# APPENDIX 1

# GENERATION OF INPUT FLOW MATRICES, MAKE MATRIX AND ASSOCIATED MATRICES

**Input flow Matrix**

A1.1 The Input and output flows for different sectors have been identified in terms of commodities, using the ASICC codes for the manufacturing sectors and the IOT sector codes for other sectors. For the sectors for which the ASICC codes have been used to code the input commodities, the same have been converted to the IOT sector codes using the ASICC-IOT concordance, specially developed for the purpose.

A1.2 The input and output flows relating to registered and unregistered manufacturing industries have been generated separately on the basis of detailed coded (ASICC) input data available from the survey results. For the registered manufacturing sector, the item directory of the detailed results of ASI, 2007-08, are available according to the ASI item codes. The data records are aggregated to the IOT-sector codes for both the industries and the commodities, using the concordance of (i) NIC Industries-IOT sectors and (ii) ASICC commodities-IOT sectors, respectively, keeping in view the coverage of IOT sectors.

A1.3 Input flows from registered manufacturing segments has been generated by combining the input data for each of the input data Blocks I, H & F of ASI and for each of the industry sub-groups. Similarly output flow has been generated from the data of block J & G (output Blocks). Within the industry sub-groups, commodities are grouped to conform to IOT sectors and similarly the industry sub-groups are merged to conform to IOT sectors. It may be noted that in each of industry sectors besides the identified inputs, there are several unidentified input items of the categories of 'other basic materials', 'other chemicals', 'other packing materials', 'others', etc. The treatment of these unidentified inputs is given in para A1.6, below.

A1.4 Specially tabulated data for inputs and outputs (commodity-wise) have been used for preparing the input/output flows of the unregistered manufacturing. Once data for unregistered manufacturing are available according to the ASICC codes for the input and output commodities, the data records are assigned the IOT-sector codes for both the industries and the commodities, using the concordance tables mentioned above. Treatment of unidentified items appearing in the above mentioned tables are same as those of registered manufacturing, except for those items which were not given ASICC codes at the time of the survey. These uncoded commodities have also been converted into IOT sector codes. Since the survey on unorganised manufacturing sector relates to 2005-06, proper adjustments have been done to convert the data for the year 2007-08. Input/output flows thus arrived at separately for registered and unregistered manufacturing are combined to arrive at the total flows of the manufacturing sectors.

A1.5 The single input flow matrix representing the entire manufacturing sector has then been combined with the input flow matrices relating to primary and service sectors of the economy and aggregated to 130 sector classification adopted. The final demand vectors are outside the 130

columns relating to inter-industry transactions. Thus, the input flow at purchasers' price has been obtained by depicting the inter-industry flows and final uses of the commodities in rows. The sectoral estimates of gross value added have then been introduced as a row at the bottom next to the row showing the total inputs by industries. The unbalanced input-output transactions table at purchasers' price is thus obtained, where the individual row and column totals show the first results of the exercise in terms of commodity utilisation and input structures of industries. The sum of the entries in a column of this table shows the output of the industry at ex-factory price. The sum of the entries along any row shows the total of the inter-industry and the final use of the commodity. Since the table is *commodity x industry* transaction presentation, the row totals do not tally with the column totals even after final balancing though the column and row headings are similar. The balancing in this case, therefore, refers to an exercise with reference to independent *industry x commodity* classification of output.

A1.6 In the combined input flow, there are a number of unidentified inputs, such as, other raw materials, other chemicals, other packing materials, consumable stores, materials consumed for repairs and maintenance of buildings, machinery and equipment and others, other fuels etc. The entries corresponding to 'other chemicals' row have been transferred to the rows of 'inorganic heavy chemicals', 'organic heavy chemicals' and 'other chemicals' in proportion to the existing entries of these three sectors of chemical industries. The materials used for the repairs and maintenance of buildings have been treated as the purchase from the construction sector. The materials consumed for the repairs and maintenance of machinery and equipment have been identified to the components of the machinery used in the industries and transfers made to the relevant producing sectors. The values of remaining unidentified items in different industries have been transferred to relevant sectors in the course of manual balancing.

**Output Matrix**

A1.7 For balancing the table, it is necessary to have an *industry x commodity* classification of outputs, i.e., a Make matrix. Similar to the procedure followed for the generation of combined input flow, the output flows relating to registered and unregistered manufacturing industries have been generated separately on the basis of detailed coded output data and finally merged into a single output flow matrix representing the complete manufacturing sector. The sources of data for the industry-wise details of output on products and by-products are the same as those utilised for the input flows. These output data are tabulated to obtain the *industry x commodity* matrix (Make matrix) by merging the output flows from registered, unregistered manufacturing sectors and the output flows from primary and service sectors.

A1.8 The IOT at purchasers' price thus obtained is, to begin with, balanced manually, leaving not more than 5 per cent gaps between generated and estimated row and column totals. For manual balancing industry totals for the year 2007-08 from NAS 2011 are used to derive the commodity controls from the make matrix. This matrix provides the commodity outputs at ex-factory price. The estimated row totals are obtained by adding distributive margins comprising of trade, transport and net indirect taxes to the commodity outputs obtained from the Make Matrix, while the estimated column totals are the outputs of the industries at factor cost. Due to non availability of commodity wise detailed data on trade and transport margins for the year 2007-08, margins have been arrived at, using the same ratios in 2003-04. Detail commodity-wise data from Railways board for the year 2007-08 has been used for obtaining the Railways margins.

**Input-Output Table (IOT) at Producers' Price**

A1.9 After the manual balancing, trade and the respective transport margins which are in vector form are converted into matrices making use of the proportions of the input flow matrix at purchasers' price. While preparing these matrices, the CIS and imports columns are not considered. The trade margin and the respective transport margin matrices are consolidated to obtain the combined trade-transport margin matrix. This combined margin matrix is subtracted from the input flow matrix at purchasers' price to arrive at input flow matrix at producers' price. Since the input flows at purchasers' price include the margins in the input values, the corresponding rows have no entries except for traveling cost in case of transport. For the input flow matrix at producers' price, values of the margins (trade, and the respective transport) are added to the entries against these services.

A1.10 The row and the column total gaps have been adjusted by manual balancing only. For manual balancing, controls of input are formed up based on the industry wise group totals of NAS 2011 for the year 2007-08 and further disaggregated based on the requisite sample ratios arrivesd from the data processing. The row control totals which are commodity-wise, intermediate uses match with the column control totals which are industry wise total inputs. Thus, the balanced inflow matrix at Producer's Price is obtained. Before applying the RAS (Richard and Stone) technique, it is checked that the aggregated row control totals tally with the aggregated column control totals. These row control totals are the commodity-wise intermediate uses and the column control totals are the industry-wise total inputs. Thus, the balanced input flow matrix at producers' price is obtained.

**Input-Output Table (IOT) at Factor Cost**

A1.11 IOT at factor cost is finally obtained by subtracting the matrix of net indirect taxes from the balanced input flow matrix at producers' price and introducing the net indirect taxes as a new row. These indirect taxes are taxes on inputs consumed by the respective industries.

A1.12 The matrix of net indirect taxes is obtained by adding the individual matrices of import duty, excise duty, export duty, sales tax and other taxes and subtracting the matrix of subsidies. To obtain these tax matrices, an import flow matrix has been prepared making use of the information on imported materials used in manufacturing industries collected in the ASI. Import duty matrix is based on the import flow matrix. The import duties are allocated to the different cells in a row of the import flow matrix in proportion to their magnitudes in the total import of the corresponding commodity sector. In this allocation, change in stocks, exports and of course the imports have been excluded. Export duties on exports are allocated to export column under final use. Excise duty has been allocated to different consuming industry sectors and final uses (excluding imports and change in stocks) on the basis of domestic flow matrix, obtained by subtracting the import flow matrix from the balanced input flow matrix at producers' price. Sales tax matrix is obtained on the basis of the input flow (domestic and imported combined) matrix at producers' price. Other indirect taxes have been appropriately allocated taking into account the nature of taxes. Subsidies are allocated to different consuming industry sectors and final use in proportion to the flow of relevant domestic indirect taxes (excluding import duties). Where subsidies are related to specific purpose, they are allocated to the respective cells of the domestic flow matrix.

**Generation of Associated Matrices**

A1.13 The Absorption (*commodity x industry*) and Make (*industry x commodity*) matrices provide the basic information for an input-output system. From these basic matrices, the *commodity x commodity* or *industry x industry* tables under different technology assumptions can be easily constructed. The usual associated matrices are: (i) *input-output coefficient* matrix derived from the *commodity x industry* matrix by dividing the column entries by the respective industry outputs (ii) *product mix* matrix derived from the make matrix by dividing the row entries by the respective industry outputs (presented as a transpose of this matrix, named 'C') (iii) *market share* matrix also derived from the make matrix by dividing column entries by the respective commodity outputs, named 'D' (iv) *commodity x commodity* matrices under *industry technology* and *commodity technology* assumption (v) *industry x industry* matrices under *industry technology* and *commodity technology* assumptions and (vi) *Leontief inverse* matrix which is used in the popular open static models for the projection purposes.

A1.14 In this Report, only commodity x commodity matrix under the industry technology assumption has been included (Table 6). The input-output coefficient, product mix and market share matrices are given as Matrix 3, 4 and 5 respectively. The Leontief Inverse for commodities is given as Matrix 7. In the presented Leontief Inverse, the coefficient matrix used related to *commodity x commodity* matrix generated under industry technology assumption. All the above matrices are presented at 130-sector classification.

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