Chapter 36: Input-output tables

(moved upwards, revised title and revised content)

(OLD Chapter 28: Input-output and other matrix-based analyses)

A. Introduction

36.1 The purpose of this chapter is to build on the presentation of the supply and use tables in chapter ~~14~~15 to examine in greater detail the possibilities offered by using a tabular and / or matrix form of presentation of the accounts. As has been noted on a number of occasions, the SNA is intended to offer a degree of flexibility in implementation as long as the inherent accounting rules are observed. The fact that the requirement to balance ~~uses~~expenditures and ~~resources~~revenues is immediately obvious within a matrix framework makes this a powerful way in which to explore different options while still ensuring the balances are satisfied. One aim of this chapter is to demonstrate the power of a matrix presentation in this way.

~~36.2~~

~~36.3 Input-output tables~~

~~36.4~~

~~36.5~~36.2 A second aim is to describe the basic ideas of input-output ~~matrices~~tables. Supply and use tables are an integral part of the SNA and the process of compiling these tables is a powerful way of ensuring consistency between the various data sources available to the compiler. For many analytical purposes, though, a transformation from a pair of supply and use tables into a single input-output table where row and column totals are equal brings very considerable advantages. Input-output tables cannot be compiled without passing through the supply and use stage (except under very restrictive assumptions). They are therefore analytical constructs that inevitably involve some degree of modelling and assumptions in their compilation.

~~36.6~~

36.3 Similar to supply and use tables covered in chapter 15, the role and use of input-output tables has also expanded significantly over the past two decades. The input-output tables provide a powerful feedback loop in terms of quality and coherence of the supply and use tables both in current prices and in volume terms. This chapter not only covers the derivation of national input-output tables but also the multi-country input-output tables which form key inputs to analyses such global value chains and trade in value added indicators.

~~36.7~~36.4 There is a vast literature on the compilation and use of national input-output tables and it is impossible in a short chapter to give a full appreciation of the range of complexities of compilation and inventiveness of applications. Likewise various international organisations and research consortia have developed multi-country databases, and in turn, multi-country input-output tables. The chapter aims only to give a feel for the sort of operations necessary to transform national supply and use tables into national input-output tables ~~and to give some ideas~~as well as compilation of ~~their possible applications.~~multi-country input-output tables. The ~~*Manual of*~~*UN Handbook on Supply~~,~~ and Use Tables and Input-Output Tables with Extensions and Applications (2018)* and a visit to the web site of the International Input-Output Association (www.iioa.org) are good places to start a more detailed investigation of the potential in this field.

~~36.8~~

~~36.9 Social accounting matrices~~

~~36.10~~

~~36.11 Both the supply and use tables and input-output tables are matrix representations of the goods and services account. It is possible to cast the whole of the sequence of accounts, including the goods and services account, in a matrix format also. Such a matrix is called a social accounting matrix (SAM).~~

~~36.12~~

~~36.13 It is possible to extend and elaborate a SAM by introducing alternative disaggregations of existing flows or~~

Commented [ED1]: Consistency with the UN Handbook on Supply and Use Tables and Input-Output Table with Extensions and Applications has been applied with the aim of minimising changes to SNA, e.g., removal of obsolete terms or incorrect terms. Also, new terminology agreed for 2025 SNA.

Commented [ED2]: Introduction has been tidied up to align with the approach applied in other chapters and additional text to link to chapter 15.

Commented [ED3]: Brief reflection of the expanded role and use of input-output tables.

Formatted: Font: 10 pt, Italic

Formatted: Font: 10 pt, Italic

Formatted: Font: 10 pt, Italic

Commented [ED4]: X.28 reference, remove reference to SAMs and section D.

new types of flows, just as long as the use and resource of these flows balance in the usual way. This is such a common extension of a SAM that the usual understanding of what a SAM is often goes further than a matrix encompassing the standard sequence of accounts to include extensions, particularly of the household sector.

36.14

36.15 The structure of the chapter

36.16

36.17 Chapter 1415 describes how the supply and use tables may be used in order to ensure the internal consistency of disparate data sets. 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

36.18 14 15. 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.

36.19

36.2036.5 Section C is concerned with how a pair of supply and use tables may be transformed into a single symmetric input--output matrixtable. Each of the supply and use tables shows disaggregation by products and industries. In an input--output table, one of these dimensions is eliminated. 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 of industries. Finally, section D covers multi-country input-output tables and the derivation and challenges involved.

Commented [ED5]: New section on multi-country input-output tables.

36.21

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 may be instructive as a stepping-off point for extensions of the accounts such as social accounting matri

Formatted: Font: 10 pt

Formatted: Normal, Space After: 6 pt

B. Flexibility in the supply and use tables

1. The treatment of margins on imports

36.2236.6 In discussing valuation in section BC of chapter 1415, consideration is given to how transport margins should be incorporated into the accounts and in particular how international transport charges should be recorded. Paragraphs 1415.61 to 1415.77 (to check) explain 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. Paragraph 1415.77 (to check) ends by discussing briefly the practical problems in deriving the desired valuation from the available data sources. It is reproduced here for convenience.

36.2336.7 It may not be possible to determine from customs declarations which unit is responsible for the transport costs and, even when it is and conceptually the transport costs should be separated from the value of the goods themselves, there may be no information and no resources available to make the separation in practice. In such a case the CIF value of imports may be the only source with a disaggregation by type of good. If the disaggregated CIF figures are used for imports of goods, though, that part of the transport costs and insurance also included in imports of services would be double-counted. In order to avoid this, therefore, an adjustment column is inserted into the supply table. The adjustment column consists of a deduction from the services items for transport and insurance equal to the CIF-to-FOB adjustment for these items with an offsetting global adjustment made to imports of goods. Table 1415.4, reproduced here as table 28.1 gives an example of such an adjustment.

Table ~~28~~36.1: An example of imports entries in the supply table with the global CIF to FOB adjustment

~~36.24~~36.8 This adjustment column shows the reallocation of service margins from the industries where they are produced (by resident or non-resident producers) to an adjustment row for the CIF/FOB adjustment. In the column for goods, the values given industry by industry include an element of these service margins~~,~~ but this is deducted on the CIF/FOB adjustment row to leave the total equal to the total of imports FOB. The adjustments in this column are analogous to a similar column that could be shown illustrating the adjustment between purchasers' and basic prices.

~~36.25~~36.9 A simpler procedure than that just described, though one not strictly consistent with ~~BPM6~~BPM7 recommendations, is to ignore the balance of payments division between goods and services and adjust the figures for imports of services by the amount of services provided by non-residents that are included in the detailed figures for imports of goods. This ensures that the total of imports of goods and services agrees with the total in the balance of payments but will not agree with the total of imports of goods FOB and of services shown there. This makes compiling the supply and use tables simpler but means that it is not possible to use imports of goods on a FOB basis to match exports of those goods from other countries. Even in this simpler version, however, the amount of freight and insurance on imports provided by residents must be shown as an export of services.

36.10 In this respect, it is important to note, as described in paragraph 15.77, that the valuation of imports and exports in relation to using CIF and FOB is likely to change to invoice values in the next update of the macroeconomic statistical standards.

2. Goods processed by a unit not assuming economic ownership

~~36.26~~36.11 A producer may carry out the same activity under quite different economic conditions. Consider farmers growing grain which is milled into flour before use. Suppose one 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 the 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 even though both produce flour for sale.

~~36.27~~36.12 In the case of milling the reasons for ~~subcontracting~~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.

~~36.28~~36.13 ~~Previous editions of~~Prior to the 2008 SNA ~~have~~, it was 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 economic 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.

~~36.29~~36.14 The question arises of how to record the activity of assembling goods to order for another unit in

Commented [ED6]: This table will be removed as it is a duplicate of the new table 15.4.

Commented [ED7]: G.1 reference.

Commented [ED8]: Minimal historic reference.

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.

~~36.30~~36.15 Suppose in year 1, a processing unit converts products only on own account. 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, all other things being equal, 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.

~~36.31~~36.16 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.

Table ~~28~~36.2: Options for recording goods not changing economic ownership

~~36.32~~36.17 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 under option 2. 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. These options are shown in table ~~28~~36.2.

~~36.33~~36.18 It should be emphasized that it is option 1 that is ~~the recommendation of the SNA and,~~recommended for goods sent abroad for processing~~, BPM6. Option 2 is shown as a supplementary presentation that may be adopted for reasons of continuity with past practices~~. Option 1 more accurately reflects the economic processes taking place while option 2 focuses on the physical transformation process.

Commented [ED9]: Minimal historic reference.

~~36.34~~36.19 When goods are sent abroad for processing, they are recorded as neither exports of goods by the country holding economic ownership, nor as imports of goods by the processing country in either the SNA or ~~BPM6~~BPM. Similarly, after processing they are recorded neither as exports by the processing country nor as imports of goods by the country of economic ownership. The only item recorded as imports and exports is the fee agreed between the economic owner and the processor.

~~36.35~~36.20 The physical flows of the goods will continue to appear in the merchandise trade figures. However, the product code after processing may be different from the code on entry, making it difficult to match the incoming and outgoing flows.

~~36.36~~36.21 The presentation of option 2 suggests that the fee can be derived as the difference between the value of the goods on arrival and departure from the processing country but while this may sometimes give a reasonable approximation of the processing fee, there are many reasons why this may not be so.

a. If processing takes any significant amount of time, there may be holding gains and losses affecting the value of the goods. These accrue to the economic owner, not the processor.

b. Goods may be lost or damaged or may simply become obsolete while in process. (This has been observed in the case of electronic components.) These other volume changes also apply to the economic owner and not the processor.

c. The value of the processed goods may be greater than the costs of the components and the processing fee to the extent that the finished product incorporates part of the value of R&D treated as fixed capital formation of the economic owner.

~~36.37~~36.22 All these situations reinforce the preference for option 1 over option 2 in table ~~28~~36.2.

3. Supply and use tables and institutional sector accounts

~~36.38~~36.23 As explained in chapter ~~14~~15, it is possible to derive a balanced estimate of GDP using the three ~~estimates of~~approaches to measuring 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 economic accounts, production accounts are needed by institutional sector. To ensure that the supply and use table and the sequence of economic 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.

~~36.39~~36.24 The starting point for the compilation is the part of the use table in table ~~14~~15.12 relating to intermediate consumption and value added. This is shown in a somewhat aggregated form in table ~~28~~36.3.

~~36.40~~36.25 The easiest allocation is for financial corporations since typically such corporations do not undertake secondary activity and other institutional units do not undertake any financial activity. When these conditions prevail, the column for the finance and insurance activity can be taken in its entirety as appropriate for the institutional sector. As the output of the central bank is typically producing non-market output, this should be allocated to non-market output. Moreover, it is possible that financial corporations may undertake some production for own final use (as capital formation), in which case some part of an appropriate column in the section of table ~~28~~36.3 relating to own account production should be added. No such adjustment has been made in this example.

Commented [ED10]: Issue X.3.

~~36.41~~36.26 ~~The~~With the exception of the central bank (see above), the columns relating to non-market producers must be allocated between general government and NPISHs. In addition, though not in this example, it is possible that either general government or NPISHs may have an establishment undertaking market production. ~~This is how it is possible that non-market producers may have small amounts of operating surplus.~~ It is also possible that both general government and NPISHs may have some production for own final use (as capital formation) but none has been assumed here.

Commented [ED11]: Issue X.3.

Commented [ED12]: X.55, consistency with sum of costs.

~~36.42~~36.27 The last step is to allocate all columns not yet accounted for between non-financial corporations and households. An indication that some part of a market production activity should be allocated to households is the presence of mixed income as part of the value added of the activity. Thus, in this example, some parts of market production of agriculture, manufacturing, construction and trade are attributable to households as well as production for own final use. (As noted in general some of production for own final use will be attributable to other sectors. It is not done so here for reasons of simplicity at such an aggregate level.)

~~36.43~~36.28 Once these calculations are complete, table ~~28~~36.4 results, showing for each sector not just total intermediate consumption but also a product breakdown of this as well as the items for value added.

~~36.44~~36.29 The figures shown for intermediate consumption, output and the elements of value added for each institutional sector are those that appear in the production account and generation of earned income account in the sequence of accounts.

Table ~~28~~36.3: The use table from table ~~14~~15.12

C. Deriving an input-output table

1. What is an input-output table?

~~36.45~~36.30 Essentially an input-output table is derived from a use table where either the columns representing industries in the two left-most quadrants are replaced by products or where the products in the two topmost quadrants are replaced by industries. The resulting intermediate consumption ~~matrix~~table is then square, showing products in both rows and columns or industries in both. In both cases the row totals for the complete ~~matrix~~table match the column totals for the complete ~~matrix~~table, product by product or industry by industry as the case may be. The resulting matrices are therefore referred to as being symmetric.

36.31 The resulting tables are often referred to as being symmetric input-output tables. From a conceptual point of view, however, it is incorrect to use the term "symmetric", in that the transformations reflect industry-adjusted product by industry input-output tables or product by product-adjusted industry input-output tables, which means, in essence, that there is no symmetry in the dimension of the table nor symmetric in mathematical terms but they are just square tables. Thus these tables should be referred to as "input-output tables" and not as "symmetric input-output tables".

Commented [ED13]: Consistency with the UN Handbook on supply and use tables and input-output tables with extensions and applications.

36.4636.32 The process of replacing the product dimension by an industry one is based on one of several possible models, to be discussed below. This process necessarily means that a symmetrican input-output matrixtable is further removed from basic data sources than a supply and use table and it is therefore useful to review why making this transition is so useful.

36.47

36.4836.33 Note that in table 1415.12, 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, identifying the primary producers rather than the number of products will determine the final size of the symmetric (square) matrix table.

Table 2836.3 (cont): The use table from table 1415.12

2. Analytical potential of an input-output matrixtable

36.4936.34 SuchInput-output tables have algebraic properties that make them particularly suitable for analyses that enable estimates to be made of the direct effect, indirect effect and induced 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. They may also 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.

36.5036.35 As noted in the introduction, 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.

36.5136.36 Suppose the entries in the inter-industry matrixtable 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 demanduses is written as y. Then

$$Ax + y = x$$

This can be rewritten as

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

or

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

36.5236.37 The matrix (I-A) is known as the Leontief matrix, after the man who pioneered the use of input-output tables and the matrix $(I-A)^{-1}$ is known as the Leontief ~~inverse~~Inverse. It is the last formulation that gives the analytical power to input-output analysis.

~~36.53~~

~~36.54~~36.38 Suppose there is an increase in demand, for manufactured products, say. Looking at even the supply and use table it can be seen that to increase the output of these goods, more inputs of almost all types of products are needed. This increase in demand for a range of products is called the direct effect of a change in demand. However, the increase in demand in all these products causes a further round of increases in output for all products and this in turn triggers another set of increases in output and so on. Each round of effects is smaller than the last until it eventually becomes insignificant. The total of all second and subsequent round effects is called the indirect effect of a change in demand.

Table ~~28~~36.4: Intermediate consumption and value added cross-classified by industry and institutional sector

~~36.55~~36.39 In terms of the algebra just introduced, the direct effect is equal to Ay, the second round effect to A^2y, the third round effect to A^3y and so on. It can be shown that $(I-A)^{-1}$ can be written as $A+A^2+A^3+A^4$ etc. This is where the power of having a symmetric matrix comes from since A needs to be square for this formulation to work.

~~36.56~~36.40 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.

~~36.57~~

~~36.58~~36.41 The matrix A is also sometimes called a matrix of technological 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 significant non-zero elements in A. As the economy develops and processing of primary products becomes more commonplace, 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 is grown as 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 the cotton and the eventual fabric in which it is used arises.

3. Secondary products

~~36.59~~36.42 An industry classification such as *ISIC* essentially identifies industries in terms of the sorts of goods or services they typically produce. However, there are more products than industries and, for all sorts of reasons, some products may be made in several industries.

~~36.2~~36.43 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~~an input-output ~~matrix~~table.

~~36.60~~

36.44 Different choices of statistical units are available for the compiler and it is important to have a clear understanding of the impact of the choice of different statistical units has on the supply and use tables and on the input-output tables. For supply and use tables and input-output tables, the focus is on two specific

Formatted: Font: 10 pt, Superscript

Formatted: Font: 10 pt, Superscript

Formatted: Font: 10 pt, Superscript

Formatted: Font: 10 pt, Superscript

Formatted: Font: 10 pt, Superscript

Formatted: Font: 10 pt, Superscript

Formatted: Font: 10 pt, Superscript

Formatted: Body Text, Right: 0", Space Before: 0 pt, Line spacing: single, No bullets or numbering, Tab stops: Not at 0.56"

Formatted: Font: 10 pt, Not Expanded by / Condensed by

Commented [ED14]: Choice of statistical unit and impact of globalisation links to secondary production.

statistical units: enterprises and establishments (local kind-of-activity units). The establishment is the recommended unit for the compilation of the production part of the national accounts and therefore the compilation of supply and use tables and input-output tables. This means, as a rule, that multi-product enterprises must be partitioned into smaller and more uniform units regarding their kind of production, if possible. For more details on enterprises and establishments, see paragraphs 6.35 and 6.36.

~~36.61~~

Table 36~~28~~.4 (cont): Intermediate consumption and value added cross-classified by industry and institutional sector

~~36.62~~36.45 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 the inter-industry ~~matrix~~table would be square as originally compiled. 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.

~~36.63~~36.46 There are three types of secondary production

a. Subsidiary products: those that are technologically unrelated to the primary product. Just a few examples include a large retailer with a fleet of trucks used primarily for its own purposes that may occasionally offer transport services to another unit, a farmer who use part of his land as a caravan site, or a mining company that builds access roads and accommodation for its workers.

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).

~~36.64~~ In order to reduce the supply and use tables to one single input-output ~~matrix~~table two possibilities exist. One is to express the input-output ~~matrix~~table in terms of products only;

~~36.65~~36.47 the other is to express the input-output table in terms of industries.

4. Reallocating secondary products

~~36.66~~36.48 There are two basic approaches to eliminating secondary products. Both come from applying information from the use ~~matrix~~table to the domestic output part of the supply ~~matrix~~table to reduce it to a purely diagonal one. Once this is done, the supply ~~matrix~~table contains no further useful information and is no longer presented. The transformed use ~~matrix~~table is what is referred to as an input-output ~~matrix~~table.

~~36.67~~

~~36.68~~36.49 In deriving a product by product ~~matrix~~input-output table in the simplest possible way, the final ~~demand~~use quadrant of the use ~~matrix~~table is unaltered. It already expresses ~~demand~~final use by product and does not need changing. The intermediate consumption and value added parts of the ~~matrix~~use table, though, need to be changed from an industry dimension to a product one. The row totals of the ~~matrix~~table already show the correct product totals so the exercise consists of reallocating entries from one column to another within the given row total. This ~~is called~~has been known as a technology approach. It assumes that the demand for intermediate consumption and labour and capital inputs are determined by the nature of the products made. It is also worth noting that, in the transformations used where technology assumptions are applied, no technology in the physical production processes is involved, but only economic transactions measured in monetary terms. With the transformations, the institutional characteristics of the industries remain unaffected.

Formatted: Indent: Left: 0.5", Space Before: 0 pt, No bullets or numbering
Formatted: Not Expanded by / Condensed by
Formatted: Not Expanded by / Condensed by
Formatted: Not Expanded by / Condensed by
Formatted: Not Expanded by / Condensed by
Formatted: Not Expanded by / Condensed by
Formatted: Not Expanded by / Condensed by
Formatted: Not Expanded by / Condensed by
Formatted: Font: 10 pt, Not Expanded by / Condensed by
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Formatted: Font: 10 pt, Not Expanded by / Condensed by
Formatted: Font: 10 pt
Formatted: Font: 10 pt, Not Expanded by / Condensed by
Formatted: Font: 10 pt
Formatted: Font: 10 pt, Not Expanded by / Condensed by
Formatted ... [1]
Formatted: Font: 10 pt
Formatted ... [2]
Formatted: Font: 10 pt
Formatted ... [3]
Formatted: Font: 10 pt
Formatted ... [4]
Formatted: Font: 10 pt
Formatted ... [5]
Formatted: Font: 10 pt
Formatted ... [6]
Formatted: Font: 10 pt
Formatted ... [7]
Formatted: Font: 10 pt
Formatted ... [8]
Formatted: Font: 10 pt
Formatted ... [9]
Commented [ED15]: Consistency with the UN Har ... [10]

36.69

36.7036.50 In deriving an industry by industry matrixinput-output table in the simplest possible way, the value added part of the use matrix is unaltered and because the level of output will not alter, only the composition of intermediate consumption changes, not its total. Thus the exercise is one of reallocating items between rows but not between columns. In contrast to the product by product case, the quadrant relating to final demanduses will change and will show demand related to the industry supplying the products and not to the products themselves. This is called a sales structure approach. It assumes that as the level of output of an industry changes, the pattern of sales will remain the same.

Table 3628.5: A numerical example of reallocating products from construction to manufacturing

36.7136.51 Both these assumptions, the technology assumption and the sales structure assumption, are rather simplistic and in practice a more generalized approach may be used but it is helpful first to examine each of the assumptions in a little more detail.

Product by product input-output tables

36.7236.52 There are two ways in which a product by product matrixinput-output table can be derived. These are:

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

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

36.7336.53 It is simplest to explain these by example. In the upper part of table 1415.12, the construction industry is shown as producing 6 units (out of 208) of manufacturing products. In the lower part of table 1415.12, reproduced as table 2836.3, the inputs necessary for manufacturing and for construction are shown. These are reproduced in the first two numeric columns in table 2836.5. 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.

36.74

36.7536.54 In order to create the product by product matrixinput-output table, it is necessary to deduct the costs associated with the production of 6 units of manufactured goods from the column for construction and add it to the column for manufacturing. On completion of this exercise for all secondary production, the columns will represent products rather than industries.

Industry technology assumption

36.7636.55 Under the industry technology assumption, the coefficients showing how manufactured products are produced are assumed to depend on the 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 construction 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 2836.5.

Product technology assumptions

~~36.77~~36.56 Under the product technology assumption, the coefficients showing how manufactured products are produced are those of the manufacturing industry regardless of where they are actually 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 manufacturing 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 36.5.

~~36.78~~36.57 It is important to note a problem that arises under this assumption. When the product technology assumption is used, manufactured products produced by the construction 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 industry technology assumption. Since negative entries are logically impossible, this is one argument in favour of using the industry assumption rather than the product assumption.

Industry by industry input-output tables

~~36.79~~36.58 Just as there are two ways in which a product by product ~~matrix~~input-output table can be derived, there are two ways in which an industry by industry ~~matrix~~input-output table can be derived. These are:

a. The fixed product sales structure where it is assumed the allocation of demand to users depends on the product and not the industry from where it is sold.

b. The fixed industry sales structure where it is assumed that users always demand the same mix of products from an industry.

~~36.80~~36.59 Although a table similar to table ~~28~~36.5 is not presented for the industry by industry input-output tables, its construction is similar and straightforward but would show the entries across the rows of the use tables rather than down the columns.

36.60 In order to create an industry by industry input-output table, it is necessary to move the use of 6 units of manufactured products from the row for the manufacturing to the row for the construction. On completion of this exercise for all secondary production, the rows will represent industries rather than products. It is worth noting that, if an enterprise in broken down into separate establishments, actual data on transactions between these establishments may be available to inform the compilation of an industry by industry input-output table.

Fixed industry sales structures

36.61 Here the 6 units of manufactured goods supplied by the construction industry are reallocated to the construction row from the manufacturing row using the proportions of the construction row. Such a table can contain negative elements.

Fixed product sales structure

~~36.81~~36.62 In this case, to allocate the 6 units of manufactured goods supplied by the construction industry to the row for construction, a proportion of the row for manufacturing is allocated to the construction row using the proportions in the manufacturing row. It follows that such a matrix will not contain negative entries.

~~Fixed industry sales structures~~

~~36.82 Here the 6 units of manufactured goods supplied by the construction industry are reallocated to the construction row from the manufacturing row using the proportions of the construction row. Such a matrix can contain negative elements.~~

Formatted: Not Highlight

Formatted: Not Highlight

Commented [ED16]: Re-ordering of the sequence of the models C and D aligns with the UN Handbook and Eurostat Handbook and other literature.

The choice of approach to be used

36.8336.63 There are four basic choices open to the input-output compiler.

a. A product by product approach using a product technology assumption,

b. A product by product approach using an industry technology assumption,

c. An industry by industry approach assuming a fixed product sales structure,

c. An industry by industry approach assuming a fixed industry sales structure.

d. An industry by industry approach assuming a fixed product sales structure,

Options a and cd may result in negative entries; options b and de do not.

36.8436.64 Both product by product and industry by industry input-output tables may be compiled. They serve different analytical functions. For example, to ensure that price indices are strictly consistent, a product by product matrix input-output table is to be preferred. For a link to labour market questions, an industry by industry input-output table may be more useful. Although traditionally a lot of interest focused on the product by product input-output tables, this was accompanied in large part by an attention to the underlying technology. Increasingly the economic interaction of different industries has brought more interest in the industry by industry input-output tables.

Hybrid approaches

36.8536.65 In practice, no single method is used on its own. Knowledge of the type of product or industry in question should dictate whether an industry-based conversion procedure or a product-based one is most appropriate. Some secondary products may be dealt with one way and others another despite the fact that, on occasion, negative values may initially appear.

36.86

36.8736.66 The extent of variation between the various approaches will depend on a number of factors, including in particular the extent of secondary production in the supply matrixtable. In general, the greater the degree of disaggregation and thus the less secondary production to be reallocated, the closer the input-output tables will resemble the supply and use tables. Indeed some countries prefer to work with very detailed supply and use tables and not produce symmetricinput-output tables at all.

36.88

36.8936.67 As an illustration of the differences involved, tables 2836.6 and 2836.7 show the results of converting the supply and use tables in chapter 1415 to, first, a product by product matrixinput-output table using only the industry technology assumption and then an industry by industry matrixinput-output table using only the product sales structure.

Table 3628.6: Example of a product by product input-output matrix

Table 3628.7: Example of an industry by industry input-output matrix

The database required for the transformation

36.9036.68 The starting point for the production of a symmetrican input- output table is a pair of supply and a use tables both at basic prices. Even the calculation of the use table in basic prices is one step away from basic statistics and actual observations, reinforcing the fact that the input-output tables are analytical constructs, not a compilation of directly observed phenomena.

36.91

Commented [ED17]: Re-ordering of the sequence of the models C and D aligns with the UN Handbook and Eurostat Handbook and other literature.

Table 28.6:Example of a product by product input-output matrix

36.9236.69 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.

36.93

36.9436.70 The exact manner of dealing with imports is a subject of considerable complexity where a number of options are available also. In some economies, some important products will only be imported and so separating these "non-competing" imports from the rest may be of particular interest.

36.95

36.9636.71 Another topic that requires careful consideration is the degree of detail that is desirable for product and industry classifications. This may vary depending on the resources available to the statistical office and the sort of use to be made of the results.

Table 28.8:The goods and services account in matrix formInput-output and other matrix-based analyses

Socia accounting matrices

Expressing the sequence of accounts in matrix form

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.

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 allocation of primary income account, the third set of rows can be so labelled as in table 28.9.

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.

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.

Commented [ED18]: X.28 reference, remove Section D.

It is also possible to extend table 28.10 to show the incorporation of the balance sheets as in table 28.11. 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 28.6. 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.

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.

Expanding the matrix

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.

Table 28.9:The supply and use table in matrix form

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.

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.

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

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.

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.

Such a table always contains lots of white space which means that it is not an effective way of presenting a large amount 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.

Disaggregating households

Expanding the accounting matrix of the sequence of accounts to incorporate the disaggregation of 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.

A SAM for labour accounts

One example of where a SAM is 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.

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:

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;

For 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 financial assets and liabilities;

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 *Towards a System of Social and Demographic Statistics* (United Nations, 1975));

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

Comparing labour incomes of all employed persons as shown in the SAM, a decomposition of these incomes into full-time equivalent employment and average wage rates, and 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.

D. Multi-country tables

Commented [ED19]: X.28 (outline) briefly covering the move from national supply and use tables to multi-country supply and use tables and multi-country input-output tables. Also the link to their uses in terms of global value chains and trade in value added indicators.

36.72 The emergence of global value chains challenges conventional wisdom on how we look at economic globalisation and, in particular, the policies we develop around the analyses of the impacts of globalisation, including environmental footprints. This has also led to the compilation of statistics on global value chains and multi-country supply and use tables and multi-country input-output tables to estimate trade in value added indicators, see chapter 23 for more detail on global value chains and trade in value added indicators. The role of national supply and use tables in generating multi-country supply and use tables and multi-country input-output tables is covered in this section.

36.73 In the absence of an internationally agreed statistical guidance to compile multi-country tables, international organisations and various research consortia have developed databases of national supply and use tables and national input-output tables as well as modelling for missing countries and missing data, as a starting point for compiling multi-country tables. In this respect, it is important to note, these databases reflect different assumptions (e.g., to remove trade asymmetries) and modelling techniques, thereby producing different estimates.

36.74 The GIANT (Global Input-output AccouNTs) initiative is an inter-agency network consisting of the Asian Development Bank, the European Commission, the International Monetary Fund, the Organisation for Economic Co-operation and Development, the United Nations Economic Commission for Africa, the United Nations Economic Commission for Latin America and the Caribbean, and the World Trade Organisation. In this respect, the GIANT initiative has been set up to converge to a common benchmark of input data into the various existing regional initiatives that compile multi-country supply and use tables and multi-country input-output tables, thus ensuring at least mutual comparability and consistency among them - thus the GIANT initiative is key. This initiative also seeks to help provide users with consistent messages and results in terms of, for instance, global value chain participation or estimation of carbon footprints, irrespective of the specificities of any given multi-country supply and use tables or multi-country input-output tables.

1. Moving from national supply and use tables to multi-country input-output tables

36.75 Moving from national supply and use tables to multi-country supply and use tables involves firstly the combined use of national accounts, balance of payments and merchandise and services trade statistics to breakdown the main national accounts aggregates by product and by industry in a fully-fledged multi-country supply and use tables framework. However, there are conceptual differences between both datasets that constitute additional challenges in the compilation of multi-country supply and use tables.

36.76 Although methodological differences between merchandise trade flows and national accounts trade statistics exist, in practice (in part because not all countries are able to fully-align with the ownership principle of the SNA) these are generally not significant at the aggregated level (e.g., country's total exports of goods). However, there are significant challenges when considering particular products, activities and trading partners and these are briefly mentioned in this section.

36.77 Some of the specific challenges moving national supply and use tables to multi-country supply and use tables include:

- Splitting exports of goods and services for intermediate use or final uses and align these flows to the underlying ownership principles, in particular processing and merchanting activities as well as products that may have dual uses (e.g., as intermediate use or final uses).
- Domestic exports or re-exports requiring detailed trade flows information about the country of origin (producer), country of consignment (re-exporter) and traded product.
- Bilateral exports resolving the trade asymmetries to determine the geographical distribution of total (domestic) exports from one country to another.

Formatted: Indent: Left: 0.59", Hanging: 0.3", Tab stops: 0.59", Left + Not at 0.47"

- Estimation of direct purchases abroad (imports) by product or service, country of purchase and country of residence of the purchaser to be derived from limited data sources.

36.78 Major steps for compiling the multi-country supply and use tables include:

- Collection and compilation of harmonised national accounts control totals, for example, imports of goods separate from services and likewise for exports of goods and services.
- Estimation of balanced foreign trade flows with rebalanced national supply and use tables and balancing cross-country trade flows by product.
- Link the import use tables by bilateral trade partner shares or alternatively, link the total exports by bilateral trade partners to import use tables. The first approach uses balanced trade statistics to split import use tables by country of origin (and implicitly estimate bilateral exports). The second approach uses balanced trade statistics to split total exports from supply and use tables at basic prices across trading partners and then use the import use tables (FOB) to split across intermediate uses and final uses.

36.79 Once multi-country supply and use tables are compiled, the methods and assumptions used to produce national input-output tables from national supply and use tables can be applied to produce multi-country input-output tables from multi-country supply and use tables. Alternatively, multi-country input-output tables can be produced from national input-output tables. However, these would not be consistent with multi-country supply and use tables, in particular in relation to the different assumptions made by countries to produce national input-output tables, also based on unbalanced trade statistics.

36.80 The standard format of multi-country input-output tables includes intermediate consumption, value added and final use sections similar to national input-output tables (see an example conceptual diagram in figure 36.1). The final uses of each country is the sum of final consumption expenditure and gross fixed capital formation of domestic and imported products, changes in inventories, exports as well as direct purchases abroad by residents. However, the definition of intermediate transactions is broader in a multi-country input-output table than the national concept as the export from one country could be for example, be either intermediate use or final use in the importing country. In addition, taxes paid abroad such as tourism and value added taxes paid on direct purchases abroad are explicitly separated at the bottom of tax receiving territories.

Formatted: Not Highlight

Formatted: Indent: Left: 0.59", Hanging: 0.3", Tab stops: 0.59", Left + Not at 0.47"

Formatted: Not Highlight

Formatted: Not Highlight

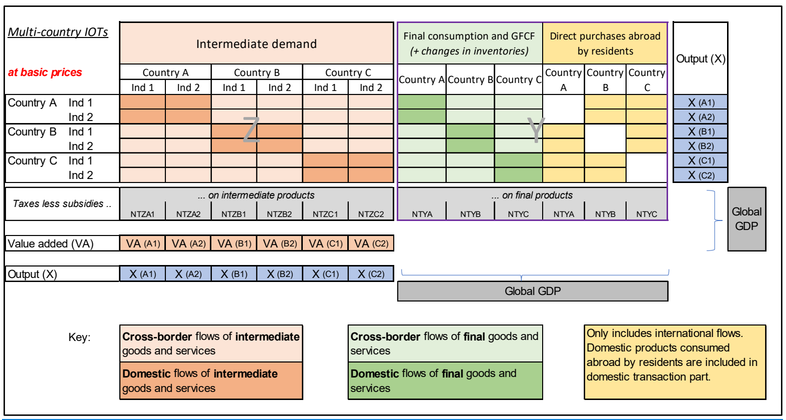
Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Figure 36.1 Multi-country input-output table (basic prices) (A three-country, two-industry

example)



Source: OECD

36.81 Many statistical and methodological challenges remain to improve the coverage and quality of the databases covering multi-country supply and use tables and multi-country input-output tables. Methodological enhancement includes asymmetric issues in bilateral trade flows in cross border and direct purchases, taxes and distribution services as well and valuation differences in merchandise trade statistics. To address these challenges and database developments, there are initiatives being coordinated amongst the international statistical organisations to unify and develop a database with agreed assumptions and data, for example, the GIANT initiative mentioned earlier.

36.82 There is various literature that documents the steps to compile multi-country input-output tables and more detail on the additional challenges that need to be addressed, for example:

Eurostat's FIGARO tables:

https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/methodology

https://ec.europa.eu/eurostat/web/products-statistical-working-papers/-/ks-tc-19-002

OECD note on the compilation of multi-country input-output tables:

https://www.oecd.org/industry/ind/ICIO_2023_Development_and_applications.pdf

2. Uses of multi-country tables

36.83 There are various uses of multi-country supply and use tables and multi-country input-output tables as well as feeding into the production of different analytical products. The following briefly touches on global value chains and trade in value added indicators.

36.84 Production, trade and investments are increasingly organised within so-called global value chains where the different stages of the production process are located across different countries. These global value chains have become a dominant feature of world trade, encompassing developing, emerging and developed economies. More details on global value chains are covered in chapter 23 and available in:

United Nations, Department of Economic and Social Affairs, Statistics Division (2021), Accounting for Global Value Chains: GVC Satellite Accounts and Integrated Business Statistics, Studies in Methods, Series F no. 120.

Formatted: Italian (Italy)

Formatted: Indent: Left: 1"

Formatted: Normal, Indent: Left: 1", Right: 0.81", Space After: 6 pt, Tab stops: 0.47", Left

UNSD web page on GVCs:

https://unstats.un.org/unsd/business-stat/GVC/

UNSD Guidelines for Accounting for GVCs:

https://unstats.un.org/unsd/business-stat/GVC/Accounting_for_GVC_web.pdf

36.85 The goods and services we buy are composed of inputs from various countries around the world. However, the flows of goods and services within these global production chains in conventional measures of international trade are not always reflected in a way which serves certain types of analysis. The trade in value-added initiative addresses this issue by considering the value added by each country in the production of goods and services that are produced and consumed worldwide. More details on trade in value-added indicators are available in chapter 23 and available in:

United Nations Economic Commission for Europe (UNECE) (2015), UNECE Guide to Measuring Global Production

OECD methodological note for TiVA indicators:

https://web-archive.oecd.org/2023-11-24/644737-TiVA_2023_Indicators_Guide.pdf

Page 8: [1] Formatted	Editors	5/12/2024 5:24:00 PM

Indent: Left: 0", Space Before: 0 pt, Line spacing: single

Page 8: [2] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [3] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [4] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [5] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [6] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [7] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [8] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [9] Formatted	Editors	6/11/2024 9:58:00 PM

Font: 10 pt, Not Expanded by / Condensed by

Page 8: [10] Commented [ED15]	Editors	5/12/2024 5:54:00 PM

Consistency with the UN Handbook on supply and use tables and input-output tables with extensions and applications.