Building the System of National Accounts - volume measures

Statistics Explained

This article is part of a set of background articles explaining in some detail how statistics producers, such as national or international statistical institutes, may build a coherent system of national accounts (SNA) , especially in developing countries. The articles are based on the official Eurostat handbook Essential SNA - Building the basics and they focus particularly on the early stages of the implementation.

This article addresses the conceptual background of price and volume measures in national accounts , the main data sources and methods used for annual estimates. Knowing the economy of a country means knowing its state and evolution in time and highlighting structural changes. This is based on national accounts compiled for successive periods as 'time series' which lead to the compilation of figures showing 'real' growth.

The 2008 SNA provides guidance about the estimations used to compile accounts in volume terms to obtain an integrated set of price and volume indices for flows of goods and services, gross and net value added , and GDP , which are consistent with general principles of national accounts.

Price and volume in national accounts

In the system of national accounts, all flows and stocks are expressed in value, which enables the aggregation of a variety of goods and services produced in the economy. However, a major concern in economic analysis is to measure economic growth in volume terms between different periods.

Volume measures enable the analysis of real growth over time to be made: 'How much higher was GDP this year in comparison to previous years?'. In order to do this, the value changes for economic aggregates need to be split between those changes arising solely from changes in price and those from volume changes.

The system of national accounts provides a framework for measuring integrated price and volume for transactions in goods and services, taxes and subsidies on products, trade margins, consumption of fixed capital, compensation of employees, inventories, and produced fixed assets.

It should be stressed that many flows or stocks presented in the SNA do not have price and quantity dimensions. In this case, the flows or stocks refer to a number of transactions relating to distribution and financial intermediation, as well as to balancing items such as value added (value added does not represent any observable flow of goods and services which can be factored into a price and a quantity component directly).

Why measure price and volume in SNA?

Analysing the evaluation of past economic performance, establishing the targets of the economic and social policy, or making comparisons between different economies is based on key variables represented by rates of inflation and economic growth. Economic growth is determined in the frame of national accounts.

The main uses of price and volume measures (or constant price estimates) in SNA are the following:

1. *Analyse the general economic growth*
   Volume measures of national accounts indicators serve to study the long term development of an economy.

It is usual to present the growth of an economy based on aggregated indicators such as GDP, but national accounts offer a wide range of data which shows the complexity of an economy.
The relative expansion or contraction of different sectors or industries presents the same importance as the aggregated growth of the whole economy. The important changes in the structure of the economy are best analysed in the framework offered by the accounts in constant prices. Data in constant prices are required not only to measure the way production increases, but also to estimate the growth or productive capacity of specific industries compared to the whole economy.

2. *Analyse economic cycle*
   Presenting the long-term movements which accompany the changes in economic growth, the accounts in constant prices serve to register and analyse the economic cycles. The fluctuations of economic activity are always important information for a market economy. Moreover, besides the registration of the economic cycle, it is necessary to analyse the causal factors, based on decomposition, as completely as possible. These causal factors are provided by national accounts in constant prices. Data and amplitude of cyclic movements of various aggregates (such as capital formation, exports, consumption, etc.) must always be systematically analysed based on their interdependence. The compilation of quarterly accounts in constant prices along with the annual ones is more useful in analysing the cyclical changes, especially for countries in development with large agricultural sectors.

3. *Economic projections*
   The national accounts in constant prices refer to past events. The forecasts and projections for the future are normally established based on these accounts, due to the fact that it is not possible to decide on realistic economic objectives without knowing the present situation of the economy and its evolution.
   For example, in order to project the increase of production, recent changes in this quantity, as well as productivity, resources, capital formation and other variables, should be taken into account.
   The changes in private consumption or total consumption of the population recorded in constant prices are used extensively to measure the changes in living conditions and realise the projection of future development. It is possible to decompose aggregates and to analyse the real consumption of a particular goods and services such as, for example, food, housing, education, etc., or expenses measured by household or inhabitant. This information normally serves to indicate the changes in the population welfare level.

4. *Basis for decision-taking*
   National accounts in current and constant prices serve to take rational economic decisions by knowing the reality of the national economy, offering decision-takers a valuable tool. Moreover, national accounts are used not only by the planning services, ministries of finances, central banks and public administration in general, but also by private institutions and enterprises. In order to analyse the flow of goods and services, the national accounts indicators in constant prices are probably more useful than the original accounts in current prices. On the other hand, accounts in current prices offer important information on other kinds of flows such as incomes, transfers, financial flows, etc., which cannot be estimated in constant prices in a convenient manner.

Conceptual background

The changes in the values of flows of goods and services can be directly factored into two components, one reflecting changes in the prices of the goods and services concerned, and the other, the changes in their volumes.

Changes in value can be broken down into price and volume components only for variables that have price and quantity elements. All transactions involving the exchange of goods and services and the levels of stocks of non-financial assets have this characteristic but income flows and financial assets and liabilities do not. Some balancing items have this characteristic but others do not and so they need to be considered individually.

Price and volume measures should be made within an integrated system of price and volume indices. An integrated system of volume measures must meet three requirements:

- The goods and services account must be balanced for two successive years both in current and constant prices;
- Each flow at the level of the total economy must be equal to the sum of the corresponding flow of the various industries;
- Every change in the value of a transaction must be associated with a change in price or a change in volume, or a combination of the two.

The value of a homogeneous product is defined by:

[math] v
equiv p
times q
quad
quad
quad
quad
quad
quad
quad
quad
mbox{(1)}[/math]

where:[math] v [/math]

= value;[math] p [/math]

= price;[math] q [/math]

= quantity unit

Periods

An important issue in volume measure is the choice of the base year. The SNA favours the use of a moving base year. In practice, this means that t-1 will be the base year. The advantages are:

- An up-to-date weighting scheme provides better estimates of growth rates;
- Introduction of new goods or disappearance of them is simplified;
- No burdensome rebasing of time series.

A **base year** is the year for which price data at the most detailed level are collected and serve as benchmark data to weight different quantities to obtain one single volume index . The change of a base year affects real rate of growth. Consequently, the price base period is the period whose prices are used as denominators in calculating relatives price[math] P_t ig / P_0 [/math]

(0 is the price base period). The quantity base period is the period whose quantities are used as denominators in calculating relative quantities[math] Q_t ig / Q_0 [/math]

(0 is the quantity base period).

A **reference year** is simply any given year selected so that a series of values with different base years can be compared. More simply, the period in an index number time series is taken to be equal to 100. A change in the reference year should not change rates of growth.

The choice of base year and the choice of reference year are, in principle, unrelated issues. For the calculation of price and volume measures, only the problem of the choice of base year is relevant.

There is the need to re-reference or chain whenever data is calculated with the previous year as the base year and data is to be expressed with respect to a fixed reference year. This system which always uses the previous year as the base year is also known as a system of 'chain indices'. However, for the calculation of the year-to-year price and volume changes, no chaining is required. An example of working with base years and reference years is shown in Figure 1.

For example take the following series of index numbers:

Years	Data
1990	100
1991	105
1992	108
1993	112
1994	120

Suppose these numbers were calculated using weights from the year 1990. Hence 1990 is the base year. It is also the reference year, since 1990 = 100. The reference year can easily be changed to e.g. 1993 (divide all by 112/100 to get 1993 = 100):

Years	Data
1990	100/1.12
1991	105/1.12
1992	108/1.12
1993	112/1.12
1994	120/1.12

Such a procedure does not change the base year, since the year-to-year variations are still calculated using weights from 1990.

Instead of having a fixed base year as in the example above, one could take, each year, the weights of the previous year. This could, for example, lead to the following series of year-to-year changes:

Years	Data
1990	100
1991	105
1992	102
1993	103
1994	106

For each of these indices: *t -1* = 100 holds. Hence the reference year is equal to the base year, but changes each year. It is easily possible to express the series on one reference year, by "re-referencing" or "chaining". This would yield:

Years	Data
1990	100
1991	105
1992	107.1
1993	110.3
1994	116.9

where:
107.1=105*102/100; 110.3=107.1*103/100, etc.

Figure 1: Example of base year and reference year - Source: Handbook on price and volume measures in national accounts, Eurostat, 2001

The methods used for measuring volume in accordance with the output and/or expenditure approach of GDP estimation are classified in three groups:

- A methods: most appropriate methods;
- B methods: those methods which can be used in case an A method cannot be applied; and
- C methods: those methods which shall not be used.

The A/B/C classification is aimed at improvement of current practice. It sets out in what direction improvements can be made. It is therefore important that the criteria for distinguishing A, B and C methods are absolute criteria, i.e. that they do not depend on the present availability of data. In this way, it becomes clear where the biggest problems exist in terms of missing data. It also makes it clear how far current practice is away from good practice. It may well be that in some cases A methods are difficult to attain in practice.

Figure 2: A, B and C methods - Source: *Handbook on price and volume measures in national accounts Eurostat 2001

Indices

The index numbers of interest within the SNA are designed to decompose changes in value aggregates into their overall change in price and overall change in volume components. A price index can be written and calculated as a weighted average of the proportionate changes in the prices of a specified set of goods and services between two periods of time, say a reference period 0 and current period t.

Similarly, a volume index can be written and calculated as a weighted average of the proportional changes in the volumes of a specified set of goods and services between two periods of time, say a reference period 0 and current period t.

There are many index number formulae differing from each other mainly in the weights which they attach to the individual relative prices or quantities and the particular form of average used, whether it is arithmetic, geometric, harmonic, etc. The most widely-used in the compilation of volume changes in national accounts are Laspeyres and Paasche indices , of which the geometric mean is the ideal Fisher index . The disadvantages of the Fisher are that it is demanding in its data requirements, its results are not easy to be interpreted and is not additive consistent. This means that the Fisher index is not easily applicable in an accounting framework where additivity is an important issue.

The Laspeyres indices are weighted with a base period; they represent an arithmetical weighted mean over the current quantities (or prices) divided by quantities (or prices) in the base period, in which the values from base period are weighting coefficients. Laspeyres price indices are presented by the equation (2) and the volume ones are presented by the equation (3):

[math]L_P =
sum_{i=1}^n
left (
frac{p_it}{p_i0}
right) s_i0 =
dfrac {
sum_{i=1}^n
left (
frac {p_it} {p_i0}
right) p_i0 q_i0} {
sum_{i=1}^n p_i0 q_i0}
equiv
frac {
sum_{i=1}^n p_it q_i0} {
sum_{i=1}^n p_i0 q_i0}
quad
quad
quad
quad
mbox{(2)}[/math]

[math]L_Q =
sum_{i=1}^n
left (
frac{q_it} {q_i0}
right) s_i0
equiv
dfrac {
sum_{i=1}^n p_i0 q_it} {
sum_{i=1}^n p_i0 q_i0}
quad
quad
quad
quad
quad
quad
quad

quad
quad
quad
mbox{(3)}[/math]

Paasche indices are weighted with the current period; they represent an arithmetical weighted mean over the current quantities (or prices) divided by quantities (or prices) in the base period, in which the values from the current period are weighting coefficients. The Paasche price and volume indices are represented in equation (4), irrespectively (5).

[math]P_P =
left [
sum_{i=1}^n
left (
frac {p_it} {p_i0}
right)^{-1} s_it
right]^{-1}
equiv
dfrac {
sum_{i=1}^n p_it q_it} {
sum_{i=1}^n p_i0 q_it}
quad
quad
quad
quad
mbox{(4)}[/math]

[math]P_Q =
left [
sum_{i=1}^n
left (
frac{q_it} {q_i0}
right)^{-1} s_it
right]^{-1}
equiv
dfrac {
sum_{i=1}^n p_it q_it} {
sum_{i=1}^n p_it q_i0}
quad
quad
quad
quad
mbox{(5)}[/math]

The Laspeyres and Pasche indices are symmetric: a price index of one of them multiplied with a volume index of the other one gives a value index. This is why the combination of Paasche price indices and Laspeyres volume indices is preferred in practice. It can easily be proved that this combination of indices fulfils the requirements mentioned above.

In order to obtain a system of price and volume indices to compile annual national accounts in prices of the previous year, available indices must be often processed into Laspeyres volume indices and Paasche price indices, even by national accountants.

The index of the change in monetary values between two periods, which is:

[math] I_v =
sum_{i=1}n̂ v_it̂
Bigg /
sum_{i=1}n̂ v_i{t-1}
quad
quad
quad
quad
mbox{(6)}[/math]

reflects the combined effects of both price and quantity changes. When Laspeyres and Paasche indices are used, the value change will decompose exactly into a price index times a volume index only if the Laspeyres price index is matched with the Paasche volume index[math](LP
times PQ = IV)[/math]

or the Laspeyres quantity index is matched with the Paasche price index[math](LQ
times PP = IV)[/math]

. For example, a price index, 1.05 representing a 5 per cent change multiplied by a volume index of 1.08, an 8 per cent change, yields a value change index of 1.134, a 13.4 per cent change.

In general, a Laspeyres index tends to register a larger increase over time than a Paasche index, that is, in general:

[math]L_P
gt P_P
quad
mbox{and}
quad L_Q
gt P_Q [/math]

From this relationship it can be easily noted whenever the relative prices and quantities (weighted by values) are negatively correlated, that is, as prices go up, the purchased quantities go down, or vice versa. Such negative correlation is to be expected for price takers, including consumers and firms purchasing intermediate inputs, which react to changes in relative prices by substituting goods and services that have become relatively less expensive for those that have become relatively more expensive.

A positive correlation would be expected for price setting firms that substitute output towards goods and services that have become relatively more expensive. In such circumstances the inequalities in the equation would be reversed.

For comparisons over longer periods of time, the Laspeyres volume indices and the Paasche price indices are calculated first in relation to the previous year and then the chain indices are determined. Chained indices present the drawback that they lead to volumes having no additivity so that they cannot be used in the balancing procedures of products based on supply and use tables. The non-additive volume data calculated with chain indices are to be published without any adjustment. This method is transparent and indicates to users the extent of the problem.

Principles

The main principles that price and volume measurement follow are:

1. In the measurement of price and volume a*detailed level of aggregation of products shall be used* . This is because price and volume changes of non-homogeneous goods must generally be weighted together in statistical practice. At national accounts level, only a single consistent weighting method may be used (the weighting method is described by the three general principles). The aggregation level is defined by the assumption that the indices used are elementary indices, i.e. indices (and/or indicators) which have

not been aggregated by the national accounts weighting method. This assumption is most plausible when the level of breakdown is very detailed.

2. *Volume* measures available at the elementary level of aggregation shall be aggregated using the *Laspeyres formula* to obtain the volume measures of all national accounts aggregates. Price measures available at the elementary level of aggregation shall be aggregated using the *Paasche formula* to obtain the price measures of all national accounts aggregates.

3. Volume measures derived at the elementary level of aggregation shall be aggregated using weights derived from the *previous year* .

How to measure price and volume in SNA

Price and volume measures are of major importance in national accounts, but the principal focus of users is on the growth rates of volume measures, rather than prices. The compilation of national accounts in volume and current value terms reflects this priority. Quantities of different products cannot, however, be aggregated without a certain weighting mechanism. For aggregate products, the **term volume** is used instead of quantity. Price and volume measures have to be constructed for each aggregate of transactions in products within the accounts. Thus, SNA offers a proper framework to construct a system of price and volume indices and to establish coherence among statistical data.

Three basic methods can be identified for deriving volume measures:

1. **Quantity revaluation** – collect quantity data and revalue it using base year prices. It is essential that homogenous products are identified and measured. In most countries this method is used for agricultural goods and for goods produced for own final use.

2. **Deflation** – divide the current price estimate by a price index to calculate the constant price estimate. Each period current price value is divided by a price index (could be PPIs, CPIs, charge-out rates, unit values, implicit price indices, etc.). Deflation should be done at the most detailed (disaggregated) level as possible. Price indices should be adjusted to take account of quality change. Deflation using a Paasche price index will give the same result as a quantity revaluation. Implicit price deflators (IPDs) are obtained by dividing a current price by its corresponding constant price value.

3. **Volume extrapolation** – the current value in the base year is updated using a volume index (constructed based on inputs or output). True volume indices take account of both quantity and quality changes – if only quantity indices are available, indices should be used at the most disaggregated level as possible to ensure homogeneity, and to be representative for all outputs in question.

With the exception of a situation of hyperinflation, or for products showing rapid quality change (e.g. personal computers) deflation can be expected to give more accurate results than volume extrapolation or quantity revaluation, since the variance in relative prices for a product in a particular month are usually less than the variance in relative quantities.

In case no deflation can be applied, as recommended, there are several specific methods at the compiler's disposal based on volume extrapolation such as:

1. **Output indicator method** , which relates, in general, to *direct measurement of the volume of output* . This can be the case, for example, for service areas where consumers are implicitly charged for services provided, such as in banking and insurance. In other cases, where there are very homogeneous products without large quality changes and where detailed quantity information is available, it can be equivalent to price deflation. It is not always easy to define exactly what the unit of output is. For individual goods and services it is in principle possible to define the output, since an actual delivery of that output takes place from the producer to the consumer(s). For example, for education, the output is the amount of teaching consumed by a pupil. For hospital services, the output is the amount of care received by a patient. For cultural services, the output is the number of theatre plays attended. For collective services, however, there is no transaction between producer and consumer since these are provided simultaneously to the society as a whole. It becomes therefore very difficult to define the output. It is very difficult to say for example what the unit of output is of defence or police services.
   The following criteria can be formulated for the appropriate use of output indicators:

   - To cover all services produced by the producer that are provided to external users;
   - To be weighted by the costs of each type of output in the base year;
   - To be defined with as much detail as possible;

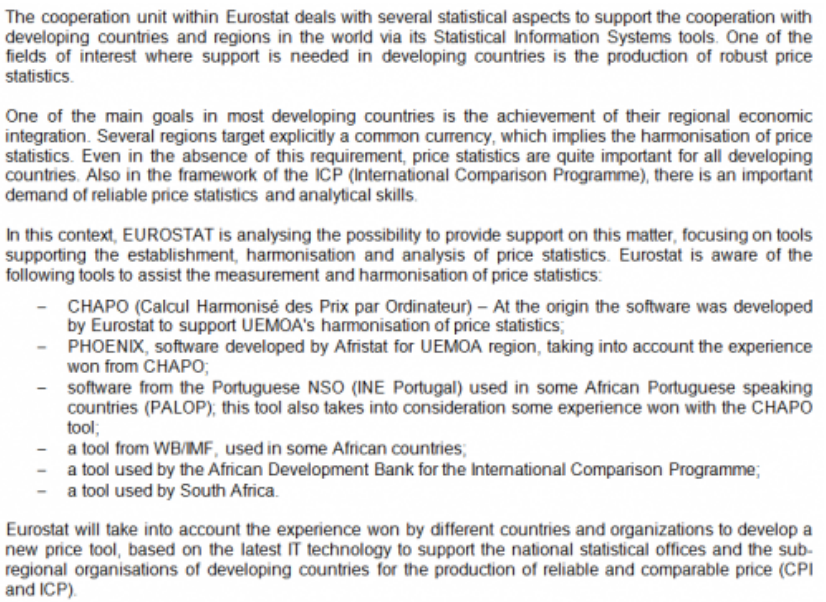
- To be quality-adjusted.

2. **Secondary indicators** which are indicators not directly related to the output, used as proxies in cases where there are no indicators for target variables (also called indirect indicators). Where direct measures of output are not available, it may be possible to identify a downstream or upstream activity that can be used as a basis to generate indicators. The methods applied assume ratios based on the benchmark data. Such ratios are more likely to be stable in constant price terms.
   For example, the supply of building materials can be used as an indicator of construction activity. Construction is often difficult to measure because of the large number of small-scale seasonal or unofficial contractors, own-account work, and work done without permits. The supply of building materials, on the other hand, can often be obtained from a relatively small number of manufacturers and quarries (with adjustments for exports and imports, if applicable). As long as there is a stable relationship between building material inputs and outputs, this is a suitable indicator that can be obtained with relatively little cost or compilation time. This assumption deteriorates if there are changes in the mix of types of buildings, techniques of building, productivity, and inventories of building materials.
   For intermediate consumption, there are usually no specific aggregated deflators, so it is necessary to build them from components of other price indices for the relevant products. Note that even when fixed input-output ratios have been used to derive volume measures for an industry, it is desirable to deflate intermediate consumption and output separately, and then to calculate value added at current prices as a residual, rather than assume fixed input-output ratios at current prices.

3. **Input indicator methods** cover input prices and input volume indicators. In general, they are less preferred methods for volume measures. *Input prices* is a method that takes prices of inputs (e.g. the price of labour or a weighted average of prices of intermediate inputs) as an approximation for the price of the output. However, if the output has a different path from the input, e.g. due to productivity changes, this method will have a clear bias and should be avoided. *Input volume indicators* used when indicators on the volume of inputs (e.g. the number of employees or the volume change of intermediate inputs) are used to approximate the volume of output. Using this assumption makes it impossible to analyse changes in productivity, and will wrongly estimate the true output change if this is different from the change in inputs. As an example, one can take the number of employees. It is simply assumed that twice as large a public service would mean twice as much output, irrespective of how those additional personnel were deployed. The advantage of the method is the ease of implementation, and the ready availability of data. This method however ignores all changes in productivity due to e.g. improved equipment (for example increased use of PCs) or more efficient procedures.

Main sources for price and volume measures

The deflation and extrapolation methods used for the volume measurement in national accounts request several indices at a very detailed level, elaborated within the statistical system of country.



The cooperation unit within Eurostat deals with several statistical aspects to support the cooperation with developing countries and regions in the world via its Statistical Information Systems tools. One of the fields of interest where support is needed in developing countries is the production of robust price statistics.

One of the main goals in most developing countries is the achievement of their regional economic integration. Several regions target explicitly a common currency, which implies the harmonisation of price statistics. Even in the absence of this requirement, price statistics are quite important for all developing countries. Also in the framework of the ICP (International Comparison Programme), there is an important demand of reliable price statistics and analytical skills.

In this context, EUROSTAT is analysing the possibility to provide support on this matter, focusing on tools supporting the establishment, harmonisation and analysis of price statistics. Eurostat is aware of the following tools to assist the measurement and harmonisation of price statistics:

- CHAPO (Calcul Harmonisé des Prix par Ordinateur) – At the origin the software was developed by Eurostat to support UEMOA's harmonisation of price statistics;
- PHOENIX, software developed by Afristat for UEMOA region, taking into account the experience won from CHAPO;
- software from the Portuguese NSO (INE Portugal) used in some African Portuguese speaking countries (PALOP); this tool also takes into consideration some experience won with the CHAPO tool;
- a tool from WB/IMF, used in some African countries;
- a tool used by the African Development Bank for the International Comparison Programme;
- a tool used by South Africa.

Eurostat will take into account the experience won by different countries and organizations to develop a new price tool, based on the latest IT technology to support the national statistical offices and the sub-regional organisations of developing countries for the production of reliable and comparable price (CPI and ICP).

Figure 3: Support to price statistics in the context of cooperation

The following price indices are the minimum required for deflation:

1. **Producer price indices (PPIs)** which cover both goods and services. PPIs are indices of **basic prices** in SNA terminology. The most widely-compiled and widely-used is the industrial production price indices. PPIs for services are more difficult to estimate. PPIs are calculated for agriculture products, measuring the change over time of the prices received by farmers for the sale of their products.

2. **Consumer price indices (CPIs)** : the price reflects the actual payments by households. It is the SNA purchasers' price, and may also include imputed expenses, such as for owner-occupied housing. In many countries, only transactions in urban areas are considered in the calculation of CPIs, which may not be representative of price changes in rural areas. Using CPIs for output deflation must rely on knowing the weight of the final consumption in total output, and the differences of changes in the price and structure in the intermediate and final use of the output.

3. **Construction price index** which provides measures of price changes in either inputs to, or outputs of construction activity.

4. **Import and export price indices** : price indices measure the change over time in transaction prices (the market sale price) of goods and services exported from or imported into a country. Those prices are measured c.i.f., including duties, freight and insurance costs. Export prices are measured f.o.b. excluding duties, freight and insurance costs.

Building the System of National Accounts - statistical sources , subsection on Price statistics presents the main price indices in detail.

In principle, separate prices of intermediate goods and gross capital formation at purchasers' prices can also be collected but are in fact rarely collected because of costs and also because the volume measurement of GDP can be computed by using PPIs instead.

Other price indices frequently collected are labour cost indices for compensation of employees, where the unit is: labour hour by type of occupation/job and industry.

Price indices	Uses of indices	Comments
Consumption Price Indices (CPI)	CPIs are designed to measure changes over time in average retail prices of a fixed basket of goods and services taken as representing the consumption habits of households. CPI is used mainly to deflate household consumption expenditure, but not total household consumption; specific components are used to deflate the relevant sub groups of household consumption.	Are normally constructed using Laspeyres formula
Producer Price Indices (PPI)	PPIs provide measures of average movements of prices received by the producers of commodities. In principle, PPIs exclude transport costs and consumption taxes PPI is used to deflate: - domestic production (for this purpose it is weighted together with an export price index); - intermediate consumption (for this purpose it is weighted together with an import price index).	Are normally constructed using Laspeyres formula
Construction Price Indices	Construction price indices provide measures of changes in the prices of either the inputs to, or outputs of, construction activity. Is used to deflate the output and the intermediate consumption of construction activity.	Are normally constructed using Laspeyres formula
Price indices for import and export	An import price index measures changes in the prices of imports of merchandise into a country. The index numbers for each reference period relate to prices of imports landed into the country during the period. An export price index is an index calculated for the price(s) of one or any specified group of commodities entering into international trade using, ideally, f.o.b. export prices. They are used to deflate exports and imports.	Are normally constructed using Paasche formula
Unit Value Indices for import and export (UVI)	UVI are used to deflate imports and exports of goods. UVI for imports good can also be used to deflate the imports of capital goods, as part of GFCF.	Can be constructed using Laspeyres or Paasche formula

Figure 4: Synthesis of uses of main price indices

GDP volume measures

Production approach

GDP represents the sum of value added, valued at market prices with taxes less subsidies on products at constant prices.

GDP (at market prices) = Sum of Gross value added (Output – Intermediate consumption) + Sum of taxes - Subsidies on products

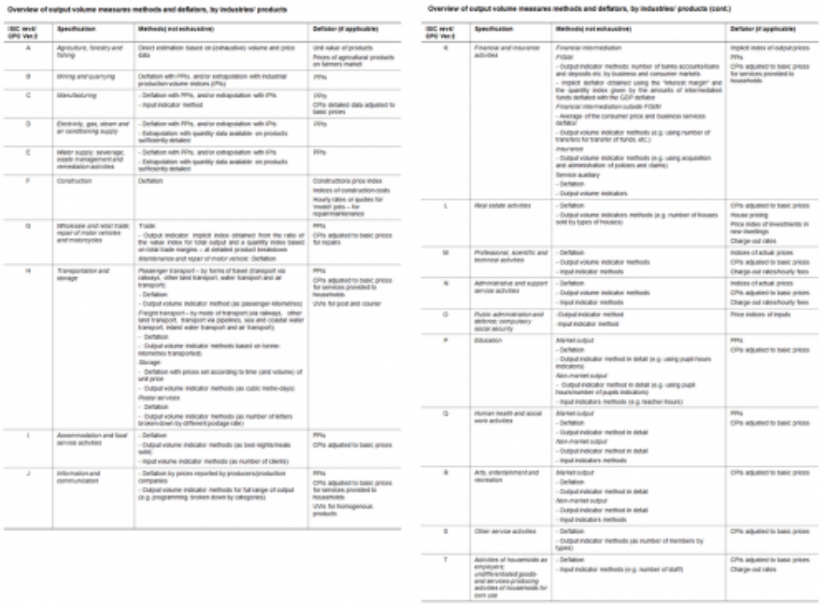


Figure 5: Overview of output volume measures methods and deflators, by industries/products

The volume index and volume estimates for the Hotels industry are presented below. To make these estimates, it is required to know:

- value of output in year *t* and year *t+1* (columns 1 and 2);
- "thousand bed-nights" by several types of accommodation, from specific surveys, for the years *t* and *t+1* (columns 3 and 4)

Based on the data, the volume and price indices are calculated (columns 5, 6, 7 and 8); Ip is resultant Paasche price index, and Iq is resultant Laspeyres volume index.

	"thou currency"		"thou bed-nights"		"currency/ bed-night"	"thou currency"	%	%
Type of accommodation, specific to Country Y	Turnover Year t	Turnover Year t+1	t	t+1	Unit cost year t	t+1 in prices of t	Ip t+1/t	Iq t+1/t
0	1	2	3	4	5=1/3	6=4*5	7= 2/6*100	8= 6/1*100
TOTAL	**16282**	**16865**				**16118**	**104.6**	**99.0**
1. Hotels	14400	14910	720	710	20	14200	105	98.6
2. Hostels	96	104	12	13	8	104	100	108.3
3. Motels	270	282	30	31	9	279	101	103.3
4. Tourists villas	624	644	48	49	13	637	101	102.1
5. Urban tourist houses	600	628	60	61	10	610	103	101.7
6. Rural tourist houses	200	200	25	24	8	192	104	96.0
7. Bungalows	32	36	8	9	4	36	100	112.5
8. Tourists house let-type units	60	61	12	12	5	60	102	100.0

Figure 6: Example of volume estimates for Hotel output

Value added is therefore a balancing item in the system of national accounts. There is conceptually no price or volume component of value added, since it is essentially an income concept. However, if GDP volume growth is calculated according to the production approach, the value added of all branches is summed, meaning that it is necessary to have a measure of value added volume.

The variety of the methods used to compile the volume measures of value added are divided into two categories:

1. **Single indicator methods** use a single variable (only one time series), which is assumed to be correlated with the movement of value added. In this case, an output or input indicator is directly applied to value added. Single indicator methods are classified according to whether the indicator is from output volume indicator methods or input indicator methods, according to whether deflation or extrapolation is used and according to the variable chosen as a proxy for measuring volume changes in value added. So, there are:

   (a) *Single output indicator methods* , classified into two variants:
   - Direct deflation of current price value added by an output price index, a consumer price index, or its relevant components;
   - Direct extrapolation of base year value added using an output volume index or physical quantity output index.

   (b) *Single input indicator methods* , classified into:
   - Direct deflation of current price value added by a price index of intermediate consumption or by a wage rate index;
   - Direct extrapolation of base year value added by input related indicators such as: price index or volume index of intermediate consumption, index of deflated compensation of employees by a wage rate index, an index based on physical quantities of inputs other that labour, an index of numbers employed, an index of man-hours worked eventually adjusted for change in productivity, etc.
     The volume index for output is preferred to one based on inputs, which has greater bias because the number and variety of outputs are smaller than the number of intermediate goods and services consumed in the production process and the commodity composition of inputs is more variable over time.

2. **Double indicator methods** take into account changes in both output and intermediate consumption, value added being obtained as a residual. Estimation methods encompass, besides deflation, methods that are based on volume extrapolation.
   Double indicator methods are, from a theoretical standpoint, superior to single indicator methods, but the availability of source data for certain activities is limited. According to applied estimation methods, there are three possible situations:

- *Double deflation* : current price output and intermediate consumption are both deflated by price indices. In general, output is deflated by PPIs or CPIs but adjusted to the correct price base for rates of trade and transport margins, and for taxes and subsidies on products basic prices. This method is preferred, but presents the disadvantage that quality changes are not easily taken into account.
- *Double extrapolation* : base year values of output and of intermediate consumption are extrapolated using volume or physical quantity indices, and derive constant price value added by subtraction. This method presents the advantage of taking into account both elements which are used to define value added. However, it presents the disadvantage that quality changes are not easily taken into account.
- *Extrapolation/deflation* : consists in deriving constant price value added from an extrapolated series of base year estimates of output using output volume or physical quantity indices, and a deflated series of current price intermediate consumption using price indices (or vice-versa, though this is more rarely the case).

The choice to be made between the use of a single indicator method (which may yield biased results) or a double deflation method (which may yield volatile results) must be based on judgment. The same choice need not be made for all industry groups.

In general, market output is estimated in constant prices using double indicator methods. Non-market output is usually estimated in constant prices using single indicator methods because of the difficulty in isolating price changes. Figure 5 presents a synthesis of possible methods applied to estimate volume measures of output.

Intermediate consumption , the second element of value added includes the value of goods and services (domestically produced and imported) consumed as inputs by a production process (excluding the use of fixed assets). Deflating intermediate consumption is necessary when double deflation is used to measure value added in constant prices or when price and volume measures are estimated in a system of supply and use tables.

Intermediate consumption should be deflated product-by-product. This requires, first of all, a breakdown by product of intermediate consumption in current prices. The total volume of intermediate consumption for each individual branch is derived by adding up the volumes of inputs of all products (this of course only works in a Laspeyres volume framework because this is additive).

Ideally, genuine price data on intermediate uses, collected from the purchasers (and reflecting purchasers' prices), should be used to deflate. Such data is rarely collected, however. As an alternative, intermediate consumption of domestically produced products can be deflated using the same methods as described for the output of that product, taking into account that intermediate consumption is valued at purchasers' prices (i.e. adding back changes in taxes and subsidies on products where appropriate). Intermediate use of imported products should be deflated by import price indices or the alternative methods (unit value index).

Taxes and subsidies on products are part of the difference between the basic price of a product and its purchasers' price. They are added to the total of gross value added at basic prices to obtain GDP from the output approach.

Building the System of National Accounts - basic concepts , Section 1: Basic concepts outlines the price system in national accounts.

Taxes and subsidies on products may be of two basic forms: based on the value of products (known as ad valorem) or based on the quantity of products. Within the ad valorem category, VAT is a special case. A detailed breakdown by products and information on each type of tax/subsidy (rates) should be available in order to properly apply the volume measures of various taxes and subsidies on products at country level.

A basic distinction must be made between quantity-based and value-based taxes (and subsidies). The volume of taxes on products is measured by applying the base-year taxation prices (amount levied per unit of taxed products) to the quantities of taxed products or by applying the base-year tax rates to the value of the taxed products at the base-year prices. In every case, the tax deflators then describe changes in taxation rates, and changes in the composition of the tax base and any price changes affecting it (for value-based tax).

How the calculation is carried out in practice depends on the type of tax and the data available. Where relevant, a distinction is made between taxation of imported and of domestically produced goods. So, taxes' volume estimation should take into account their direct link with the production or the import. Thus, the price index calculation is based on the production price index (or import price index), adjusted by an indicator that

reflects the evolution of the share of the default tax in production from year to year.

The calculation for subsidies is carried out in the same manner.

Expenditure approach

Final consumption expenditure

a) Final consumption expenditure of households

Final consumption expenditure of households is primarily made up of goods and services purchased in the market but also includes consumption of household production for own final use, such as consumption of goods produced within households for the households' own consumption, the services of owner-occupied dwellings, and goods or services received as income in kind. It does not include social transfers in kind, intermediate consumption or gross capital formation, acquisitions of non-produced assets, payments to NPISHs , taxes other than taxes on products, or voluntary transfers.

Methods based on deflation of household expenditure using appropriately detailed CPIs (valued at purchaser prices including VAT) are recommended. PPIs adjusted for valuation differences, import/export prices, or volume indicators could also be used, where no CPIs are available.

The volume measure of some specific components of final consumption expenditure of households is estimated as follows:

- *Consumption of own-produced goods and services* is not included in the CPI calculation; the general rule here is that products produced for own-consumption should be valued at the prevailing basic price for equivalent products, or at costs of production if market prices are not available. Where output for own final use is a significant part of total consumption of a certain product, it will be necessary to separately deflate it by a suitable basic price index; otherwise use of the CPI is appropriate.
- *Goods and services received as income in kind* are valued at basic prices if they are produced by the employer, and at market prices if the employer has to purchase them from a third party. If the former types of products are significant, then deflation should be undertaken using a suitable basic price index.
- *Goods and services purchased abroad by resident households* is not included in the CPI calculation, because it covers all purchases made by resident and non-resident households on the economic territory of a country. If purchases abroad by residents represents a significant part of total household consumption, and prices are evolving differently from domestic prices, one method that can be undertaken to deflate the prices is to use the CPI data from countries where the purchases are usually made. Adjusting for exchange rates would imply that the effects of exchange rate movements feed through into prices fully and immediately.
- *Services of owner-occupied dwellings* is a special case of the products for own consumption and represent a high proportion of final consumption of households. The recommended method for deflating this element in national accounts is by a suitable index of actual rent levels.

b) Final consumption expenditure of government and NPISHs

The principles applied in the general government sector and to NPISHs sector are similar. By convention, the final consumption expenditure of general government and NPISHs consists of:

- The value of non-market goods and services produced by government or NPISHs other than own-account capital formation and sales;
- Purchases by general government and NPISHs of goods and services produced by market producers that are supplied, without any transformation, to households as social transfers in kind.

Final consumption expenditure consists of both individual and collective consumption, whose value is measured by convention as the sum of costs. The collective consumption is characteristic only to government, and is called 'actual final consumption'. Final consumption of non-market goods and services in volume measures is usually obtained using the input indicators method (as the output is compiled as sum of costs), by deflating the value of inputs by suitable deflators. For individual services, the recommended methods are output indicator methods (such as 'pupil-hours' or 'patient treatments by type').

For social transfers in kind consisting of goods or services purchased by government from the market, deflation is made by suitably detailed CPIs, adjusted for:

- Any discounts which the Government may have negotiated directly with suppliers;
- Any contributions which are payable by those receiving the transfers.

Gross capital formation

a) Gross fixed capital formation

Gross fixed capital formation (GFCF) covers both tangible and intangible fixed assets which represent a wide range of products. GFCF could be measured from either supply or demand side. The supply side approach is more used, because of the general availability of necessary data: domestic output less exports plus imports of capital goods, at a detailed level.

The availability of appropriate price indices for GFCF varies considerably between different types of asset.

- For*new dwellings* CPIs are used, and for new buildings and structures PPIs are used . The costs of ownership transfer should be deflated separately. The current value and volume estimates are usually derived from separate estimates of the constituent parts, legal fees, transport and installation costs etc.
- For standard products such as*machinery and equipment* , PPIs are likely to be available but a lot of capital formation is specific to the purchaser and appropriate indices may have to be developed using the best information available. Price indices for equipment vary considerably in their growth rates (such as, for example, the case of computers, whose prices have fallen rapidly year after year, whereas the prices of transport equipment have increased). It is necessary in such cases that the different types of equipment are deflated separately using the matching price indices (or, equivalently, an appropriately weighted Paasche price index is used to deflate the aggregate).
- *Software* included in GFCF represents, in a large proportion, own-account production; the deflation could be done by choosing between a pseudo-output price index and an input price index, obtained by weighting together price indices of the inputs. However, input volume estimates used as a proxy for output do not reflect any productivity growth and so this is not recommended. In the absence of a better alternative, the most obvious option is to use the price index for custom made software.
- *Research and experimental development* (R&D) is another activity that is often undertaken on own account. However, given the heterogeneous nature of R&D, the choice for deflation lies between deriving pseudo-output price indices and using input price indices.

The matter of new products has particular importance in the Gross fixed capital formation matter, and not only. Many capital goods are produced only as a single item and thus appear as new products. This is also the case of many services which are never provided in exactly the same way, e.g. research and development services. There are two types of approaches in cases of new products for estimating the price for the previous year:

- the first supposes that the price of the new product changes like the price of similar products using a price index calculated on the basis of a sample of homogeneous products existing in both successive years,
- the second is the hedonic method which consists of determining the price of a product on the basis of its main characteristics and the input method which uses the cost of a product to calculate its price

The large range of different products calls for estimating GFCF volume at the detailed product level to ensure good quality estimates. The following list of products should be considered to be the minimum acceptable:

- Construction products:
  - Dwellings;
  - Other buildings and structures including Buildings other than dwellings, Other structures, Land improvements;
- Machinery and equipment:
  - Transport equipment as: Aircraft, Ships, Railway trains and carriages, Other transport equipment;
  - ICT equipment;
  - Other machinery and equipment;
- Weapons systems

- Cultivated biological assets, e.g. trees and livestock;
- Costs of ownership transfer on non-produced assets like land, contracts, leases and licenses;
- Intellectual property products:
  - Research and development;
  - Mineral exploration and evaluation;
  - Computer software and databases;
  - Entertainment, literary and artistic originals;
  - Other intellectual property products.

b) Changes in inventories

The calculation of changes in inventories in volume terms is particularly important due to the impact in the GDP size, but it is in the same time, a challenging task. Changes in inventories can take positive, negative or zero values; in these conditions, a chain index could not be derived directly. Chain volume estimates of changes in inventories should be derived by first deriving chain volume estimates of the opening and closing stocks of inventories and then taking the difference.

Volume measurement of changes in inventories is linked to the estimation of output and intermediate consumption. Moreover, the transaction is a difference between two phenomena: entries and withdrawals, considering also the value of any gains/recurrent losses of goods held, thus volume indices are not economically significant. The estimation methodology for change in inventories both at current and constant prices is highly dependent on the kind of information on inventories that is available. Hypothesis and assumptions should be made.

There are four types of inventories: materials and supplies; work-in-progress (includes livestock raised for slaughter); finished goods; and goods for resale. It is important to note that change in inventory represents part of the output and intermediate consumption calculations as follows:

Output = sales + changes of inventory of finished products + change in work-in-progress[math]
quad
quad
quad
quad (7) [/math]

Intermediate consumption = purchases - changes of inventory of materials and supplies[math]
quad
quad
quad
quad (8) [/math]

For a wholesale or retail trader:

Output = sales - purchases (of goods for resale) + changes of inventory of goods for resale[math]
quad
quad
quad
quad (9) [/math]

Closely related to the calculation of changes in inventories are holding gains. Holding gains are the results of price changes during the period for which the inventory is held. Such gains are not part of output. Holding gains can be negative, in which case they are called holding losses. If there are no price changes during the accounting period, the holding gain is zero. Holding gains can be calculated using the following identity:

Value of inventory at end of accounting period - value of inventory at beginning of accounting period = change in inventory + holding gains[math]
quad
quad
quad
quad (10)[/math]

Ideally, information on quantities and values of stocks should be available. In general, only information on values of stocks at the beginning and the end of the year (period), by type, is available according to enterprises' bookkeeping systems. These accounting systems value inventories according to historic cost systems, *LIFO* (last in - first out), or *FIFO* (first in - first out) systems, etc.

According to information obtained from the bookkeeping systems of enterprises, or based on assumptions, the values of the levels of inventories can be deflated with:

- Available prices and quantity data are obtained. The change in quantity (between the beginning and the end of the period) has to be multiplied by the average price of the desired year to obtain volume change of the inventories.
- A price index that describes the price development of the stock according to the known or assumed bookkeeping practice and the value of changes in inventories in constant prices is obtained directly. This should then be reflated with an average price index according to national accounts valuation rules to determine changes of inventory at current prices.

The price indices should be in accordance with the *four kinds of inventories* , by products:

- For inventories of finished products: PPIs at basic prices;
- For inventories of materials and supplies, similar indices as used for intermediate consumption (genuine intermediate consumption prices, or PPIs adjusted to purchasers' prices);
- For inventories of goods for resale: PPI (for retailers, strictly speaking, a PPI should be adjusted for wholesale trade margins);
- For works-in-progress: deflation carried out in a consistent way with the deflation of output, i.e. with output price indices at basic prices.

In case no information is available for stocks, changes in inventories are compiled based on 'commodity flow method', but the residual result will reflect measurement errors in the various aggregates.

Imports and exports

Exports and imports consist of both goods and services, valued when change of ownership between a resident unit and a non-resident owner takes place and include or exclude transportation costs according to whether the supplier does or does not include transportation to the purchaser in the amount charged.

Foreign transport and insurance services between the importer's and the exporter's frontiers should not be included in the value of goods, but recorded as services. However, it is not always possible to obtain f.o.b. values at the detailed product level and details of foreign trade are then shown valued at the importer's frontier. In this case, all transport and insurance services to the importer's frontier are included in the value of imports, referred to as cost, insurance and freight (c.i.f.). This is the valuation used for imports in the supply and use tables. Where the price of exports and imports includes an element of transport or insurance service, these need to be dealt with correctly in the price and volume measures.

A correct estimation of import and export volume implies considering goods and services separately.

There are a number of methods suitable for goods volume estimation such as:

1. *Actual export and import prices*
   Export and import price indices can be compiled based on the prices actually charged by exporters of goods (exports), or paid by consumers (imports). The main advantage is that they cope better with the problem of heterogeneous products as the price index is constructed to reflect a fixed specification that allows price effects to be isolated and quality changes to be controlled. Disadvantages are: (i) as a

result, they are costly to produce and represent a burden on respondents; (ii) they can have an incomplete coverage of the actual exports and imports of products to which they are applied as deflators; (iii) price indices may also reflect inadequately the actual prices paid by purchasers. The price indices are compiled using data from surveyed establishments on the prices of representative items exported and imported. The surveyed prices will be of items that are defined according to detailed specifications so that the change in price of the same item specification can be measured over time.

2. *Unit value indices (UVIs)*
   UVIs are readily available from trade statistics being derived as the ratio of value to volume (weight or quantity). They do not generally control for changes in the product mix within one item, leading to quality changes mistakenly included in the price component. Their coverage of products is generally complete, but even at the most detailed level of trade classification they can often include a range of different products and the homogeneity is not realistic. It may be possible to construct more homogeneous UVIs if the country of origin (or destination) is also taken into account. UVIs are clearly unsuitable for products that are unique or change quickly in specification.
   It could be also a mixed approach that involves compiling establishment survey-based price indices for some product groups and customs-based unit value indices for others.

3. *Adjusted PPIs*
   It is possible to use domestic PPIs to deflate current price estimates for exports and imports in the same way that actual export and import prices may be used. PPIs reflect prices on the domestic market and may not be a good reflection of the prices charged for exports or imports in some circumstances, where competition between domestic producers and imports exists. However, there may be little difference between domestic prices and those of imports or exports where these compete directly with each other in the market. In these conditions, the use of PPIs for exports or imports may be acceptable.
   A way of improving the domestic PPIs to make them more representative of exports and imports would be to adjust them in some way to reflect better the actual export and import prices. Such an adjustment could be made in a number of ways:

   - By taking account of exchange rate movements between the domestic currency and that of the countries to which the exports are going to or the imports coming from;
   - By estimating an adjustment factor based on some other variable like UVIs; this represents a ratio between UVIs of a selected group of products (stable in evolution) and the PPIs of the same products applied to a PPI that represents a range of products present in the export or import estimates for which other more suitable price or volume indicators are not available.

4. *Export prices of a foreign country*
   The export prices from a foreign country are used to deflate imports, broken down by product group and country (a process necessary to make best use of this method). This approach is most suited to unique products of a specialised nature. Adjustments may be done:

   - By accounting for exchange rate movements, on the assumption that movements in exchange rates impact directly and immediately on the price of the imports;
   - By taking account of other factors that affect prices between the exporting and importing countries, such as transport margins.

Exports and imports of services consist of a large range of different **services** . The current data sources for price indices for international trade in services are less comprehensive than in other areas, and methods to estimate price and volume are less well developed.

If actual prices are available for exports and imports of services, they can be readily used to derive the required volume estimates. If they are not, methods for exports and imports of services should be guided by those recommendations for similar domestically produced or consumed services. Methods to be used for domestically produced services are, in general, the same as those used for market output of services: charge-out rates, output indicator methods, input indicator methods. For example:

- Volume estimates of freight transport services could be derived using PPIs according to the form of transport;
- Volume estimates of accommodation services could be derived using the appropriate CPIs;
- For other imported services, price indices of the countries exporting the services, adjusted for changes in the exchange rate, may have to be used.

Actual price indices are the preferred method for deflation. For exports and imports, these prices need to reflect the actual prices charged in the case of exports and the prices paid for imports. These prices will differ from those in the domestic market because of exchange rate influences and potentially different pricing policies in the case of domestic and export sales. A further difficulty associated with the collection of export and import prices is the identification of the sampling frame necessary for the collection of prices.

About PPPs

Countries have different price levels and currencies posing the problem of interspatial comparisons of prices and volumes. Nominal exchange rates are not suitable conversion factors in such comparisons, because they do not adequately reflect price level differences, and because they are not sufficiently stable over time.

The solution is to apply purchasing power parities (PPPs). A PPP is defined as the number of units of country B's currency that is needed in country B in order to purchase the same quantity of goods and services that one unit of country A's currency will purchase in country A. PPPs can thus be interpreted as the exchange rate of an artificial currency commonly referred to as the purchasing power standard (PPS). If the expenditures of countries A and B expressed in national currencies are converted into PPS, the resulting figures are expressed in the same price level and the same currency, allowing a meaningful comparison of volumes. PPPs for market goods and services are based on international price surveys. Such price surveys are carried out simultaneously in all participating countries, based on a common product sample.

The resulting set of transitive PPPs for all countries and all basic headings (the lowest level of aggregation for which numerical weights are available) are aggregated up to the level of total GDP using expenditures from national accounts as weights. The aggregate PPPs at the level of GDP or any other category can be applied in, for instance, the calculation of real expenditures and spatial volume indices. A PPP divided by the nominal exchange rate between two countries produces a price level index (PLI), that can be used in analyses of countries' comparative price levels.

The European Commission (Eurostat) is responsible for calculating PPPs for the Member States in accordance with Regulation (EC) No 1445/2007 of the European Parliament and of the Council of 11 December 2007 establishing common rules for the provision of basic information on Purchasing Power Parities and for their calculation and dissemination (OJ L 336, 20.12.2007, p. 1). In practice, these PPP calculations are embedded in a wider PPP program coordinated jointly by Eurostat and OECD.

Concluding remarks

The direct measurement of GDP can be obtained from the output and expenditure sides and is the result of the measures of its components. The income approach cannot be used to measure GDP volume, since one of its components, the operating surplus, cannot be measured directly at constant prices.

It is important to compile one unique measure of GDP volume growth. Although one may argue whether or not conceptual differences may exist between GDP volume from the output and expenditure approaches, in practice, it would be highly undesirable to publish two different GDP growth rates.

In many countries, the measurement of GDP volume growth is currently based heavily on only one of the two approaches. This can be either the output or the expenditure approach, depending on the strengths and weaknesses of the data sources, which can vary greatly between countries. As an example, in some countries, data on household consumption expenditure might be regarded as less reliable than output data, so that generally the output approach is preferred.

Figure 7 presents an overview of the methods to compile volume measures in national accounts, and recommended deflators of these methods.

SNA aggregates	Methods (not exhaustive)	Deflators - recommended
Output, market	- Deflation - Output indicator method - Secondary indicator method - Input indicator method	PPIs CPIs detailed data adjusted to basic prices Charge-out rates
Output, non-market	*Individual*: - Output indicator method - Input indicator method *Collective*: input indicator method	Price indices of inputs
Output for own final use	- Deflation, - Output indicator method - Secondary indicator method - Input indicator method	PPIs of similar products on market CPIs detailed data adjusted to basic prices Output price indices of fixed assets
Intermediate consumption	-Deflation product-by-product	Price indices data from purchasers Same prices applied for output of that products
Value added – direct	- Output indicator method - Input indicator	
Final consumption expenditure by households	- Deflation - Volume indicators - Secondary indicator	CPIs (detailed) PPIs adjusted for valuation differences Import/export prices
Final consumption expenditure by government and NPISHs	- Output indicator method, input indicator method (as for non-market output) - Deflation for social transfers in kind (purchases from the market)	CPIs suitably detailed for social transfers in kind
Gross fixed capital formation	- Deflation by types of assets - Deflation for related services - Input methods	Genuine investment price indices PPIs adjusted to purchasers' prices Charge-out rates Import prices
Changes in inventories	- Deflation - Commodity flow method - Secondary indicators	PPIs CPIs Implicit price deflators
Acquisition less disposals of valuables	- Deflation	PPI for an industry producing valuables
Exports and imports of goods and services	*Goods* - Deflation - Input indicator methods	Actual export or import prices UVIs Suitable PPIs (adjusted, when the case) Export prices of a foreign country
	Services: - Deflation - Input indicator method	Actual export or import prices Suitable PPIs (adjusted, when the case) Export prices of a foreign country
	Expenditure of non-residents on the domestic territory: deflation *Expenditure of domestic residents abroad*: deflation	CPIs for country CPIs for visited country adjusted for exchange rates

Figure 7: Overview of methods for volume measures and deflators by SNA aggregates

The main recommendations for national accounts estimation in volume terms could be summarised as follows:

- Volume estimates of transactions in goods and services are best compiled in a supply and use framework, preferably in conjunction with, and at the same time as, the current value estimates;
- The estimations could be made at the most detailed level of products as data sources and resources permit; it is important to develop a comprehensible system of price statistics;
- The method recommended to measure volume in national accounts is deflation. It is better to deflate the current value with an appropriate price index, rather than constructing the volume estimates directly;
- If it is not practical to derive estimates of value added in real terms from a supply and use framework and either the volume estimates of output and intermediate consumption are not robust or the latter are not available then satisfactory estimates can often be obtained using an indicator of output, at least in the short term. An output indicator derived by deflation is generally preferred to one derived by quantity extrapolation.
- The preferred measure of year-to-year movements of GDP volume is a Fisher volume index; changes over longer periods are obtained by chaining, that is, by cumulating the year-to-year movements;
- Chain indices that use Laspeyres volume indices to measure year-to-year movements in the volume of GDP and the associated implicit Paasche price indices to measure year-to-year inflation provide acceptable alternatives to recommended Fisher indices.

Questions for practitioners

- Are estimations of price and volume made in your country?

- Which price indices (from those necessary) are available? How is the quality of the data? Which price indices should be collected in addition? Are the weight updates of price indices applied regularly?
- What methods are used for volume estimates? Are single deflators used?
- Which output activities do you consider poorly measured in your country? Are there any plans for improvements?
- Is the compilation level detailed enough to ensure the quality of estimates? If not, are there plans to improve the compilation practice to get a more disaggregated level? Are there enough resources to implement the plans?

See also

- Building the System of National Accounts (online publication, overview of all articles)

Dedicated section

- International statistical cooperation

Publications

- Essential SNA - Building the basics
- Handbook on price and volume measures in national accounts

External links

- IMF

Export and Import Price Index Manual , Theory and Practice, ILO, IMF, OECD, Eurostat, UNECE, World Bank, 2009

Producer Price Index Manual: Theory and Practice , (the International Labour Organization, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, Economic Commission for Europe and the World Bank, 2004)

- United Nations

National Accounts: A practical introduction , Studies in Methods, Series F, No.85, UN 2003; chapter XV:Price and volume measurement

The 2008 SNA (Chapter 15 – Price and volume measures), European Commission, IMF, OECD, UN, World Bank, 2009