1}$
	V_{21}	V_{22}	...	V_{2n}	$V_{2, n+1}$
	V_{k1}	V_{k2}	...	V_{kn}	$V_{k, n+1}$
Output	X_1	X_2	...	X_n	

X_{ij} is the amount of the output of i th sector utilized as input for the production of j th sector.

F_i is the amount of the final demand of the output of the i th sector and is equal to

$$C_i + G_i + I_i + E_i - M_i + S_i.$$

Where these components of final demand are private consumption, government consumption, gross fixed investment, exports, imports and changes in inventories, respectively.

$V_{ij} \quad i = 1, 2, \dots, \kappa, \quad j = 1, 2, \dots, n$, are the different primary input rows.

$V_{i, n+1} \quad i = 1, 2, \dots, \kappa$ are the primary inputs into the final demands.

The IOTT can be derived from the absorption (use) and make matrix (supply). This is essential because Classification of commodities into various commodity groups or sectors is affected by the problem of secondary production. For example the data on industrial products is generally based on the industrial censuses of different establishments. There are very few establishments, which are producing a single commodity. The establishments are classified into different industries on the basis of their primary products. It may so happen that an establishment produces commodities, which do not belong to the sectors (commodity groups) to which it is assigned. Any such production is termed as secondary. The data are then aggregated for different establishments coming under each industry and are published for the industry as a whole. The output of the industry consists of one or more primary products (commodities) and several secondary products (commodities). The data on inputs relates to the inputs into industries and not the particular commodities produced in those industries. The inputs are given in terms of the commodities. The tables compiled on the basis of these data on inputs and outputs are called commodity x industry tables (Absorption matrix). In this table the column total of a sector is not necessarily the same as its row total. In most of the cases where secondary production is there or where a part of the production comes from other sectors, the row total is not equal to the corresponding column total. For getting a symmetrical I-O table, which is to be used for the I-O model, an additional table called the make matrix is required. Each row of the make matrix gives the distribution of the output of different commodities produced by an industry. Each column of this matrix represents the value of the output of a commodity produced by different industries. The method of construction of the absorption and the make matrix is given in the next section.

For planning purposes the commodity x commodity¹ tables are of main importance. This is because, in most of the cases, the final demands are available only in terms of commodities and the level of total outputs of these commodities are to be worked out with the help of I-O methodology. At times, industry x industry tables are quite useful, e.g., when one is interested in knowing the primary inputs into industries, this kind of tables may be useful. In using industry x industry tables to obtain total industry outputs, the final demands are also required in terms of industries. It is a complicated process to derive the industry-wise final demands. The commodity x commodity tables are therefore of major importance.

For preparing commodity x commodity I-O tables the inputs consumed in the production of the secondary products as well as their outputs should be separated from the inputs consumed in the production of the primary products and their outputs. The outputs and inputs should be rearranged in such a form that the inputs as well as the outputs correspond to the primary products of different industries (sectors). This procedure is usually known as redefinition of sectors. Theoretically, this is the most satisfactory solution. In general, this method cannot be applied because the inputs are not available separately for different products of an industry. This can be done with the help of mathematical models and by making certain alternative assumptions about the input structure of commodities. One assumption states that the input structure of secondary products is the same as the input structure of the sector in which these are primarily produced. This assumption is called the commodity technology assumption. The other alternative assumption is that all commodities produced

¹ Commodity x commodity table does not imply that the output is from a single commodity. It simply means that the output of commodities produced by but not classified in a particular sector is excluded in a commodity output and the output of all commodities classified in the sector and produced by the other sectors is included. Corresponding to the industry concept the output of secondary products (of other sectors) produced by the industry is included and the output of the main products of the sector produced by other sectors is excluded.

by an industry are produced with the same input structure. This is called the industry technology. This technology says that commodities will have different input structures depending on the industry in which they are produced. The following system of linear equations could be used to solve the problem of separating out inputs of secondary products.

Let us first take the commodity technology assumption. The inputs required for producing the output of industry j comprise of the weighted average of the inputs required for producing output of each of different commodities produced by industry j.

$$b_{ij} = a_{i1}c_{1j} + a_{i2}c_{2j} + \dots + a_{in}c_{nj}$$

b_{ij} is the coefficient for input of the output of commodity i for producing the output of industry j.

or B is the coefficient matrix obtained by dividing the inputs in column of the absorption (commodity X industry) matrix by the industry output of the column.

a_{ij} is the input coefficient of the output of commodity i for producing commodity j.

$c_{1j}, c_{2j}, \dots, c_{nj}$ are the proportions of output of different commodities produced in industry j and are taken from the make matrix. C is a matrix of weights obtained by the product mix assumption obtained from the make matrix.

In matrix form the above equations can be written as

$$B = AC$$

or

$$A = BC^{-1}$$

If B and C matrices are known, the required A matrix can be computed. A matrix is the input-coefficient matrix. By multiplying the coefficients in each column of this matrix with the corresponding commodity output of the column (sector) the commodity X commodity input-output table (flow matrix) can be obtained.

Under the industry technology assumption the inputs required for production of commodity j will be the weighted average of the inputs required by each of the industries which produced commodity j.

$$a_{ij} = b_{i1}d_{1j} + b_{i2}d_{2j} + b_{i3}d_{3j} + \dots + b_{in}d_{nj}$$

$d_{1j}, d_{2j}, \dots, d_{nj}$ are the proportions of the output of commodity j from various industries and are obtained from the make matrix by making use of columns (market share) than rows.

The commodity coefficient matrix can be worked out as

$$A = BD$$

B normally refers to the product coefficient matrix only. If B also includes the rows of taxes and value added, one can obtain the required rows of taxes and value added for the C X C tables, in the same way as the C X C flow matrix.

In both cases the intermediate consumption of the I-O table can be prepared by multiplying the A matrix with the commodity values of output vector.

Industry by Industry model can be worked out as follows.

The basic relationship in the use table is

$$q = Bg + F$$

Where q and g are the commodity and industry output vectors of different sectors and F is the final demand vector respectively in commodities.

$g = Dq$ and $y = DF$ where y is the final demand vector in terms of industries. By multiplying both sides of industries equation by D one gets

$$Dq = DBg + DF$$

$$\text{Or } g = DBg + DF$$

$$(I - DB)G = DF = y$$

$$G = (I - DB)^{-1}y \text{ which is an industry x industry model.}$$

For Indian IOTT, industry technology is used.

Construction of I-O Table for 2004-05

In this section we describe the methods and sources of getting the estimates of the sector wise values of output produced, inputs consumed and components of final demand by broad section of the economy for the year 2004-05.

Producing Sectors

Agriculture

Crop wise annual estimates of value of output and the values of major inputs consumed by the agriculture and animal husbandry taken together are available from the National Accounts Statistics (NAS) 2008. Based on the values of output for 2003-04 and 2004-05, the growth rates are worked for 20 sectors under agriculture. These growth rates are applied to the sector-wise values of output of the Absorption Matrix (AM) 2003-04 to get the corresponding values for 2004-05. Crop wise values of output are directly not taken because some sectors include milling also. It is assumed that the ratio of milling to total crop values will be the same for 2003-04 and 2004-05. Also the ratio between the industry and commodity values of output is based on 2003-04 I-O table. In fact, these ratios are kept constant for all sectors of the economy.

Based on the estimated values of output and using the input structure of 2003-04 AM, the structure for 2004-05 including GVA and NIT is obtained. Sector wise GVA's are pro rata adjusted to get the GVA's consistent with that given in the NAS for the year 2004-05. The estimates of important inputs like seed, organic manure, fertilizers, pesticides, electricity, diesel oil, repair and maintenance etc. are available for the year 2004-05 from the NAS. The estimates of total of these inputs obtained by using the 2003-04 structure are pro rata adjusted to get the estimates consistent with those given in the NAS. For remaining minor inputs the 2003-04 structure is used in such a way that the total of all inputs for different sectors (20) is equal to the total value of output- GVA –NIT, as available from NAS.

There are sectors namely (i) milk and milk products (ii) animal services to agriculture consisting of animal services to draught animals for different agricultural operations (iii) poultry and eggs and (iv) other livestock products consisting of various edible and non-edible products. The services rendered by animals for carrying goods and passenger buffalo are consider as a part of transport under animal husbandry the item wise yearly values of output and GVA for the entire animal husbandry sector are available from the NAS. Also available are the annual estimates of cost of feed, which is the main input for sectors under animal husbandry. These estimates along with the structure of inputs in different sectors under animal husbandry as available from the AM 2003-04 are used to get the structure for 2004-05.

For forestry and fishing the values of output as well as GVA are directly available from the NAS. 2003-04 input structure is used for the year 2004-05.

For mining the mineral wise values of output are available from the NAS. GVA's are separately available only for fuel minerals, other major minerals and minor minerals. GVA to GVO ratios for 11 sectors under mining for 2004-05 is based on the corresponding ratios given in the AM for 2003-04, after making pro rata adjustments in these so as to be consistent with the GVA estimates separately available for 3 groups of minerals. Once the sector wise GVA's and GVO's are obtained, the I-O 2003-04 structure is used to get the input structure for all the sectors for the year 2004-05.

Manufacturing Industries

Manufacturing industries can be divided into registered and unregistered manufacturing. NAS gives annual estimates of GVA and gross value of output for registered as well as unregistered manufacturing at 2 digit level of industrial classification. For 2004-05 these estimates have been taken as the control totals. For getting the estimates of GVA and values of output at a higher level of disaggregation, ASI data, for 2004-05 have been used. For getting the input-structure, for the sectors under manufacturing raw data for the years 2003-04 and 2004-05 have been used. Input structure of 2004-05 has been divided by input structure of 2003-04. These coefficients are multiplied with the

2003-04 AM to get the 2004-05 AM input structure. However, due to data error, in many places we have used 2003-04 input structure. Also 2004-05 input structure is not directly used because the inputs are available at purchaser's prices and are to be converted to those at factor cost and we do not have trade, transport and indirect tax margins for the year 2004-05. We have assumed that the margins will remain same for the two years.

Other Services

For sectors under this group the GVA's are available from the NAS. For some of the sectors like construction and railway transport the values of output are also available from the NAS. For the remaining sectors, the GVA to value of output ratios of the year 2003-04 AM are used. The structure of inputs of the year 2003-04 is used.

Final Demand

The components of final demand are: - Private Final Consumption Expenditure (PFCE), Government Final Consumption Expenditure (GFCE), Gross Fixed Capital Formation (GFCF), Change in Stocks (CIS), exports and imports. The method of getting the estimates of these components is given below:

PFCE

PFCE represents the consumption expenditure of households and non-profit institutions. CSO gives annually the estimates of PFCE of major items of consumption, in the NAS. At our request CSO provided us, the estimates of item wise consumption at a detailed disaggregated level for the years 2003-04 and 2004-05. Based on these estimates the growth rates in the 2004-05 over 2003-04 were calculated for different sectors of the I-O table. These growth rates were applied on the PFCE estimates of 2003-04 I-O table to get the corresponding estimates for 2004-05. Here also it is assumed that the trade and transport margins and net indirect tax rates are the same for the two years.

GFCE

The total estimate of GFCE is available from the NAS. 2003-04 structure is assumed for 2004-05 also.

GFCF

The estimate of GFCF for the construction sector is available from the NAS. The GFCF under animal husbandry is also available from the NAS in the form of increment in livestock. The estimate of GFCF in machinery and equipment is distributed among sectors by assuming the 2003-04 AM structure.

CIS

For manufacturing industries the estimates are based on the ASI data while in a number of cases these are taken as residual.

Exports and Imports

Sector wise growth rates of exports and imports are obtained by making use of Export and Import Data Bank of India, Ministry of Commerce and Industry. The estimates are directly not used because the estimates of exports are available at FOB prices but these are to be taken at factor cost and because there may be some conceptual difference in putting the item wise trade into sectors.

The estimates of inputs and outputs obtained for different sectors and the sector wise estimates of different components of final demand are put in a consistent frame work to get the AM for the year 2004-05. The structure of industry commodity classification of output i.e. make matrix of 2003-04 is assumed for 2004-05. By making use of the AM and the make matrix and assuming industry technology we have constructed the commodity x commodity table or IOTT. The AM and IOTT are given in Table I and Table II respectively.

List of Abbreviations

Abbreviations	
IOTT	Input-Output Transactions Table
NAS	National Accounts Statistics
IDF	India Development Foundation
NIT	Net Indirect Taxes
GVA	Gross Value Added
IO	Input- Output
C X C	Commodity x Commodity
AM	Absorption Matrix
GVO	Gross Value Output
PFCE	Private Final Consumption Expenditure
GFCF	Gross Fixed Capital Formation
GFCE	Government Final Consumption Expenditure
CIS	Change in Stocks
CSO	Central Statistical Organisation
FOB	Free on Board