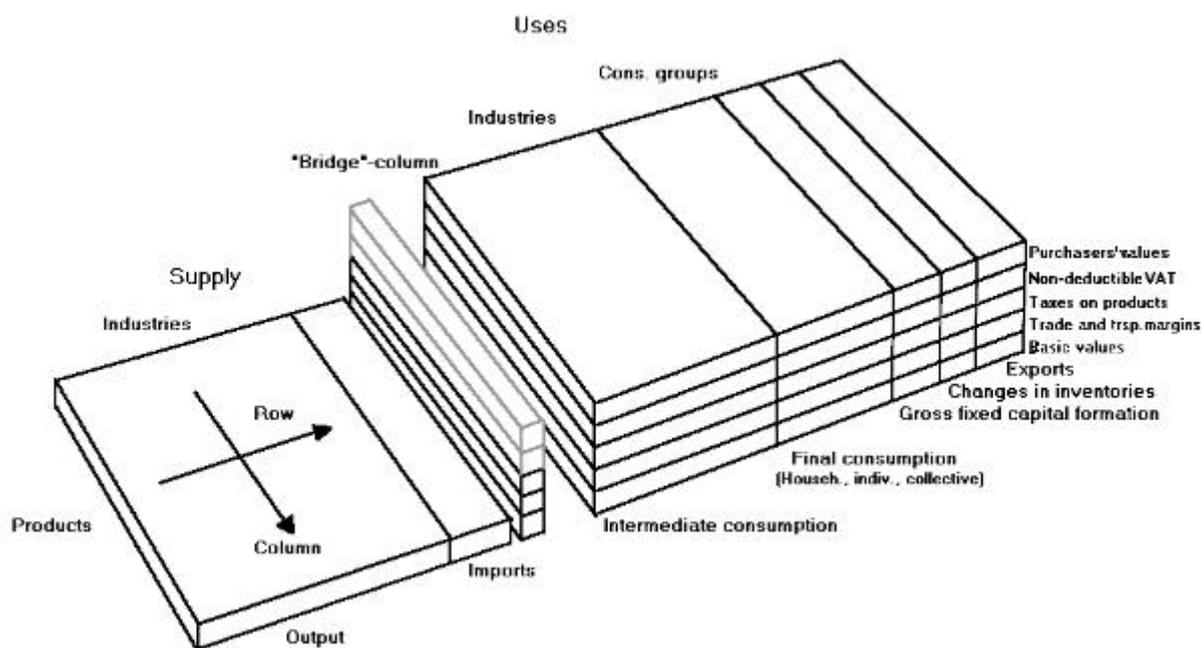


## V The framework for balancing supply and uses by industry/category of final use and commodity.

### V.1 Introduction.

This chapter will deal with the balancing of the commodity-flow system in practice. It is assumed that in this stage the relevant data on the actual year's supply and uses have been prepared in a form that conform with the concepts used in national accounts.

The following three-dimensional figure can be used to illustrate the complete system of product-balances:



Here rows = commodities, columns = categories of use (by industries, consumption groups etc. when relevant). Notice that what is here called a row or a column consists of all the “layers”. Supply is shown as a matrix of basic values only. The layers on the uses side show how the cells at the uses side are composed of basic values, trade and transport margins, taxes on products and non-deductible VAT that add up to purchasers’ values.

In the balanced commodity flow system total supply must equal total uses at basic values for each product except for trade and transport margins. At the supply side these margins will be shown as output at basic values from the industries where they are produced. On the uses side they are shown in the margin-layer where they are distributed together with the basic values to which they are related.

In an analogous way all net taxes on products and the total of non-deductible value added tax is distributed as matrices that in principle cover the whole uses side.

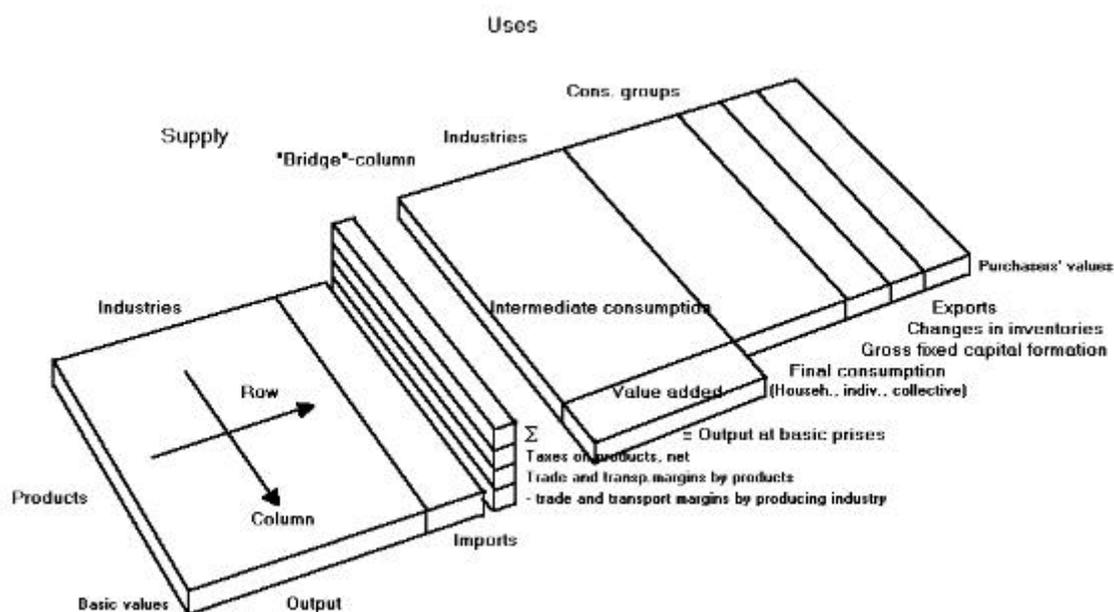
To close the gap between total supply and use for each product a “bridge column” is shown to the right of the supply matrix at basic values. Here margins are moved from the basic value layer to the

margin layer. In the basic values layer the margins are shown as negative values that cancel out the supply of the “margin- products”, in the margins-layer the same total amount is instead distributed as supply of margins on all traded products. The “bridge column” is also used to show the “supply” of net taxes on products and non-deductible VAT by product.

Trade and transport margins by commodity may be calculated before the balancing process itself, and taxes and subsidies will usually be related to the relevant products already in the statistical sources. On the other hand non-deductible value added tax by product should be calculated using all the information on the uses side, as the magnitude of non deductible VAT will usually depend on both the product and its distribution among the different uses. This is the reason why the VAT and purchasers value -layers of the bridge-column are shown with a pale colour. They will not be available until the final balancing of the whole system.

It follows that when the supply includes the “bridge column”, total use will equal total supply in all levels for every product in the balanced system.

A simplified version of the commodity-flow system is illustrated by the following figure:



Here the uses side is only present at purchasers’ values. The figure corresponds to tables 15 and 16 in the ESA 1995 transmission programme of data and table 9.5 and 9.6 in ESA 1995. VAT and all other taxes on products, net, are treated as a single layer. The value added section on the uses side has been added to illustrate that this is really like table 16 from the transmission programme. Value added at basic values by industry is the difference between output in basic prices and intermediate consumption in purchasers’ prices by industry, so implicitly it was already present in the figure showing the full system. In the balancing procedure one can assume that targets have already been fixed for these totals. The three-dimensional structure is still used to show that it is a subset of the information contained in the full system.

Trade- and transport margins, net taxes on products including non-deductible VAT by product might for instance be calculated using information from previous years or other information that do not depend on the balancing procedure itself, disregarding the fact that this will probably create an internal incoherence in the system. In this case all balancing on the uses side could be done at purchasers' values only.

However ESA 1995 recommends that a complete system of trade and transport margin matrices and matrices for VAT and other taxes and subsidies on products is established. Balancing supply and uses in all levels simultaneously should be preferred for a number of reasons. One reason is that trade- and transport margins and non deductible VAT ought to reflect the uses of the actual year and not those of a previous year. Another reason is that the breakdown of all purchasers' values into basic value, trade and transport margins, net taxes other than VAT and VAT is needed for deflation purposes and must be calculated later if it is not present when the balancing is carried out. A last good reason is, that in the balancing process modern EDP-systems can easily do most of the work involved in maintaining an updated version of all the layers of the system.

If a system with 1000 or more product-balances is going to be balanced every year the system will for obvious reasons depend on electronic data processing in one form or another. The system of product balances can in principle be viewed as a flat master file. For every new year an initial file must be created using data from numerous statistical and other available sources. Once a complete system has been created for a base year, the compilation of initial files for following years can be viewed as an updating procedure, where an existing file is adjusted to the new target totals and independently calculated values of the actual year. Corrections to the initial version of the product balances can be viewed as one or more transaction files, that must be merged with the master file to create corrected versions of the original file. However the actual implementation may use different types of software such as databases and spreadsheets.

Balancing a detailed commodity-flow system by manual corrections alone could be time- and resource-consuming even with the help of modern electronic data processing. To be manageable the system would probably need to be limited in size with no more than a few hundred products. On the other hand a commodity-flow system that is merely an automatic projection of a base year with a new set of target totals could easily move away from statistical sources, and one might miss the obvious opportunity to check the internal consistency of the system and to detect and correct possible errors in the underlying data from primary statistics. A combination of automatic procedures and manual adjustments is needed to create a detailed consistent system of product-balances.

## **V.2 Overview of the balancing process.**

The process of compiling a balanced commodity-flow system can be summarised in the following way:

The first step will be to gather all the information on target totals and the values that can be entered directly into the system as predetermined. It is here assumed that these have already been prepared and that all data from subsystems that produce input to the balancing process have already been compiled.

The next step will create an initial version of the product balances. This version can be compiled using automatic processes, but at this stage a number of unsolved problems will remain: For some products supply will not equal uses. For most categories of use the totals will usually differ from their targets. Total trade and transport margins and total VAT may also differ from their respective targets.

Then follows a step, where the initial version of the product-balances is adjusted manually. The unsolved problems are examined closely. In many cases such problems will reveal errors in the calculations that produce data-input to the product-balances or in the primary statistics itself. Solutions to such problems may be found in co-operation with the relevant sections of the statistical bureau and may involve changes in supply, predetermined uses or target-totals. A number of commodities are redistributed between uses to bring the distance between totals and targets within an acceptable range for each category of use. Corrections to the initial balances are entered into the system to create a new - but not yet final - version.

In the last step the differences between totals and targets are removed except where such differences are considered acceptable. In this step trade and transport margins and VAT are finally adjusted to their targets.

### **V.3 Assumptions about available data on the actual year.**

Before the commodity-flow system can be compiled the necessary data must be available. It is here assumed, that following data have been prepared in a suitable form. (The description of how they are compiled from statistical and other sources should be covered in other chapters of the manual).

#### **Supply side at basic values:**

- Output at basic prices by industry x product.
- Imports CIF by product.

#### **Uses side, targets for column totals (usually at purchasers' values):**

- Intermediate consumption by industry.
- Private, individual and collective consumption by purpose.
- Gross fixed capital formation by category.
- Changes in inventories .
- Exports FOB by product.
- Total trade and transport margins (wholesale and/or retail) may be specified for some uses.

#### **Uses side, targets for row-totals:**

- Total use = total supply by product at basic prices.
- (Trade and transport margins by commodity. Such row totals may be calculated in a subsystem.)
- Net taxes and subsidies on products by product.

#### **Uses side, targets for total use:**

- Trade and transport margins.
- Total value added tax.

### Uses side, predetermined values:

- Exports by product at purchasers' prices.
- Changes in inventories by product. Should be calculated in a subsystem.
- Subsystems covering special areas of the uses side basic - purchasers' prices.
- Fully predetermined products, fully predetermined categories of use.
- Other information on areas or specific cells on the uses side.

It is assumed, that targets are available for all categories at the uses side and that the difference between total supply and total uses is already brought within an acceptable limit. However there is always a risk that the balancing procedure will reveal the need for substantial changes to the initial targets!

## V.4 Creating an initial version of the uses side, predetermined and estimated values.

### V.4.1 Predetermined values.

In the following the expression "predetermined values" is used about values that are entered directly into the system and kept constant at their original values during the process of automatic balancing. There may be several reasons to keep values constant during automatic balancing: They may be considered to have a high degree of certainty, or they may just be considered better estimates than the values that can be expected to emerge from an automatic balancing process. It does not necessarily follow that all cells that are treated as predetermined in the compilation of an initial version of the commodity flow should not be corrected manually later in the process.

The available information may in some cases show the exact values to be entered into specific cells of the system. As examples can be mentioned accounts data with full coverage and a high level of detail or detailed data that have already been grossed up when received from the providers of primary statistics.

When comprehensive information is available about a group of related commodities it may be feasible to compile the supply and use balances for these commodities in a separate subsystem. In principle no further balancing of these commodities is needed, and they can be treated as predetermined rows when the general balancing is carried out.

The same applies to some categories of use. If they can be specified in detail before the start of the general balancing process, it is feasible to treat all values in these columns as predetermined in the general balancing process.

### V.4.2 Other values estimated from statistical information on the actual year.

However many statistical sources based on samples do not contain information on the actual values that need to be entered into the cells of the system, but they are used to break down the actual year's totals into these values. Even if the statistical data behind such breakdowns refer to the actual year, values calculated in this way are less likely to be chosen as predetermined because they are to some degree a result of guesswork.

#### **V.4.3 Use of statistical information from preceding (or following) years.**

In many areas comprehensive information may be available for specific years only, and the same information will have to be utilised over a period of time following each census year. This does not imply that this kind of information can be entered into the system only in a base-year where everything is subject to revisions at the same time. When, for instance, a survey of the use of raw materials in manufacturing is carried out regularly with an interval of some years, a procedure should exist for revision of the composition of intermediate consumption in manufacturing each time the results from a new survey is available. It may sometimes even be feasible to use results of statistical surveys covering periods after the actual year because this must be considered the best way of using recent information.

The initial version of the uses side should as far as possible utilise all available information on the actual year and other recent information. Nevertheless all cells in the system must be assigned initial values whether or not recent information is available for each particular cell.

When the commodity-flow system is created from scratch the whole system must be filled with values for at least one base year. Where no statistical information is available one must search other types of information like enterprise accounts and other published material. It is often possible to find people, who have some knowledge on the conditions in industries that are badly covered by statistics. Even when this kind of knowledge may be difficult to quantify it can be useful in the absence of “hard” statistical information. Combined with common sense it may not be the worst solution, at least the more improbable values can be avoided in this way. A last resort could be to look at material from neighbouring countries.

In an established commodity-flow system the problem of missing information is smaller. A default solution is here to use values and relations from the balanced commodity-flow system of the preceding years. In the absence of better knowledge one can assume that input structures are constant, and that trade margin percentages, percentages of taxes on products and VAT are constant over time or at least are moving in the same direction in a proportional way.

When deciding, which values should be considered predetermined and which values should be allowed to change in the balancing process, one should of course take into consideration the quality and coverage of the statistical sources. It is however also necessary to look at the way these values fit together in the system. When, for instance, predetermined values add up to a high percentage of the intermediate consumption of an industry, the residual may tend to fluctuate from year to year in a way that seems improbable. Without adjustments the automatic changes in other inputs will result in big changes in the input coefficients from one year to another in this industry. If this is considered unrealistic one has the choice either to manually adjust some predetermined values, to change the target-total or to decide that one or more of the inputs that were originally predetermined should anyway be allowed to change in the balancing procedure.

#### **V.4.4 Moving from one year to another.**

In the following paragraphs it is assumed that a commodity-flow system already exists for the year previous to the actual year. It can usually be assumed that the general structure of the system will be like the preceding year, but occasionally changes from one year to another need to be taken into account. Changing nomenclatures of products may create a need for redefining some product groups, and new industries or consumption groups may be introduced. In these cases it is usually

possible to transform last years file into the structure of the actual year. The file can be inflated to the price level of the actual year before it is used as a source of default-values. In this way last year's input coefficients at constant prices will be used to calculate the initial inputs where values are not supplied in other ways.

A preliminary system of unbalanced "product balances" is then put together using the best possible data-source for each value.

It is assumed that the complete supply side have been calculated for the actual year cf. page 4. In other words

all values on the supply side should be entered as predetermined. Empty cells that used to have a value in earlier years should be deleted from the file or set to the value zero. (It may on the other hand be a good idea to check that the data-input is complete in such cases!)

On the uses side all predetermined values are preferred to values calculated in other ways.

When complete rows or columns are calculated in subsystems and entered into the master-file as predetermined values, the cells in these rows or columns that do not get a predetermined value should be deleted from the file or filled with zeroes.

Exports at purchasers' values are known by product from primary statistics and should be treated as predetermined. Changes in inventories may not be known by product in the strict sense, but when a distribution is calculated in a subsystem, it may nevertheless be a good idea to treat these changes at purchasers' values as predetermined to avoid changes to their column-totals during the automatic balancing process.

When the input structure of industries can be based on recent surveys of the use of raw materials or services this structure should of course be preferred to the input structure that could be calculated from the inflated file from the preceding year. In the same way the structure of private consumption can be based on surveys of consumer expenditure, if not every year then at least at regular intervals.

Some types of gross fixed capital formation may already have been calculated in special subsystems. Investment in construction and civil engineering works may be known from the system that is used to calculate production in the construction industry. It may also be possible to decide the size of investment in automobiles, railway rolling stock, ships, aircraft etc. outside the general supply and use framework. In these cases the values can be entered as predetermined.

Compiling good initial columns of gross fixed capital formation in other machinery and equipment, software, artistic and literary originals or net acquisitions of valuables may prove more difficult. Ideally a complete industry x product matrix should be created for each of these categories. In principle such matrices could be an integrated part of the commodity-flow system. In practice they may exist as special subsystems. Several reasons can be given for this. Primary statistics are often scarce in these areas, and the "investment structures" of industries can be expected to be less stable over time than the input structures. If the investment-matrices had to be finished together with the rest of the commodity-flow system it might slow down the balancing procedure. Nevertheless it might be possible to use a preliminary version of such a subsystem to create initial columns for the

categories of gross fixed capital formation that can be preferred to the columns from the inflated system from the preceding year.

#### **V.4.5 Initial trade and transport margins.**

When a commodity-flow system is created from scratch trade and transport margins must be assigned to all the products that carry such margins. In the figures above, cf. paragraph V.1, all margins are shown as a single layer, but in practice wholesale-, retail and transport margins may be separated into two or more layers. I should be stressed that "transport margins" cover only the share of total transport services, that is not already shown as purchases of transport services in the accounts of the units that sell or buy the transported goods. Total margins by product may be based on accounts statistics for the trade industries using assumptions on the mix of traded products through each branch of trade. Any other type of available relevant information may also be used when an initial set of trade margin percentages is created.

In the full system trade and transport margins for each product must be distributed over the uses of that product. The trade margin percentages may show some variation between different uses of the same product. The obvious case is retail trade margins that are high on private consumption and may be lower on other categories of final use, while in most industries intermediate consumption and gross fixed capital formation carry no retail trade margin at all. Wholesale trade margin percentages may also vary between uses: They are more likely to be high in the cases where many suppliers are confronted with many buyers of the product than in the case where a few big enterprises are buying the product from a few big suppliers. In the absence of hard information on such differences use of common sense may lead to more realistic assumptions than the use of uniform trade margin percentages for all uses of the same product.

When moving from a balanced commodity-flow system for one year to the next year, a first estimate of the initial trade and transport margin matrices can as a default be based on the trade margin percentages from the preceding year. Where trade and transport margins in the actual year are known these values should of course be preferred to the default values. Such values should be entered into the system as predetermined.

The total margins that are calculated in this way will usually not add up to the supply of trade and transport margins, so some proportional adjustments of the non-predetermined margins may be needed before the margin layer(s) can be used in the initial version of the uses side.

#### **V.4.6 Initial net taxes on products.**

It is here assumed that taxes and subsidies on products are known by product before the start of the balancing process. In the full system they will have to be distributed to all the categories of use that are paying the taxes or receiving the subsidies. When a system is build from scratch, every type of tax or subsidy must be distributed according to the relevant legislation. For instance some net taxes may be paid exclusively by private consumption, others should be distributed among all uses except exports in proportion with basic values, some subsidies may be received by selected industries only.

When moving from one year to the next year a default solution like the one proposed for trade and transport margins can be used if the tax-rules are the same in the two years. In such cases a first estimate of net taxes can be calculated using tax percentages from the preceding year. The taxes calculated in this way will only add up to the row-targets by coincidence, but in a later step the tax

on each product can be proportionally adjusted to the target value. This automatic procedure is somewhat more dangerous than the similar procedure for trade and transport margins and should be used with care, especially where rows contain combinations of taxes and subsidies. To eliminate the risk of strange results it is a good idea to enter all taxes or all subsidies in such a row as predetermined values. In several cases the only safe solution will be to calculate the distribution manually.

#### V.4.7 Initial Value added tax.

According to ESA 1995 only non-deductible VAT is entered into the system. In the full system total VAT is distributed by product x category of use as non-deductible VAT related to the relevant values exclusive of VAT on the uses side. Unlike trade and transport margins and other net taxes on products the VAT-distribution by products is difficult to calculate without knowledge of the detailed uses side of the system. In each cell VAT will depend on:

- The VAT-rate. VAT-rates may be different for different products
- The share of the product's value that is VAT-exempt.
- The share of the value that is hidden from taxation.
- The share of VAT that is deductible in each industry when the product is used as intermediate consumption or gross capital formation.
- Any exception or special arrangement that follows from the VAT-legislation and administrative practices. Examples: VAT on certain products may never be deducted whether they are used by industries that deduct VAT or not. Products may be VAT-exempt when used for certain purposes. VAT for certain products may be based on basic value plus trade and transport margins while the general rule is that VAT is paid on the sum of basic value, trade and transport margins and other net taxes.
- An downward adjustment may be needed when the legislation allow for deduction of bad debts from taxable value added,

The VAT-legislation can be simulated using an EDP-procedure. In a detailed system it is possible to calculate VAT for each individual cell of the uses side. The VAT-values can also be updated whenever values at the uses side are changed in the balancing process. The total VAT that is calculated initially can be compared to the total VAT as shown in government accounts. This comparison may show a need for adjustments in the procedure used for estimating VAT or in some of the initial values of the system.

As is the case with intermediate consumption, non-deductible VAT on investment will depend on the distribution of gross fixed capital formation among industries. This is an important argument in favour of compiling a set of initial investment matrices before creating the initial version of the uses side.

#### V.4.8 Use of "virtual" industries and products.

A number of commodities are used in most industries in small amounts, but are not covered by any kind of surveys. They do not belong to raw materials for industrial use and usually they may be hidden together with various services in "other expenditure" in business accounts. It may be feasible to group such products together in one or a few rows of the system to facilitate the balancing

procedure. On the other hand it may not be appropriate to define this row as one product as it can contain commodities that are placed far from each other in the product nomenclature.

A solution to this problem can be the creation of “virtual industries”. A virtual industry will receive products that are grouped together as intermediate consumption. Its output will be a single virtual product whose value at basic prices will equal the total of the inputs at purchasers’ prices when the system is balanced. It follows that no value added is created in the virtual industry and it can of course not have any employment or capital formation. The virtual product is distributed among uses like any other commodity. When the system is balanced the virtual industry and the corresponding virtual product can be replaced by a product x industry matrix using the assumption, that each use of the virtual product consists of proportional shares of all the inputs in the virtual industry. It must be stressed, that products that are grouped together as one virtual product should be of relatively insignificant sizes.

## **V.5 Balancing procedures.**

### **V.5.1 Automatic balancing.**

Before the start of the automatic balancing procedure all data is put together as a complete unbalanced commodity-flow system for the actual year. In practice a EDP-file is created with values in all cells that are supposed to be non-zero in the finished system.

All predetermined cells are assigned their correct values. Predetermination must be recognisable to the computer-programs, otherwise predetermined values would change during the balancing process. A simple solution is to put a mark in the record whenever a value is predetermined. When all levels of the uses side are balanced simultaneously the levels should be marked individually. Predetermined values on the uses side may not always be specified for all levels from basic to purchasers value. To ensure that the all records are consistent, an EDP-procedure must recalculate non-predetermined levels of the records containing predetermined values using relations from the default records of those cells.

All other cells are filled with their initial values. Where no other information is available the inflated values of the preceding year serve as default values.

In the unbalanced file use will not equal supply at basic values for most products, and the column totals will usually differ from targets.

#### **V.5.1.1 Column-adjustments. “Vertical balancing”.**

A first step towards a balanced system is adjustment of the column totals to the columns targets. For most uses targets exist for totals at purchasers’ values, in the full system targets may exist for other levels as well. Trade margins used in certain consumption groups can be an example.

The adjustments should not change any predetermined values. When adjusting purchasers’ values to the target, the sum of all predetermined purchasers’ values must be calculated. It is important to notice, that in simultaneous balancing at all levels, some values may be implicitly predetermined as a

result of other levels being predetermined. Also the share of VAT that can be calculated from predetermined values should be treated as predetermined. To adjust a column, all non-predetermined purchasers' values are multiplied by:

$(\text{target value} - \text{sum of predetermined values}) / (\text{original total} - \text{sum of predetermined values})$ .

In the simple case, with a target for purchasers' values only, the same correction-factor can (in principle) be used for non-predetermined values in all levels. If targets exist for other levels, the situation is somewhat more complex and there is a need for general corrections to trade margin percentages and/or tax-percentages used in the column. All these problems can be solved with some clever programming!

Some restrictions should be put on the automatic adjustments to avoid creation of strange values. Automatic changes of sign should not be allowed. It is a good idea to restrict acceptance of negative basic and purchasers' values to certain products (examples: scrap, ships, cars) and uses (example: changes in inventories) unless the negative values are entered as predetermined. When both positive and negative uses are present in the same column the results of proportional adjustments can be unpredictable. In such cases one may prefer to enter all negative uses as predetermined values. Negative trade and transport margins outside changes in inventories should as a general rule only be accepted as predetermined values. The programming can ensure, that such improbable values are trapped and replaced by acceptable values. Warnings should be issued when problems of this kind are encountered.

It follows that automatic adjustment will in certain cases fail to equal column totals to targets. In these cases the columns can be written to a list of unsolved problems. (If predetermined values are marked in the list, the cause of the problem will often be obvious!).

After "vertical balancing" we have a set of columns that (with the exception of the problematic columns mentioned above) represent an initial breakdown of the target value for purchasers' values into commodities using the initial assumptions about input coefficients of industries except for those inputs that have been deliberately changed by predetermined values. When all levels are balanced simultaneously we have also a breakdown of all purchasers' values into the levels from basic prices to VAT.

Total use of each product will only equal supply in special cases as a result of predetermined values or by pure coincidence. This applies to all levels with target values on the supply side. As a consequence the difference between total calculated trade and transport margins and their target values can be misleading and should not be used to judge the realism of the general level of trade margin percentages. On the other hand total VAT may be rather close to what it will be in the final balancing, if the same assumptions are used in the VAT-calculations.

In principle it should be possible to eliminate all the differences between supply and uses by manual corrections. However in a system with 1000 or more products this would be an extremely time-consuming task. An automatic elimination of most of these differences should be preferred.

### V.5.1.2 Row-adjustments. “Horizontal balancing”.

It seems, when no better knowledge is available, sensible to assume that substitution between products tends to move in the same direction in most uses. The next step towards balanced system should therefore be an adjustment of the row-totals to the row-targets.

As shown earlier in this chapter, a primitive commodity-flow system, cf. paragraph V.1, may only have targets for purchasers values by products. In this case balancing the supply and uses of each row is done by multiplying each of the original non-predetermined values at the uses side by:

$$(\text{supply at purchasers' prices} - \text{sum of predetermined values}) / (\text{original total} - \text{sum of predetermined values}) .$$

In the full system such targets will exist for basic values, as a result of the assumption that the supply matrix at basic values is complete and predetermined. If there is a need to correct basic values on the supply side, it ought to be done either by entering other values for the predetermined supply or by entering corrections to the row later in the manual balancing process. Targets for trade and transport margins by product may exist for some or all of the rows. Usually target totals also exist for net taxes on products other than VAT.

Here corrections should start in the basic values level. The sum of predetermined values at basic prices should be calculated including such values that are implicitly predetermined. This will have to include basic values in cells with predetermined purchasers' values to avoid either distortion to trade margin percentages or changes to the original predetermined purchasers' values of these cells. All the non-predetermined basic values are multiplied by

$$(\text{supply at basic prices} - \text{sum of predetermined values}) / (\text{original total} - \text{sum of predetermined values})$$

and in these uses non-predetermined margins and taxes on products are changed by the same factor.

If the row has a target for trade and transport margins a similar proportional correction can be made to all non-predetermined trade and transport margins of the row. (If changes to margins are allowed in uses with predetermined purchasers' values, the situation becomes more complex. In this case an iterative solution can be needed to solve the problem). Consequential corrections to non-predetermined values in the higher levels should be calculated.

In the same way all net taxes on products that are not predetermined can be adjusted to the target value. It may however be advisable in a final round to repeat the vertical/horizontal balancing process where all these adjusted net taxes on products are used as predetermined values, because this may stabilise the system considerably.

Non-deductible VAT should of course be recalculated to reflect the adjustments in the other levels.

Like in the vertical balancing procedure the computer-program must be able to trap adjustments that would lead to strange and incredible values. For the same reasons as mentioned above the automatic balancing will fail to equal supply and use for a number of products. Typically supply is insufficient to cover the predetermined uses of the product. The rows that are left unbalanced in one or more levels can - like the unbalanced columns - be written to a list of unsolved problems.

The file that is the result of the horizontal balancing procedure will (except for the unbalanced products mentioned above) fulfil the requirement that for every product total use must equal total supply at basic values and that net taxes on products should equal the target.

The sum of all trade and transport margins on the uses side can be considered a reasonable estimate of the final value that can be expected with the given trade margin percentages. On the other hand total VAT may now have moved away from the value to be expected because the column-sums at purchasers' prices are no longer equal to the column-targets.

### V.5.1.3 Automatic balancing as a repeated process.

For illustrative purposes the description of vertical and horizontal balancing has here treated the automatic balancing as two separate processes. In reality the whole procedure can be handled by a single job that uses a few minutes on a modern PC (with a master file of approximately 50.000 records. Preparation of the data-inputs for the process is far more time-consuming). Every time the job is run, new listings of unsolved problems and resulting totals are produced.

When run for the first time with data for a new year a number of serious problems in the data-inputs will usually be revealed. Often problems can be traced back to errors and inconsistencies in data from the statistical sources. Some of these will need to be corrected because they will otherwise cause major distortions in the initial balances.

Before the system is ready for manual balancing the totals of trade and transport margins and non-deductible VAT should be brought within acceptable distance from their respective targets. Adjustments to total trade and transport margins can be done by proportional adjustments to all trade margin percentages of the original unbalanced file before the vertical/horizontal balancing except in cells with predetermined trade and transport margins. A few systematic guesses will usually bring trade and transport margins within acceptable limits. If total VAT cannot be brought within acceptable limits by small adjustments to rates and assumptions used in the calculations, VAT may be left unbalanced at this stage. A search for a specific explanation of the difference may be more appropriate in this case.

In principle the vertical-horizontal balancing procedure could be repeated in an iterative manner, where each new iteration would use the result from the preceding as a starting point. This could however be a dangerous method in this early stage, where many problems are unsolved. Considerable distances between totals and their respective targets have not yet been examined. Some distances between column-totals and their targets may even change sign when other problems are corrected.

### V.5.2 Manual balancing:

The initial version of the master file should, despite the unsolved problems mentioned above, be reasonably close to the final version in its general structure. Now it is up to the persons, who are going to manually correct the system, to find explanations to these problems, to check the credibility of the results from the automatic balancing and to redistribute products between uses until column-totals are inside an acceptable distance from their targets.

### V.5.2.1 Organisation of the manual balancing.

In a detailed commodity-flow with more than 1.000 products, the manual balancing can be done within a month by 4 to 6 persons. Each person can be made responsible for an area of the economy. Such areas should ideally consist of a complex of industries and categories of final use with a high degree of interaction and their common products on either the uses- or production side. On the other hand all products and categories of use must belong to a complex to ensure, that they all are looked after by a responsible person.

Each person is allowed to correct the master file within some limits and restrictions. If only spreadsheets are used in the manual balancing process, it may be necessary to restrict the corrections of each person to his/her complex of responsibility. In a system where corrections are entered into a shared updated master-file/database, such a restriction is not needed, but the rules of good conduct among “balancers” should ensure that major changes outside one’s own complex are always negotiated with the “owners” of the other complexes involved, and that information is passed between the relevant persons.

To keep the system manageable the rules of good conduct should also imply that all products are kept balanced with total uses = supply during the balancing process. This also applies to net taxes on products other than VAT. Usually the first task of the “balancers” is to remove such differences that still exist after the automatic balancing. These differences can have various explanations. As mentioned earlier, serious problems may reveal a need to correct data from primary statistics. However, many remaining differences may be explained by differences in the coding of the same kind of products between production- and foreign trade- statistics, and the problem can then be solved by moving output, im- or exports from one product to another. Since the introduction of “Intrastat”, such problems frequently arise as a result of the automatic grossing up of foreign trade to cover transactions below threshold-values.

The “balancers” will usually be confronted with many well-known problems. To ensure a consistent treatment over time they should have access to notes showing how the same problems were solved in previous years.

When all independently motivated corrections have been made, differences between column-totals and their targets will still exist. The target-values will usually not be equally well founded on statistical sources. Some columns should be fully adjusted to the targets, while discrepancies should be allowed elsewhere. For final uses a check on growth rates, preferably in constant prices, may indicate if the column-totals are acceptable.

The remaining corrections needed to adjust the column-totals will have to be of a more arbitrary nature. Corrections that bring inputs back in line with the results from the “vertical balancing” of intermediate consumption for those industries that have not shown major changes since the preceding year may, if possible, often be preferred.

### V.5.2.2 EDP-use in manual balancing.

In a modern PC-environment the use of spreadsheets is often the preferred way of handling small and medium sized calculations. A detailed commodity-flow system will usually be too big for a pure spreadsheet-system. (In the Danish system with approximately 2.700 products the master file

consists of some 50.000 records each with information on all levels from basic to purchasers' values, an optional "pure primary statistics-value" without any grossing up, and codes that tell which levels are predetermined, which subsystem has produced the original values, and the initials of the person that has entered the last correction). The spreadsheet can nevertheless be used as an interface to the shared master-file under these circumstances. Procedures for extracting data from master-file to spreadsheet and transferring corrections from spreadsheet to the updated master-file can be made available as macros in the spreadsheet.

When updating a shared master-file it is important, that no invalid data are allowed as corrections. All corrections should be tested for errors before they are accepted. In a full system with simultaneous balancing of all levels on the uses side, corrections to the cells need not necessarily be specified by the "balancers" for all levels from basic- to purchasers prices. The program that is used to update the master-file can carry out the calculation of the missing values from default assumptions. The original trade margin percentages from the master-file can be used, and VAT can be recalculated using the updated values.

In the process the "balancers" need access to updated information on the state of the system like remaining differences between supply and uses at basic prices by product and the actual distances between column-totals and their targets. The "balancing-tools" should at least include easy ways of extracting products and uses to lists and spreadsheets. It should also be possible to extract the same kind of information from the master-files of previous years for comparison purposes.

It can be useful for the "balancers" to have access to constant price as well as current-price data. The commodity-flow systems at constant prices from previous years will already exist. A preliminary constant-price version of the file that is being updated can be computed, if price-indices are available for all products. This will usually be the case, because such price indices have already been used to inflate last years' master-file. An updated file at constant prices could easily be accessed by the tools like those used to extract data from the master-file at current prices.

### V.5.2.3 Documentation.

Many corrections entered by the "balancers" will be independently motivated with references to statistical and other available sources or with common-sense considerations. It is important that the considerations behind the solutions are visible to other "balancers" and that the solutions can be reproduced, when the same problems are encountered in following years. Such corrections should be commented in a systematic way. The corrections entered to remove remaining differences between column-totals and their targets may be of an more arbitrary nature, but nevertheless it may be a good idea at least to indicate the purpose of the correction by a comment. (Comments may be written together with the actual corrections in spreadsheets that are used as data-input to the corrected master-file). A good system of comments is extremely important when targets are changed as a consequence of inconsistencies exposed during the balancing process, as these corrections will often have consequences for other areas of the national accounts.

### V.5.3 Final balancing.

When all manual corrections have been made, a complete picture of the accepted column totals should exist. In principle all totals with “binding” targets are adjusted to their target values. With appropriate EDP-facilities this may not be required. In this case it is sufficient that these totals are brought within a (relatively small) distance from their targets. When all levels on the uses side are balanced simultaneously, they may anyway still change a little in the final balancing of trade and transport margins.

#### V.5.3.1 Final balancing of trade and transport margins.

In the full system, trade and transport margins can be expected to have changed as a result of manual corrections either because new values have been specified explicitly by the “balancers” or because the automatic calculation of trade and transport margins have generated changes when products have been moved between uses with different margin-percentages. The total use of margins will usually not equal supply even if in balance in the initial version of the system. A new adjustment to the targets can usually be done by proportional adjustments of non-predetermined margins. If many specific targets for use of margins are present, as may for instance be the case for retail trade margins on private consumption, it may however be necessary to change some of these targets before balancing is successful. VAT should of course be recalculated based on the adjusted values.

After the successful balancing of trade and transport margins differences between column-totals and their binding targets should be removed. It is possible to remove these differences with some clever programming.

The cells that can participate in these corrections without causing inconsistencies in the system can be isolated. Corrections that equal column-totals to binding targets can be computed by a vertical balancing restricted to these cells. This will create new (small) differences between supply and uses for many products. These can be removed by a new horizontal distribution among the uses without binding targets. In this process total trade and transport margins should not be allowed to change and changes to margin percentages should be kept to a minimum. If these calculations should result in significant distortions the program should issue warnings. Some manual adjustments may still be needed where too little value can be moved without creating significant distortions.

Other ways of removing such differences may be considered. It could be done manually. One could even decide that a number of small differences are insignificant and should just be accepted.

#### V.5.3.2 Virtual industries and their virtual products.

When virtual industries exist, they may have been left unbalanced during the manual balancing process. Before automatic final balancing they should be examined. The product-mix of each input-column should not be against common sense. The total use of the virtual product that is output at basic prices from each virtual industry should in the end be exactly equal to its total input at purchasers prices. At the start of the final balancing procedure it may be sufficient that this is approximately true, as the column-targets for virtual industries could often be treated as “non-binding” at this stage. Final adjustments to the inputs in and/or outputs from virtual industries can be entered manually with other final manual corrections that may be needed to balance the whole

system. All virtual industries and products can be eliminated by an automatic calculation when the whole system is balanced.

### **V.5.3.3 Final balancing of non-deductible VAT.**

The total of non-deductible VAT that is a result of the balancing procedure cannot be expected to exactly match the target that is based on government accounts. If only official rates and tax-legislation is used in the calculations, the computed VAT-total should normally exceed the target. However to be realistic, the model used to calculate VAT should take into account the expected patterns of tax evasion. A good VAT-model should result in a computed total that is not too far from the target. Still total computed VAT cannot be expected to reach the target value automatically, so final corrections will be needed. It may be preferred to proportionally adjust VAT in specific columns, where the exact share of VAT-liable use is uncertain. A final proportional adjustment of VAT on all private consumption can be used to eliminate the remaining difference.

Comparisons between computed “theoretical VAT” and observed total VAT-assessments serve as an important check on the level of total VAT-liable uses. A sudden change in the distance between the computed total and target may indicate errors in the growth rates of important components of GDP.

### **V.5.3.4 Final manual corrections.**

The more or less automatic procedures used in the final balancing of the system will usually bring the system very close to its final form, but a few differences between supply and use will usually remain. Some column total may also have moved away from their targets in an unacceptable way. As the last step of the final balancing such remaining problems must be detected. They will have to be eliminated by a few final manual corrections.

## **V.6 Conclusion.**

The commodity-flow system can be more or less detailed depending on available data and resources. A detailed system with more than 1.000 products and a simultaneous balancing of all levels at the uses side can be managed with specialised tools and an organisation that divide responsibility among a number of persons. On the EDP-side the simultaneous balancing of a big system can be facilitated by use of shared file-systems and specialised EDP-programs that do most of the calculation work. On the other hand a small system may be balanced manually by a few persons using a pure spreadsheet-solution, that may fulfil the minimum-requirements of ESA 1995. Because the level of ambition may vary greatly, it is difficult to give precise recommendations on the methods and routines that should be used in each case.

When possible, a system with a high level of detail should be preferred. The commodity-flow system is not just a way of compiling data for input-output tables. In the balancing process many weaknesses of primary statistics can be detected and corrected. In this way the system serves as a reliable foundation for compiling national accounts. The detailed data that are the result of confrontations of most available statistical sources can be used for many purposes, where they can be more adequate and reliable than data from primary statistics.