ANNEX A to the

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on the European System of national and regional accounts in the European Union

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Chapter 10: Price and volume measures

10.01 In a system of economic accounts, all the flows and stocks are expressed in monetary units. The monetary unit is the only common denominator which can be used to value the extremely diverse transactions recorded in the accounts and to derive meaningful balancing items.

The problem when using the monetary unit as a measuring unit is that this unit is neither a stable nor an international standard. A major concern in economic analysis is to measure economic growth in volume terms between different periods. It is then necessary to distinguish, in the value changes for certain economic aggregates, the changes arising solely from price changes from the remainder which is called the change in 'volume'.

Economic analysis is also concerned with comparisons in space, i.e. between different national economies. These focus on international comparisons in volume terms of the level of production and income, but the level of prices is also of interest. It is therefore necessary to factor the differences in value of economic aggregates between pairs or groups of countries into components, which reflect the differences in volume and the differences in price.

10.02 When time comparisons of flows and stocks are concerned, equal importance is to be attached to the accurate measurement of changes in prices and in volumes. In the short term, observation of price changes is of no less interest than the measurement of the volume of supply and demand. On a longer term basis, the study of economic growth has to take account of movements in the relative prices of the different types of goods and services.

The primary objective is not simply to provide comprehensive measures of changes in prices and volumes for the main aggregates of the system but to assemble a set of interdependent measures which make it possible to carry out systematic and detailed analyses of inflation and economic growth and fluctuations.

10.03 The general rule for comparisons in space is that accurate measures must be made for both the volume and the price components of the economic aggregates. As the spread between the Laspeyres and Paasche formulae often is significant in spatial comparisons, the Fisher index formula is the only acceptable one for this purpose.

10.04 The economic accounts have the advantage of providing a suitable framework for constructing a system of volume and price indices as well as ensuring the consistency of the statistical data. The advantages of an accounting approach can be summarised as follows:

   a) on a conceptual level, the use of an accounting framework covering the entire economic system requires the prices and physical units for the

different products and flows in the system to be specified consistently. In a framework of this type, the price and volume concepts for a given group of products are defined identically in both resources and uses;

b)   on a statistical level, the use of the economic accounts framework imposes accounting constraints which must be respected at both current prices and in volume terms and will normally require some adjustments to be made to ensure consistency of the price and volume data;

c)   furthermore, the creation of an integrated system of price and volume indices in the context of a system of economic accounts provides the national accountant with extra checks. Assuming the existence of a balanced system of supply and use tables at current prices, the construction of such balanced tables in volume terms means that a system of implicit price indices can be automatically derived. Examination of the plausibility of these derived indices can lead to revision and correction of the data in volume terms and even, in some cases, of the values at current prices;

d)   finally, the accounting approach permits the measurement of price and volume changes for certain balancing items in the accounts, the latter being derived by definition from the other elements in the accounts.

10.05   Despite the advantages of an integrated system based on the balance, both overall and by industry, of transactions in goods and services, it has to be acknowledged that the price and volume indices thus obtained do not meet all needs or answer all possible questions on the subject of change in prices or volume. Accounting constraints and the choice of price and volume index formulae, although essential for the construction of a coherent system, can sometimes be a hindrance. There is also a need for information for shorter periods such as months or quarters. In these cases, other forms of price and volume indices may prove useful.

SCOPE OF PRICE AND VOLUME INDICES IN THE NATIONAL ACCOUNTS

10.06   Amongst the flows, which appear in economic accounts at current prices, there are some, mainly concerning products, where the distinction between changes in price and volume is similar to that made at micro-economic level. For many other flows in the system, the distinction is far less obvious.

Where the flows in the accounts cover a group of elementary transactions in goods and services, the value of each being equivalent to the product of a number of physical units and their respective unit price, it is sufficient to know the breakdown of the flow into its components in order to determine changes in price and volume over time.

Where a flow comprises a number of transactions relating to distribution and financial intermediation as well as to balancing items such as value added, it

is difficult or even impossible to separate directly current values into price and volume components and special solutions have to be adopted.

There is also a need to measure the real purchasing power of a number of aggregates, such as compensation of employees, disposable income of households or national income. This can be done, for example, by deflating them by means of an index of the prices of the goods and services which can be bought with them.

10.07 The objective and the procedure followed when measuring the real purchasing power of income estimates are different from those followed when deflating goods and services and balancing items. For flows of goods and services an integrated system of price and volume indices can be established, which provides a consistent framework for measuring economic growth. The valuation in real terms of flows of income uses price indices which are not strictly linked to the income flow. So the choice of price for income growth can differ according to the objectives of the analysis: there is no unique price identified in the integrated system of price and volume indices.

The integrated system of price and volume indices

10.08 The systematic division of changes in current values into the components 'changes in price' and 'changes in volume' is restricted to flows representing transactions, recorded in the goods and services accounts and in the supporting supply and use framework. It is carried out both for the data relating to individual industries and products, and for those relating to the total economy. Flows which are balancing items, such as value added, cannot be directly factored into price and volume components; this can only be done indirectly using the relevant flows of transactions.

The use of the accounting framework imposes a double constraint on the calculation of the data:

a) the balance of the goods and services account must for any sequence of two years be obtained at both constant and current prices;

b) each flow at the level of the total economy must be equal to the sum of the corresponding flows for the various industries.

A third constraint, not inherent in the use of an accounting framework but resulting from a deliberate choice, is that every change in the value of transactions must be attributed either to a change in price or to a change in volume, or to a combination of the two.

If these three requirements are fulfilled, valuation of the goods and services accounts and production accounts in volume terms means that an integrated set of price and volume indices can be obtained.

10.09   The items to be considered when constructing such an integrated set are as
         follows:

Transactions in products

Output	P.1
Market output	P.11
Output for own final use	P.12
Non-market output	P.13
Intermediate consumption	P.2
Final consumption expenditure	P.3
Individual final consumption expenditure	P.31
Collective final consumption expenditure	P.32
Actual final consumption	P.4
Actual final individual consumption	P.41
Actual final collective consumption	P.42
Gross capital formation	P.5
Gross fixed capital formation	P.51
Changes in inventories	P.52
Acquisition less disposals of valuables	P.53
Exports of goods and services	P.6
Exports of goods	P.61
Exports of services	P.62
Imports of goods and services	P.7
Imports of goods	P.71
Imports of services	P.72
Taxes and subsidies on products	
Taxes on products, excluding VAT	D.212 and D.214
Subsidies on products	D.31
VAT on products	D.211

Balancing items

Value added	B.1
Gross domestic product	B.1*g

Other price and volume indices

10.10   In addition to the price and volume measures considered above, the
         following aggregates can also be decomposed into their own price and
         volume components. The objectives for these measures vary.

         Inventories at the beginning and at the end respectively of each period may
         have to be calculated in volume terms in order to have the balance sheet
         aggregates. The stock of produced fixed assets has to be calculated in volume
         terms to estimate capital output ratios, as well as to obtain a basis for
         estimating consumption of fixed capital at constant prices. Compensation of

employees can be calculated in volume terms for purposes of measuring productivity and in some instances also when outputs have been estimated by using data in volume terms on inputs. Consumption of fixed capital, other taxes on production and other subsidies on production must also be estimated in volume terms when calculating costs in volume terms.

10.11   Compensation of employees is an element of income. For the purpose of measuring purchasing power it can be valued in real terms by deflating with an index reflecting the prices of products purchased by employees. Other income elements too, such as disposable income of households and national income, can be measured in real terms in the same general way.

GENERAL PRINCIPLES OF MEASURING PRICE AND VOLUME INDICES

Definition of prices and volumes of market products

10.12   Volume and price indices can only be derived for variables that have price and quantity elements. The notions of price and quantity are closely linked to that of homogeneous products, i.e. products for which it is possible to define units which are all considered equivalent and which can thus be exchanged for the same monetary value. It is thus possible to define the price of a homogeneous product as the amount of money for which each product unit can be exchanged.

For each homogeneous product flow, e.g. output, it is thus possible to define a price (p), a quantity (q) corresponding to the number of units and a value (v) defined by the equation:

$$v = p \times q$$

Quality, price and homogeneous products

10.13   Another way of defining a homogeneous product is to say that it consists of units of the same quality.

Homogeneous products play an essential role in national accounts. Indeed, output is valued at basic price determined by the market at the time when it takes place, i.e. very often before sale. The units produced have therefore to be valued, not at the price at which they will actually be sold, but at the price at which equivalent units are sold at the time of production of the units concerned. This is possible in a rigorous way only for homogeneous products.

10.14   In practice, however, two units of a product with identical physical characteristics may be sold at different prices for two types of reasons:

a)   Two units with identical physical characteristics can be considered not equivalent if they are sold in different places, at different periods or according to different conditions. In this case, the units have to be regarded as corresponding to different homogeneous products.

b) Two units with identical physical characteristics can be sold at different prices, either due to lack of information, or to restrictions brought to purchase freedom, or to the existence of parallel markets. In this case, the units have to be regarded as belonging to the same homogeneous product.

A homogeneous product can thus also be defined as a product of which all units would be sold at the same price in perfect competition. In the absence of perfect competition, the homogeneous product price is defined by the average price of its units. Therefore, in national accounts, for each homogeneous product there is one price and only one price, so that it is possible to apply general rules of valuation of products.

10.15 Lack of information means that purchasers may not always be properly informed about existing price differences and may therefore inadvertently buy at higher prices. This, or the opposite, may occur also in situations where individual buyers and sellers negotiate or bargain over the price. On the other hand, the difference between the average price of a good purchased in a market or a bazaar, where such bargaining often occurs, and the price of the same good sold in a different type of retail outlet, such as a department store, should normally be treated as reflecting differences in quality due to different sales conditions.

10.16 Price discrimination implies that sellers may be in a position to charge different prices to different categories of purchasers for identical goods and services sold under exactly the same circumstances. In these cases, there is no or limited freedom of choice on the part of a purchaser belonging to a special category. The principle adopted is that variations in price are to be regarded as price discrimination when different prices are charged for identical units sold under exactly the same circumstances in a clearly separable market, i.e. when different prices are charged for the same homogeneous product. Price variations due to such discrimination do not constitute differences in volume.

The possibility of the retrading of goods in a given market implies that price discrimination for these types of products in most cases can be assumed to be insignificant. The price differences that may exist for goods can normally be interpreted as due to lack of information or to the existence of parallel markets.

In service industries, e.g. in transportation, producers may charge lower prices to groups of individuals with typically lower incomes, such as pensioners or students. If these are free to travel at whatever time they choose, this must be treated as price discrimination. However, if they are charged lower fares on condition that they travel only at certain times, typically off-peak times, they are being offered lower-quality transportation since transportation with conditions and transportation without conditions can be considered as different homogeneous products.

10.17   Parallel markets may exist for several reasons. Buyers may be unable to buy as much as they would like at a lower price because there is insufficient supply available at that price, and a secondary, parallel market, where higher prices are quoted, may exist. There is also the possibility that a parallel market exists, where sellers can charge lower prices because they can avoid certain taxes.

10.18   Thus, if quality is defined by all the characteristics common to all units of a homogeneous product, differences in quality are reflected by the following factors:

    a)   physical characteristics;

    b)   deliveries in different locations;

    c)   deliveries at different times of the day or at different periods of the year;

    d)   differences in conditions of sale or the circumstances or environment in which goods or services are supplied.

Constant prices and volume

10.19   The introduction of the notion of volume in national accounts rests on the desire to eliminate the effect of price variation in the pattern of values expressed in monetary units, and it thus appears as an extended use of the notion of quantity for groups of products. In fact, for a given homogeneous product the equation v = p x q allows the change of a value over time to be broken down into change of price and change of quantity. In practice, however, there are too many homogeneous products to be dealt with individually, with the result that national accountants have to work at a more aggregated level. At this aggregated level, however, the equation v = p x q is no longer useful since, while it is possible to aggregate values, it is not meaningful to aggregate quantities in order to derive prices.

10.20   There is however a simple way of breaking down the change in the value of a set of homogeneous products between two periods, one of which is considered the base period and the other the current period. The effect of change in price can be offset by calculating what the value of the set of products would have been if there had been no change in prices, i.e. by applying the prices of the base period to the quantities of the current period. This value at constant prices defines the notion of volume.

In this way, the value of a set of products in the current period may be written as:

$$v^1 = \sum_i p_i^1 \times q_i^1$$

Where exponent 1 refers to the current period and index i to a specific homogeneous product. The volume of the set of products for the current period is thus defined in relation to the base period by the formula:

$$Volume = \sum_i p_i^0 \times q_i^1$$

Where exponent 0 refers to the base period. By comparing the volume of the set of products for the current period and their overall value for the base period it is possible to measure a change which is not affected by any price variation. A volume index can thus be calculated by the formula:

$$IVol^1 = \frac{\sum_i p_i^0 \times q_i^1}{\sum_i p_i^0 \times q_i^0}$$

The volume index which is thus defined is a Laspeyres index of quantities in which each basic index is weighted by the proportion of the basic product in the overall value of the base period.

Once the notion of volume has been defined, it is possible to define by analogy with the equation v = p x q not a price but a price index. The price index is thus defined by the ratio between the value for the current period and the volume. i.e. by the formula:

$$IP^1 = \frac{\sum_i p_i^1 \times q_i^1}{\sum_i p_i^0 \times q_i^1}$$

This index is a Paasche price index in which each base price index is weighted by the proportion of the base product in the overall value for the current period.

The volume and price indices defined in this way prove the equation:

Value index = price index x volume index

This equation is a more general version of the equation v = p x q and it allows any change in the value of a set of products to be broken down into a change in volume and a change in price.

In the calculation of the volume, quantities are weighted up by prices of the base period, so that the result depends on the price structure. Changes in price structure are likely to be less important for short periods than for long periods. Therefore, the calculation of the volume is made only for two successive years, i.e. the volume is calculated at the prices of the previous year.

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.

10.21 The main advantages of using Paasche price indices and Laspeyres volume indices are the interpretation and calculation simplicity and the additivity property in the supply and use balances.

10.22 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.

10.23 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. This does not preclude the possibility that there may be circumstances in which compilers may judge it preferable to eliminate the discrepancies in order to improve the overall consistency of the data. When base year values are extrapolated by chain volume indices, it will have to be explained to users why there is no additivity in the tables.

10.24 In practice, since it is impossible to measure prices and quantities for all the homogeneous products of an economy, volume or price indices are calculated using samples of representative homogeneous products, the underlying idea being that the volumes or prices of products not included in the sample change in the same way as the sample average. It is therefore necessary to use a product classification which is as detailed as practicable so that each product identified has maximum homogeneity, regardless of the level of detail used in the presentation of results.

10.25 In view of the equation linking the value, price and volume indices, only two indices need to be calculated. Usually, the value index is obtained directly by simply comparing the overall values for the current and base periods. It is then a matter of choosing between a price index or volume index to be calculated. In most cases the assumption of parallel change which underlies the method is proven more by prices than by volumes because the prices of different products are often significantly influenced by certain common factors such as the cost of raw materials and wages. In this case, the price index is to be calculated using a sample of products of constant quality over time, with quality being determined not only by the physical characteristics of the product but also by the conditions of sale, as explained above. In this way all the variations in the overall value caused by structural changes among the various products will appear as variations in volume and not in price. In some cases, however, it will be easier to calculate a volume index and to use it to derive a price index. Occasionally it may even be preferable to calculate the value index on the basis of a price index and a volume index.

New products

10.26 The method of calculating price and volume indices outlined above assumes that the products exist in both successive years. In actual fact, however,

many products appear and disappear from one year to the next and the price and volume indices need to bear this in mind. Where volume is defined using the prices of the previous year, there is no particular difficulty in the case of products which existed in the previous year but which no longer exist in the current year, since they are simply linked to a zero quantity for the current year. The problem is more complicated in the case of new products, since for the previous year it is not possible to measure the price of a product which does not exist.

There are two types of methods in such a case for estimating the price at the previous year: the former supposes that the price of the new product changes like the price of similar products, while the latter attempts to calculate directly what the price of the new product would have been if it had existed in the base period. The former amounts simply to using a price index calculated on the basis of a sample of homogeneous products existing in both successive years, and in practice this is the method used for most new products since new products are generally too numerous to be explicitly specified, especially when the definition of homogeneous products is strictly applied. With the other approach, the methods which are most commonly used are 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 matter of new products has particular importance in certain fields. 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.

10.27   For transactions in services it is frequently more difficult to specify the characteristics which determine the physical units and differences of opinion on the criteria to be used may arise. This may concern important industries such as financial intermediation services, wholesale and retail trade, services to enterprises, education, research and development, health or recreation. The choice of physical units for these activities is presented in the Handbook on price and volume measures in national accounts.

Principles for non-market services

10.28   The establishment of a comprehensive system of price and volume indices covering all supply and uses of goods and services encounters a particular difficulty when measuring the output of non-market services. These services differ from market services in that they are not sold at a market price and their value at current prices is calculated as the sum of the costs incurred. These costs are intermediate consumption, compensation of employees, other taxes less subsidies on production and consumption of fixed capital.

10.29   In the absence of a unit market price, the unit cost of a non-market service can be considered as the equivalent to the price. In fact, the price of a market product corresponds to the expenditure which the purchaser must incur in order to take possession of it, while the unit cost of a non-market service

corresponds to the expenditure which society must incur in order to make use of it. Thus, where it is possible to define units of quantity for non-market services, it is also possible to apply the general principles for calculating volume and price indices which were outlined above.

It is generally possible to define units of quantity for non-market services which are consumed on an individual basis, such as education and health services, which means that the general principles must be routinely applied in the case of such services.

The method consisting in calculating volume by applying unit costs of the previous year to the quantities of the current year is called the output method.

10.30 But it is difficult to define units of quantity for collective non-market services, such as for example services in connection with general government, justice or defence. In this case, therefore, other methods need to be used by analogy with the general method. This method defines volume on the basis of constant prices, i.e. it defines volume as the expenditure which purchasers would have incurred if prices had not changed. This latter definition may be used when it is not possible to define a unit of quantity provided that it is applied, not to a unit of product, but to the expenditure as a whole. Since the value of a non-market service is determined by the costs involved, it is thus possible to calculate the volume by the value of the costs at base period prices, i.e. by the value at base period prices of intermediate consumption, compensation of employees, other taxes net of production subsidies and consumption of fixed capital. This method is known as input method. The calculation at constant prices of the compensation of employees, consumption of fixed capital, taxes and subsidies on production will be covered in the paragraphs which follow.

Even in the most favourable case of the non-market services consumed on an individual basis, such as those of education and health, it is not always easy to distinguish homogeneous products. Indeed, the characteristics of these services are seldom defined in a sufficiently precise way for it to be possible to determine with certainty if two different service units can be considered or not equivalent, i.e. if they have to be regarded as correspondent with one same homogeneous product or with two separate products. Two equivalence criteria can be retained by the national accountants:

a) The unit cost criterion: two units of non-market services being considered equivalent if they have the same unit cost. This criterion rests on the idea that, collectively, those who benefit from the public services are also those who decide and pay them. For example, citizens decide on public services via their representatives and pay them by their taxes. Under these conditions, citizens cannot be expected to pay different prices for service units that they consider equivalent. Thus, according to this criterion, two service units of different cost have to be regarded as correspondent to different products and a non-market homogeneous product is characterised by the unity of its unit cost.

b)   The outcome criterion: two units of non-market services being considered equivalent if they give the same outcome. This criterion rests on the idea that two service units considered by the citizens equivalent can however be produced at different costs because citizens do not check completely the production process of these services. The unit cost criterion is no longer then relevant and has to be replaced by a criterion corresponding to the usefulness of the non-market services for society.

As the outcome criterion often seems more relevant, numerous works were completed to develop methods based on this criterion and research to improve them continues. In practice, these methods often result in the introduction into the volume calculation of correction coefficients applied to quantities; they take then the name of methods with explicit correction for quality.

The principal difficulty of implementation of these methods is related to the definition and the measurement of outcome. Indeed, measuring outcome presupposes to have defined objectives, which is not so simple in the field of non-market services. For example, what are the objectives of the public health service: improving the state of public health or extending lifetime? Certainly the two, but then how weigh up various objectives when they are not equivalent. For example, what is the best treatment, that which makes it possible to live an additional year in good health or that which makes it possible to live two additional years in bad health? In addition, outcome estimates are often controversial, thus, in numerous countries, the controversies on improvement or deterioration of the pupils' school level is recurrent.

In the European Union, considering the conceptual difficulties and the absence of consensus on output methods adjusted for quality (based on outcome), these methods are excluded from the central framework in order to preserve the comparability of the results. These methods are reserved on an optional basis for supplementary tables, while continuing research. Thus, in the field of the non-market health and education, the estimates of production and of consumption in volume terms have to be calculated on the basis of direct output measures – not adjusted for quality - by weighing up the quantities produced by the previous year unit costs of these services, without applying them any correction to take account of quality. These methods have to be applied to a sufficient level of detail, the minimum level being defined by Eurostat's handbook on price and volume measures in national accounts.

Although the use of input-based methods is generally to be avoided, it is possible in the field of health, to apply the input method when the variety of the services is such that it is practically impossible to determine homogeneous products. In addition, explanatory information has to accompany the national accounts estimates that draw users' attention to the methods of measurement.

Principles for value added and GDP

10.31   Value added, the balancing item in the production account, is the only balancing item to form part of the integrated system of price and volume indices. The very special characteristics of this item must, however, be emphasised, as must the significance of its related volume and price indices.

Unlike the various flows of goods and services, value added does not represent any single category of transactions. It cannot, therefore, be directly broken down into a price component and a volume component.

10.32   Definition:

Value added in volume terms is defined as the difference between output in volume terms and intermediate consumption in volume terms.

$$VA = \sum P(0)\, Q(1) - \sum p(0)\, q(1)$$

where P and Q are prices and quantities for output and p and q are prices and quantities for intermediate consumption. The theoretically correct method to calculate value added in volume terms is by double deflation, i.e. deflating separately the two flows of the production account (output and intermediate consumption) and calculating the balance of these two revalued flows.

10.33   In some cases, where the statistical data remain incomplete or not sufficiently reliable, it may be necessary to use a single indicator. If there are good data on value added at current prices, one alternative to double deflation is to deflate current value added directly by a price index for output. This implies the assumption that prices for intermediate consumption change at the same rate as for output. Another possible procedure is to extrapolate value added in the base year by a volume index for output. This volume index can be calculated either directly from quantity data or by deflating the current value of output by an appropriate price index. This method in fact assumes that the volume changes are the same for outputs and for intermediate consumption.

For certain market and non-market service industries, such as finance, business services or defence, it may not be possible to obtain satisfactory estimates of price or volume changes for output. In these cases the movements of value added in volume terms can be estimated by means of changes in compensation of employees at constant wage rates and consumption of fixed capital at constant prices. Compilers of data may be forced to adopt such expedients, even when there is no good reason to assume that labour productivity remains unchanged in the short or long term.

10.34   By their very nature, therefore, the indices of volume and price for value added are different from the corresponding indices for the flows of goods and services.

The same applies to price and volume indices of aggregate balancing items such as gross domestic product. The latter is equivalent to the sum of all the

values added, i.e. to an addition of balancing items, plus taxes less subsidies on products and from another point of view can be seen to represent the balancing item between total final uses and imports.

SPECIFIC PROBLEMS IN THE APPLICATION OF THE PRINCIPLES

10.35   Although essentially limited to transactions involving goods and services, the integrated system of price and volume indices does not exclude the possibility of calculating measures of changes in price and volume for certain other transactions.

Taxes and subsidies on products and imports

10.36.   The possibility mentioned above exists, in particular, in the case of taxes and subsidies directly linked to the quantity or value of the goods and services which are the subject of certain transactions. In the supply and use tables, the values of these are shown explicitly. By applying the rules described below, it is possible to obtain price and volume measures for the categories of taxes and subsidies which are recorded in the goods and services accounts, namely:

a)   taxes on products, excluding VAT (D.212 and D.214);

b)   subsidies on products (D.31);

c)   VAT on products (D.211).

10.37.   The simplest case is that of taxes which represent a fixed amount per unit of quantity of the product which is the subject of the transaction. The value of the revenue from such a tax depends upon:

a)   the quantity of products involved in the transaction;

b)   the amount levied per unit, i.e. the taxation price.

The breakdown of the value change into its two components presents virtually no difficulties. The variation in volume is determined by the change in the quantities of products taxed; the price variation corresponds to the change in the amount levied per unit, i.e. to the change in the taxation price.

10.38.   A more frequent case is that in which the tax represents a certain percentage of the value of the transaction. The value of the revenue from such a tax then depends upon:

a)   the quantity of products involved in the transaction;

b)   the price of the products involved in the transaction;

c)   the tax rate (as a percentage).

The taxation price is then obtained by applying the rate to the price of the product. The change in value of the revenue from a tax of this type can also be divided into a volume change, determined by the change in the quantities

of products taxed, and a price change corresponding to the change in the taxation price (b x c).

10.39. The amount of taxes on products, excluding VAT (D.212 and D.214) is measured in terms of volume by applying to the quantities of products produced or imported the taxation prices of the base year or by applying to the value of output or imports, revalued at the prices of the base year, the tax rates of the base year. Attention has to be paid to the fact that taxation prices may differ among different uses. This is taken into account in the supply and use tables.

10.40. Similarly, the amount of subsidies on products (D.31) is measured in terms of volume by applying to the quantities of products produced or imported the subsidy prices of the base-year or by applying to the value of output or imports, revalued at the prices of the base-year, the rates of subsidy of the base-year, taking into account different subsidy prices for different uses.

10.41. VAT on products (D.211) is, both for the whole economy and for individual industries and other users, calculated on a net basis and refers only to non-deductible VAT. This is defined as the difference between VAT invoiced on the products and VAT deductible by the users of these products. Alternatively, it is also possible to define VAT on products as the sum of all non-deductible amounts which have to be paid by users.

Non-deductible VAT at constant prices can be calculated by applying the VAT rates in force in the base-year to the flows expressed in the prices of the base-year. Any change in the rate of VAT for the current year will therefore be reflected in the price index and not in the volume index of non-deductible VAT.

The fraction of deductible VAT in invoiced VAT and hence non-deductible VAT may change:

a) either because of a change in the right to deduct VAT, resulting from a change in tax laws or regulations, taking effect with or without a time lag;

b) or because of changes in the pattern of uses of the product (e.g. increase in the proportion of uses on which VAT may be deducted).

A change in the amount of deductible VAT resulting from a change in the right to deduct VAT will by the method described be treated as a change in the taxation price, as will a change in the rate of invoiced VAT.

On the other hand, a change in the amount of deductible VAT resulting from a change in the pattern of uses of the product constitutes a change in the volume of deductible VAT to be reflected in the index of the volume of VAT on products.

Other taxes and production subsidies

10.42.   The treatment of other taxes (D29) and subsidies (D39) on production raises a particular difficulty to the extent that, by definition, it is not possible to assign them directly to units which are produced. In the case of non-market services this difficulty is compounded by the fact that they are used only when it is not possible to define units of quantity. However, it is generally possible to get around this difficulty by defining other taxes and production subsidies at constant prices by the amount to which they would have risen if there had been no change in the tax rules and prices as a whole in relation to the base period. For example, taxes on property or the use of an asset can be evaluated at constant prices by applying to the current period the rules and the price of assets of the base period.

Consumption of fixed capital

10.43.   The calculation of volume measures of the consumption of fixed capital poses few problems when good data on the composition of the stock of fixed capital goods are available. The perpetual inventory method, used by most countries, already implies, for the estimation of the consumption of fixed capital at current prices, the need to pass via a calculation of the stock of fixed capital goods at constant prices. To go from a valuation at historic cost to one at replacement cost, it is first necessary to value capital goods acquired over a number of different periods on a homogeneous basis, i.e. base-year prices. The price and volume indices derived in the process can therefore be used to calculate the value of the consumption of fixed capital at constant prices and the associated price index.

Where there is no perpetual inventory of the stock of fixed capital goods, the change in the consumption of fixed capital at constant prices can be obtained by deflating the current price data by price indices derived from data on gross fixed capital formation by product. Account has then to be taken of the age structure of the capital goods acquired.

Compensation of employees

10.44.   For the purpose of measuring the volume of input from employee 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 work must be recognised and quantity relatives calculated for each separate type of work. The price associated with each type of work is the compensation paid per hour, which may vary, of course, between different types of work. A volume measure of work done may be calculated as a weighted average of the quantity relatives for different kinds of work, 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.

Stocks of produced fixed assets and inventories

10.45. Volumes at the prices of the previous year are needed both for stocks of produced fixed assets and for inventories. For the former, such data as are necessary for the calculation of capital output ratios are available if use is made of the perpetual inventory method. In other cases information on the values of stocks of assets may be collected from producers and deflation made by the price indices used for fixed capital formation, taking into account the age structure of stocks.

Changes in inventories are measured by the value of entries into inventories less the value of withdrawals from inventories, and the value of any recurrent losses of goods held in inventories during a given period. Volumes at the prices of the previous year can be derived by the deflation of these components. In practice, however, it is rare for entries and withdrawals of stocks to be actually known, and often the only available information is the value of the stocks at the start and at the end of the period. In this case, it will often be necessary to assume regular entries and withdrawals during the current period, so that the average price for the period can be considered relevant for both entries and withdrawals. Under this condition, calculating the variation in stocks by the difference between the values of the entries and withdrawals becomes equivalent to calculating the difference between the values of the initial and final stocks. The variation in stocks at constant prices can then be calculated by deflating the initial and final stocks to bring them in line with the average price of the base period. When the variations in stocks are known in quantity terms, it is possible, again assuming regular entries and withdrawals, to calculate the volume of the variation in stocks by applying the average price of the base period to the variation in stocks in quantity terms.

MEASURES OF REAL INCOME FOR THE TOTAL ECONOMY

10.46. It is generally not possible to divide income flows into a price and a quantity component and for this reason price and volume measures cannot be defined in the same way as for the flows and stocks of products. Income flows can be measured in real terms only if one chooses some selected basket of goods and services on which the income is typically spent and uses the price index for this basket as a deflator of current incomes. The choice is always arbitrary in the sense that income is seldom spent specifically for purchases during the period in question. Some of it may be saved for purchases in later periods or, alternatively, the purchases during the period may be partly financed from savings made earlier.

10.47. Gross domestic product at previous year prices measures the total production (less the intermediate consumption) in volume terms for the total economy. The total real income of residents is influenced not only by this volume of

production but also by the rate at which exports can be traded against imports from the rest of the world. If the terms of trade improve, fewer exports are needed to pay for a given volume of imports, so that at a given level of domestic production goods and services can be reallocated from exports to consumption or capital formation.

The real gross domestic income can be derived by adding the so-called trading gain to volume figures on gross domestic product. The trading gain — or, as the case may be, loss — is defined as:

$$T = \frac{X - M}{P} - \left[\frac{X}{P_x} - \frac{M}{P_m} \right]$$

i.e. the current balance of exports less imports, deflated by a price index P, less the difference between the deflated value of exports and the deflated value of imports. The choice of an appropriate deflator P for the current trade balances should be left to the statistical authorities in a country, taking account of the particular circumstances of that country. In the circumstances in which there is uncertainty about the choice of deflator an average of the import and the export price indices is likely to provide a suitable deflator.

Various real income aggregates are identified and defined in the way shown in the following.

Gross domestic product at constant prices

plus the trading gain or loss from changes in the terms of trade

equals real gross domestic income

plus real primary incomes receivable from abroad

minus real primary incomes payable to abroad

equals real gross national income

plus real current transfers receivable from abroad

minus real current transfers payable to abroad

equals real gross national disposable income

minus consumption of fixed capital at constant prices

equals real net national disposable income.

To be able to express the various national income aggregates in real terms, it is recommended that receivables and payables of primary incomes and transfers from and to abroad should be deflated with an index of gross domestic final expenditure. Real national disposable income is to be

expressed on a net basis by deducting from its gross value the consumption of fixed capital at constant prices.

INTERSPATIAL PRICE AND VOLUME INDICES

10.48. The fact that countries have different price levels and currencies poses a challenge to 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.

10.49. Instead, purchasing power parities (PPPs) are applied. 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.

10.50. PPPs for market goods and services are based on international price surveys. These price surveys are carried out simultaneously in all participating countries, based on a common product sample. The sample items are clearly specified in terms of their technical characteristics, as well as other variables that are assumed to influence the price, like installation costs and the terms of sale. While priority is given to the comparability of the sample items, this must nevertheless be weighted against their representativity in national markets. The product sample should ideally be equally representative in all participating countries.

10.51. For non-market services, interspatial comparisons face the same problem as intertemporal ones, since no market prices exist in either dimension. Traditionally, an input approach (or an input cost approach) has been applied, under the assumption that output equals the sum of inputs. This approach, which implies direct or indirect volume comparisons of inputs, fails to take differences in productivity into account. For this reason, as for intertemporal comparisons, methods are preferred which focus either on the direct measurement of output or on output prices which are subsequently used to deflate expenditure, at least for individual services such as education and health.

10.52. In the calculation of PPPs, the same index number formulae are applied as in the calculation of temporal indices. In a bilateral context involving two countries, A and B, either country can be used to give the weights. Viewed from the angle of country A, a Laspeyres-type index with weights from country A can be calculated as well as a Paasche-type index using weights from country B. However, if the two economies are structurally different, the spread between these two indices may be quite large, and the end result

would be heavily influenced by the choice of index. In binary comparisons, it is thus preferable to apply the average of the two, that is, a Fisher index.

10.53. Explicit numerical weights are usually not available at the level of individual sample items. Therefore, a form of implicit weighting is applied, based on whether countries regard a particular item as representative of the domestic consumption pattern or not. The lowest level of aggregation for which numerical weights are available, is referred to as the basic heading (BH) level.

10.54. Transitivity implies that the direct PPP between countries A and C is equal to the indirect PPP derived by multiplying the direct PPP between countries A and B (or any other third country) and the direct PPP between countries B and C. The Fisher PPPs at BH level are not transitive, but it is possible to derive from them a set of transitive PPPs that resemble the original Fisher indices, using the criterion of least squares for this purpose. Applying the so-called Èltetö-Köves-Szulc (EKS) formula minimises the deviations between the original Fisher indices and produces a complete set of transitive PPPs at BH level.

10.55. The resulting set of transitive PPPs for all countries and all BHs 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.

10.56. The Commission (Eurostat) is responsible for calculating PPPs for the EU 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 the calculation and dissemination. In practice, these PPP calculations are embedded in a wider PPP program co-ordinated jointly by Eurostat and OECD. The detailed methods used in the program are described in the "Eurostat-OECD Methodological manual on purchasing power parities".