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Streamlining the SNA 1993 chapter on Supply and use tables and input-output

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Abstract
In the present *1993 SNA* (System of National Accounts) and the derived *1999-UN Handbook on Input-Output tables*, the text and recommendations cause confusion, particularly among new compilers of symmetric input-output tables (SIOT), and may lead them to adopt inefficient compilation procedures, which hamper the integration of supply and use tables (SUT) and input-output (IO) in the national accounts, as recommended since the *1968 SNA*. Indeed, 'best practice' compilers of IO-tables do not follow some of the major recommendations made in the SNA. Against this backdrop we reconsider which type of recommendations should pertain to the compilation of supply and use and IO-tables in the *updated SNA*, scheduled for publication in 2008, and offer some suggestions for clarification and change of the contents of Chapter XV: Supply and use tables and symmetric tables, reflecting the developments in compilation methods as well as in theoretical and empirical research since the 1990s.

The authors are Council Members of the International Input-Output Association (IIOA).

Contents of the paper
Section 1 sets out some basic requirements the contents of the IO-chapter must fulfill in order to serve as an international standard against which the compilation work in individual countries will be assessed. Section 2 lists the recommendations made in the present IO-chapter. Section 3 discusses the structure and scope of the present IO-chapter. Annex 1 contains specific comments on individual paragraphs. Section 4 contains our major recommendations on changes to the chapter, including changes to terminology and structure. Annex 2 contains some observations on the related "technology" terminology. Section 5 outlines of the possible contents of a technical appendix that will establish the connection to the use of input-output tables. In the interest of compilers, we simplify the terminology and play down the significance of mathematical exercises that have plagued this area. Section 6 concludes.

1. Requirements an IO standard better fulfill

To be an international standard the IO-chapter of the SNA better meets the following requirements:

- A large number of countries should be able to comply with the recommendations. The various quality assessments of statistics (IMF's ROSC Data Module, Eurostat, national quality assessment systems etc.) urge individual countries to "observe" international recommendations. The management of a statistical office is in difficulty if its methods are found to be in conflict with the text of the SNA.

- The recommendations of the SNA should reflect best international practices, also in the sense of striking a sound balance between the requirements of the produced data and the use of resources. Considerable flexibility (pragmatism) should be possible without leading to the assessment of non-observance. Too strict or even ideal requirements force statistical offices to either deploy excessive resources to the compilation of input-output tables or to disengage from this task.

- The relationship between the compilation of statistics and their uses in analysis should be delineated. National accounts statistics are multipurpose data that users may transform, aggregate or otherwise manipulate to fulfill their specific needs. Input-output, however, has a tradition of no distinction between the data compilers and analytical users. IO-tables were compiled with intervals of many years and there was focus on the "stability" or "constancy" of input-output coefficients (such as also reflected in SNA par. 15.125). From a statistical point of view there is no stability requirement and one of the important uses of the time series of IO-tables is the study of the variation of the coefficients over time. IO data are not different from any other type of economic data that analytical users apply in order to identify various types of relationships in their modeling or forecasting. The more or less stable relationships between various sets of data found in analysis should in general not feed back into the way data are compiled, to avoid circularity between data and analytic results, such as meaningless significance tests.

2. The recommendations of the 1993 SNA for input-output tables

In this section we simply collect the explicit or implicit recommendations of the 1993 SNA IO-chapter. The italics and additions in brackets are ours.

15.1 The System *includes* an integrated set of supply and use tables, or matrices, as well as symmetric input-output tables, or matrices.

15.7. The system *recommends* that the statistical supply and use tables should serve as the foundation from which the analytical input-output tables are constructed.
[A possible interpretation: Classifications should not be modified in compiling the SIOT, and SUT should be made with this purpose in mind.]

15.12 Statistical units, in particular establishments grouped in industries serve as a common basis for the production accounts and the supply and use tables, while using institutional units is *not recommended* for input-output compilation.

15.13 Institutional units may engage in several different kinds of productive activity simultaneously. For the detailed analysis of production, the System therefore *recommends* that they should be partitioned into separate establishments each of which engages in only a single kind of economic activity at a single location. Industries are then defined as groups of establishments engaged in the same kinds of productive activities.

15.23 The product classification scheme *recommended* for classifying data on goods and services is the Central Product Classification (CPC)

15.32 The system *recognizes* two kinds of prices for output, both defined to exclude any VAT or similar deductible tax invoiced on the output sold.

15.33 The *preferred method* of valuation [of output] is at basic prices.

15.38 The measure *recommended* throughout the System and reflected in the supply and use table, is gross value added at basic prices.

15.49 The system *recommends* the use of the so-called net system of recording VAT.

15.54 The *recommended* supply and use tables of the System are presented in table 15.1. [Detailed supply table at basic prices adjusted to total supply at purchasers' prices for each product, and use table at purchasers' prices only.]

15.124 In order to respond to these requirements [mentioned in 15.123]: (a) Decompose purchasers' prices of uses into basic price etc.(b) Separate out imported products, and (c) express rows and columns in the same classification] the system *recommends* the following set of input-output tables to complement the basic supply and use tables. [Use table at basic prices, all other tables of the product by product type.]

15.134 In the system it is *recommended* in the analytical input-output tables to make a separate input-output table for imported products.

15.146-147. [Discussion of the merits of the two alternative technology assumptions, mainly based on Kop Jansen and ten Raa's four axioms[1] plus an additional first one which states that industry technology is highly implausible. There is no clear cut conclusion in the text, although the implicit conclusion in the chapter seems to be that the product technology is to be *preferred* (and subsequently the product by product type of symmetric IO-table, see 15.150 below.]

[1] P. Kop Jansen and Th. ten Raa, "The Choice of Model in the Construction of Input-Output Coefficients Matrices," *International Economic Review* 31, 1, 213-27 (1990)

15.148. Make *proper adjustments* to the basic data so as to obtain a supply and use table of good quality. [It is not very clear what this means. Good quality in which sense and in which way related to the choice of "technology." The intention could be in the direction of the "two step process."[2]]

15.150 Since the product by product table *will often prove most useful*, only this table is actually described in detail in this manual.

15.167 Symmetric input-output tables *should also be prepared at constant prices*. They are obtained in the same way as the input-output tables at current prices, i.e. from the supply and use tables at constant prices.

15.169 Compilation of input-output tables *should be closely linked to economic statistics and national accounts in general***.**

3. Discussion of the structure and scope of the IO-chapter

The structure of the chapter is not clear. It is not obvious what determines the sequence of the various sections. Nor are the headings and contents of the various sections and subsections easily fitted into a logical framework. The critical remarks in this section should, however, not be seen as deducting anything from the enormous positive influence that this chapter has had on compilation procedures, or as directed against the authors of the present IO chapter.

The *strategic considerations* and *purpose* of the whole exercise that relate to questions that the reader may have during most of the chapter are only dealt with in the two last sections (E and F). It would be user friendly to put these considerations at the beginning of the chapter, and to describe the place of the commodity-flow method and supply and use table in the overall compilation framework of national accounts. Also certain parts of section B (balancing, constant price compilation, basis for the compilation of preliminary annual and of quarterly data (as recommended in the IMF manual on QNA) could usefully be moved forward. Other important strategic considerations concern the *change of base year for constant price estimates* (without a new balancing process) and the *recalculation of back series following major revisions*.[3] The strategic considerations should impact the contents and recommendations in the remainder of the chapter.

The above would in particular imply that many of the considerations dealt with in the section D: "Derived and analytical input-output tables" should be moved forward and play a decisive role in the recommendations on how to compile the supply and use tables. For example the use table at basic prices could (should) be made part of the standard SUT, as it is needed for the constant price calculation and for the direct use of the SUT for analytical purposes. Also, the choice and definition of economic activities in a consistent system of national accounts tables (annual, quarterly, supply and use tables, symmetric input-output tables) bear on the quality and the resource requirement of the national accounts, including the ability of the statisticians to maintain a system of consistent time series over several rounds of major revisions, changes in basic classifications, and changes of base year for constant price calculations.

[2] See the last section of B. Thage, "Symmetric Input-Output Tables: Compilation Issues," Fifteenth International Input-Output Conference paper, Beijing (2005)
[3] Unfortunately IO-tables are often effectively lost in connection with a major revision.

Strategic choices should be clarified: Do ideal IO-tables exist? (There is in fact a section under this heading in the 1968 SNA). And under which restrictions should they be defined. The situation of a "stand-alone" table for a single year should be evaluated against the case of time series of IO-tables, comparability to other types of data, the ease with which it can be revised, the transparency of compilation methods etc, and of course the resources needed for the compilation. In short: System requirements versus individual table requirements.

The title of section B. "Disaggregation of goods and services account" is not well chosen. It is essential for compilers and users of national accounts data to realize that aggregated data are *aggregated* and that the detailed data are the point of departure instead of something derived. Thus we should be careful not by the choice of wording to lend support to the practice in some countries where SUT and SIOT are compiled after the annual accounts have been declared final, and therefore have to be adjusted to a priori known totals. Much of the purpose of the IO-compilation is missed in this way.

What is in the chapter about the famous "*technology"* question and the choice between industry by industry and product by product tables is fragmentary (such as the section "Adding analytical assumptions to basic data", and cannot easily be understood by a reader without any background in this area, even though it forms the basis for important recommendations. A reference to the Handbook is not sufficient here. (The present handbook may not be that helpful to an IO-compiler and contains a number of problems of its own). A reference to the more elaborated treatment in the 1968 SNA may be useful for the understanding of what this is all about in more theoretical terms, but cannot account for all the developments since the mid 60ties.[4]

"*Modeling*" arguments appear in various parts of the text and may contribute to the confusion. In general the chapter seems to be based on the tacit assumption that everybody knows what IO analysis is about, and that there is a firmly established common agreement on what assumptions to make and how they should affect the data compilation.[5]

The only new type of classification introduced in the IO-chapter is a product classification. All other classifications and definitions have already been set out in other chapters of the SNA. The choice of product classification is, however, only briefly discussed (15.23-24), and is mainly a recommendation of using the CPC classification. There is no discussion of the properties we would like to see, or why CPC should be particularly suited. The question of the product classification is closely related to the requirements of a product by product type of table, and the CPC is the only product classification with "industry" characteristics. As a result, product by product and industry by industry tables will be closely related. The concepts of characteristic products and/or industries also belong in this context; it is not very clear what 15.137a and 15.138 really say about this question. Thus the result of letting the empirical evidence (as contained in the supply table) define in which economic activity a product is characteristically produced will be different from choosing the theoretical guideline contained in the CPC. If the former alternative is chosen, it does not matter which product classification is used, but in a product by product table the classification will in that case be a tailor made one that minimizes what is classified as secondary production in any particular

[4] See Th. ten Raa, "Input-Output Requirements of National Accounts," *Handbook of National Accounting: Use of Macro Accounts in Policy Analysis*, Studies in Methods, Series F, No. 81, 65-82, United Nations (2002).
[5] Modeling arguments appear at least in 15.125, 15.127, 15.131, 15.134, 15.147 and 15.155 prior to the section dedicated to IO-analysis (15.174-178).

year. In the case of a product by product table comparability over time will need a special interpretation.

It has led to much confusion that products are given industry names. Why not for example compile product by product tables for certain aggregation levels of the HS or the SITC or by products according their degree of technical sophistication or other characteristics? A discussion of this aspect will clarify that when compiling symmetric IO tables we are basically always dealing with industry by industry tables, but that some may be modified more than others when compared to the classifications used for the source data in basic statistics. This may bring the classic discussion about industry by industry tables versus product by product tables more down to earth. Thus an industry is not transformed into a product just because some secondary production is reclassified. Industries are – contrary to products – made up of organizational units. These conceptual issues are further discussed later in the paper.

The section on the import matrix (15.131-136) does little more than defining three alternative ways of treating import in the table. The discussion of complementary versus competitive imports is not related to the level of aggregation for which they are defined, and thus not very informative. There is certainly a reason why such a distinction is made in very few countries. The treatment here is a very fragmentary left over from the detailed discussion of this issue in the 1968 SNA. Missing is also a discussion of properties of the ”residual” domestic matrix, and on which reasonable assumptions it can be transformed into a symmetric input-output table, as the dominant concept is now market shares and not any type of “techniques”. There is no indication that the global table, with domestic output and imports lumped together, also have important analytical uses (it is misleading to use the term “simple method” about this type of table in 15.131).

Annex 1 contains detailed specific remarks on individual paragraphs of the present IO-chapter.

4. Suggestions

The 1968 SNA introduced input-output tables as integral part of the system of national accounts. The system of supply and use tables followed naturally from the famous matrix representation in Richard Stone’s Table 2.1 “An illustration of the complete system” and empty matrices cried to be filled by symmetric industry by industry and product by product tables, and mathematical techniques were developed to show how this could be done.[6] The 1968 SNA made practically no distinction between modeling considerations and compilation issues. The origin of input-output is more model-oriented than the rest of the national accounts. In the 1993 SNA the presentation of input-output is more operational and concrete, but the modeling aspects are still just below the surface, and at the end of the chapter some purely theoretical considerations are given considerable weight in the recommendations concerning the choice of type of IO-table and compilation techniques, which later spill over into the UN Handbook.

[6] For the history we refer to F. Bos, *The national accounts as a tool for analysis and policy*, Dissertation, University of Twente (2003).

<table>
<tr><td colspan="3">Chart A: The three step approach in the compilation and dissemination of input-output tables</td></tr>
<tr><td colspan="3">1: Compilation of the supply and use tables</td></tr>
<tr><td colspan="3">Choose standard classifications by product (CPC, HS, SITC) and by economic activity (ISIC, Other possibilities?)</td></tr>
<tr><td colspan="3">Decide the levels of detail for products and economic activities</td></tr>
<tr><td colspan="3">Decide where to use redefinitions for economic activities (such as creation of certain “pure” activities in certain areas such as agriculture, construction and trade, or in general “pure” tabulation categories (SNA 5.30-34).
Should be consistent with the tables by economic activity in the current national accounts.</td></tr>
<tr><td colspan="3">Decide where to use redefinitions for products, including decisions on where to include various types of special products (repairs, work on others materials, the fish farm case etc.)</td></tr>
<tr><td colspan="3">Compile the supply and use tables, including the use table at basic prices (i.e. separate matrices for trade and transport margins, and taxes and subsidies on products).</td></tr>
<tr><td colspan="3">2: Prepare data for analytical uses (3 alternatives)</td></tr>
<tr><td>Direct application of the rectangular supply and use table. Use table must be at basic prices. (Possibly more aggregated versions of supply and use tables than above).</td><td>Compilation of symmetric activity by activity consistent with classification on the supply and use tables, and standard national accounts tables by economic activity.</td><td>Compilation of “pure” activity symmetric table (each product belong in one single activity only)</td></tr>
<tr><td></td><td>Assumption:
Fixed product sales structures (i.e. the distribution of a product by users is independent of the producing economic activity).
As input structures by economic activity are left unchanged, no assumptions on input structures are needed.</td><td>Assumption:
The inputs needed to produce a “product” depend on the characteristic producer rather than the actually producing activity (if they are different).</td></tr>
<tr><td></td><td>Practical implementation:
(1)Subdivision of the rows of the use table by actually producing activities (applying the information given by the supply table)
(2) Addition according to activity code.</td><td>Practical implementation:
(1) Aggregation of the supply and use tables to square tables, creating product groups that defines the output of “pure” activities.
(2) Transformation of the columns of the use table into “pure” industries (applying the information given in the square supply table).</td></tr>
<tr><td colspan="3">3: Dissemination. Standard analytical results (impact multipliers, productivity etc.)</td></tr>
<tr><td>Assumption:
The input structure (in terms of products) of an activity is independent of the product mix of the output
(Alternatively: Independent of the user of the product, as the rectangular tables tell that different users use the outputs from an activity in different proportions.)</td><td>Assumption:
The input structure of an activity is independent of the user of the output (an activity or a final use).
The input structure is thus assumed independent of the underlying product mix.
(We do not talk about “changes” in the underlying mix, as this mix is given by the basic data for each individual element.)</td><td>Assumption:
The input structure of a “pure” activity is independent of the user of the output (a “pure” activity or a final use).
The input structure is thus assumed independent of the underlying product mix.
(Although the ways the “pure” activities have been obtained may at this stage make it difficult or impossible to identify the product mix of the individual elements in terms of supply and use table products.)</td></tr>
</table>

Chart A depicts the three step approach in the compilation and dissemination of input-output tables. First and foremost, also in terms of statistical office resources, is the compilation of the *supply and use tables*. The second step is the preparation of the data for analytical uses and the third step is the calculation of some standard analytical results, to disseminate some IO data in a user friendly form.

The increased focus on supply and use tables has been an important trend during the latest 10-15 years. More countries produce such tables as an integrated part of their national accounts work, following the recommendation given in the 1993 SNA to apply the commodity flow method as the basic compilation techniques for the production part of the national accounts in both current and constant prices. Additionally, the direct application of supply and use tables in economic analysis has become more wide-spread. This development is based on both computational and analytical progress, down to econometric analysis of micro data directly in connection with the analysis.[7] The traditional symmetric input-output table and much of the discussion of the underlying assumptions may be approaching retirement. These new developments should be reflected in the updated IO chapter. The main text need not dwell on the construction of symmetric IO tables; this can be relegated to an annex.

Chart A avoids traditional (and often controversial or unnecessarily complicated) input-output terminology, such as "homogeneous" units or activities, technology assumptions, industry by industry or product by product tables. The new organizing principle is that of a more or less "pure" *activity*. It is relevant for decisions that are taken both prior to the compilation of the supply and use tables, and in the preparation of data for analytical uses. In the latter context the term "pure activity" replaces the traditional term "product" in product by product symmetric input-output tables, as it better describes what is actually going on, namely that all symmetric input-output tables are of the economic activity by economic activity type - only the degree of "purification" of the activities may differ.[8]

Step 1 makes the fundamental choices of number of economic activities and products and their classifications. As the product classification has no counterpart in any other part of the national accounts, it can be chosen on pragmatic premises. The recommendation to use the CPC classification should be modified and seen in the context of "pure" activities as discussed above. However, as the production part of the current national accounts contains data classified by economic activity, it better be recommended that the classification in the supply and use tables is consistent with the classification used in the rest of the national accounts. According to the SNA the relevant unit in the production part of the national accounts (and thus also the SUT) is the kind of activity unit (KAU). For national accounts purposes a further breakdown is recommended for KAUs that have production in two or more *tabulation categories* of the ISIC (i.e. broad industry groups such as agriculture, fishing, mining, manufacturing, construction etc).[9] In principle this condition should apply to both horizontally and vertically integrated KAUs. These additional breakdowns, or *redefinitions* are typically made "by hand" based on the best available information and judgment of the national accountants. When redefinitions are carried out already as an

[7] See Th. ten Raa, "Input-Output Requirements of National Accounts," *Handbook of National Accounting: Use of Macro Accounts in Policy Analysis*, Studies in Methods, Series F, No. 81, 65-82, United Nations (2002) and Th. ten Raa, *The Economics of Input-Output Analysis*, Cambridge University Press (2005).

[8] Concerning the use of the term "activity" as reflecting a middle way between traditional "industries" and "products," see P. Konijn and A. Steenge, "Compilation of Input-Output Data from the National Accounts," *Economic Systems Research* 7, 1, 31-45 (1995).

[9] See SNA par. 5.30-5.34. This recommendation is relevant only if the basic statistics have not been broken down already.

integrated part of the current national accounts work, this will at the same time facilitate the balancing of the SUT because the input structures will be less complicated. If the units are primarily of the enterprise or legal unit type the redefinition process becomes even more important.

National accountants are not supposed to create their own versions of all types of basic statistics; that would be neither cost effective, nor user friendly. In practice the redefinition procedure[10] will be restricted to a few activities: agriculture, energy, construction and trade. For some activities redefinitions have already been carried out in the source data. For example, the European System of Agricultural Accounts requires that all agricultural activity is covered by the accounts, and there are very limited possibilities to retain non-agricultural secondary production within the system's definition of agriculture. Similarly all dwellings are usually grouped together in one single industry independently of the activity of the actual owner. Trade activities outside the trade industries must by definition already have been separately identified in the national accounts, as only the trade margins and not the gross turnover of the traded products should be counted as output. Construction activities are also often redefined to one single "pure" construction activity which also facilitates the distribution of the intermediate consumption of building materials.

In traditional input-output terminology these redefinitions bring the table closer to the "product by product" type of table, and the methods applied will most often implicitly assume some kind of "product technology," although the redefinitions deal only with that part of secondary production that belongs to another tabulation category, and can be controlled in detail. The results will come as no surprise and not give rise to negative elements. Although the redefinitions serve the purpose of more "pure" activities and thus facilitates IO analysis, their main purpose is to produce an activity classification that is relevant for the national accounts as a whole.

Redefinitions should be addressed in the IO-chapter (and perhaps earlier chapters where production by economic activities is discussed) as the decisions made here are crucial for properties of the system of accounts. Three different situations can be distinguished: (1) No redefinitions take place in the national accounts or SUT, before the SIOT is calculated; (2) Redefinitions have been carried out for all national accounts data and in the SUT prior to the calculation of the SIOT; and (3) Redefinitions are not carried out when the current national accounts are compiled, but applied when the SIOT (and possibly the SUT) is worked out. In the first two cases the consistency and comparability between current national accounts and SIOT classifications are upheld, but not in the third case.

The present IO-chapter says little about the final uses. Transformation matrices connecting final uses classified according to function (COICOP, COFOG) or, for fixed capital formation, by type and economic activity, are useful for statistical and analytical IO-work. It should be noted that in the

[10] This redefinition or *two-step process* emerges from the practice in several countries. It is explained in detail for the United States in Jiemin Guo, Ann M. Lawson and Mark A. Planting: *From make-use to symmetric I-O tables: An assessment of alternative technology assumptions.* BEA, paper presented at the Input-output conference in Montreal, Canada 2002. The article also analyses the differences between the resulting tables when redefinitions are not applied (case (1) in the following), and when they are applied (case (2) in the following). The redefinition method is also used in Canada and Denmark, whereas industry by industry tables in Norway are of the case 1 type to retain to a maximum degree of micro-macro link. The industry by industry SIOT of the Netherlands seems to fit somewhere between case 1 and 2. In France the first step (redefinition), based on enterprise units, is carried to such an extreme that the supply matrix becomes diagonal. The use matrix is thus also the SIOT, and the second step (compiling the SIOT) becomes superfluous (see full exposition of the French case in the paper of Michel Braibant: *French experience of input-output tables since 1950*, prepared for this IARIW conference)

SNA final uses are not classified by economic activity of origin (“pure” or not). These transformation matrices are therefore needed to link the standard SNA classifications of final uses to production.

As the 1993 SNA accepts that separate matrices for margins and taxes on products must be prepared in connection with the user table in order to obtain the totals by product in the supply table at purchasers’ prices, these various layers of value in the use table my just as well be introduced as part of the basic supply and use framework. In other words, this should be moved upfront to step 1[11].

Step 2 is limited to the direct application of the supply and use tables for analytical purposes, and an outline of the two relevant cases of “stylized” symmetric input-output tables (see Annex 2).

Step 3 is about the dissemination of input-output data. It makes little sense to publish the detailed supply and use matrices or symmetric input-output tables and their Leontief inverse on paper, but by a little further processing of the input-output data the users can be supplied with results that may be seen as examples and may induce further analysis and thus promote this type of national accounting. Step 3 also clarifies the relationship between statistical and analytical IO tables and explains why analytical aspects of the IO-tables are included the SNA-System. After all, many other parts of economic theory, such as linear expenditure systems, Cobb-Douglas or CES production functions are not facilitated by specific data structures. The criterion for including such elaborations in the System may be that they still represent very *simple structures* that can be interpreted as further processed statistical data rather than models, and in particular are not based on assumptions about techniques or behavior. It may also be noted that these further processed data is a way of checking data quality and creating continuity in time series in spite of structural changes. Thus the development in the direct and indirect contents of for example labor and capital will be independent of changes in outsourcing and ownership of capital, increased reliance on semi-fabricated intermediate consumption etc.

5. Outline of a technical appendix

The purpose of a technical appendix is to establish the connection between the national accounts oriented compilation of IO data and the vast theoretical and technical literature that exist in this field. Although the mathematical annex to the IO chapter in the 1968 SNA is the classical reference it should not necessary be taken as the only point of departure or its terminology adopted uncritically (see Annex 2 below on the problems related to the “technology” terminology). On the other hand enough information should be given to permit a meaningful dialog with theoretical and analytical users of the IO data. Another aspect is simplification. The compilers deal with a world made up of millions of products and thousands of activities, and should be keenly aware of the role that more simplified models can play as guidelines for their actual compilation work. Thus some

[11] In its opinion on the European transmission program for national accounts data the European Central Bank notes: “The ECB would prefer use tables also in basic prices, so that symmetric input-output tables could be constructed at annual intervals. If these annual tables were also broken down into import and domestic components, the symmetric input-output tables for domestic output and imports at basic prices would not be a priority requirement for the ECB. The ECB considers that the symmetric input-output table at basic prices and the symmetric input-output tables for domestic output and imports at basic prices at five-yearly intervals are less relevant due to the time lag and low frequency of their data”. Official Journal of the European Union, 7.3.2006.

types of assumptions are mostly relevant for the analytical users whereas others may usefully spill back into the techniques used in the data compilation.

The outline in this section touches on some new aspects and should not be seen as exhaustive. The terminology advocated in other sections of this paper is not fully reflected below and there is a balance to be struck between a modified terminology and what is now found in existing literature. The full contents of the annex may refer to up-to-date textbook and manuals, such as (ten Raa 2002 and 2005, see footnote 7) and others.

The point of departure is the Supply and Use Table (SUT). In the SNA, the supply and use table have opposite dimensions. The use table, U, has product rows and industry columns, while the make table, V, has industry rows and product columns. Industry j thus feeds column j of use table U and row j of supply table V. At the level of data collection, the role of industries is assumed by activities. In other words, source data for activity j feed column j of use table U and row j of supply table V. Because the number of industries or activities is not equal to the number of products, supply and use tables are rectangular. A traditional input-output matrix, A, has the same number of rows as of columns and, therefore, is square. Typical element a_{ij} of this matrix represents the amount of input i required per unit of output j.

If the input and the output of an input-output matrix represent industries, matrix A is an industry-by-industry table. The inputs of industry j are given by column j of the use table and consist of products. To express these quantities in industry outputs, a correspondence between products and industries is needed. The compilation of industry-by-industry input-output matrices from either rectangular or square supply and use tables could be discussed. The appendix should provide the formula for the industry-by-industry input-output matrix.

If the input and the output of an input-output matrix represent products, matrix A is a product-by-product table. The first column of such a matrix lists all the product requirements per unit of product 1 and, therefore, constitutes the 'recipe' or 'technique' for product 1, etcetera. Contrary to the general conception the construction of a product-by-product table can be seen as requiring no aggregation of the supply and use tables to square tables. The main two models for the construction are the industry technology model and the commodity technology model. The appendix should provide the two formulas. Next the advantages and disadvantages of the two models should be discussed, including a classification of economic problems for which they are relevant.

The main application of input-output matrices is multiplier analysis. The total product outputs of an economy, listed in gross output vector x, are obtained by summing the entries of the supply table, V, over activities or industries. Since its dimension is industries by products, this is obtained by pre-multiplication by the unit row vector, $e' = (1 \ldots 1)$, or, equivalently, by post-multiplication of the transposed supply table, V', by the unit column vector: $x = V'e$. Similarly, the intermediate input vector is obtained by summing the entries of use table over activities or industries: Ue. In input-output analysis, the intermediate input is assumed to be proportional to the gross output: $Ue = Ax$, where A is a product-by-product input-output matrix.[12] The difference between the gross output and intermediate input vectors is the net output vector: $y = x - Ax$. The solution to this material balance equation is $x = (I - A)^{-1}y$, where $(I - A)^{-1}$ is the matrix of cumulated input-output coefficients, also called multipliers, or the Leontief inverse.

[12] This assumption is fulfilled both by the industry technology model and the commodity technology model (Kop Jansen and ten Raa, 1990).

This matrix of production multipliers is still published by several countries, but this practice gets out of fashion for a number of reasons. First, the calculation of any Leontief inverse is within reach of practitioners. Second, all the elements of the material balance equation (x, y and A) are derived from the supply and use tables, V and U. The net output of the economy can be expressed more directly as $y = (V' - U)e$. Unit vector e can be considered an activity vector. Its replacement by a variable s (of the same dimension) yields the net output of the economy if the level of activity j is increased by a factor s_j. In this activity variant of input-output analysis, the variable is activity vector s instead of gross output vector x, and the problem of constructing an input-output matrix is circumvented. Employment and other multipliers can still be calculated, including their confidence intervals.

Preservation of the supply and use table at the disaggregated level of data collection enables statistical input-output analysis. For example, commodity technology input-output coefficients fulfill $U = AV + \varepsilon$, where ε is an error term. This relationship between inputs and outputs can be considered a regression equation and thus be used to estimate the input-output matrix, A. The more observations, the better will be the estimate. Since the number of observations is the number of activities (or industries), it is commendable to preserve supply and use statistics at the level of reporting units.

6. Concluding remark

The contents of this paper are *input* into the ongoing updating process of the 1993 SNA and, therefore, not completely self-contained and consistent. The latter objective becomes within reach if the switch in emphasis from SIOTs to SUTs proposed in this paper finds it way in the revision of the SNA and much ado about alternative SIOT constructions can be deleted or at least relegated to a technical annex.

Annex 1: ***Specific observations in SNA Chapter XV: Supply and use tables and input-output***

For the purpose of this annex readers may also wish to have the 1993 SNA at hand as references are made to the text of individual paragraphs without this text being reproduced here.

15.3-7. The distinction between statistical and analytical IO-tables no longer coincides with the distinction between the supply and use tables and the symmetric IO-tables. Major producer and user countries of IO (Canada, USA, and Norway with a few exceptions) do not even compile symmetric IO-tables. Furthermore, whereas analysis can be carried out using the supply and use tables directly, symmetric tables may on the other hand be put to statistical uses (such as overall checks through impact multipliers) and as framework for compiling quarterly accounts. See also 15.143 where this point of view is reflected. It would be better to refer to the "family" of IO-tables.

15.7. The description of major conceptual compilation issues for the symmetric IO-tables should not be referred to a Handbook as handbooks can be published without any prior agreement or approval. The major principles and terminology should be defined in this chapter, and the notion that the compilation of analytical tables requires highly abstract assumptions and/or reliance on types of source data that are usually outside the realm of economic statistics and national accounting, should in principle not be accepted when compiling official statistics.

15.13. The term "ideally" is problematic. The real world is often organized in extremely complex ways, and it is not helpful that national accountants should wish that it were ideally otherwise, and try to remodel it as such. Rather we have to deal with the complex world in the most appropriate way. The term "homogeneous production units" did not exist in the 1968 SNA, though general statements such as "as homogeneous as possible" were used. In fact this *ESA-term* was only introduced in the 1993 SNA to make it portray also the then existing version of the ESA which did not contain the concept of industries.[13] Thus national accounts tables by economic activity were at that time (and until the mid 1990s) supposed to be reported to Eurostat according to "homogeneous branches" based on a classification of homogeneous production units that never had an operative definition. (For example, "single kind of productive activity" depends on the level of aggregation.) As industries have been introduced in the 1995 ESA, the "homogeneous unit" concept is no longer needed in the SNA, and should be avoided. [The concept may still (check draft text to the introduction to the new ISIC) be mentioned in the ISIC when developing the theory of economic units, but this need not necessary influence the SNA terminology.]

15.17. It should be underlined that the units and classifications used in the sequence of accounts for industries in the System are also those that should be used in the SUT (and SIOT). But the expression "as far as practically possible" should be clarified. The national accountants are not supposed to create their own versions of all types of basic statistics, as also reflected in the last sentence of 15.15. Thus the recommended "separations" should be defined more precisely, such as by reference to SNA 5.30-34 and some practices.(For example the fact that the supply matrix outside manufacturing industries is strictly diagonal in most countries due to the lack of relevant product information for service industries).

[13] For the introduction of the concept of "homogeneous branches" in the 1970 ESA and its relation to the French national accounts practice see F. Bos, *The national accounts as a tool for analysis and policy*, Dissertation, University of Twente (2003), p. 18.

15.22. It is not the exception, or in "some cases" that basic data are missing or incomplete for some elements, but the normal situation (as is also explained in the 1968 SNA). This point is important because potential or new compilers of supply and use tables often believe that it is extremely data demanding and therefore impossible or very difficult in their case - whereas in fact the use of the commodity flow method is very much to be recommended when the basic data situation is poor.

15.23. Unclear what "lacking full benefits" is referring to. The last sentence should either be explained or deleted. (See comments on the recommendation of CPC elsewhere).

15.28. The elevation of producers' prices to be used as an alternative to basic prices in the 1993 SNA (already the 1968 SNA strongly recommended the use of basic prices in IO compilation) was mainly caused by the fact that the 1970 ESA only contained the producers' price concept (and not basic prices at all). With the changes that took place with the 1995 ESA it would be relevant to play down even more the producers' price concept in the SNA, in particular as under the net VAT recording producers' prices do not even include non-deductible VAT. It should possibly be explicitly stated that compiling value added by economic activity at producers' prices is not in agreement with the (updated) SNA. The complicated parallel description of measurements at producers' prices in several paragraphs of the SNA could then be avoided.

15.28 (and following). The concept of transport margin and its relationship to invoicing procedures may need more explanation. Thus if a purchaser of a good receives two separate invoices, one for the good as such, and another one for its transportation, he is supposed to *add* them before reporting his purchase of this good. To get this right not only invoicing procedures should be known, but the instructions on the questionnaires should also reflect this. In general the understanding of basic prices as highly pragmatic (and therefore useful) concept seems to be somewhat lacking among both compilers and users of national accounts data.

15.48. The definition of VAT should be broadened to include also the for example the Japanese consumption tax. In the Japanese case VAT is not (usually) specified on the invoices, but those enterprises liable to pay VAT have to complete an annual tax return, on basis of which their total sales less their total purchases is taxed with a certain percentage consumption tax rate. Thus VAT is not invoiced, but the tax will of course affect the purchasers' prices as if it were the case.

15.58 (and 15.61). As it is accepted that the estimates at purchasers' prices in the supply table is not possible unless the matrices for margins and taxes on products have already been compiled (table 15.2) from the user side, the recommended approach may as well be to compile the supply table also at basic prices from the outset, and not see it as something that only comes into play when the analytical tables are compiled.

15.68. Could some way be found to avoid the cif/fob adjustment, at least in the present form, as it creates a many difficulties for both compilers and users (and what are the current practices?). The cif/fob registration from the 1968 SNA could be adopted again for IO purposes. It is much easier to understand, and does not require separate rows and columns. The deficit/surplus on the BOP for goods and services would still be consistent with the summary tables for the national accounts.

15.75 (and 15.93). The use of the term "non-allocated" is confusing. The reader may be given the erroneous impression that it is only that part of net taxes on producers that has not been included in the purchasers' prices of intermediate uses that should appear here. But the fact is that the *total net* *taxes on products* should appear here, no matter how they are eventually being borne by intermediate and final users. 15.93 may give the key to the correct interpretation of 15.75, namely that 15.75 also covers the case of valuation at producers' prices. To avoid misunderstandings it may be useful to note here that the System does not cover the *payment* flows of taxes and subsidies on products – thus there are no transactions showing the actual payments of VAT by functional or institutional units to government – the tax collector is not identified in the System.

15.86. To better understand the implications of changes in inventories for intermediate uses and input-output coefficients it would be useful to explain that changes in inventories at current prices consist of two parts: (1) Physical changes in inventories valued at the average prices of the year, and (2) Valuation adjustment item to adjust for the fact that production and use may be distributed differently over the year (which again should not be mixed up with the concept of "holding gains").

15.88. The argument that the treatment of financial leasing as change of ownership leads to a "more homogeneous" registration of capital, may be correct, but this is not the reason for this convention. The reason is that this type of leasing is actually a financial transaction in the System. If "homogeneity" were the aim, we should also reclassify all those capital items that are operationally leased, especially commercial buildings, but also for example ships and airplanes. Thus we have to accept that for these reasons there may be major differences in input structures between otherwise similar establishments.

15.101-105. This text is too summary to be useful. Concerning productivity it would be better – later in the chapter – to illustrate the possibilities by means of the IO-calculations of direct and indirect capital and labour contents. This type of calculation is IO specific and may in many respects produce results that are more relevant (analysing the whole economy as one single system) and comparable over time than the standard productivity measures by economic activity.

15.106-110. Cross classification by institutional sectors may be moved to some other chapter. There is nothing IO-related about this.

15.111-15.119. It is difficult to see the purpose with all these formal equations. They only contribute to complicate matters. This may have survived from some similar expositions in the 1968 SNA.

15.121-122. As noted earlier, the differences between statistical and analytical IO tables should be deemphasized.

15.123. The tables (a) and (b) should be part of the standard SUT system, and not only seen as a means of arriving at an analytical IO table

15.125. Two assumptions about static IO-tables are suddenly brought in here, as if they were well known and necessary – which they are not. It is not clear whether the purpose of the three following par. is to modify these assumptions, or what the final conclusion is supposed to be.

15.131-136. The import matrix was already discussed above. One important case for a separate import matrix in less developed countries is when practically all manufactured products are imported, and may be allocated to uses on the basis of the usually very detailed foreign trade statistics. In this case the import matrix is not separated out ex post, but the total matrices for intermediate consumption and final uses are obtained by *adding* the import matrix and the domestic matrix.

15.137-143. This summary exposition is not helpful. Too many conditions and practical aspects are left out. The reference to the *collection of supplementary statistical information* in par. 15.140 and the focus on secondary production have very far reaching implications. (See the reference to P. Konijn et al. in footnote 8). This also includes the important questions about being faithful to standard classifications and existing basic statistics.

15.144. This is the first time that the term *technology assumption* is used.

15.148-149. Key to practical approach but should appear much earlier. But which kinds of adjustments are we talking about. The idea of "Mixed technology" is not a special case, but in practice underlying all IO compilation work. If 15.149 is taken literally (which it should be) then why is this talk about technology?

Section 4: Conversion of the supply and use tales into symmetric tables must be seen as an introduction to section 5: Symmetric input-output tables.

15.150. It is not explained in which sense or to whom a product by product table will prove "most useful". May have been taken from the 1968 SNA where there is a similar statement with more arguments.

15.157-158. This formal exposition is not very useful to the reader (same arguments as for 15.111-119)

15.159-162. These two sections should be redrafted and moved to the introductory part of the chapter.

15.169. Statement that compilation of IO should be closely linked to economic statistics and national accounts in general. This is, however, not clearly reflected in many other parts of the chapter.

15.170. Note that the weights of input price indices must refer to inputs in economic activities (industries and not "products"). This is an important use of IO data in preliminary yearly, and quarterly national accounts, as well as in some price indices in the short term statistics

15.174. This section dealing with input-output analysis could for example be separated into subsections dealing with increasingly sophisticated uses, such as:

1. Tables showing standard set of multipliers or impact or structural analysis that can be comparable over time. The results of such calculations could be seen as a type of more processed *data* that it would be relevant for a statistical institution to calculate and publish along with the IO-table (or rather instead, as is for example done for Denmark in the annual IO-publication, as publishing detailed IO-table and inverse on paper may be of limited user interest). The major point here is the simplicity of the calculations, but still relevance of the results. This could also include labour productivity and environmental accounting.
2. More sophisticated IO analysis, but still predominantly based on IO data.
3. Other types of analysis or modeling, where IO plays a partial role only.

Annex 2: Product and industry assumptions and tables

Chart 1 illustrates the four standard methods set out in the *1968 SNA* for deriving SIOTs from the SUT.[14] According to the SNA there are two types of tables, product-by-product and industry-by-industry tables, that each can be derived using either the assumption of a product technology (assuming that a product has the same input structure in whichever industry it is produced) or the assumption of an industry technology (assuming that all products produced by a particular industry have the same input structure). Application of the product technology assumption will usually result in some negative elements.

Chart 1. The four alternative symmetric input-output tables in the *1968 SNA*

	Product-by product table	Industry-by industry table
Product Technology	(a) Negative elements	(b) Negative elements
Industry Technology	(c) No negative elements	(d) No negative elements

It has been pointed out that the terminology first introduced in the 1968 SNA is misleading, when the term "technology" is used also in connection with the construction of a SIOT of the industry-by-industry type from supply and use tables (SUT).[15] Thus, in *Chart 2* the main distinction is not between two technology assumptions, but between technology and sales assumptions. Two boxes are automatically empty and the two types of standard tables (b) and (c) should not be considered further, as it is difficult to find any rationale for them.[16]

Chart 2. An alternative terminology for symmetric input-output tables

	Product-by product table	Industry-by-industry table
Technology Product technology Industry technology	 (a) Negative elements (c) No negative elements	Empty
Sales structures Fixed product sales structures Fixed industry sales structures	Empty	 (d) No negative elements (b) Negative elements

The market share assumption (fixed product sales structure) represents the minimum manipulation of data that will lead from the SUT to the SIOT. This was the method generally used to construct SIOTs before the 1968 SNA terminology was introduced, and this is still the preferred method in those countries where IO tables are compiled on a current basis as an integral part of official statistics.

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[14] These standards methods are also discussed in summary form in the *1993 SNA* and the *1995 ESA*, and in more detail in the UN *Handbook on Input-Output Tables* (1999).

[15] Konijn P.A. and A.E.Steenge: *Compilation of input-output data from the national accounts*, Economic System Research, no 1, 1995.

[16] Although the formal characteristics of the four tables (a)-(d) in the two charts remain the same, the criteria for the choice of compilation method becomes more transparent in Chart 2. The industry-by-industry table based on the fixed product sales structure (d) involves neither technology assumptions, unlike (a) and (c), nor the need to adjust for negatives, unlike (a) and (b), and retains the link to the national accounts data and basic statistics. It should also be noted, that the *overall sales share* in a row is not based on an assumption, but actually observed. The assumption only concerns the break-down of the individual row elements. Even if this assumption is not fulfilled at the element level this will only marginally affect the analytical properties of the resulting table.