Supply-Use and Input-Output Tables

Sourish Dutta

Centre for Development Studies

Sources

1. UN Handbook on Supply and Use Tables and Input-Output Tables with Extensions and Applications (2018)
2. Eurostat Manual of Supply, Use and Input-Output Tables (2008)

A Three Step Approach

- When input-output statistics are compiled in practice it is essential to take into account the desired properties and compilation methods of the symmetric input-output tables already while working on supply and use tables.
- By making appropriate choices of the groupings and structure of the supply and use tables it is possible to construct a data base which is relevant and useful in the current national accounts and at the same time can be transformed into a symmetric input-output table with a minimum of data manipulation.
- It is recommended to implement a three step approach:
    - Compilation of supply and use tables
    - Preparation of input-output data for analytical uses
    - Calculation of standard analytical results

Compilation of Supply and Use Tables (1)

- Supply-Use Tables (SUTs) consist of two interlinked tables: the supply table and the use table. The SUTs describe the whole economy by industry (for example, the motor vehicle industry) and by product (for example, sports goods).
- The tables show links between components of GVA, industry inputs and outputs, and product supply and use together with details of imports and exports of goods and services, final consumption expenditure and capital formation.
- The supply table shows the supply of goods and services by type of product and by type of industry, distinguishing between supply by domestic industries and imports of goods and services.
- The supply table provides information on the output (by product) generated by economic activities and the imports (by product) from abroad.

Industries / Products	Industries				Imports	Total
	Agriculture, forestry, etc.	Mining and quarrying	...	Services		
Agriculture, forestry, etc. Ores and minerals, etc. ... Services	Output by product by industry				Imports by product	Total supply by product
Total	Total output by industry				Total imports	Total supply

Figure: Simplified Structure of the Supply Table

- The totals in the last column represent the total supply by products and the totals in the bottom row represent the total output by economic activity and total imports.

Compilation of Supply and Use Tables (2)

- The use table provides information on the uses of the different products. It shows the use of goods and services by type of product and by type of use, in other words, as intermediate consumption by industry, final consumption, gross capital formation or exports.
- Furthermore, the table shows the components of gross value added by industry – namely, compensation of employees, other taxes less subsidies on production, consumption of fixed capital and net operating surplus.
- The classification of products, in practice, is often more detailed than the classification of industries, thus generating rectangular SUTs. For example, the output of the dairy industry is separately shown in the SUTs for the products of processed milk, butter, yoghurt, cheese and so forth, and not as only one aggregate product for all dairy products.

Products \ Industries	Industries				Final uses			Total
	Agriculture, forestry, etc.	Mining and quarrying	...	Services	Final consumption	Gross capital formation	Exports	
Agriculture, forestry, etc. Ores and minerals, etc. ... Services	Intermediate consumption by product and by industry				Final uses by product and by category			Total use by product
Value added	Value added by component and by industry							Value added
Total	Total output by industry				Total final uses by category			

Empty cells by definition

Figure: Simplified Structure of the Use Table

- The totals by row represent the total uses by product, the total by column represent the total output by economic activity, total final consumption, total gross fixed capital formation and total exports.

Preparation of Input-Output Data for Analytical Uses (1)

- The Input-Output Tables (IOTs) derived from the SUTs further describe the interrelationships between industries and products, along with the sale and purchase relationships between producers and consumers within an economy.
- They can be produced to illustrate flows between the sales and purchases (final and intermediate) of industry outputs (referred to as industry-by-industry tables) or to illustrate the sales and purchases (final and intermediate) of product outputs (referred to as product-by-product tables).
- A simplified IOT has the columns of the original use table referring to industry-based structures are transformed into product-based structures. The relations between output and input are now relations between products and primary inputs (not outputs of other industries) necessary to produce outputs in similar production units.

Products \ Products	Products				Final uses			Total
	Agriculture, forestry, etc.	Ores and minerals; etc.	...	Services	Final consumption	Gross capital formation	Exports	
Agriculture, forestry, etc. Ores and minerals; etc. ... Services	Intermediate consumption by product				Final uses by product and by category			Total use by product
Imports	Intermediate consumption of imported products				Final use of imported products			
Value added	Value added by component							Value added
Total	Total supply				Total final uses by category			

Empty cells by definition

Figure: Simplified IOT (product by product)

- The selection of the appropriate type of IOT – product-by-product or industry-by-industry – depends on a number of statistical and practical considerations. For example, industry-by-industry IOTs are closer to statistical sources and actual market transactions. Product-by-product IOTs are believed to be more similar in terms of cost structure and production activities.

Preparation of Input-Output Data for Analytical Uses (2)

- There are four main transformation methods used to derive IOTs from SUTs. the four basic transformation models are based on the following assumptions:
    - Product technology assumption (model A): Each product is produced in its own specific way, irrespective of the industry where it is produced.
    - Industry technology assumption (model B):Each industry has its own specific way of production, irrespective of its product mix.
    - Fixed industry sales structure assumption (model C): Each industry has its own specific sales structure, irrespective of its product mix.
    - Fixed product sales structure assumption (model D): Each product has its own specific sales structure, irrespective of the industry where it is produced.

		Product-by-product IOT	Industry-by-industry IOT
Technology	Product technology	**Model A** Each product is produced in its own specific way, irrespective of the industry where it is produced. *Negative elements may occur*	
	Industry technology	**Model B** Each industry has its own specific way of production, irrespective of its product mix. *No negative elements*	
Sales structure	Fixed industry sales structure		**Model C** Each industry has its own specific sales structure, irrespective of its product mix. *Negative elements may occur*
	Fixed product sales structure		**Model D** Each product has its own specific sales structure, irrespective of the industry where it is produced. *No negative elements*

Figure: Basic Transformation Models

Preparation of Input-Output Data for Analytical Uses (3)

- A technology assumption is a strong assumption in the sense that it is based on production theory that cannot be underpinned by observed statistical data.
- The sales structure assumptions are weaker assumptions as, in general, they only use observed sales structures for the actual year.
- It is important to note that the assumptions made for the IOTs (whether technology assumptions or sale structure assumptions) relate to the situation in the particular year for which the IOTs are compiled. They do not include any assumptions about constant input proportions or market shares over time.
- In fact, when IOTs are compiled on an annual basis (or every five years), the time series of these tables can be used to examine the dynamic changes of the input structures in models dealing with the structural development of the economy.

	Industries	Output	Imports	Supply
Products	V^T	x	m	q
Output	g^T			

Figure: Supply Table

	Industries	Final use	Use
Domestic products	U_d	Y_d	x
Imported products	U_m	Y_m	m
GVA	W		w
Output	g^T	y	

Figure: Domestic Use Table

	Domestic products	Industries	Final use	Total
Domestic products		U_d	Y_d	x
Imported products		U_m	Y_m	m
Industries	V			g
GVA		W		w
Total	x^T	g^T	y	

Figure: Integrated Supply and Use Framework

Preparation of Input-Output Data for Analytical Uses (4)

- The benefit of the input-output framework is that all information of the SUTs and IOTs can be integrated into one matrix. The first two rows of the integrated input-output framework refer to products.
- In particular, the first row shows the use of domestic products as intermediate output by industries (the matrix U_d) and final uses (the matrix Y_d). The matrix U_d has products in the rows and industries in the columns.
- Similarly, the second row of the integrated input-output framework shows the use of imported products as intermediate output by industries (U_m) and final uses (Y_m). The matrix U_m has products in the rows and industries in the columns.

Preparation of Input-Output Data for Analytical Uses (5)

- The typical element of the matrix U_d, say, in rows i and column j, represents the amount of product i used up in the production of industry j. The row sums of this matrix represent the total intermediate use of the various products in production. The column sums represent the intermediate use of all products by the various industries.
- The matrix Y_d has again products in the rows and final uses categories in the columns. Each element of the corresponding summation vector represents the net final use of a particular domestic product for consumption, capital formation and net exports.
- The column sums of V give the domestic output of the various products, the row sums of V give the domestic output of the various industries. These row totals are the elements of the vector of industry outputs (g). The column totals are the elements of the transposed vector of industry output (g^T).

Preparation of Input-Output Data for Analytical Uses (6)

- The third column of the integrated input-output framework shows the total costs required to produce the industry outputs. The column sums of U_d and U_m, which represent the cost of intermediate inputs, and the elements of the row vector W, which represent the cost of primary input (value added), determine the value of industry output.
- The fifth row and column of the "Integrated input-output framework" relate to total input and total output of products and industries, but also to total value added and net final expenditures.
- The system is balanced if total input of products (x^T and m^T) equals total output of products (x and m) and total input of industries (g^T) equals total output of industries (g). If this is the case, total value added (w) equals total net final expenditure (y).

Preparation of Input-Output Data for Analytical Uses (7)

- When the input table for imports (ITI) has been derived, it can be presented in different ways. But here we consider that the full ITI is added, element by element, to the domestic output part of the IOT (the first subtable) to obtain an IOT where no distinction is made between domestically produced products and imported products.
- This type of IOT can also be obtained directly from the SUTs, with no distinction made between domestic output and imports. This distinction is therefore not a precondition for compiling an IOT.
- Here we also consider the industry technology assumption (model B). It means that each industry has its own specific way of production, irrespective of its product mix.
- This assumption applies best to cases of by-products or joint products, since in these cases several products are produced in a single production process.

Calculation of Standard Analytical Results

- The formula for model B can be derived through the following transformation matrix: $T = C^T$, where $C = V^T(\hat{g})^{-1}$ is the product-mix matrix (share of each product in output of an industry)
- Input coefficients intermediates: $A = UT(\hat{x})^{-1}$
- Input coefficients value added: $R = WT(\hat{x})^{-1}$

Notes:

Capital letters denote matrices and the small letters vectors.

Transpose matrices are written as matrices with the attachment of a superscript (T).

Vectors are written as column vectors and row vectors are written as transposed column vectors with the attachment of a superscript (T).

Use of superscript ˆ indicates diagonalization of a vector.

Conclusion

- Over the past 60 years, there have been many descriptions generalizing the matrix multiplication for the IOTs. Using the method proposed by Rueda-Cantuche and ten Raa (2009), the starting point for the construction of the product-by-product IOTs is the amount of product i used by industry j (to produce product k): intermediate use u_{ij}
- Schematically, the transformation underlying product-by-product IOTs is: product $i \rightarrow$ industry $j \rightarrow$ product k
- For the industry-by-industry IOTs, this will be viewed as a product i contribution to the delivery from industry j to industry k. This is: industry $j \rightarrow$ product $i \rightarrow$ industry k
- This common framework for IOTs is made precise by indexing the so-called input-output coefficients by three subscripts. The first subscript indexes the input, the second the observation unit, and the third the output.