Supply and use tables in constant prices

by

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Contents

1. Introduction

The main objective of national accounts is to provide comprehensive data, which can be used, for analysing and evaluating the performance of an economy. Data on the major economic flows such as production, household consumption, capital formation serve as input for the formulation of economic policy. The importance is shown by the extensive data requirements of the European Union for the purpose of economic policy. Intensive use of national accounts data is made within the framework of de EU-administration and the Economic and monetary union (EMU). Examples are the contributions to the EU based on GNP and VAT and the excessive debt procedure. In these cases data valued at current prices are used. Additional requirements resulted from the Stability Pact, which introduced the use of real growth rates, and thus constant price estimates, for administrative purposes. This imposes high quality standards on constant price estimates within national accounts.

Furthermore, national accounts data are used to investigate the causal mechanisms within an economy. Estimation of the parameters of macroeconomic models by applying econometric methods requires time series of national accounts data, focussed on annual changes, caused by a combination of two factors: a change in price and a change in quantity and quality (in national accounts often denoted as: volume change).

Both from policy and modelling point of view, the decomposition of annual value changes in price changes and volume changes is an important item in the compilation of national accounts. Contrary to data at current prices, data at constant prices cannot be directly observed. They have to be derived from current price data combined with price and/or quantity indicators, implying that constant price estimates are more *modelled* than estimates at current prices. This is the more so in national accounts where nearly all transactions are aggregates and even the choice of index formulae can influence the result of the estimate.

Compiling prices and volumes within an accounting framework, such as the supply and use tables has several advantages. Firstly data on the economic growth and inflation at the level of the total economy can be derived easily. In addition price changes and volume growth at the meso level such as final demand categories and industries can be derived. The latter offering the opportunity to perform detailed analysis of, for example, productivity changes. Even in more detail, price and volume changes on a commodity level are available. Secondly a check is provided on the numerical consistency, reliability and plausibility. Thirdly constant price estimation, when imbedded in an accounting framework provides volume indices and deflators of various variables and at different levels of aggregation that are interrelated in a systematic way. Last but, for sure, not least, an accounting framework offers the opportunity to derive price and volume measures for important balancing items like gross domestic product (GDP).

Constant price estimation is not straightforward, because nearly all items in the national accounts are aggregates or aggregates of aggregates. Examples are total consumption of households, total imports and exports, total output and intermediate consumption of industries. Unfortunately, direct observation of price and volume changes of aggregates is - by definition - impossible. Price and volume indices of aggregates have to be compiled using price and volume indices of individual goods and services. Then the question rises how price and volume changes of individual goods can be added to price and volume changes of aggregates. Various methods are available to solve this problem. Different index formulae can be applied using different weighting schemes, implying that a choice must be made. It is beyond the scope of this manual to discuss in depth the theoretical and practical considerations with respect to this choice. For a broader discussion of the theoretical and practical considerations with respect to the choice of index number formulae and weighting schemes the reader is referred to e.g. Allen (1975) and to Al et al. (1986).
Next to aggregates, special attention must be paid to balancing items, of which of course GDP is most important. GDP is defined as the difference between the aggregates total output and total intermediate consumption by all industries. Ideally, GDP at constant prices is calculated as the difference between

total output at constant prices and total intermediate consumption at constant prices, the so-called double deflation method.

2. The role and choice of price and volume indicators

2.1 The object of measurement and the choice of indicators

Price and volume indexes are derived from price and quantity changes of separate products at a low level of aggregation. Generally speaking, the lower the level of aggregation, the more the requirement of homogeneity will be fulfilled. Homogeneity is necessary to assure that, according to the ESA-rules, quality changes are included in the volume component of the annually value changes.
An important and for the reliability decisive question is how to measure price and quantity changes at the detailed product level. Or, in other words, to define which price and quantity data are appropriate indicators to apply for the calculation of price and volume indexes.
Before starting the observation of indicators, it is necessary to define firstly the object of measurement, i.e. answering the question, in case of production, what are the true outputs of a certain productive activity. At first sight, this seems to be asking for the sake of asking, as for most production processes generating goods and services it is quite clear which are the outputs and one has to observe the prices and quantities of those outputs. However, in some particular areas an exact definition of what is produced is more difficult. Examples are the banking and the insurance sector in the case of market production and government production, education services and medical services in the case of non-market production. In such cases it is tempting to apply any quantity or price indicator which is available, even if the indicators refer to an input or to an intermediate factor in the production process. The given example is based on the notion that every production process is characterised by more or less fixed relations of inputs and outputs. However, such indicators do not provide good price or volume indexes for the deflation of production. This kind of mistakes can be prevented by firstly defining which are the true products of an activity and than try to find indicators directly related to these products.

Two examples

The main service rendered by hospitals is the treatment of patients with a certain disease. Appropriate indicators are the numbers of complete treatments of patients (classified into kind of disease, age of the patients etc.) and the prices (in case of marked production by hospitals) of complete treatments. In spite of their frequent availability, indicators like the number of nursing days and the prices of nursing days are not appropriate indicators for the measurement of the volume of the output of medical hospitals. The reason is that nursing is not the true purpose of the activities of hospitals but an intermediate factor in the production of the true service: i. e. the treatment of patients. The use of indicators like nursing days can cause serious errors in e.g. calculations of the productivity of hospitals.

True services rendered by police activity are e.g. advancing the safety of the citizens and maintaining the law. This purpose can be arrived at in different ways among which provision of information on dangerous situations, prevention by intensive observation and surveillance and discouraging by fining transgressors of traffic rules. Finding good quantity indicators here is very difficult. If, for instance, the number of fines (or the number of arrests) is available, it is alluring to use that information as indicators for the output of the police force. However, this would give a wrong notion of the real output, since a high amount of fines would not always mean that the policy operates well. It is possible that the same quality of service can be reached by more prevention measures and less fines. Applying the number of fines as an indicator would ignore this.

2.2 The relation of value, price and volume in the collection of data

2.2.1 Different methods to separate value changes in price and volume changes

In an imaginary, ideal statistical world integral information on values, quantities and prices of transactions would be available. However, the real world is quite different. The acquisition of data is difficult and expensive. Fortunately, for good estimates at constant prices we need not all the mentioned information. If for two of the three variables appropriate data are available, the third can be derived. In this section we discuss the data requirement in case of market products, non-market services consumed on an individual basis and collective non-market services.

Standard price method

Often values at current prices are available e.g. from production surveys. What remains is the question how to separate the change in value into a volume and a price change. Information has to be obtained either on prices, or on quantities. The not-observed component can be derived afterwards. This means already a considerable reduction of the observation need.

However, the information problem has not been solved yet. The reason is that integral information nor on prices nor on quantities is mostly available. Therefor, approximations have to be made based on limited information. In such cases one has to keep in mind that limited price data and limited quantity data do not provide the same possibilities. When applying limited information, it is an essential requirement that the derived price index or volume index is representative for the not-observed transactions.

It may be expected that price information from a sample with a certain size is more representative than quantity information from a sample of the same size. This statement is based on the consideration that if there is an open market for a homogeneous product there will be a tendency to one price for the total supply of that product. In that case a relatively small sample will be sufficient for the observation of the price and price changes of the total supply of that product.

However, changes of quantities are less liable to such equalising tendencies. It is true that in an expanding market all producers will try to increase their supply but the realisation will depend of restrictive factors among which production capacity and financing facilities. Next to quick growers there will be slow growers and, maybe, even decreasing producers. This means that to obtain reliable estimates samples for quantity information have to be large. Their size perhaps has to be comparable with the samples necessary for estimates at current prices. This means that appropriate samples of quantity information will be much more expensive than samples for appropriate price information.

As a consequence, it is common practice to derive price indexes from price samples and afterwards derive volume indexes and values at constant prices by combining values at current prices and price indexes. This approximation method is in many cases efficient and cost saving. The reliability of the result depends on the extent that equalising tendencies at the markets exist in reality.

Quantity method

The standard price method can be applied for many goods and services. At least in principle, direct observation of prices at a detailed level is possible. However, in practice in many cases price observation has not been realised yet and will not be in the near future. Next to that, in particular cases from the nature of the definition and measurement of output at current prices, direct observation of (appropriate) prices is not possible. Well-known examples are non-market services and services of banks (FISIM) and insurance companies. If prices are not available, alternative methods have to be found. A widespread alternative at the moment is applying input methods. However, in the future input methods will not be allowed any longer at least for market production.

One, for some services promising, alternative is the use of already available quantity information. In the former paragraph it was stated that for reliable quantity indicators a large amount of data is required which would cause high costs. Fortunately, for some particular industries, mostly object of government interference (e.g. public transport, medical services, culture) or government supervision (e.g. banking, insurance), many integral quantity data are collected by the statistical office or government agencies. Since this information has been collected already for other purposes, the high cost impediment does not exist here.

Values derived from price and quantity
Although perhaps less than in the past, there are still production areas where value information is not available. In case that representative quantity information is available in combination with representative price indices, values at current prices can be derived by extrapolation of the values of t-1. An example is agriculture, where often a high amount of quantity and price information is collected.
A more general application of values from prices and quantities is in case of preliminary estimates. For example the estimation of the output of theatres from the number of visitors and ticket prices.

Relation between current price and constant price measurement of non-market production
The value at current prices of non-market services, by definition, equals the sum of the costs of inputs. In discussions on the deflation of non-market services it is sometimes stated that there has to be a strong relation between the measurement methods of values at current and at constant prices. Since for non-market production the value of the output at current prices equals the sum of the costs of inputs, it is argued that this should also be so for output at constant prices and an input method should be prescribed here. Accepting this statement means a considerable restraint to the estimation of high quality volume and price indexes for non-market services. With input methods independent estimates of value added at constant prices and productivity changes are not possible. On account of the high amount of non-market services the estimate of the volume growth of macro totals like GDP is also liable to mistakes.
Furthermore it can be argued that the requirement of equal methods for constant and current prices is unnecessary. The prescribed method for current price estimates can be considered as an emergency solution arising from the impossibility to observe the value of non-market production in a direct way. If for constant price estimates better methods are available there seems to be no reason not to apply them. An additional objection is that estimates at constant prices are made subordinate to estimates at current prices.
Since in the case of non-market services prices are invisible, quantity methods have to be applied.

2.2.2 Practical requirements for price and quantity indicators

Price and quantity indicators have to meet a number of practical requirements in order to be used to estimate price and volume indexes. The requirements are defined in relation to the output of commodities by industries. However, they are also relevant to all other transactions in goods and services.

- The prices/quantities should <u>relate directly to output</u>. This means that they should refer to complete end products and not to contributory activities or to contributory intermediate or primary inputs.
- The prices/quantities should have <u>sufficient stratification</u>: This means that different prices/quantities should be available for all different product groups comprising output.
- Product groups should have <u>sufficient homogeneity</u>. This requirement will be met if there is only one product in a product group. If there is more than one product within a product group, an additional requirement is that the composition of the product group does not change over time.
- The prices/quantities should be <u>sufficiently representative</u> of the product group. Usually, prices/quantities available do not cover all products of the product group and/or are based on a sample. Changes in the prices/quantities that are observed should be representative of changes in the prices/quantities that are not observed.
- The prices/quantities for a product group should account for <u>changes in the quality</u> of products. Changes in values resulting from changes of quality should be excluded from the price index and included in the volume index. The volume index = quantity index x quality index.

The requirements are the same for both prices and quantities with one exception. The <u>sufficiently representative</u> requirement is less severe for prices than for quantities. It is expected that price changes observed in a sample are representative for the whole population more often than quantity changes observed in a sample of the same size. This is an important advantage of output price methods over output quantity methods. It is more difficult to get a good coverage of output with quantities than with prices.

2.3 Aggregation levels for the deflation of goods and services transactions

General considerations
Deflation should be carried out at the lowest level of aggregation of transactions as possible. The following arguments in favour of a low aggregation level have to be mentioned.

- Generally speaking, price and volume indicators will be more representative at a low level of aggregation of transactions.
- The requirement of a proper measurement of quality change is fulfilled to a higher degree when transactions are more homogeneous. Changes in the composition of the supply or use of a commodity group can be taken into account.
- Available price indexes from price statistics often are Laspeyres type. The objection that they are applied in a Paasche environment is less severe if they are used at a low level of aggregation of the transactions since indexes at a higher aggregation level can be derived applying the Paasche formula.

Aggregation levels for the derivation of constant prices per entry of the supply and use tables
Even if the classification of commodities and industries in the existing supply and use tables is highly detailed, most entries will be aggregates. For the reasons mentioned above it should be recommended that for every entry the deflation will be carried out as detailed as possible. Constrains are the level of aggregation of the underlying values at current prices and the degree of detail of the available price and quantity indicators.

Aggregation levels for the balancing of transactions at constant prices.
Generally speaking, balancing of the supply and use of a commodity at constant prices is easier when the number of commodities distinguished in the supply and use tables is higher. In addition the quality of the balanced results will be higher. This is especially true when price and volume indicators are less reliable or even missing. This is illustrated below with a fictitious example.

Suppose a commodity group includes complete machines as well as spare parts. The former are part of fixed capital information; the latter are part of intermediate consumption by industries. Suppose that separate price indexes are available for the supply of machines and spare parts but direct price indicators for fixed capital formation and intermediate consumption are not available. In such a situation proxy deflators have to be “borrowed” from the supply side. Especially when working under pressure of time limits, different balancing results can occur dependent of the aggregation level in the supply and use tables.

Case I Separate commodity groups for machines and spare parts

	Supply	Use	
	Total	Intermediate consumption	fixed capital formation
Machines			
Value at current prices t	800		800
Price index	110.0		110.0
Value at constant prices	727		727
Volume index	103.9		103.9
Value at current prices t-1	700		700
Spare parts			
Value at current prices t	500	500	
Price index	105.0	105.0	
Value at constant prices	476	476	
Volume index	105.8	105.8	
Value at current prices t-1	450	450	
Total			
Value at current prices t	1300	500	800
Price index	108.1	105.0	110.0
Value at constant prices	1203	476	727
Volume index	104.6	105.8	103.9
Value at current prices t-1	1150	450	700

Case II One commodity group for machines and spare parts

	Supply Total	Intermediate consumption	fixed capital formation
Total			
Value at current prices t	1300	500	800
Price index	108.1	108.1	108.1
Value at constant prices	1203	463	740
Volume index	104.6	102.9	105.7
Value at current prices t-1	1150	450	700

It appears that in this example in case of only one commodity group intermediate consumption at constant prices would have been underestimated and gross domestic product as well as fixed capital formation would have been overestimated.

3. Weighing

3.1 Choice of index number formulae

In order to calculate price and volume measures, a number of methodological choices must be made. Firstly a choice must be made which index number formulae will be applied (See annex I for examples). Secondly the choice between a fixed base year and annually changing base year must be made. In this section these issues will be discussed.

Economic theory suggests that, in general, a symmetric index that assigns equal weight to the two situations being compared is to be preferred. Among others this is why the SNA and ESA show preference for so-called superlative indices, like Tornqvist and Fisher. However this preference is not strongly marked. Although the superlative indices have a number of attractions, it should be noted that they have also disadvantages:

i. The superlative indices are demanding in their data requirements and will increase the work burden significantly, possibly leading to delays in publication
ii. The superlative indices are less easy to understand as Laspeyres and Paasche indices
iii. The superlative indices are not additively consistent, which is a serious constraint when applied in an accounting framework. This even holds for the most elementary case of year to year changes.

From a practical point of view a number of requirements can be imposed on the index numbers:

- The applied index formulae should be a good approximation of the actual changes as expressed by the superlative indices
- A change in value must be divided into a price change and a volume change without residual
- Values at constant prices for aggregates should equal to the sum of values at constant prices of constituent parts, applying the same index formulae.

Additionally it is often required that the index formulae are rather straightforward and easy to interpret for users.

Imposing these requirements limits the number of possibilities in the choice of index number formulae. Most widely applied is the use of a combination of a Laspeyres volume index and a Paasche price index.

Laspeyres volume index

$$Lq = \frac{\sum p_0 q_t}{\sum p_0 q_0} = \frac{\sum p_0 q_0 \frac{q_t}{q_0}}{\sum p_0 q_0}$$

Paasche price index

$$Pp = \frac{\sum p_t q_t}{\sum p_0 q_t} = \frac{\sum p_t q_t}{\sum p_t q_t / \frac{p_t}{p_0}}$$

It can be easily shown that the decomposition of value changes in volume and price changes is without residual.

Pv = $$\frac{\sum p_t q_t}{\sum p_0 q_0} = Lq * Pp$$

Deflation of values in current prices by means of a Paasche price index yields:

Pv / Pp = $$\sum p_t q_t \,/\, \frac{\sum p_t q_t}{\sum p_0 q_t} = \sum p_0 q_t$$

The interpretation of this result is quite clear. The derived real values read in the previous year's prices.

Characteristic for the Laspeyres volume index is that the volume changes of individual goods are weighted together with the value in a former year (the "base year"). Characteristic for the Paasche price index is that the price changes of individual goods are weighted together with their value in the current year. The deflated values derived with this index formula combination can easily be explained as "values in prices of the base year".

An alternative solution is the combination of a Paasche volume index and a Laspeyres price index. This combination of index numbers also provides a decomposition in price and volume changes without residuals. However, this combination is not applied while the deflated current price data by means of a Laspeyres price index are difficult to interpret. Another disadvantage would be that values at constant prices of aggregates do not equal the sum of the constituent parts at constant prices.

3.2 Choice of base year

Applying the Laspeyres volume index number formula, volume changes are weighted with the values in a "base year". The question arises which year should be chosen as the base year. Generally speaking there is a choice between a fixed base year and a changing base year. The latter method is often called the "method of chain indices".

With the method of fixed weights for a series of years, the weights are derived from a single year in the past. An advantage of this method is that in longer series of values in constant prices, deflated parts of aggregates exactly add up to the deflated aggregate. However, a very serious disadvantage is that volume changes of aggregates are calculated with outdated weights. This disadvantage is especially severe when relative prices change rapidly. As a result economic growth is often significantly overestimated.

Applying the chained Laspeyres volume index means that weights change every year and are derived from the previous year. Since those weights are more up-to-date, a better approximation of the "real world" volume changes is obtained than with the method of fixed weights. Time series results can be obtained by multiplying separately estimated year-to-year volume indices: hence the name chain indices. An important advantage of the chain index method is that the above mentioned overestimation of growth rates is avoided. There is also a disadvantage: in time series in constant prices the deflated parts of an aggregate no longer exactly add up to the deflated aggregate. As a result "mathematical discrepancies" will appear that cannot be removed without disturbing the underlying "actual" volume and price movements.

The contrast between fixed weight methods and changing weight methods is to a certain extent not absolute but only exists in relative terms. Also the application of fixed weights, periodically asks for changing the weights to another base year. In chaining the sub-series also the non-additivity problem will appear.

Confronted with the choice between fixed weight and changing weight methods, a preference for yearly changing weights is expressed in recent international guidelines. The following quotations are from SNA and ESA.

SNA-1993 says:
(section 16.41) " If the objective is to measure the actual movements of prices and volumes from period to period indices should be compiled only between consecutive time periods. Changes in prices and volumes between periods that are separated in time are then obtained by cumulating the short-term movements: i.e., by linking the indices between consecutive periods together to form "chain indices". Such chain indices have a number of practical as well as theoretical advantages. For example, it is possible to obtain a much better match between products in consecutive time periods than between periods that are far apart, given that products are continually disappearing from markets to be replaced by new products, or new qualities. Chain indices are also being increasingly demanded by economists and others for analytical purposes and are being increasingly used for special purpose indices, such as consumer price indices, in order to have indices whose weighing structures are as up-to-date and relevant as possible".

ESA-1995 says:
(section 10.62) "The preferred measure of year to year changes in volume is a Fisher volume index which is defined as the geometric mean of the Laspeyres and the Paasche indices. Changes in volume over longer periods being obtained by chaining, i.e. by cumulating the year to year volume movements.
(section 10.64) "Chain indices that use Laspeyres volume indices to measure changes in volume and Paasche price indices to measure year to year price movements provide acceptable alternatives to Fisher indices."

3.3 Some practical results of different index number formulae and base years.

Table I gives the results of alternative estimates of the growth rates of GDP, imports and final demand categories for the Netherlands. Table II gives the corresponding time series of volume indices.

When discussing the results the chain Fisher volume indices are considered as a "standard" with which other results are compared.

Table I. Growth rates (t/t-1) according to different index number formulae (1986-1993): macro totals for the Netherlands (%)

	Laspeyres (weights 1986)	Laspeyres (chain)	Fisher (chain)	Paasche (chain)	Paasche (weights t, 1986)
Gross Domestic Product (market prices)					
1987	1,4	1,4	1,4	1,4	1,4
1988	3,4	2,6	2,6	2,6	2,7
1989	4,8	4,7	4,6	4,4	4,6
1990	4,2	4,1	4,0	3,9	3,5
1991	2,3	2,3	2,2	2,2	2,0
1992	2,0	2,0	2,0	2,0	2,0
1993	1,3	0,8	0,8	0,8	0,7
Consumption expenditure of households					
1987	2,7	2,7	2,7	2,7	2,7
1988	0,7	0,8	0,8	0,8	0,8
1989	3,5	3,5	3,5	3,5	3,5
1990	4,2	4,2	4,2	4,2	4,1
1991	3,3	3,1	3,1	3,1	2,9
1992	2,5	2,5	2,5	2,5	2,4
1993	1,1	1,0	1,0	0,9	0,9
Exports					
1987	4,0	4,0	3,9	3,7	3,7
1988	10,3	9,0	9,0	9,0	9,1
1989	6,8	6,6	6,5	6,3	6,2
1990	5,4	5,3	5,3	5,2	5,0
1991	4,9	4,7	4,7	4,6	4,7
1992	3,1	2,9	2,8	2,8	2,9
1993	2,1	1,5	1,4	1,4	1,4

Table II. Time series of volume indices according to different index number formulae (1986=100)

	Laspeyres (weights 1986)	Laspeyres (chain)	Fisher (chain)	Paasche (chain)	Paasche (weights t,1986)
Gross Domestic Product (market prices)					
1987	101,4	101,4	101,4	101,4	101,4
1988	104,9	104,1	104,0	104,0	104,1
1989	109,9	108,9	108,8	108,6	108,9
1990	114,5	113,4	113,1	112,8	112,7
1991	117,1	116,0	115,6	115,3	115,0
1992	119,5	118,3	117,9	117,5	117,3
1993	121,0	119,2	118,9	118,5	118,2
Consumption expenditure of households					
1987	102,7	102,7	102,7	102,7	102,7
1988	103,5	103,6	103,6	103,6	103,5
1989	107,1	107,2	107,2	107,1	107,1
1990	111,6	111,7	111,7	111,6	111,5
1991	115,3	115,2	115,1	115,0	114,7
1992	118,2	118,1	118,0	117,9	117,4
1993	119,5	119,3	119,2	119,1	118,5
Exports					
1987	104,0	104,0	103,9	103,7	103,7
1988	114,8	113,4	113,2	113,0	113,1
1989	122,6	120,9	120,5	120,1	120,1
1990	129,1	127,4	126,9	126,4	126,1
1991	135,4	133,4	132,8	132,2	132,0
1992	139,5	137,2	136,6	135,9	135,9
1993	142,5	139,3	138,5	137,8	137,7

The results in Table I show that most substantial divergences occur with Laspeyeres fixed weight indices. The Laspeyres, Fisher and Paasche chain type indices in most cases yield comparable results and the differences between the Paasche fixed weight and chain indices are generally speaking much smaller than between the Laspeyres fixed weight and chain indices. A remarkable and for the statistical practice very important conclusion which can be drawn from Table II is that, as ESA states, the Laspeyres chain indices provide good approximations of the "ideal" Fisher chain indices and that the Laspeyres fixed weight indices do less or, sometimes, not at all. This is especially important for the cases where the differences between Laspeyres and Paasche fixed weight indices and between the Laspeyres fixed weight index and the Laspeyres chain index are substantial. See: GDP (1988 and 1993), Consumption of households (1991), Capital formation (1992 and 1993), Exports (1988, 1989, 1990 and 1993) and Imports (1990, 1991 and 1993).

Generally speaking the results in Table I also bear out the statement of SNA that Laspeyres volume indices yield higher growth rates than Paasche volume indices and that the differences between the Laspeyres and Paasche chain indices are smaller than between the corresponding fixed weight indices.

Table II presents the time series of volume indices corresponding with the annual growth rates in table I. It will not be surprising that the conclusions that can be drawn from the results in table I and II are quite similar.

3.4 Weighing detailed quantity information to a volume indicator at the aggregation level of the supply table

Especially in particular parts of the service sector values at current prices are only available at rather high level of aggregation. As a result the product classification in supply and use tables is necessarily heterogeneous, which hampers good estimates of price and volume indexes.
In some cases there is a proxy solution possible for this problem. This is the case when more detailed quantity information can be found. Weighing the more detailed quantity data can derive the quantity indicator at the product level of the supply and use tables. Since values in current prices of t-1 are not available at the detail level, alternative weights have to be found. Which weights should be used is difficult to define and will depend of the industry. Only one requirement has to be fulfilled: the weighted quantity indicators have to be more appropriate than the unweighted indicators. An example is given below.
Suppose that services provided by homes for the elderly is only one product group in the supply table. The reason is that the value of output at current prices is only available at that aggregation level. The output of homes for the elderly is often heterogeneous since inhabitants ask different levels of care. A candidate volume indicator for the output is the number of resident days. However, the indicator would be more appropriate if one could take into account the differences in care needs. Sometimes in social statistics inhabitants are classified by “heaviness of care”. Weighing the quantity indexes for the separate care categories can derive a better volume index then. Candidate weights are the costs per resident per care category. If this information is not available, perhaps, as a last resort, expert guesses could be helpful.

4. *Deflation of the supply of goods and services.*

In this paragraph a number of deflation methods is discussed. The discussion is not meant to be exhaustive. For more extensive explanations the reader is referred to the Constant Price Manual that is in preparation by Eurostat.

4.1 Domestic production.

Market production

Deflation by production price indexes
Production price indexes (PPI's) usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of goods and services. A problem at the moment is that PPI's often cover only a part of the service sector.
In principle, PPI's account for changes in quality. A disadvantage is that most PPI's are Laspeyres type indexes and that they use fixed weighing schemes, generally updated only once per five years. This pleads in favour of applying PPI's at the lowest level of detail as possible when deflating the domestic supply of commodities.

Deflation by unit value indices
In case that for (a part of) domestic supply of a commodity both value and quantity information is available (e.g. from production surveys), unit values can be derived. Using these, so-called unit value indexes can be calculated. A problem with unit value indexes when used for deflation purposes is that they often refer to heterogeneous product groups. Therefore, the possibilities for their use, generally spoken, are limited. However, if no appropriate PPI's are available and they refer to homogeneous mass products of which the quality does not change in time rapidly, they can be applied as useful approximate deflators.

Deflation by tariff indexes
Certain kinds of services (e.g. commercial business services, services of general medical practitioners) are paid for by tariffs. For example a fee per time unit. Two impediments have to be reviewed here. Changes in the quality of the services rendered as well as changes in the productivity per time unit are not accounted for in this approach. So, tariff-based price indexes are only appropriate deflators if adjustments can be made for changes of quality and productivity or when it is surely known that such changes are within acceptable limits.
If the service rendered does not change too much in time indexes derived from fee information can be used as approximate deflators for the supply of such services. Special attention has to be paid to the requirement of representativity of the observed tariff data for the whole domestic supply.

Deflation by consumers price indexes (CPI's)
In some cases where PPI's are not available, CPI's can be used as approximate deflators for domestic supply of commodities. Two impediments have to be reviewed.
Firstly, only if private households use a considerable part of the supply of a commodity, CPI's are appropriate deflators for the supply of a commodity.
Secondly, only if trade and transport margins and taxes play a modest part in the purchaser's value, a CPI is an appropriate deflator for the supply of a commodity.
As a result CPI's especially are candidate deflators for services mainly rendered to private households.
An advantage is that CPI's account for changes in quality. A disadvantage is that most CPI's are Laspeyres type and that they use fixed weighing schemes, generally actualised only once per five years. This pleads in favour of applying CPI's at the lowest level of detail as possible when deflating the domestic supply of commodities.

Deflation by the model pricing approach
The model pricing approach asks producers to provide price estimates for typical existing, or even hypothetical, products. Model price indexes can be candidate approximate deflators when there are significant changes in product specification from one year to the next and especially in areas where products are unique. An important advantage is that since the same product or project is priced, the quality is unchanged. However, a disadvantage is that, especially in areas of rapid product change, the representativity of the observed price change for the total supply is questionable.

Deflation by hedonic price indexes
Hedonic price indexes are candidate deflators when product specification and quality changes significantly. The method is based on an assessment of certain measurable characteristics that make up such a product. For example, in personal computers memory and processing speed are two such characteristics. The main advantage is that quality changes are explicitly captured so that productivity changes are taken into account. A serious drawback is the complexity of the method. Furthermore, the resulting quality adjustment factor seems to be highly dependent on the choice of the characteristics and the choice of the regression model.

Extrapolation by quantity indicators
In section 2.2.1 was mentioned that the use of quantity indicators for splitting up value changes into volume and price changes is mostly more expensive than deflation by price indexes. However, it appears that for some commodities where price observation is difficult or not yet carried out, a considerable amount of quantity data are collected for other purposes. Examples can be found in the medical sector (e.g. number of inpatients of short-stay hospitals classified by Diagnoses Related Groups), the cultural sector (e.g. number of visitors of theatrical performances) and the banking sector (e.g. number of saving accounts, number of credits granted to commercial and private customers, number of payments on bank accounts). Since the data have already been collected, the high cost impediment does not hold here. Of course, quantity indicators have to fulfil the requirements discussed in 2.2. If they do, quantity indicators are appropriate indicators, especially in the case of specific services where price indicators are not available.

Deflation by a combination of price and quantity information
Although not often applied, another approach that has to be mentioned here is a combination of price and quantity information. Suppose that an industry supplies different products and no price indicators are available. However, for some of the products quantity indicators are available in combination with the corresponding values in current prices. Then, for the noted part of production price indexes can be derived. Under certain conditions those prices indexes can be applied also for the non-noted part of supply, on condition that for the non-noted part the price generating circumstances are strongly comparable. If this is not the case, the representativity of the deflators is questionable.

Input-methods
Input methods use the weighed price or volume changes of the intermediate and primary inputs as a proxy for the price or volume change of the output of an industry. The advantage of input methods is that in case of deflation within a supply and use framework the necessary date are readily available, as all inputs have been deflated already. However, a considerable disadvantage is that the price and volume indicators are not directly related to output. As a result the change of value added at constant prices and also productivity changes of an industry cannot be calculated in a proper way. For that reason, input methods have to be precluded as much as possible. Another disadvantage is that input methods can only be applied for the total production of an industry. A separate deflation of the different products of an industry is impossible. According to Commission Decision **… t**he use of input methods for the deflation of market production will be aloud no longer in the future.

Non-market production

Non-market production can be classified into non-market services, which are consumed on an individual basis, and collective services. In the former case, quantity indicators can be found, e.g. by counting and classifying the customers of a service. In the latter case the search for appropriate quantity indicators is much more laborious.

Non-market production consumed on an individual basis
Basically, in the area of non-market production there is also a volume and a price component in the change of value. However, in this case price changes are invisible. So the only way left is direct observation of quantity information. Generally speaking, just like with market production, the collection of sufficiently reliable quantity data would be expensive. However, especially for some non-market services consumed on an individual basis a high amount of quantity data is available, which has already been collected for other purposes. Examples can be found in the areas of public transport, medical services, culture and educational services. Of course, such data have to meet the national accounts requirements for volume indicators. One requirement is that they have a direct relation to the activity at hand. Another requirement is that they account sufficiently for changes in quality.

Collective services
Collective services are not rendered to separate customers but to groups of citizens or to total society. Because of their collective character, it is very difficult, if not impossible, to find direct price or volume indicators for collective services. From this circumstance, it would be alluring to apply any quantity information that is available. However, it must be emphasised that the indicators have to be related to the true output of the activity and not to an input or an intermediary activity.
Because of the absence of appropriate indicators, the last resort for the deflation of collective services seems to be the use of a kind of input method. As mentioned above, a serious drawback of this approach is that productivity changes cannot be measured in an independent way. If reliable independent estimates of productivity growth by producers of collective services are available from sources outside the statistical office they can be used to estimate value added at constant prices including productivity change.
Another way to amend the usual input methods is to use as a quantity indicator the change of the working hours of employees directly engaged in rendering the service. A requirement is that the working hours of people engaged in managing, co-ordination and auxiliary activities are left out. If such a method could be carried out in a proper way, at least a part of the productivity measurement problem has been solved.

4.2 Imports of goods and services

Deflation by imports price indexes
Import price indexes usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of imported goods. A problem at the moment is that import price data are generally not available for services.
In principle, import price indexes account for changes in quality. A disadvantage is that they mostly are Laspeyres type and that they use fixed weighing schemes, generally actualised only once per five years. This pleads in favour of applying them at the lowest level of detail as possible.

Deflation by unit value indices
Foreign Trade Statistics often provide the value of imports as well as the corresponding quantities at a detailed level. From this information unit value indexes can be derived. A problem with unit value indexes when used for deflation purposes is that they often refer to heterogeneous product groups. Sometimes the unit of measurement is kg; often the unit is simply the number of items. This implies that in many cases unit value indices suffer from heterogeneity. Therefore, the possibilities for their use as deflators, generally spoken, are limited. However, if no appropriate information from price statistics is available and the unit values refers to homogeneous mass products of which the quality does not change in time rapidly, they can be applied as useful proxies of deflators.

Other proxies
At the moment deflation by imports price data and by unit value indexes is only possible for imported goods. Direct deflators for services are not available. Two impediments have to be mentioned here. The first is a the more general problem of the exact observation of the imports per commodity group according to the classification in the supply and use tables. The second, and for deflation most important, problem is that the price observation of imported (and exported) services is an underdeveloped area in nearly all countries. This is the reason why in the national accounts for the deflation of the imported services we have to resort to proxies based on rough assumptions.
An obvious assumption would be that for every commodity the price generating conditions at the domestic market tend to bring about one price, which holds for both domestic supply and imported services. As far as this assumption is true, the price index of the domestic supply of a service is a good proxy for the price index of the imports of that service.

5. Deflation of trade and transport margins

5.1. Deflation of trade margins

The output of the trade industry consists of trade margins at one hand and other trade services at the other hand. An example of other trade services is commissions. The deflation of other trade services is fully comparable with other business services and does not need special attention.
However, trade margins play a special role in supply and use tables as an intermediary value between the supply and use value of goods. They are the remuneration for the services rendered by the trade industry to producers and consumers in the distribution of goods. A special aspect of the deflation of trade margins is that the trade margin at constant prices has to be consistent with both the deflated supply and the deflated use at constant prices.
Just like with other services the appropriate deflation of trade services requires price or volume indicators directly related to the service rendered. At present, methods to derive price and volume indices based on direct price and quantity indicators seem not to be available. A main reason is that difficult conceptual problems have to be solved. Most of them are related to the measurement of the quality of the services. So, for the time being approximate methods must be applied.
The value of trade margins is relatively large and the trade industry generates a considerable part of GDP. For that reason it would be very important to develop methods for the direct observation of price and volume changes of trade in the next future. In this paragraph firstly some aspects of such a direct approach are discussed. After that an often-applied approximation is discussed.

Direct deflation of the output of the trade industry
It is very difficult to define the services rendered by the trade industry precisely. Also in economic literature no unambiguous picture is presented. Numberless aspects are mentioned which all influence the quality of the services of the trade industry: e.g. amount of information given to the customers, after sales services, delivery time, assortment, quality of shop assistants and availability of parking lots. The multiplicity of the relevant aspects makes it very difficult to collect the right data for direct deflation of trade services (including changes in quality) and, if they are available, to weight the quality aspects together.
A possible approach to keep track of quality changes and at the same time circumventing the direct observation of quality aspects, is to deflate purchases for resale and the corresponding sales of trade industry separately, applying appropriate price indexes and subsequently calculate trade margins in constant prices as the difference. However, this approach requires high quality price indexes for both purchases and sales of products by the trade industry. Perhaps prospects are best for retail trade. Especially, if PPI's and CPI's are available at a very detailed product level. For wholesale trade prospects are worse.

Approximation by the volume-index of the commodity flow
An often applied proxy for the estimation of the volume index of the trade margin on a product is to assume that the volume change in the trade margin equals the volume change of the commodity flow. This is the same as to assume that the percentages of the trade margin at constant prices are unchanged between t-1 and t.
The volume index for trade margins is:

$VI_{tr} = VI_{flow}$

where:

VI_{tr} = volume index of trade margins
VI_{flow} = volume index of the corresponding commodity flow

Trade margins at constant prices can be written as:

$TR_{t/t-1} = TR_{t-1/t-1} * VI_{flow}$

where:

$TR_{t/t-1}$ = trade margins of t of prices of t-1
$TR_{t-1/t-1}$ = trade margins of t-1 of prices of t-1

This method can be highly improved when applied at a detailed commodity level as used in a supply and use table. A further improvement can be reached by a breakdown of the trade margin on a commodity to type of outlet, assuming that different outlets provide different qualities of services. In this way quality changes due to turnover shifts between outlets is accounted for.
The modified formula for the calculation of the volume index for trade margins is:

$$\sum_i \sum_j \frac{TR(i,j)_{t-1/t-1} * VI(i,j)_{flow,i,i}}{TR(i,j)_{t-1/t-1}}$$

in which:

TR(i,j) = trade margins for commodity i and outlet j
VI(i,j) = volume index for the flow of commodity i and outlet j

5.2. Deflation of transport margins

For the deflation of transport margins price indexes for the output of transport industries can be used. A necessary condition is the existence of a matrix of transport margins by type of transport (column) and commodity (row). Per column the price index of the relevant output can be applied. Volume changes of the transport margins linked to volume changes of the transported commodities can be used to check the plausibility of the results. Generally one expects that these two volume changes are more or less the same.

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6. Deflation of taxes (and subsidies) on products

6.1 Introduction

Taxes and subsidies on production and imports as applied in the supply and use framework are divided into:
a) taxes and subsidies on products
b) other taxes and subsidies on production.

Taxes (subsidies) on products are taxes (subsidies) that are payable per unit of some good or service produced or transacted. The tax (subsidy) may be a specific amount of money per unit of quantity of a good or service, or it may be calculated as a specified percentage of the price per unit or value of the goods and services transacted. Examples of taxes on products are value added type taxes, excises, duties on imports, etc.
For an accurate estimation of the volume index of a tax or a subsidy, it is very important to determine witch part of the supply or use of a commodity is levied by this tax or subsidy. For instance, taxes are levied only on domestic consumption of a product and not on exports. Another example is subsidies on diary products, which are only given on exports to countries outside the European Community. In other cases special subsidies are given only on production surpluses used as raw materials by the cattle-fodder manufacturing industry.

Other taxes (subsidies) on production consist of all taxes (subsidies) that units incur (receive) as a result of engagement in production, independently of the quantity or value of the goods and services produced or sold. Examples are road tax, taxes on ownership of dwellings, subsidies to payroll or work force, etc. The deflation of other taxes is discussed in section 8.3

6.2 Taxes and subsidies on products

Taxes and subsidies on products affect the *price* of a product and not the *volume*. This means that for deflation it is a requirement that the volume index of the value inclusive tax (subsidy) of a product equals the volume index of the value exclusive tax (subsidy). As a result also the volume index of the tax (subsidy) value must equal the volume index of the value inclusive (or exclusive) tax (subsidy). In this paragraph constant price estimation for taxes and subsidies on products is elaborated for taxes. For subsidies similar calculations can be made.

Suppose q(t-1) and q(t) are the quantities of a taxed product in t-1 and t;
bp(t-1) and bp(t) are the prices exclusive tax (basic prices);
ta(t-1) and ta(t) are the taxes per quantity unit; and
pp(t-1) and pp(t) are the prices inclusive tax (producers prices).

Volume index

The volume index according to the Laspeyres formula of the *value exclusive tax* is

$$\frac{\Sigma \; bp(t-1) * q(t)}{\Sigma \; bp(t-1) * q(t-1)} = \frac{\Sigma \; bp(t-1) * q(t-1) * [q(t) / q(t-1)]}{\Sigma \; bp(t-1) * q(t-1)}$$

The volume index according to the Laspeyres formula of the *value inclusive tax* is

$$\frac{\sum pp(t-1) * q(t)}{\sum pp(t-1) * q(t-1)} = \frac{\sum pp(t-1) * q(t-1) * [q(t) / q(t-1)]}{\sum pp(t-1) * q(t-1)}$$

The volume index according to the Laspeyres formula of the *value of the tax* is

$$\frac{\sum [pp(t-1) - bp(t-1)] * q(t)}{\sum [pp(t-1) - bp(t-1)] * q(t-1)} = \frac{\sum ta(t-1) * q(t)}{\sum ta(t-1) * q(t-1)}$$

$$= \frac{\sum ta(t-1) * q(t-1) * [q(t) / q(t-1)]}{\sum ta(t-1) * q(t-1)}$$

and the value of the tax in t in prices of t-1 is $\sum ta(t-1) * q(t-1) * [q(t) / q(t-1)] = \sum ta(t-1) * q(t)$

Price index

The price index of the tax according to the Paasche formula is

$$\frac{\sum ta(t) * q(t)}{\sum ta(t-1) * q(t)} = \frac{\sum ta(t) * q(t)}{\sum ta(t) * q(t) / [ta(t) / ta(t-1)]}$$

Value index

The value index calculated from the volume and the price index is

$$\frac{\sum ta(t-1) * q(t)}{\sum ta(t-1) * q(t-1)} * \frac{\sum ta(t) * q(t)}{\sum ta(t-1) * q(t)} = \frac{\sum ta(t) * q(t)}{\sum ta(t-1) * q(t-1)}$$

There are two categories of taxes (subsidies) on products: taxes levied on quantity and taxes on value. In the next sections we will discuss them separately.

Indirect taxes levied on quantity

Examples are *excises* on tobacco, alcoholic drinks and fuel by kind.

The volume index according to the Laspeyres formula of the *value of the tax* is

$$= \frac{\sum ta(t-1) * q(t-1) * [q(t) / q(t-1)]}{\sum ta(t-1) * q(t-1)}$$

In case of taxes on quantities *ta(t-1)* is the tariff *tq(t-1)* of the tax in t-1. So, the volume index of the tax is

$$= \frac{\Sigma\ tq(t-1) * q(t-1) * [q(t) / q(t-1)]}{\Sigma\ tq(t-1) * q(t-1)}$$

and the value of the tax for t in prices of t-1 is $\Sigma\ tq(t-1) * q(t-1) * [q(t) / q(t-1)]$ $= \Sigma\ tq(t-1) * q(t).$

The price index of the tax value is

$$\frac{\Sigma\ tq(t) * q(t)}{\Sigma\ tq(t-1) * q(t)} = \frac{\Sigma\ tq(t) * q(t)}{\Sigma\ tq(t) * q(t) / [tq(t) / tq(t-1)]}$$

If tq(t) and tq(t-1) are the same for every transaction this can be rewritten as

$$\frac{tq(t)}{tq(t-1)} * \frac{\Sigma\ tq(t) * q(t)}{\Sigma\ tq(t) * q(t)} = \frac{tq(t)}{tq(t-1}$$

So, in that case the price index of a tax on quantity is the tariff index.

Indirect taxes levied on value

An important example is value-added tax (VAT).

The volume index according to the Laspeyres formula of the *value of the tax* is

$$= \frac{\Sigma\ ta(t-1) * q(t-1) * [q(t) / q(t-1)]}{\Sigma\ ta(t-1) * q(t-1)}$$

In case of taxes on value *ta(t-1*) is the tariff *tv(t-1)* of the tax in t-1 multiplied by the price *p(t-1)* (exclusive tax) of the product. So, the volume index is

$$= \frac{\Sigma\ tv(t-1) * p(t-1) * q(t-1) * [q(t) / q(t-1)]}{\Sigma\ tv(t-1) * p(t-1) * q(t-1)}$$

and the value of the tax for t in prices t-1 is $\Sigma\ tv(t-1) * p(t-1) * q(t)$

The price index is

$$\frac{\Sigma\ ta(t) * q(t)}{\Sigma\ ta(t-1) * q(t)} = \frac{\Sigma\ tv(t) * p(t) * q(t)}{\Sigma\ tv(t-1) * p(t-1) * q(t)}$$

$$= \frac{\Sigma \; tv(t) * p(t) * q(t)}{\Sigma \; tv(t) * p(t) * q(t) / \{[tv(t) / tv(t-1)] * [p(t) / p(t-1)]\}}$$

In case of a tax on value the price index of the tax value usually is different for different transactions. The reason is that they depend of the price index of the basic value of the transactions. Further on e.g. for VAT different tariffs exist for different commodities.

Subsidies

The practical elaboration of constant price estimation of taxes on products presented above can be similarly applied to subsidies on products.

Real versus theoretical tax revenue

In practice, for several reasons, the actual tax revenue (the tax receipts by the tax authorities) of a certain tax can differ from the theoretical tax revenue (tax calculated from the multiplication of tax tariffs and basic values of transactions). Reasons could be non-collectability by the tax authorities, measuring errors, etc. In national accounts it is an important question how to deal with differences between the theoretical tax value index and the index of the actual tax revenue: will it be added to the volume index or to the price index? This is a choice between two evils: to affect the volume index or the price index. Both are important in national accounts. However, the answer to that question can be given from the consideration that in national accounts the estimation of volume growth rates is still somewhat more important than the estimation of price indexes. So, the difference has to be added to the price index and the volume index will not be changed.
It is recommendable, when deflating taxes on products, firstly to estimate the volume index (from the volume index of the value inclusive or exclusive tax) and the value of taxes in year t in prices of t-1 and than calculate the price index of the tax as a residual.

An additional problem is that usually the actual tax revenue is only available for the total of all transactions that have been levied with that tax. At the detailed transaction level only the theoretical tax revenue can be calculated. Differences between the value indexes of the actual and the theoretical tax revenues are only manifest at the aggregated level.
An important question is whether to make corrections for differences between the actual and the theoretical revenue or not. And in case that corrections have to be made, whether this happens only at the aggregated level (one special correction row in the use table) or also at the detailed level.
For the deflation of taxes it is important that corrections never affect the estimated volume indexes at the detailed level. Since weights based on actual tax revenues differ from weights based on theoretical tax revenues it is unavoidable that volume indexes at the aggregated level are more or less different.

Newly introduced and disappearing taxes and subsidies

As was stated above, taxes and subsidies on products affect the *price* of a product and not the *volume*, implying that the volume index of the value inclusive tax (subsidy) of a product equals the volume index of the value exclusive tax (subsidy). As a result the latter also equals the volume index of the tax (subsidy) value. These conditions give raise, at first sight, to queer results, in case of newly introduced or disappearing taxes (subsidies).

Example 1. Newly introduced taxes on products

Applying the guidelines that the volume change at producers prices equals the volume change at basic prices, implies that taxes on products in constant prices equal zero, while the current price amount is not zero, since:

	Year t current prices	Price index	Year t constant prices	Volume index	Year t-1 current prices
Output at basic prices	1000	100	1000	100	1000
taxes on products	100		0		0
Output at producers prices	1100	110	1000	100	1000

Example 2: Disappearing taxes on products

Applying the guidelines that the volume change at producers prices equals the volume change at basic prices, implies that taxes on products in constant prices are not zero, while in current prices the amount equals zero, since:

	Year t current prices	Price index	Year t constant prices	Volume index	Year t-1 current prices
Output at basic prices	1000	100	1000	100	1000
taxes on products	0	0	100	100	100
Output at producers prices	1000	91	1100	100	1100

7. *Deflation of use of goods and services*

7.1 Intermediate consumption by industries

Deflation by intermediate consumption price indexes

Intermediate consumption price indexes (ICPI's) usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of intermediate consumption of goods. A problem is that ICPI's hardly ever cover intermediate consumption of services.
In principle, ICPI's account for changes in quality. A disadvantage is that most ICPI's are Laspeyres type and that they use fixed weighing schemes generally actualised only once per five years. This pleads in favour of applying ICPI's at the lowest level of detail as possible when deflating the domestic supply of commodities.

Deflation by unit value indices
In case that for (a part of) intermediate consumption of a commodity both value and quantity information is available (e.g. from production surveys), unit values can be derived. Using these, so-

called unit value indexes can be calculated. A problem with unit value indexes when used for deflation purposes is that they often refer to heterogeneous product groups. Therefore, the possibilities for their use, generally spoken, are limited. However, if no appropriate ICPI's are available and they refer to homogeneous mass products of which the quality does not change in time rapidly, they can be applied as useful proxy deflators.

Deflation by price indexes of supply
In some cases where ICPI's are not available, price indexes of supply can be used as approximate deflators for intermediate consumption of goods and services. Two impediments have to be reviewed. Firstly, price indexes of supply are only appropriate deflators for intermediate consumption of a commodity in case intermediate consumption accounts for a considerable part of the turnover of a commodity.
Secondly, price indexes of supply are only appropriate deflators for the intermediate consumption of a commodity in case margins and taxes play a modest part in the composition of the purchaser's price. As a result price indexes of supply are especially candidate deflators for intermediate consumption of services.

Deflation by consumers price indexes
In some cases where ICPI's are not available, CPI's can be used as proxy deflators for intermediate consumption of commodities. An important requirement is that market conditions for intermediate and private consumption are comparable. This means for example that the share of wholesale and retail margins in the purchaser's price is nearly the same. An example of goods where intermediate and private consumption often show comparable price changes is fuel for motorcars.

In a number of cases the error in the estimation of total GDP due to the use of less appropriate price indexes is limited. When intermediate consumption is the main part of turnover of a domestically produced commodity, underestimation of intermediate consumption and thus overestimation of value added in one industry will be counterbalanced by an underestimation of output (commodity, trade or transport margins) thus an underestimation of value added in another industry.

7.2 Exports of goods and services

Deflation by exports price indexes
Exports price indexes usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of exported goods. A problem at the moment is that export price statistics are often not available for services.
In principle, export price indexes account for changes in quality. A disadvantage is that they mostly are Laspeyres type and that they use fixed weighing schemes generally actualised only once per five years. This pleads in favour of applying them at the lowest level of detail as possible.

Deflation by unit value indices
Foreign Trade Statistics often provide the value of exports as well as the corresponding quantities at a detailed level. From this information unit value indices can be derived. A problem with unit value indexes when used for deflation purposes is that they often refer to heterogeneous product groups. Sometimes the unit of measurement is kg; often the unit is simply the number of products. That means that unit value indices in many cases suffer from heterogeneity. Therefore, the possibilities for their use as deflators, generally spoken, are limited. However, if no appropriate information from producer's price statistics is available and the unit values refer to homogeneous mass products of which the quality does not change in time rapidly, they can be applied as useful proxies of deflators.

Deflation by price indexes of supply

In some cases where price indexes for exports are not available, price indexes of supply can be used as approximate deflators. Two impediments have to be reviewed.
Firstly, price indexes of supply are only appropriate deflators for exports of a commodity in case exports accounts for a considerable part of the turnover of a commodity.
Secondly, price indexes of supply are only appropriate deflators for the exports of a commodity in case margins and taxes play a modest part in the composition of the purchaser's price. As a result price indexes of supply are especially candidate deflators for intermediate consumption of services.

Other proxies
At the moment deflation by exports price data and by unit value indexes is only possible for export of goods. Direct deflators for services are generally not available. Two impediments have to be mentioned here. The first is a the more general problem of the exact observation of the exports per commodity group according to the classification in the supply and use tables. The second, and for deflation most important, problem is that the price observation of exported services is an underdeveloped area in nearly all countries. For that reason in the national accounts for the deflation of the exported services we have to resort to proxies based on rough assumptions.
A simple but rough assumption is that for every commodity the price index for exports equals the price index of domestic production. Another possibility would be to collect information on the price changes of that service in the customer countries (see imports of services).

7.3 Private consumption of households

Deflation by consumption price indexes
Consumption price indexes (CPI's) usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of the private consumption of goods and services.
In principle, CPI's account for changes in quality. A disadvantage is that most CPI's are Laspeyres type and that they use fixed weighing schemes generally actualised only once per five years. This pleads in favour of applying CPI's at the lowest level of detail as possible when deflating the domestic supply of commodities.

Deflation by price indexes of supply
In some cases where CPI's are not available, price indexes of supply can be used as approximate deflators for private consumption of goods and services. Two impediments have to be reviewed.
Firstly, price indexes of supply are only appropriate deflators for private consumption a commodity in case private households use a considerable part of the supply of a commodity,.
Secondly, price indexes of supply are only appropriate deflators for the private consumption of a commodity in case margins and taxes play a modest part in the composition of the purchaser's price. As a result price indexes of supply are especially candidate deflators for private consumption of services.

7.4 Government consumption

Government consumption equals government production minus sale of market production by government. Constant price estimates can be derived likewise.

7.5 Gross fixed capital formation

Deflation by price indexes of capital goods
Specific price indexes for capital goods (FCPI's) usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of gross fixed capital formation in goods. A problem is that FCPI's are hardly ever part of the program of the statistical offices.

In principle, FCPI's account for changes in quality. A disadvantage is that most FCPI's are Laspeyres type and that they use fixed weighing schemes generally actualised only once per five years. This pleads in favour of applying FCPI's at the lowest level of detail as possible when deflating the domestic supply of commodities.

Deflation by price indexes of supply
In some cases where FCPI's are not available, price indexes of supply can be used as approximate deflators for gross fixed capital formation in goods and services. Two impediments have to be reviewed.
Firstly, price indexes of supply are only appropriate deflators for private consumption a commodity in case private households use a considerable part of the supply of a commodity,.
Secondly, price indexes of supply are only appropriate deflators for the private consumption of a commodity in case margins and taxes play a modest part in the composition of the purchaser’s price. As a result price indexes of supply are especially candidate deflators for private consumption of services.

Deflation by consumers price indexes
In some cases where FCPI's are not available, CPI's can be used as proxy deflators for gross fixed capital formation. An important requirement is that the market conditions for business and private consumption are comparable. This means for example that the share of wholesale and retail margins in the purchaser’s value is the same. As a result price indexes of supply especially are candidate deflators for private consumption of services. An example of goods where fixed capital formation and private consumption often show comparable price changes is person cars.

Changes of inventories

The price indexes used to deflate changes in stocks should be in accordance with the kind of inventory in question. For inventories of finished products, PPIs at basic prices are the appropriate choice. For inventories of materials and supplies, similar indices as used for intermediate consumption should be used. These are preferably genuine intermediate consumption prices, but in practice mostly PPIs adjusted to purchasers’ prices. For inventories of goods for resale a PPI will usually be a good indicator (for retailers should, strictly speaking, a PPI be adjusted for wholesale trade margins).

Full information
In the ideal case, information is available on the price of the product during the year, as well as the exact times and quantities of additions to and withdrawals from the inventory. Then it is in principle not difficult to calculate the changes in stocks at current and at constant prices. Additions and withdrawals have to be valued at the prices prevailing at the times at which they take place. The sum of all additions minus the sum of all withdrawals gives then the value of CI over the year. In practice, this calculation can be done on a monthly or quarterly basis. The annual value is the sum of CI in the months or quarters.

The changes in stocks at constant prices are calculated by valuing the quantities of additions and withdrawals at the average prices of the previous year.

In a slightly less ideal world we will not have detailed information on additions and withdrawals, but only the levels of inventories (in quantities) at the beginning and end of the year. In this case, changes in stocks (both at current and constant prices) is calculated by multiplying the change in quantity with an average price of the year (current year or previous year, respectively). If the price of the product or the change in quantity has been constant during the year, this provides an exact estimation. If the price and the change in quantity have fluctuated, however, this method provides only an approximation of the ideal. The degree of fluctuation determines the accuracy of the approximation. The more prices or quantities vary during the year, the more necessary it becomes to calculate changes in stocks and holding gains on a quarterly or monthly basis.

Information of values of inventories
In many cases, enterprises will not be able to give data on quantities, but only on the value of the level of their inventories at the beginning and end of the year according to their own bookkeeping system. These bookkeeping systems generally do not value inventories according to ESA rules, but for example following historic cost system, LIFO system, etc. (see the annex for definitions of a few frequently occurring bookkeeping systems). Therefore, these values cannot directly be used in the national accounts. In this case, first the change in volume has to be derived, which can then be multiplied with an appropriate price index to arrive at changes in stocks at current prices.

In order to calculate correctly the change in volume of inventories, information is needed on the bookkeeping system used in the enterprise. Some countries ask this information in their production or inventory surveys. If no information is available, an assumption will have to be made. On the basis of the known or assumed bookkeeping system, the values of the levels of inventories can be deflated. If actual prices are available, then the values can be divided by these prices to obtain quantity information. The change in quantity then has to be multiplied with the average price of the desired year to obtain changes in stocks (at current or constant prices). If a price index is available that describes the price development of the stock according to the known or assumed bookkeeping practice, the values can be deflated to arrive at changes in stocks at constant prices directly. This should then be reflated with an average price index according to national accounts valuation rules to determine changes in stocks at current prices.

8. Value added by industry

8.1 Total value added

For the estimation of real value added various methods are available. In general one can make a split in two classes:

- Double indicator methods
- Input method
- Single indicator methods

Double indicator methods
Double indicator methods take into account changes in both output and intermediate consumption of goods and services. Value added at constant prices is derived as a residual by subtracting constant prices estimates of intermediate consumption from constant prices estimates of output. Double indicator methods are, from a theoretical point of view, superior to single indicator methods, since they take into account changes of both output and input and derive value added as a residual, in conformity with its definition.

Double deflation
In double deflation, current price estimates for output and of intermediate consumption are both deflated by appropriate price indices. Constant price value added is derived by subtraction. This method is considered preferable to others, because price relatives tend to be more stable over time than corresponding quantity relatives.

Double extrapolation
In double extrapolation, base year value of output and intermediate consumption are extrapolated using appropriate volume indexes, and derive constant price value added by subtraction.

Extrapolation/deflation
For example, in case no price data are available for output of a certain industry, constant price estimates can be compiled applying volume indicators (e.g. specific services). When compiling constant price estimates within a supply and use framework, it will, in general, be possible to deflate intermediate consumption by price indexes. In this case a mix of deflation and extrapolation is applied for constant price estimation.

Single indicator methods
Single indicator methods consists in estimating constant price value added using a single variable, the movements of which are assumed to be correlated with those of value added. As with the input method, these methods should be avoided if possible, because productivity changes cannot be measured in an independent way.
Within the class of single indicator methods, one can distinguish between methods using output indicators and input indicators

Single output-related methods
The first possibility is direct deflation of current price value added by a price index of output or a consumer price index. A second possibility is to extrapolate value added of the base year using the volume index of total output.

Single input-related methods
Value added can be submitted to direct deflation using the price index of intermediate consumption or a wage rate index
Direct extrapolation value added can be applied using the volume index of intermediate consumption, the volume index of compensation of employees, volume indexes of employment (numbers employed, man-hours worked, man-hours worked adjusted for change in labour productivity.

8.2 Compensation of employees

Compensation of employees is part of total value added to be estimated in constant prices. The results can be applied in analysis of labour productivity. For the purpose of measuring the volume of input of labour, the quantity unit for compensation of employees may be considered to be an hour’s work of a given type and level of skill. As with goods and services, different qualities of labour must be recognised. The price associated with each type of work is the compensation paid per hour, which may vary, of course, between different types of labour. A volume index for labour input may be calculated as a weighted average of the separate volume indexes for different kinds of labour, weighted by the values of compensation of employees in the previous year or fixed base year.
Alternatively, a wage rate index may be calculated for work by calculating a weighted average of the proportionate changes in hourly rates of compensation for different types of work, again using compensation of employees as weights. If a Laspeyres-type of volume index is calculated indirectly by deflating the changes in compensation of employees at current values by an index of the average change in hourly compensation, the latter should be a Paasche-type index.

Price or volume indicator
Wages at constant prices can be derived either by means of a volume indicator or a price indicator.

A volume indicator relies heavily on the availability of data on labour divided in "quality classes". Because of the heterogeneity of labour, the level of detail should be very high. In many cases sufficient detailed data will not be available, implying a choice for the use of price indicators.

Compensation of employees consists of two parts: Wages and salaries, both in cash and in kind and employers' social contributions. The deflation of both parts should be closely connected, applying either a price indicator or a volume indicator. The applied indicators must be comparable to other indicators in the sense that changes in quality are included in the volume changes.

8.2.1. Wages and salaries

A breakdown of the wage raise in case of an individual full time employee consists of:

Price change: raise of the hourly contractual wages resulting from the applicable collective labour agreement
Volume change – quantity: change in actual hours worked or contractual hours worked
Volume change – quality: incidental changes in wages, like annual steps within a salary scale or bonuses

This breakdown asks for comments. The price change is chosen to be equal to the change in wages derived from applicable collective labour agreements. It goes without saying that part of this change is compensation for changes in labour productivity and thus should be included in the volume. On the other hand, it is very unlikely that incidental wage changes are a pure volume change. The above breakdown seems to be acceptable as a compromise.
For the quantity type volume changes, the actual hours worked is the ideal indicator. However, if not available, changes in the contractual hours worked can be applied as a second best solution.

On an industry level one can apply the same breakdown:

Price change: raise of the hourly contractual wages resulting from the relevant collective labour agreement
Volume change – quantity: change in actual hours worked or contractual hours worked
Volume change – quality: incidental changes in wages and the result of intake and outflow of employees

The quality-type of volume chance consists of two parts: the incidental wage changes and the result of the intake and outflow of employees. In general one would expect the second part to be negative, as newly incoming employees nearly always earn less than leaving employees. This even holds in case of a limited upgrading of personnel.

Generally speaking the definition of wages in the national accounts does not correspond fully to the definition of wages in collective labour agreements. In order to apply a wage index derived from collective labour agreements, the differences in definition must be calculated explicitly.

For example:

Wages and salaries in conformity with national accounts (Wna)
minus: wages in kind (Wik)
minus: allowances for transport to and from work (TE)
plus: payments in case of illness (PI)
= Wages and salaries in conformity with collective labour agreements (Wla)

or in a formula:

(i) Wna = Wla – PI + TE + Wik

The differences in definitions will be country specific, so no general summing up of items can be given in this manual. This paragraph uses the example for further elaboration of the deflation of compensation of employees.

In order to arrive at constant price estimates for Wna, implies that for all items of formula (i) a price or volume indicator must be available.

Wages based on collective labour agreements can be deflated applying the changes of the hourly wage rate, derived form the applicable labour agreements.
Wages in kind are often a specific part of output or a specific part of intermediate consumption for which the price indices used in the supply and use tables can be applied.
If expenses for transport to and from work are separately available, matching price indices per type of transport can be applied. If not separately available, a second best solution could be to see them as included in wages in conformity with collective labour agreements (Wla) and implicitly apply the price change of Wla.
Payments for illness concern payments for non-productive contractual hours due to illness. In national accounts these payments are part of social contributions and are therefore deducted from Wla. A raise in absence through illness implies less wages in national accounts, but Wla will be unchanged. A sophisticated approach to compile constant price estimates for PI links up with actual hours worked and uses changes in the rate of absence through illness as input for the calculations.
A simplified solution could be to use contractual work hours, implying that the volume change of PI equals the volume change of Wla.

Social contributions

In general there is only an indirect link between changes labour input and changes in employers' social contributions, as changes in legislation in this field affect the current price level of social contributions, without corresponding changes in labour input. Constant price estimates can be derived using the volume change of wages and salaries as indicator. The price change for this item can then be derived.

An example

Table 1 presents data to be used for the compilation of constant prices estimates for compensation of employees. In addition plausibility checks on the final result are part of the calculation scheme.
The quantity unit in volume estimation of compensation of employees is "an hour of work of a given type and level of skill" (ESA, par 10.54). If data on actual hours worked are not available, as in case of this example, estimates can be derived from labour force data based on contractual hours worked (table 1 item 1) and the rate of absence through illness (table 1 item 3) using:

*Actual hours worked = labour force in contractual hours * (1 – absence through illness [%]/100)*

The result is presented as item 5 in table 1.

The hourly wage rate (table 1 item 2) serves as an indicator for the price changes in wages and salaries.

A special item is "payments for illness" (table 1 item 4), indicating the level of wages paid during the period of illness. Sometimes not the full wage is paid during periods of illness, but only a certain percentage. Generally this rate ranges from 70% to 100%. This rate of payment affects the calculation of wages in conformity with collective labour agreements (see below).

Table 1. General data

		1995	1996	Index
1	Labour force (mln. contractual hours)	8403	8544	1,7%
2	Hourly wage rate (1995 = 100)	100,0	102,9	2,9%
3	Absence through illness (%)	7,2%	6,9%	-4,2%
4	payments for illness	100%	100%	0,0%
5	actual hours worked (1*(1-3/100))	7798	7954	2,0%

Table 2. Compensation of employees in constant prices

		1995	1996		1996 - 1995		
		current	current	constant	% changes		
		prices	prices	prices	value	price	volume
	data on compensation of emplyees						
1	compensation of employees	341,1	353,3	345,6	3,6%	2,2%	1,3%
2	employers' social contributions	51,4	51,6	52,1	0,4%	-0,9%	1,3%
3	wages and salaries (=1-2)	289,7	301,7	293,5	4,1%	2,8%	1,3%
4	Wages in kind	28,1	29,1	28,6	3,6%	1,7%	1,8%
5	Actual payments for illness	20,3	20,2	19,6	-0,5%	2,9%	-3,3%
6	wages including PI (=3-4+5)	281,9	292,8	284,6	3,9%	2,9%	0,9%
7	Deducted wages in case of illness	0,0	0,0	0,0			-3,3%
8	Wages linked to illness	20,3	20,2	19,6	-0,5%	2,9%	-3,3%
9	Wages cf CLA (=6+7)	281,9	292,8	284,6	3,9%	2,9%	0,9%

From the supply table one can derive data on compensation of employees, divided in wages and salaries and employers' social contributions at current prices. In addition it is assumed that wages in kind at current and constant prices are available (table 2, items 1 – 4).

Using the above-mentioned data as a starting point, compensation of employees at constant prices can be estimated.

The first step is to calculate wages and salaries in conformity with collective labour agreements (table 2 item 9)

Wages linked to illness (Wi, being part of social contributions) can be calculated as:

*Wi = Wla * absence through illness [%]/100*

Not always the full wages linked to illness are paid:

*Actual payments for illness = Wi * payments for illness[%]/100)*

Then wages and salaries in conformity with national accounts equal:

Wna = Wla – actual payments for illness + wages in kind

Combining these equations one can derive a formula for Wla having observed data as inputs:

*Wcla = (Wna – Wik)/(1- Absence through illness[%]*payments for illness[%])/10000)*

Current price estimates for the other items are easily calculated, using the formulae above.

Constant price estimation
The hourly wage rate index of table 1 is applied to deflate wages and estimate the volume index of wages in conformity with collective labour agreements (Wla). The same index can applied for wages and payments linked to illness.
The volume index for social contributions can be calculated using the items above as the volume index of:

Wla + actual payments for illness – Wages in kind

The price index for social contributions can be derived from current price data and this volume index. Similar estimation procedures can be used for the remaining items of table 2.

Plausibility check
The results of the estimation process for compensation of employees in constant prices can be submitted to a plausibility check. Table 3 shows the data

Table 3. Plausibility checks on compensation of employees in constant prices.

	1996 - 1995 % changes			volume changes due to:		
	value	price	volume	contr. Hours	illness	quality
data on compensation of emplyees						
compensation of employees	3,6%	2,2%	1,3%	1,7%	0,4%	-0,7%
employers' social contributions	0,4%	-0,9%	1,3%	1,7%	0,3%	-0,7%
wages and salaries	4,1%	2,8%	1,3%	1,7%	0,4%	-0,7%
Wages in kind	3,6%	1,7%	1,8%	1,7%	0,8%	-0,7%
Actual payments for illness	-0,5%	2,9%	-3,3%	1,7%	-4,2%	-0,7%
wages including PI	3,9%	2,9%	0,9%	1,7%	0,0%	-0,7%
Deducted wages in case of illness			-3,3%			
Wages linked to illness	-0,5%	2,9%	-3,3%	1,7%	-4,2%	-0,7%
Wages cf CLA	3,9%	2,9%	0,9%	1,7%		-0,7%

In table 3 the volume indices estimated above are broken down in 3 items:

- changes due to changes in the total number of contractual hours; these account for 1.7% of the volume changes.
- changes in the rate of absence through illness account for a shrink of the volume of actual payments for illness; these account for –0.4 of the volume changes of total wages.

- changes in quality of the labour force, calculated as a residual account for -0,7 of the volume change of total wages. The negative sign can be caused by the intake of new employees, earning less than the leaving employees.

Secondary information should be used to judge the results of these plausibility checks, especially in case of the quality indicators.

8.3 Deflation of other indirect taxes and subsidies on production

8.3.1 Introduction

The payment of other indirect taxes on production is e.g. related to the use of certain inputs in the production processes or to socially unwelcome results of production processes. Examples of the former are taxes on real estate property and taxes on motorcars and motor-lorries owned by producers. An example of the latter is levies on pollution caused by the production process of producers.
Taxes can be based on values (e.g. the value of a building) or quantities (e.g. tons of pollutants), implying that the deflation of other taxes on production is in principle comparable with the deflation of taxes on products and that the same formulae are applicable. The reader is referred to paragraph 6.

However, in practice the deflation of other taxes on production is more difficult because of a serious lack of appropriate data. This holds for current prices as well as for constant prices.
Data on the total payments per separate tax are often available from the tax authorities. However, a serious problem is the time lag in the tax reception. Tax payments are generally paid in a different period than they refer to. Assuming a constant time lag often solves this problem. However, in practice time lags can differ between successive years.
Another problem is that data on the payment of other taxes on production paid for by separate industries are scarce and, if available, often incomplete and not divided by kind of tax.
For estimates at constant prices an additional problem is the lack of appropriate indicators for price and volume. In theory, price indexes could be derived from tariff information. In practice the tariff structure appears to be very complex and the required data are often not available, especially at the level of separate industries.

8.3.2 A proxy solution for the deflation problem

As a first step it is recommended to try to find a solution for the deflation problem at the macro-level: the total payments by industries. Two reasons can be mentioned here. The first is that more and more reliable data are available at the macro level. The second reason is that the deflation of macro totals is more important.
Suppose, for example, that at the macro level indirect taxes are available divided by kind of tax, but at the level of industries only aggregated tax data are available. Also in this case it is preferable to carry out the deflation by separate kind of tax at the macro level and compile estimates on the industry level afterwards. The result will be more reliable estimates at the macro level.

Deflation of the total payments per tax category
In principle, applying price indicators or quantity indicators can be used to derive the value at constant prices of other taxes on production. However, because of the complexity of the tariff structure of most taxes and the lack of appropriate data, quantity methods will prevail. Another plea for the use of quantity data is that for several reasons, the actual tax revenues can differ from theoretical tax revenues. Reasons can be the time lag problem, non-ability of tax collection by the tax authorities, measuring errors, etc. In national accounts it is an important question how to deal with differences between the theoretical tax value index and the index of the real tax revenue: is it part of volume or of price? This is a choice between two evils: to affect the volume index or the price index. Both are important in national accounts. However, the answer to that question can be given from the

consideration that in national accounts the estimation of volume growth rates is still somewhat more important than the estimation of price indexes. So, the difference has to be added to the price index and the volume index will not be changed. Therefor, it is recommendable, when deflating indirect taxes, firstly to estimate the volume index.

Suppose rev(t-1) and rev(t) are the actual tax revenues in t-1 and t. then the volume index is

$$= \sum \frac{rev(t-1) * [q(t) / q(t-1)]}{rev(t-1)}$$

and the value of t in prices t-1 is *rev(t-1) * [q(t) / q(t-1)]*.

The quantity indicators require a direct relation to the basis of the tax. For instance, the indicator for the tax on real estate property needs a direct relation to the amount of real property owned by producers. A candidate proxy indicator is the volume index of the total stock real estate property. For taxes on pollution the index of the total tons of emitted pollutants per kind of pollution tax could be an appropriate indicator.
The price indexes are derived afterwards from the combination of the value index and the volume index. They can be applied for the deflation of the tax payments by industry.

Deflation of the tax payments per industry
The way the tax payments by a separate industry should be deflated depends of the amount of tax paid and the availability of data.
If the tax payments in current prices for an industry are divided by kind of tax, the above-derived price indexes for the total payments can be applied.
If no separation by kind of tax is available, but tax payments are relatively small, the average (weighted) price index of the total of other taxes on production could be used as a proxy deflator.
If no separation by kind of tax is available and tax payments are considerable, dependant of the character of the production process, a (mixed) price index has to be chosen from the set of derived price indexes per kind of tax.

Subsidies

The practical elaboration of constant price estimation of taxes on production presented above, can be similarly applied to subsidies on production.

9. Simultaneous compilation of supply and use in constant and current prices.

9.1 Organisation of the statistical process.

In this paragraph a number of aspects of the organisation of the statistical process are discussed. ESR requires the compilation of supply and use tables in current prices as well as in constant prices. Two methods are distinguished. The first one is to balance the tables both current and constant prices “at the same time”. At the end of the process tables are available in current as well as in constant prices. This method is referred to as the simultaneous approach.
The second method first completes all the phases in the compilation process (data collection, adjusting the data and balancing) in current prices. After that the tables are deflated and values in constant prices are balanced. This is called the sequential approach.

In this paragraph we discuss the advantages and disadvantages of a simultaneous approach of the compilation process of supply and use tables compared with a sequential one. We also explain that this approach can be useful not only in the balancing phase but also in the phases of the process in which data is collected and adjusted to national account standards.

There can be a number of reasons up why the sequential approach is to be preferred above the simultaneous one. The most important one is probably that it is less complicated because one only has to deal with values in current prices and value indices. Another reason to choose for the sequential method is the lack of reliable price data on a sufficiently detailed level. In that case a possible way of organising the work is to compile the tables first in current prices, then aggregate and deflate and finally balance the tables in constant prices. The major disadvantage of a sequential approach is however that problems encountered while compiling a constant price table sometimes make it necessary to make changes the current price tables that are already finished (and perhaps published).

The main advantage of the simultaneous approach is that it gives the possibility to analyse value-, price- and volume indices in correlation with each other. The outcome of the analysis may effect constant as well as current prices. In other words all three indices must give a plausible picture. This clearly improves the quality of the outcome of the balancing process. Another advantage of the simultaneous approach is that it provides a better method to divide aggregates over productgroups. This is of significance is the case where price differences of the productgroups within the aggregate are large.

Independent of the way the compilation process of supply and use matrices is organised, it can be summed up in a column- row - column scheme. In the first step is the work is concentrated on the *columns*. The system has to be filled with data from a variety of sources. Data has to be collected, made complete and adjusted to NA standards. The second step is the start of the integration process. At this stage the system contains a full description at product and activity level. Now the focus is on the *rows*. Supply and use are to be balanced on product level.
The decisions made during this step have their effect on production and intermediate consumption and as a result on value added. So, in the third step the attention is again on the *columns.* More specific on the value added per industry. When the changes of value added are unacceptably large one has to go back to step two to make the necessary corrections. To a certain extent it is an iterative process. It must be stated, however, that step two and step three are not successive steps. If large corrections are necessary to balance supply and use it is practical to check their effect on the value added of that specific industry immediately.

Both the simultaneous and the sequential approach follow this *column - row - column* scheme.

9.2 Simultaneous compilation of current and constant prices

From source statistics to SUT (first step in the column-row-columns scheme)

Compiling a SUT begins with the collection of the data. Of course the availability of the sources differ per country. In most countries data is available on output specified per productgroup. Data on intermediate consumption is often available for the total or specified for a (limited) number of product groups. Foreign trade statistics and a budget survey may give data on imports, exports and consumption of households. Sometimes there are surveys on fixed capital formation.

The source data has to be transformed to be usable in a supply and use framework. The main transformations in current prices must be adjusted for incomplete surveys, for the black economy, for continuity[1], for definition differences between commercial and national accounts bookkeeping, and, finally, for the classifications of the supply and use table.

An important step in this transformation procedure is the estimation of data in prices of the preceding year. These constant price estimates are in most cases based on the deflating the current price information. At this stage a simultaneous approach already can be useful because its offers another opportunity to check the data before it is entered in the system of supply and use tables.
In most countries information on producers' prices is available to deflate data on the production of goods. Also consumer price information is often available to deflate consumption of households. Price indices of intermediate consumption are not always at hand. It can be calculated by using weighted output prices. Here, it is necessary to make assumptions about the price of margins and taxes. Deflation of formation of fixed capital formation, exports and government consumption is performed likewise.
At the end of this part of the estimation procedure, for every column of the supply and use table a complete picture is available. Every activity, output and intermediate use is described in terms of product groups not only in current prices but also in prices of the previous year. The same goes for imports and final expenditure.
For every entry in the supply and use table, the information can be presented in the following scheme:

Scheme 1. Available data

description		*data*	
t at current prices	price index	215	102.4
t at prices of t-1	volume	210	105.0
t-1 at prices of t-1	value index	200	107.5

This set of data allows the national accountant to double-check the data on consistency: even if the results in current prices look plausible, analysis of the volume and price data can show big problems.

An important check is the comparison between changes in the volume of output by industry and its intermediate consumption and value added. When prices are changing rather rapidly it is evident that analysis in real terms has certain advantages.

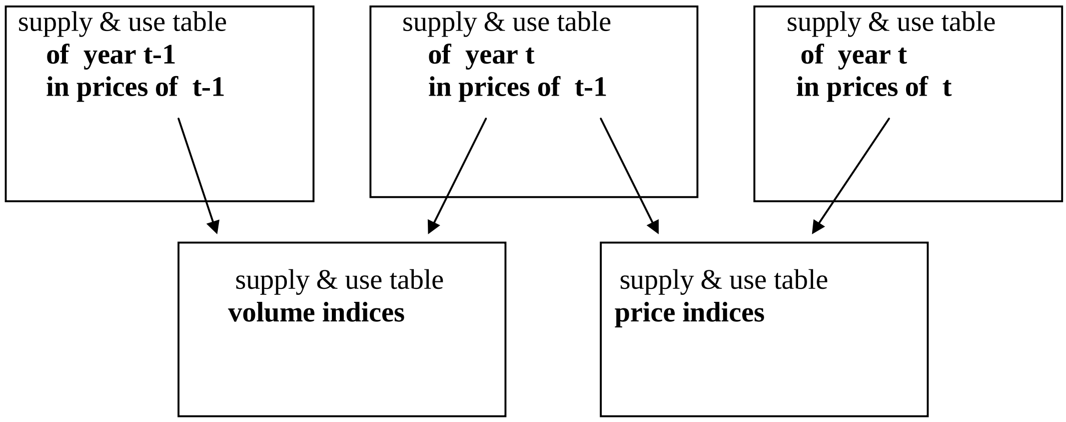
This value-price-volume analysis can lead to corrections on either of the estimated variables.
In some cases, these data can be checked with real volume data. For example, in a lot of countries volume data on the supply and use of energy products can be used. Another example is agriculture where volume data is available due to European agriculture policy.
Another check that is made possible by the simultaneous approach is the relation between the volume of value added and the number of jobs.
Before entering the next step of the compilation process it is important to have a clear view on the reliability of the data for example on value added per industry or on the subtotals of intermediate consumption per industry.

Balancing with the emphasis on the product groups (second step in the column-row-columns scheme)
The end product of the transformation process that was described in the previous paragraph is a data set that can be balanced in a supply and use framework. Just as was the case in the preceding phases of

[1] The term continuity refers to the year-to-year comparability of the data. Continuity can be disturbed by many causes, such as changes in the activity classifications or changes in definitions. There also can be disturbances in the data observed by source statistics.

the statistical process, the balancing takes place simultaneously for the data in current prices, the data in constant prices, volume indices and price indices (scheme 2).
Adjusting elements in either the use table or the supply table eliminates differences between the estimates of the supply and the use of a product group. If a figure in current prices is adjusted the consequence for the corresponding figures in prices of the previous year, the volume index as well as the price index is examined. If a figure in constant prices must be adjusted and as a result the volume index changes, then it has to be decided also whether the price index must be adjusted. In other words the question must be answered whether the value in current prices has to be adjusted or not? In this way the plausibility of an intended correction is checked.

Scheme 2. Simultaneous balancing of a supply and use table



Price indices that are found in the various columns of the use table and the supply table for one product group are a good starting point for the analysis of the differences. These were determined independently from each other in the previous phases of the statistical process. Now they are compared and their consistency is checked. Scheme 3 gives an example of a product group where price information is not consistent and where is a reason for further analysis.

Scheme 3. Analysing price differences

	Price index
Domestic production	102
Imports	90
Total supply	**95**
Intermediate consumption	95
Exports	105
Final consumption	100
Total use	**100**

Assume in this example that price information is available about variables except intermediate consumption. Here the assumption is made that the price equals the supply-price. The difference between export and import price is remarkable. It is however hardly to draw a conclusion without having examined volume- and value indices. One can imagine that price adjustment will also have an effect on those indices.

The checks can point out where corrections should be made. Some corrections will mean also corrections on important aggregates like total output or total intermediate consumption of an industry. As a consequence, value added as determined in the stages before also will change. Simultaneous corrections of data in current and constant prices make it possible to analyse the consequences for operating surplus and for the volume change of value added at the same time; the same holds for intended corrections on final demand.

Below a number of examples are given that illustrate the usefulness of a simultaneous balancing process. With each example one must in mind that it is important to form an opinion about the reliability of the data before a solution is searched for.

- Price and volume changes between domestic production and export can be compared as is the case in the simplified example in the scheme below. The figures in the frames are grouped as in Scheme 1.

S – U	Domestic production		Export		Others users	
-10	525	103	420	100	115	103
-21	510	102	420	105	111	111
0	500	105	400	105	100	115

In this example there is a discrepancy as well in constant prices as in current prices. The first step is to form an opinion about the reliability of the data. In this example data on domestic production and exports, both in current prices, are considered as reliable. So a sensible thing to do is to adjust other users. If the price index (103) is considered as good, the adjustment can be made in current and in constant prices. This gives the following situation.

S – U	Domestic production		Export		Others users	
0	526	103	421	100	105	103
-12	511	102	421	105	102	102
0	500	105	400	105	100	105

The balancing discrepancy in current prices is now disappeared but it still exists in constant prices still exists. The difference between the volume index of export suggest a solution: under the assumption that the price of domestic production is the most reliable figure in this example the price of the export must be adjusted.

- The relation between volume changes between the users of important raw materials on the one hand and volume changes of the largest suppliers (for instance imports) on the other. Large discrepancies here indicate that there are problems.

S – U	Domestic production		Imports		Main user		Others users	
0	50	100	468	104	426	100	92	100
-18	50	100	450	100	426	104	92	518
0	50	100	450	104	410	104	90	500

In this constructed example the balancing discrepancy does not show in current prices. Analysis reveal that volume indices of imports and the main user differ: 100 versus 104.

If, according to the statistical experts, intended corrections on value added or final demand in either current prices or volume turn out to improbable results, alternative ways should be found to eliminate a difference. It may be expected that simultaneously balancing in current and constant prices will result in a different allocation of corrections than the balancing in only current prices.
When the balancing phase has been completed, the user of the national accounts has at his disposal a system of tables containing consistent and detailed data on values, volume changes and price changes of goods and services. In addition, this system comprises detailed information on levels and trends in primary incomes and final demand in both nominal and real terms.

- Another simple check that can be made if volume indices are available is to compare the margins with the related commodity flow. More specific, if information per margin category is available, the volume index of retail margins must have some resemblance with the volume of the consumption of households. Volume indices of transport margins and the total supply can be compared. It is important to repeat this check during the balancing phase, because corrections on supply or use have also effect on one or more margin categories.

Balancing with the emphasis on the industries and final command categories (third step in the column-row-column scheme)

At the end of the second step supply and use is balanced for each productgroup. Corrections that were have had their effect on value added of the industries and therefore on GDP. So, a third step is necessary the check the results. Often the changes on value added are of minor importance. If not, the balancing of the rows is reopened for a limited number of product groups.

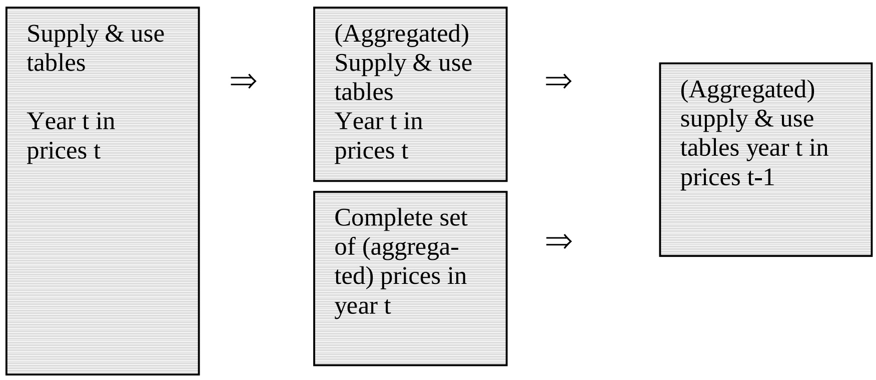
9.3 Sequential compilation of current and constant prices

Starting point of a sequential compilation method is a balanced system of supply and use tables in current prices. A necessary requirement is the availability of a complete set of prices. If prices are only available on an aggregated level it can be decided to make the tables on that aggregation level. If the price set is sufficiently detailed it is preferable to choose for the same level of detail as the tables in current prices. Suppose the following prices are available: producers' prices for domestic production import and export prices and consumers prices per product group. About margins and taxes assumptions are made (see also paragraph 5). In such a situation assumptions must be made to estimate prices of the remaining destinies (intermediate consumption, fixed capital formation, etc.). Assume, for instance prices for fixed capital formation are a weighted average of the prices of domestic production and imports. As in paragraph 2 the whole process can be described in a column-row-column scheme.

Deflating the current price tables (first step in the column-row-column scheme)

The first step is to deflate the current prices and to compile supply and use tables in prices of the preceding year as illustrated in scheme 4.

Scheme 4. Sequential balancing in constant prices



As in paragraph 2 attention must be focused on the value added per industry group in constant prices. Analysis of the plausibility of the volume indices can give reason to adjust the price set and for instance change the price of intermediate consumption.

Balancing with the emphasis on the product groups (second step in the column-row-column scheme)

In this step the discrepancies between supply and use per product group have to be brought down to zero. In practice the adjustments would be expected in the parts of the tables where price info is less reliable: such as intermediate consumption, fixed capital formation and changes in stocks. In some cases constant prices can only be balanced if current prices are also adjusted. If it is not possible to reopen the tables in current prices the consequence is that odd prices have to be accepted.

Balancing with the emphasis on the industries and final command categories (third step in the column-row-column scheme)

At the end of the second step supply and use are balanced for each product group. Corrections were have had their effect on value added of the industries in constant prices and therefore on GDP in constant prices. So, as in paragraph 2 it is necessary the check the results. If necessary the balancing of the rows must be reopened again.

Annex Index number formulae

1) Fixed weights

Laspeyres volume index

$$\frac{\sum p_0 q_t}{\sum p_0 q_0} = \frac{\sum p_0 q_0 \frac{q_t}{q_0}}{\sum p_0 q_0}$$

Paasche volume index

$$\frac{\sum p_t q_t}{\sum p_t q_0} = \frac{\sum p_t q_t}{\sum p_t q_t / \frac{q_t}{q_0}}$$

Fisher volume index

$$\sqrt{Laspeyres * Paasche}$$

2) Annual changing weights

Laspeyres volume index

$$\frac{\sum p_{t-1} q_t}{\sum p_{t-1} q_{t-1}} = \frac{\sum p_{t-1} q_{t-1} \frac{q_t}{q_{t-1}}}{\sum p_{t-1} q_{t-1}}$$

Paasche volume index

$$\frac{\sum p_t q_t}{\sum p_t q_{t-1}} = \frac{\sum p_t q_t}{\sum p_t q_t / \frac{q_t}{q_{t-1}}}$$

Fisher volume index

$$\sqrt{Laspeyres * Paasche}$$

1) Fixed weights

Laspeyres price index

$$\frac{\sum p_t q_0}{\sum p_0 q_0} = \frac{\sum p_0 q_0 \frac{p_t}{p_0}}{\sum p_0 q_0}$$

Paasche price index

$$\text{Pp} = \frac{\sum p_t q_t}{\sum p_0 q_t} = \frac{\sum p_t q_t}{\sum p_t q_t / \frac{p_t}{p_0}}$$

Fisher price index

$$\sqrt{Laspeyres * Paasche}$$

2) Annual changing weights

Laspeyres price index

$$\frac{\sum p_t q_{t-1}}{\sum p_{t-1} q_{t-1}} = \frac{\sum p_{t-1} q_{t-1} \frac{p_t}{p_{t-1}}}{\sum p_{t-1} q_{t-1}}$$

Paasche price index

$$\text{Pp} = \frac{\sum p_t q_t}{\sum p_{t-1} q_t} = \frac{\sum p_t q_t}{\sum p_t q_t / \frac{p_t}{p_{t-1}}}$$

Fisher price index

$$\sqrt{Laspeyres * Paasche}$$