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Chapter 28: Input-output and other matrix-based analyses

A. Introduction

28.1 The purpose of this chapter is to build on the presentation of the supply and use tables in chapter 14 to examine in greater detail the possibilities offered by using a matrix form of presentation of the accounts. A matrix presentation can aid understanding of the system and also lead to different forms of analysis.

28.2 Chapter 14 describes how the supply and use tables may be used in order to ensure the internal consistency of disparate datasets. Section B of this chapter looks at two particular aspects of the supply and use tables where it may be useful to adopt a different approach to that described in chapter 14. The first of these concerns the treatment of insurance and freight on imported goods and the second concerns the treatment of goods that are processed by a unit that is not the legal owner of them. Section B also discusses how information cross-classified by establishment and industry can be transformed into information relating to institutional sectors.

28.3 Section C is concerned with how a pair of supply and use tables may be transformed into a single symmetric input-output matrix. Each of the supply and use tables shows disaggregation by products and industries. In an input-output table, one of these dimensions is eliminated by reducing the supply table to a purely diagonal matrix. Thus a single table may show the relationship between the supply and use of products or alternatively the output of industries and the demand for the output by industries.

28.4 Section D goes on to show how the whole of the accounting system can be represented in matrix form. This is a useful pedagogical tool and maybe instructive as a stepping-off point for extensions of the accounts such as social accounting matrices, which are described in section E.

B. Further discussion of the supply and use tables

1. The treatment of margins on imports

28.5 In discussing valuation in section B of chapter 14, consideration is given to how transport margins should be incorporated into the accounts and in particular how international transport charges should be recorded. It is explained there that the parallel between basic and producer prices does not carry forward simply to a distinction between CIF and FOB-based prices. The distinction depends on whether it is the unit providing the goods or the unit taking delivery of the goods that is responsible for providing the transport and insurance. Table 14.3 shows a detailed analysis of these options.

28.6 The traditional way in which international trade and transport have been recorded in supply and use tables is shown in table 14.4. The basic idea underlying this table is that the value of goods remain at their CIF values but a deduction is made for the total value of transport and insurance margins embedded in these valuations. In the example given, the size of the adjustment is 10. Of this, 6 is supposed to relate to transport and 4 to insurance. A complete articulation of imports of goods and services can be seen in table 28.1.

Table 28.1: Imports of goods valued CIF and FOB

	Value CIF	Transport	Insurance	Value FOB
1. Agriculture, forestry and fishery products (0)	37	1		36
2. Ores and minerals; electricity, gas and water (1)	61	1	1	59
3. Manufacturing (2-4)	284	4	3	277
Purchases abroad by residents	20			20
Total	402	6	4	392

28.7 In table 14.4, it is assumed that all the margins are supplied by non-residents , so a further adjustment table for services can be compiled as shown in table 28.2.

Table 28.2: Imports of services adjusted for the CIF to FOB element in goods

	Value	Of which: included in goods CIF	Value FOB
5. Trade, accommodation, food and beverages; transport services (6)	62	6	56
6. Finance and Insurance (7) excluding real estate	17	4	13
8.Business and production services (8)	5		5
Purchases abroad by residents	23		23
Total	107	10	97

28.8 A recording of the product detail of goods and services strictly in accordance with balance of payments recommendations would be the right-most column of table 28.1 and the left-most column of figures of table 28.2 (392 plus 107, total 499) but it can be seen that the same overall result is achieved by taking the left-most column of figures from table 28.1 and the right-most column from table 28.2 (402 plus 97). This is because the total is invariant to exactly how the adjustment from CIF to FOB takes place; whether it is by deducting elements from goods or deducting the same total amount from services. One of the tasks of compiling supply and use tables is to decide how to allocate the margins on imports and ensure that the product detail of goods and services is in overall conformity with balance of payments totals.

Table 28.3: Imports of services adjusted for the non-resident only CIF to FOB element in goods

	Value	Of which: included in goods CIF	Value FOB
5. Trade, accommodation, food and beverages; transport services (6)	62	4	58
6. Finance and Insurance (7) excluding real estate	17	3	14
8.Business and production services (8)	5		5
Purchases abroad by residents	23		23
Total	107	7	100

28.9 There is a complication not addressed in chapter 14. This is the assumption that all margins are supplied by non-residents. Suppose that only 7 out of the total value of 10 are provided by non-residents, 4 out of 6 for transport and 3 out 4 for insurance. Table 28.1 is still correct as a means of converting a set of CIF values to FOB values but table 28.2 is not correct. It should be as shown in table 28.3.

28.10 Two possibilities present themselves. One is to keep tables 28.1 and 28.2 and to treat the amount of margins supplied by residents as in effect an export that is then re-imported. Though this is not consistent with balance of payments recommendations, the current balance on goods and services is not affected. The alternative is to treat the 3 as the true CIF to FOB adjustment and record the articulation of goods and services by product in the supply and use tables as shown in table 28.4.

Table 28.4: Detailed imports of goods and services for the supply and use table

	Value
1. Agriculture, forestry and fishery products (0)	37
2. Ores and minerals; electricity, gas and water (1)	61
3. Manufacturing (2-4)	284
4. Construction (5)	
5. Trade, accommodation, food and beverages; transport services (6)	58
6. Finance and Insurance (7) excluding real estate	14
7.Real estate services; and rental and leasing services (72-73)	
8.Business and production services (8)	5
9.Community, social services (92-93)	
10 Other services (94-99)	
11. Public Administration (91)	
CIF/FOB adjustment	-3
Purchases abroad by residents	43
Total	499

2. Goods processed by a unit not the legal owner

28.11 One complexity of production is that many units produce more than one product. In order to limit the number of products per unit and to allow integration with basic production statistics, the concept of establishment is introduced. In principle, an establishment produces only one product at one location but the SNA recognizes that in practice it is not possible to separate production into such fine detail. Dealing with the fact that many establishments produce more than one product is fundamental to the idea of calculating a symmetric input-output matrix as described below in section C.

28.12 However another aspect of difference in the type of activities undertaken in an establishment concerns the ownership of the items being processed. Consider a farmer growing grain which is milled into flour before use. Suppose a farmer acquires a mill to process his own grain but once this is acquired he may offer to mill grain for others for a fee. The production account for a farmer with a mill will look somewhat different from that for a farmer who does not have a mill but pays the first farmer a fee for milling.

28.13 In the case of milling the reasons for sub-contracting the activity to another may be the availability of suitable fixed capital. Increasingly, however, similar processes are being carried out internationally and in respect of activities more usually associated with manufacturing such as the assembling of component parts. Here the motivation is less one of the availability of capital than of the costs of labour. If the average wages in country X are half of those in country Y, it may be cost-effective for a unit in Y to dispatch the components to a unit in X for assembly and then have the completed product returned to Y or even shipped directly to a final purchaser.

28.14 Previous editions of the SNA have recommended that components for assembly should be recorded as delivered to the unit in country X and that the whole of the value of the completed product should be recorded as output of X and exports from X to Y. This does not match the treatment of grain milling or, for example, repairs to machinery where no such change of ownership of the goods being processed is imputed. Imputing a change of ownership of the parts to be assembled gives rise to

significant data compilation problems because the value of the assembled product may be greater than the cost of the components plus the fee to assemble them. The value of the finished product may incorporate the results of research and development of the unit contracting the assembly, for instance. The SNA now recommends that products should only be recorded as being delivered to another unit if there is a change of ownership or, in the case where both producing units belong to the same enterprise, the producing unit taking delivery also assumes responsibility for subsequent risks and rewards of production such as deciding how much to process, what price to charge and when to sell.

28.15 The question arises of how to record the activity of assembling goods to order for another unit in the supply and use tables and the input-output table. The processes of assembly for oneself and for another are physically similar but the economics are different.

28.16 Suppose in year 1 a processing unit converts products only on own account; and in year 2 the unit processes the same amount on its own account but also processes a similar amount on behalf of another. Suppose the cost of items processed in year 1 is 90, the cost of associated products needed to assemble them is 10 and the value added is 35. The total value of output is thus 135. In year 2, intermediate consumption increases by another 10 to 110 and value added to 70 bringing the value of output to 180. The change in the structure of production is difficult to understand in the absence of information on the change in the role of the producer who is operating no longer only on his own behalf but also on behalf of others.

28.17 There are essentially two ways to proceed. The first is to treat processing on own account and on behalf of another as different types of activity and different products. In this way in the second year the producer would have one activity with inputs of 100 value added of 35 and output of 135 as in the first year plus another activity with inputs of 10 value added 35 and output of 45.

28.18 The second alternative is to show the intermediate inputs in the second year as 200, value added as 70 and output as 270. Value added is the same under both options and the comparison between the second and the first year makes more sense from a transformation point of view. However, adding an extra 90 to both output and intermediate consumption is essentially artificial. Further, as noted above, it may be difficult for the processor to put a value on the components he receives and the output he provides to the other unit. The chances are that he only knows that he receives a fee of 45 to cover his incidental expenses of 10 and leave an amount of value added, 35 in this case. Thus while for reasons of continuity with past practices this second approach may have some attractions, it is the first that is the basic recommendation of the SNA because this more accurately reflects economic reality.

3. Supply and use tables and sector accounts

28.19 As explained in chapter 14, it is possible to derive the three estimates of GDP from a set of supply and use tables. Since these tables can be expressed in volume terms, estimates can also be made of growth rates based on the tables. However, to complete the sequence of accounts, production accounts are needed by institutional sector and to ensure that the supply and use table and the sequence of accounts are perfectly integrated and consistent, it is desirable to take the part of the use table showing intermediate consumption and the components of value added and allocate the columns to institutional sectors. This gives a table showing for each sector not just what the total intermediate consumption is but also a product breakdown of this as shown in table 28. 5.

(Table 28.5: Intermediate consumption cross-classified by industry and sector to come from UNSD)

28.20 It greatly facilitates the compilation of a table like table 28.5 if, in the original supply and use table, a distinction is made between the three types of output; market output, output for own final use and non-market output, with different columns for different types of output even if the output is similar, for example to show a column for market education separately from that for non-market education.

C. Deriving an input-output table

1. What is an input-output table?

28.21 Essentially an input-output table is derived from a use table where either the columns representing industries in the first and second quadrants are replaced by products or where the products in the first and third quadrants are replaced by industries. Such a table has algebraic properties that make it particularly suitable for analyses that enable estimates to be made of the effects of changing relative prices, of labour and capital requirements in the face of changing output levels, of the consequences of changing patterns of demand and so on. It also may be used as the basis for an expanded version that may be used to estimate the demands made by the economy on the environment, for instance.

28.22 Because the industry and product dimensions are collapsed into a single dimension, the total of the columns showing the supply of items is equal, cell by cell, to the use of items shown in the corresponding row totals. Further, the inter-industry part of the matrix becomes square which means that it can be inverted. Because the matrix is square with the same units for the rows and columns, it is often described as being symmetric.

28.23 Suppose the entries in the inter-industry matrix are each divided by the figure for output at the bottom of the corresponding column, and the resulting matrix is designated as A; the vector of outputs is written as x and the vector of total final demand is written as y. Then

$$Ax + y = x$$

This can be re-written as

$$(I-A)\, x = y$$

or

$$x=(I-A)^{-1}y$$

28.24 The matrix (I-A) is known as the Leontief matrix, after the man who invented the idea of input-output tables and the matrix $(I-A)^{-1}$ as the Leontief inverse. It is the last formulation that gives the analytical power to input-output analysis. As long as changes in demand, y, are sufficiently small that the average coefficients in A are likely to be good approximations to the new situation, the new level of x can be calculated. The approach breaks down if the changes in demand are so great that significant changes in A are likely to follow and marginal rather than average coefficients are needed.

28.25 The matrix A is also sometimes called a matrix of technology coefficients and can provide insights into the way an economy works. In an economy dominated by primary products with little processing carried out in the domestic economy, there are relatively few non-zero elements in A. As the economy develops and processing of primary products becomes more common-place, A becomes more populated with entries reflecting greater vertical and horizontal integration of activities within the economy. By exploring different industries associated with different stages in the production process it is possible to say where value added is generated. For example, cotton as grown is an agricultural product. It is then subject to separation into lint and seed (ginning), then the lint is converted to yarn and the yarn to fabric. If each of these activities appears in a different industry, it is possible to see where the value added between the growing of it and the eventual fabric in which it is used arises.

28.26 There is a vast literature on how to compile and use input-output tables. The purpose of this section is simply to indicate the key aspects of converting a pair of supply and use tables into an input-output table. (list of references to appear here).

2. Secondary products

28.27 The reason that manipulation of supply and use tables is needed to produce an input-output table is the existence of secondary products. If there were the same number of industries as products, and if each industry only produced one product, the supply table for the domestic economy would be unnecessary; the column totals for industries would be numerically equal to the row totals for products and because the inter-industry matrix was square, it could be inverted directly. As noted elsewhere, the intent behind using establishments rather than enterprises, and working at a fairly detailed level in the supply and use tables, is to get as close to this situation as is reasonably practicable. Inevitably though some secondary production remains.

28.28 There are three types of secondary production

a. Subsidiary products: those that are technologically unrelated to the primary product

b. By-products: products that are produced simultaneously with another product but which can be regarded as secondary to that product, for example gas produced by blast furnaces

c. Joint products: products that are produced simultaneously with another product that cannot be said to be secondary (for example beef and hides).

In order to reduce the two tables to one single input-output matrix two possibilities exist. One is to express the input-output matrix in terms of products only; the other is to express the input-output table in terms of industries. Each of these options is discussed in turn below.

3. Product by product tables

28.29 There are two ways in which a product by product matrix can be derived. These are:

a. The product technology assumption where each product is produced in its own specific way irrespective of the industry where it is produced, and

b. The industry technology assumption where each industry has its own specific means of production irrespective of its product mix.

28.30 It is simplest to explain these by example. In the upper part of table 14.12 the construction industry is shown as producing 6 units (out of 208) of manufacturing products. In the lower part, the inputs necessary for manufacturing and for construction are shown. These are reproduced in the first two numeric columns in table 28.7. The next two numeric columns express these in percentage form. Thus, for example, one unit of manufacturing requires 0.038 units of agricultural products, 0.102 units of ores and minerals and so on. Construction uses no agricultural products, 0.005 units of ores and minerals and so on.

Product technology assumption

28.31 Under the product technology assumption, the coefficients showing how manufactured products are produced are assumed to be the same whichever industry they happen to be produced in. Thus to reallocate the 6 units of manufacturing products from the construction industry to a column that will now refer to manufactured products only (ignoring other secondary products for the moment) a set of inputs, derived as 6 times the coefficients for manufacturing is added to the manufacturing column and deducted from the construction column. The results of this are shown in the fifth and sixth numeric columns of table 28.7.

28.32 The product technology assumption is the one most frequently employed. Theoretically it is most appropriate when the secondary products are subsidiary products but may be applied for joint products also.

28.33 Note that in table 14.12, there is a product for ores and minerals, electricity and water but no column for it. If there is no industry for which this is the principal product, it is not possible to use the process just described and so, in practice, identifying the primary producers rather than the number of products will determine the final size of the symmetric (square) matrix.

28.34 Once all the secondary products have been reallocated in the inter-industry matrix, an input-output table will remain. In this table, final demand is the same as in the supply and use table; the columns for industries are transformed into columns for products with consequential changes to total intermediate consumption for each product, value added and output.

28.35 An example of such a table, consistent with those in chapter 14, is shown in table 28.6.

Table 28.6 to show a product by product matrix. Need a volunteer to compile it.

Industry technology assumptions

28.36 Under the industry technology assumption, the coefficients showing how manufactured products are produced depends on the industry where they are actually produced. They thus vary according to where they happen to be produced. In this case, to reallocate the 6 units of manufacturing products from the construction industry a set of inputs derived as 6 times the coefficients for construction is added to the manufacturing column and deducted from the construction column. The results are shown in the seventh and eighth numeric columns of table 28.7.

28.37 The industry technology assumption is most appropriate for by-products. It implies that even if the output mix of an industry changes, the proportions in which the inputs are used are not affected.

Table 28.7: Deriving a symmetric table

Use of products	Manufacturing and other industry	Construction	Manufacturing and other industry	Construction	Manufacturing and other industry	Construction	Manufacturing and other industry	Construction
	Use table		Coefficient form		Product technology		Industry technology	
1. Agriculture, forestry and fishery products (0)	71	0	3.8	0.0	71.0	0.0	71.2	-0.2
2. Ores and minerals; electricity, gas and water (1)	190	1	10.2	0.5	190.0	1.0	190.6	0.4
3. Manufacturing (2-4)	675	63	36.3	30.3	676.8	61.2	677.2	60.8
4. Construction (5)	9	5	0.5	2.4	9.1	4.9	9.0	5.0
5. Trade, accommodation, food and beverages; transport services (6)	65	3	3.5	1.4	65.1	2.9	65.2	2.8
6. Finance and Insurance (7) excluding real estate	36	5	1.9	2.4	36.1	4.9	36.1	4.9
7.Real estate services; and rental and leasing services (72-73)	15	1	0.8	0.5	15.0	1.0	15.0	1.0
8.Business and production services (8)	70	12	3.8	5.8	70.3	11.7	70.2	11.8
9.Community, social services (9) excluding other services and public administration	1	0	0.1	0.0	1.0	0.0	1.0	0.0
10 Other services (94-99)	1	0	0.1	0.0	1.0	0.0	1.0	0.0
11. Public Administration (91)	0	0	0.0	0.0	0.0	0.0	0.0	0.0
14 Total	1 133	90	61	43	1135.6	87.4	1136.7	86.3
17. Total gross value added/GDP	728	118	39	57	731.4	114.6	730.3	115.7
28. Total output	1 861	208	100	100	1 867	202	1 867	202

Comparing the results

28.38 In this case, because a relatively small amout of secondary product is being reassigned, the changes to the original figures are not extensive but the differences due to the two methods are still apparent. In total, output of manufacturing increases by 6 and that of construction decreases by 6, as required. The breakdown by product varies somewhat. One important feature should be noted. When the industry technology assumption is used, construction products produced by the manufacturing industry are assumed to use a small amount of food. However, no agricultural products are actually recorded as being used in the construction industry so deducting these inputs from the recorded entries for construction leads to a negative entry. Negative entries cannot appear under the product technology assumption and their appearance under the industry technology assumptions is one reason why the product technology assumption is often preferred. Extensive discussion on how to deal with negative entries can be found in, for example, the *Eurostat Manual of Supply, Use and Input-Output Tables.*

The hybrid technology assumption

28.39 In fact a further alternative exists, which is to assume the product technology assumption applies to some of the secondary production and the industry technology assumption to the rest. This is an attractive option but more difficult to implement than the product technology assumption.

4. Industry by industry tables

28.40 The principles employed to convert the supply table to an industry by industry table are similar to those described for the product by product transformation but in this case the operation works by adding and deducting amounts along the rows of the table rather than down the columns. As with the product by product matrix case, there are two possible sets of assumptions:

a. The fixed industry sales structure where each industry has its own specific sales structure irrespective of its product mix, and

b. The fixed product sales structure where each product has its own specific sales structure irrespective of the industry where it is produced.

28.41 For similar reasons as before, negative elements may result when using the fixed industry sales structure but are not possible under the fixed product sales structure.

5. The database required for the transformation

28.42 The starting point for the production of a symmetric input-output table is a supply and a use table both at basic prices. Even the calculation of a supply table in basic prices is one step away from basic statistics and actual observations, reinforcing the fact that the input-output table are analytical constructs, not a compilation of directly observed phenomena.

28.43 Further, it is advantageous to separate the use table at basic prices into two, one showing those elements relating to domestic output and the other those elements relating to imports. The statistical requirements for such a separation are demanding but the results allow considerable flexibility in the treatment of imports and permit a clear analysis of the impact of demand on supplies from resident producers and on foreign suppliers.

D. Expressing the sequence of accounts in matrix form

28.44 The part of the use table relating to the destination of products represents one side of the goods and services account in matrix form. However, it can also be expressed as a series of sub-matrices; one

for intermediate consumption, one for final consumption, one for capital formation and one for exports. These sub-elements can be associated with the production account, the use of income account, the capital account and the rest of the world account respectively. Similarly the supply table represents the other side of the goods and services account but can also be written as two sub-matrices, one associated with the production account (output) and one with the rest of the world (imports). By writing the supply table horizontally and the supply table vertically in terms of these sub-matrices and their associated accounts, table 28. 8 emerges. The rows and columns labelled E denote the total economy and those labelled R the rest of the world.

Table 29.8: The goods and services account in matrix form

	Goods and services account		Production account		Use of income accounts		Capital accounts		Total use
	E	R	E	R	E	R	E	R	
Goods and services account			Intermediate consumption		Final consumption		Gross capital formation		
E	Exports	540	1 883		1 399		414		4 236
R	Imports	499							
Production account	Output								
E	3 737								
R									
Total supply	4 236								

28.45 The attraction of this format is that the total across the set of rows for the goods and services account is equal to the total down the columns for the same account. There is no match for the second set of rows for the production account, but it is not difficult to bring this about. The entries for value added can be inserted in a third set of rows with the entries underneath intermediate consumption. In this way the sum down the columns for the production account is then equal to the rows for the same account. But there is now an unmatched third set of rows containing value added. Since value added ultimately carries forward to the primary distribution of income account, the third set of rows can be so labelled as in table 28.9.

Table 28.9: The supply and use tables in matrix form

	Goods and services account		Production account		Use of income accounts		Capital accounts		Total
	E	R	E	R	E	R	E	R	
Goods and services account			Intermediate consumption		Final consumption		Gross capital formation		
E	Exports	540	1 883		1 399		414		4 236
R	Imports	499							499
Production account	Output								
E	3 737								3 737
R									
Primary distribution of income accounts			Value added						
			1 854						
		- 41							
Total	4 236	499	3 737						

28.46 If, to match this third set of rows, a third set of columns is inserted between the production account columns and those for the use of income account, property income can be inserted at the intersection of the third set of rows and columns and a fourth set of rows inserted to show the balance of primary income as it appears in the secondary distribution of income account. Proceeding in this way, successive sets of rows and columns can be introduced until the whole sequence of accounts is covered, as in table 28.10.

28.47 By including the entries for the rest of the world as well as for the total economy, the balancing items from the balance of payments can be shown as, for instance, the -41 in table 28.9.

28.48 It is also possible to extend table 28.10 to show the incorporation of the balance sheets. For this, a row above the initial table is introduced to show the opening balance sheet and three rows below it. The first of these shows the entries for the other changes in the volume of assets account, the second relates to the revaluation account and the last is the closing balance sheet. Two adjustments also need to be made to table 28.10. The first concerns the item for the consumption of fixed capital, which is transposed from the row for the capital account and column for the production account and placed in the column for the capital account and row for the production account but with a negative sign. The second is to subdivide the capital account with the first set of rows and columns covering all items in the account but the second set covering the product details for gross capital formation and thus forming part of the asset account for non-financial assets.

28.49 Reading down the columns starting with the opening balance sheet entry for fixed assets, for example, this value plus the value of capital formation, less consumption of fixed capital, plus other changes in the volume of assets plus revaluation items is equal to the value on the closing balance sheet. For financial assets less liabilities the matching identity holds.

1. Expanding the matrix

28.50 It is possible to expand and rearrange the rows and columns of the matrix so long as this is done consistently in both dimensions. It is not strictly necessary to adhere to the order of the sequence of accounts or the degree of detail shown there. The transactions to be included can be expanded or contracted as can the sets of institutional units to be identified.

28.51 The example of transposing consumption of fixed capital from being a positive entry on one side of the account to a negative entry on the other demonstrates how the matrix formulation may be used to enhance the articulation of the asset accounts.

28.52 It is also possible to include alternative classifications of key items. For example a row called “human needs” could be included showing how much food, housing etc was needed for each group of households, based on the functional classification of household consumption. In the column for consumption expenditure, the set of needs can be then cross-classified by product and household group.

28.53 A further expansion of the matrix may be to show the from-whom-to-whom details of such flows as property income and transfers.

28.54 The matrix presentation is very powerful in terms of the flexibility it can encompass, and in displaying the interaction of the accounts in a compact and graphic manner. On the other hand, there are disadvantages to the matrix presentation also.

a. Without explanatory text describing each of the main elements, a reader has to have a very good understanding of the SNA to interpret the numeric entries in the table.

b. Such a table always contains lots of white space which means that it is not an effective way of presenting a very great deal of data.

In general, the matrix format is best used to explain the structure of the accounts being presented with individual cells , or a combination of cells, following in a more traditional format.

E. Social accounting matrices

28.55 Expanding the accounting matrix of the sequence of accounts to incorporate the disaggregation of the households is the usual form of a satellite account known as a social accounting matrix (SAM). As such it moves beyond a rigorous accounting structure based on observations to make an allocation of income into household groups possibly based on a household income and expenditure survey. In some cases this is based on a single survey. The problem, as explained in chapter 24 on the household sector, is that income flows in the SNA relate to individuals whether as employees, recipients of property income or transfer recipients while expenditure relates to households. Mapping individuals to households is necessarily difficult and depends to a greater or lesser extent on a set of assumptions. Any analysis of how government policies will affect households and their consumption depends on making such a mapping.

1. A SAM for labour accounts

28.56 One example of where a SAM might be useful is in the case of labour accounts, showing the level and composition of employment and unemployment. SAMs have often provided additional information on this issue, via a subdivision of compensation of employees by type of person employed. This subdivision applies to both the use of labour by industry, as shown in the supply and use table, and the supply of labour by socio-economic subgroup, as shown in the allocation of primary income account for households. It implies that the matrix presents not only the supply and use of various products, but also the supply and use of various categories of labour services.

28.57 In order to have a comprehensive picture of the relationship between households and the labour market, the following sets of information are likely to be needed:

a. Various stocks underlying the flows in the SAM, such as size and composition of the population by household group (including the potential labour force) and production capacity by industry;

b. in the case of the self-employed, it may be desirable to have information on the possession of assets (for example agricultural land, consumer durables) as well as information on and financial assets and liabilities;

c. Related non-monetary socio-economic indicators, such as life expectancy, infant mortality, adult literacy, nutrient intake, access to (public) health and education facilities, and housing situation by household group (see the United Nations publication *Towards a System of Social and Demographic Statistics*);

d. Some re-routings such as social transfers in kind by groups of household.

28.58 Comparing (a) labour incomes of all employed persons as shown in the SAM, (b) a decomposition of these incomes into full-time equivalent employment and average wage rates, and (c) the potential labour force by type of person and household group (expressed in "full-time" equivalents), yields detailed information on the composition of unemployment and an aggregate indicator ("full-time equivalent unemployment") which is consistent, both conceptually and numerically, with the other macroeconomic indicators; these can also be derived from the SAM-framework.

Table 28.10: The flow accounts of the sequence of accounts in matrix form

	Goods and services account		Production account		Primary distribution of income accounts		Secondary distribution of income accounts		Use of income accounts		Capital accounts		Financial accounts		Total
	E	R	E	R	E	R	E	R	E	R	E	R	E	R	
Goods and services account			Intermediate consumption						Final consumption		Gross capital formation				
E	Exports	540	1 883						1 399		414				4 236
R	Imports	499													499
Production account	Output														
E	3 737														3 737
R															0
Primary distribution of income accounts			Value added		Property income										
			1 632		438	69									2 139
		- 41			40										- 1
Secondary distribution of income accounts					Balance of primary income		Current transfers								
E					1 661		1 174	17							2 852
R						- 70	55								- 15
Use of income accounts							Disposable income		Change in pension entitlements						
E							1 623		11						1 634
R								- 32							- 32
Capital accounts			Consumption of fixed capital						Saving		Capital transfers				
E			222						224		61	1			508
R										- 32	4				- 28
Financial accounts											Net borrowing or net lending				
E											29				29
R												- 29			- 29
Total	4 236	499	3 737	0	2 139	- 1	2 852	- 15	1 634	- 32	508	- 28	0	0	

Table 28.11: The sequence of accounts including balance sheets in matrix form

		Goods and services account E	Goods and services account R	Production account E	Production account R	Primary distribution of income accounts E	Primary distribution of income accounts R	Secondary distribution of income accounts E	Secondary distribution of income accounts R	Use of income accounts E	Use of income accounts R	Capital account R	Capital account E	Asset account E	Asset account R	Financial accounts E	Financial accounts R	Total
Opening balance sheet														Non-financial assets 4 821		Financial assets less liabilities 269		
Goods and services account	E	Exports	540	Intermediate consumption 1 883						Final consumption 1 399				Gross capital formation 414				4 236
	R	Imports 499																499
Production account	E	Output 3 737												Consumption of fixed capital - 222				3 515
	R																	0
Primary distribution of income accounts	E			Value added 1 632		Property income 438	69											2 139
	R		- 41			40												- 1
Secondary distribution of income accounts	E					Balance of primary income 1 661		Current transfers 1 174	17									2 852
	R						- 70	55										- 15
Use of income accounts	E							Disposable income 1 623		Change in pension entitlements 11								1 634
	R								- 32									- 32
Capital account	E									Saving 224		Capital transfers 61	1					286
	R										- 32	4						- 28
Asset account	E											Acquisition of non-financial assets 192						192
	R																	0
Financial accounts	E											Net borrowing or net lending 29						29
	R												- 29			29		0
Total		4 236	499	3 515	0	2 139	- 1	2 852	- 15	1 634	- 32	286	- 28	192	0	29	0	
Other changes in the volume of assets account														10		7		
Revaluation account														280		8		
Closing balance sheet														5 303		313		