# BASIC PRINCIPLES AND PRACTICES IN REBASING AND LINKING NATIONAL ACCOUNTS SERIES

## 1. Introduction

The System of National Accounts is a comprehensive, consistent and flexible set of macro-economic accounts based on internationally agreed concepts, definitions and accounting rules. The national accounts statistics are compiled by the countries to meet the needs of government, private analysts, policy makers and decision takers. The major use of the national accounts statistics is to assess how a country's economy is growing (or contracting) over time. Analysts are particularly interested in the behaviour of an economy at various stages in the economic cycle. It is quite common to see analyses that compare the extent to which an economy has emerged from a recession compared with that of earlier stage. The changes over time as observed in the current price estimates depict a combination of a change in prices and a change in the underlying volumes. Therefore, compilation of estimates adjusted for the effects of price change (i.e. constant price or "volume" estimates) is an important component of any national accounting system.

Preparation of estimates of national accounts aggregates year after year generates a time series. This information may not be of much interest in the form of a time series. For example, we may observe from such a series that national income has been doubled in the last ten years. This does not reveal real growth in the national income since beside institutional changes, the observed growth may largely reflect increase in prices of goods and services produced in the economy. In practice, what is wanted in such a case is to be able to say something about the average change in prices and the average change in quantities. Such decomposition of value in terms of prices and quantities is required for various aggregates presented in the system of national accounts for studies relating to growth, policy formulation etc. In practice, since different goods and services produced in the economy cannot be aggregated in quantity terms, for the purposes of presenting aggregated picture, goods and services for different years are evaluated at prices of one of the 'fixed' year (popularly known as base year) to get the quantity comparison over years. Estimates prepared at base year prices are known as estimates at 'constant prices' or in 'real' term.

In producing volume estimates in the national accounts, the aim is to remove from the money values the effects of the price changes. In concept, a volume estimate may be thought of as being derived by expressing the current price value of each component transaction as the product of a price and a quantity, and by substituting for each actual current price the corresponding price in the chosen base year. Subtotals and totals at constant prices for each period are then obtained by summing constant price values for the individual transactions. In effect, the volumes of the individual commodities involved in the transactions are aggregated using their prices in the base year as weights

For any single base year, constant price measures vary only with changes in the quantities of the goods and services involved. However, the choice of base year does

influence the movements in the constant price series because the underlying (relative price) weights will be different in different years since the rate of price change is not the same for all goods and services. The usefulness of constant price series depends on both the extent of the rate of price divergence for the commodities in the measure and the extent to which the relative price weights of the base period differ from the price relationships of other periods included in the series.

This paper discusses the general principles of price and volume measurements in the national accounts, concept of constant prices, price and volume indices and the formulae of the standard indices of price and volume namely Laspeyres, Paasche and Fisher. Besides the concept of valuing the output at constant prices, this paper considers the concept of Gross Value Added (GVA), i.e., the domestic product from production approach at constant prices, which is the most important concern of the national accountants. It also considers the concept relating to GDP (from expenditure approach) at constant prices. Alternative methods of obtaining constant price estimates of value added through production approach and practices adopted by the countries for estimating constant price value added and components of gross domestic product from expenditure approach have been considered as a prelude to the rebasing of national accounts series. Finally in this paper attention is focussed on the issues and practices in rebasing and linking the national accounts series.

## 2. General Principles of Price and Volume Measurements in the National Accounts

The accounting framework of the system of national accounts provides integrated price and volume measurement in the transactions of goods and services. Also it makes it possible to define and construct "price" and "volume" measures for value added, which is the balancing item in the production account, and do not represent any observable flow of goods and services which can be factored into a price and a quantity component directly. Generally the countries use values at the constant price of some base year, with corresponding Paasche price indices, as volume and price measures for Gross Domestic Product (GDP) and its components, the base year being changed periodically after every 5 to 10 years.

Price and volume measurements for GDP are always obtained by constructing price and volume measures for the components of GDP, at as detailed level as possible. For example, for the production approach, by obtaining price and volume measures for output, intermediate consumption and value added by economic activities. Similarly, for the expenditure approach, by obtaining price and volume measures for Government final consumption expenditures, Private (Households and Non-Profit Institutions serving households) final consumption expenditures, capital formation, exports, and for imports. Thus, to be able to obtain price and volume measures for GDP and its components, we need to understand what conceptually is meant by price and volume measurements for aggregates of goods and services. How in practice to obtain price and volume measures for these aggregates, and how to aggregate over price and volume measures for sub-components to obtain price and volume measures for more aggregated items.

## *2.1. Concept of Constant prices, price and volume indices*

The current value of a single product *i* at time *t* can be expressed as the product of the market price (per unit of quantity) of that product times the number of units of quantities ($v_{i,t} = p_{i,t}*q_{i,t}$). Instead of being expressed at the market price of the current period, the value of this product can be expressed in the market price of some previous period. Measuring transactions for a product at constant prices means to construct a time series where all transactions for that product are expressed in the price of a selected base period *0* (i.e., $p_{i,0}*q_{i,t}$). Finally, the current price value of this single product can be expressed as the increase in the price of this product from the base period 0 to the current period times the constant price value of the product ($v_{i,t} =(p_{i,t}/p_{i,0}) * p_{i,0}*q_{i,t}$).

A similar set of relationship can be established1 at an aggregated level between the aggregated rate of change of the value at current prices, and a Paasche price index and a Laspeyres volume index, or between the aggregate value at current prices, a Paasche price index and the aggregate value measured at constant prices. Formally the latter can be expressed as

$$V_t = \sum_i v_{i,t} = \sum_i p_{i,t} \cdot q_{i,t} = \frac{\sum_i p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,0} \cdot q_{i,t}} \cdot \sum_i p_{i,0} \cdot q_{i,t} = P_{0,t} \cdot Q_{0,t} \qquad (1)$$

That is, the current price value is equal to Price times Quantity, where the aggregated "quantity" measure is given as the value at constant prices:

$$Q_{0,t} = \sum_i p_{i,0} \cdot q_{i,t} \qquad (2)$$

and the corresponding aggregated "price" measure as a Paasche price index:

$$P_{0,t} = \frac{\sum_i p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,0} \cdot q_{i,t}} = 1 / \sum_i \left( \frac{p_{i,0}}{p_{i,t}} \right) \frac{p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,t} \cdot q_{i,t}} = 1 / \sum_i \left( \frac{p_{i,0}}{p_{i,t}} \right) w_{i,t} \qquad (3)$$

Where:

$$w_{i,t} = \frac{p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,t} \cdot q_{i,t}}$$

From above it is clear that the aggregated price measure, a Paasche price index defined as the ratio of the value of all goods and services at current prices divided by the value at constant prices, is equivalent to a current weighted harmonic average of the individual price relatives ($p_{it}/p_{i0}$). The Paasche price index is one of several alterative aggregated price index measures (in particular it differs from the Laspeyres index normally used in price index statistics).

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1. For more detailed discussion on principles and concepts of price and volume indices reference may be made to the document SNA, 1993. Also, IMF Statistics Department in their Lecture Notes for training on National Accounts & Prices give detailed discussion on the subject with illustrations. The formulae presented in this section have been drawn quite heavily from these documents.

Constant price measures are a measurement of the in monetary value of some aggregates, where each individual quantity is valued at its own prices in an earlier period, and these prices are kept constant. By keeping the prices on each item fixed, period-to-period changes in the constant price estimate for aggregates of items reflect changes in the quantities (and/or quality) of the different products only. Thus, constant price measures constitute an aggregated volume measure.

It is interesting to note that the above aggregated price measure is in monetary terms, and as in all monetary measures, constant price data are additive and thus constitute a convenient way of constructing aggregate volume measures. Further it may be noted that the change from the base period (period 0) in the constant price data constitutes a Laspeyres volume index (that is, a base period weighted arithmetic average of the individual quantity relatives ($q_{it}/q_{i0}$):

$$LQ_{0,t} = \frac{Q_{0,t}}{Q_{0,0}} = \frac{\sum_i p_{i,0} \cdot q_{i,t}}{\sum_i p_{i,0} \cdot q_{i,0}} = \sum_i \left( \frac{q_{i,t}}{q_{i,0}} \right) \frac{p_{i,0} \cdot q_{i,0}}{\sum_i p_{i,0} \cdot q_{i,0}} = \sum_i \left( \frac{q_{i,t}}{q_{i,0}} \right) w_{i,0} \qquad (4)$$

Similar relationship can be established at an aggregated level between value, price and quantity indices. Thus the value index, the ratio of current and constant price values becomes quantity index times price index:

$$\frac{V_t}{V_0} = \frac{\sum_i p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,0} \cdot q_{i,0}} = \frac{\sum_i p_{i,0} \cdot q_{i,t}}{\sum_i p_{i,0} \cdot q_{i,0}} \cdot \frac{\sum_i p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,0} \cdot q_{i,t}} = Q_t \cdot P_t \qquad (5)$$

where,

$V_t$ is the total value at current prices in period *t*;
$v_{it}$ is value of item *i* at current prices in period *t*;
$P_{0,t}$ is a Paasche price index with period *0* as base period;
$p_{it}$ is the price of item *i* in period *t*;
$Q_{0,t}$ is the total value in period *t* measured at the prices of period *0*;
$LQ_{0,t}$ is a Laspeyres volume index with period *0* as the base period; and
$q_{it}$ is the quantity of item *i* in period *t*.
$w_{i0}$ is the base period weight, that is, item i's share of the total value in the base period.
$w_{it}$ is the current period weight, that is, item i's share of the total value in the current period.

It need to be noted that the change in the quality of different products is regarded not as a change in price but as a part of the change in "volume" of these products. For this reason, at the aggregated level, the term ‘volume’ is preferred over the term ‘quantity’.

Above we have seen the Value index as the product of Laspeyres volume and Paasche price index. Alternative index formulae for price and volume measures in the national accounts could be seen in the Value index as the product of Paasche volume and Laspeyres price indices, or as the product of Fisher price and Fisher volume index.

*The pair of Paasche volume and Laspeyres price indices*

The Laspeyres price index

$$LP_{0,t} = \frac{P_{0,t}}{P_{0,0}} = \frac{\sum_i p_{i,t} \cdot q_{i,0}}{\sum_i p_{i,0} \cdot q_{i,0}} \tag{6}$$

The Paasche volume index

$$PQ_{0,t} = \frac{Q_{t,t}}{Q_{0,t}} = \frac{\sum_i p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,t} \cdot q_{i,0}} \tag{7}$$

Value index = Price index times volume index

$$\frac{V_t}{V_0} = \frac{\sum_i p_{i,t} \cdot q_{i,t}}{\sum_i p_{i,0} \cdot q_{i,0}} = \frac{\sum_i p_{i,t} \cdot q_{i,0}}{\sum_i p_{i,0} \cdot q_{i,0}} \cdot \frac{\sum_i p_{i,t} \cdot q_{i,t}}{\sum p_{i,t} \cdot q_{i,0}} = LP_t \cdot PQ_t \tag{8}$$

It may be noted that a Paasche output volume index is equal to the current price value of output in period t divided by the value of output in the base period valued at the prices prevailing in the current period (period t). The latter can be obtained by inflating the base year value with the corresponding Laspeyres price index.

$$\sum_i p_{i,t} \cdot q_{i,0} = \sum_i p_{i,0} \cdot q_{i,0} \cdot LP_{0,t} = \sum_i p_{i,0} \cdot q_{i,0} \cdot \frac{\sum_i p_{i,t} \cdot q_{i,0}}{\sum_i p_{i,0} \cdot q_{i,0}} \tag{9}$$

*The pair of Fisher volume and Fisher price indices*
The Fisher price index

$$FP_{0,t} = \sqrt{LP_{0,t} \cdot P P_{0,t}} \tag{10}$$

The Fisher volume index

$$FQ_{0,t} = \sqrt{LQ_{0,t} \cdot P Q_{0,t}} \tag{11}$$

Value index = Price index times volume index

$$\frac{V_t}{V_0} = FP_{0,t} \cdot FQ_{0,t} = \sqrt{LP_{0,t} \cdot P P_{0,t}} \cdot \sqrt{LQ_{0,t} \cdot P Q_{0,t}} \tag{12}$$

$$= \sqrt{[LP_{0,t} \cdot P P_{0,t}] \cdot [LQ_{0,t} \cdot P Q_{0,t}]}$$

$$= \sqrt{[LP_{0,t} \cdot P Q_{0,t}] \cdot [LQ_{0,t} \cdot P P_{0,t}]}$$

From the expressions of various volume, price and value indices discussed above we observe that there could be broadly three basic methods for obtaining a constant price (or volume) measure for an item, namely, revaluation, deflation, and volume extrapolation.

a. *Revaluation*, which means to collect physical quantities and explicitly value each period's quantities using the base year's prices. The method requires that, for all products, homogenous physical quantities can be defined and observed and that a complete coverage of the quantities transacted can be collected. For this reason, in most countries, direct revaluation is used mainly for agricultural products and for goods produced for own final use.

b. *Deflation*, which means to divide each period's current price value with an appropriate price index ($Q_{0,t} = V_t / P_{0,t}$).

c. *Volume extrapolation*, which means to update the base year's value according to an appropriate volume index (volume indicator)
($Q_{0,t} = V_0 * LQ_{0,t} / LQ_{0,0} = Q_0 * Q_t / Q_0$).

With the possible exception of hyperinflation situations, constant price estimates derived through deflation can in general be expected to produce more accurate results than extrapolation with quantity indicators. The justification for this is that price relatives ($p_t/p_0$) generally display less variation than quantity relatives ($q_t/q_0$).

## *2.2 Concept of Gross value added at constant prices*

Gross Value added (GVA) is a non-observable concept. It is the balancing item in the production account and as such at current prices it is defined as the value of output (at basic prices) minus the value of intermediate consumption (at purchasers prices). As such it cannot be decomposed into a price and a quantity component. However, similar to the concept of value added at current prices, a concept of value added at constant prices can be defined and measured as output at constant prices minus intermediate consumption at constant prices. Adopting the symbols defined below,

$P_{Oi,,t}$ is the output price (per unit, at basic prices) for product *i* in period *t*;
$O_{ij,t}$ is the quantities of product *i* produced in industry *j* in period *t*;
$P_{in,i,t}$ is the price of product *i* (at purchasers prices) in period *t* used as intermediate consumption;
$in_{ij,t}$ is the quantity of product *i* used for intermediate consumption in industry *j* in period *t*;

The GVA of an industry j at current and constant prices can be expressed as

| | | |
|---|---|---|
| Value added at current prices in industry j | $\sum_i p_{O,i,t} \cdot O_{ij,t} - \sum_i p_{in,i,t} \cdot in_{ij,t}$ | (13) |
| Value added at the constant prices of the base year in industry j | $\sum_i p_{O,i,0} \cdot O_{ij,t} - \sum_i p_{in,i,0} \cdot in_{ij,t}$ | (14) |

Thus following the analogy of concept for aggregate products, a Laspeyres "volume" index for value added in the j-th industry can be defined as ratio of GVA of the j-th industry in

period t at the constant prices and GVA of the j-th industry in the base year at the base year prices:

$$LQIVA_{j,0,t} = \frac{\sum_i p_{O,i,0} \cdot O_{ij,t} - \sum_i p_{in,i,0} \cdot in_{ij,t}}{\sum_i p_{O,i,0} \cdot O_{ij,0} - \sum_i p_{in,i,0} \cdot in_{i,0}} \quad (15)$$

and a Paasche "price" index for GVA of the j-th industry can be defined as the ratio of GVA of the j-th industry in the period in queston (t) at current and constant prices:

$$PPVA_{j,0,t} = \frac{\sum_i p_{O,i,t} \cdot O_{ij,t} - \sum_i p_{in,i,t} \cdot in_{ij,t}}{\sum_i p_{O,i,0} \cdot O_{ij,t} - \sum_i p_{in,i,0} \cdot in_{ij,t}} \quad (16)$$

Gross Value added at constant prices is designed to be a measure of the contribution of an individual production unit, or a group of production units, such as an industry, to the total output at constant prices of goods and services available for final use in the economy (consumption, capital formation, and net export). A change in value added at constant prices can mean no more than a change in value added measured at some fixed set of prices and has no physical counterpart in the real world.

Alternative index formulae for price and volume measures for GVA, i.e., Paasche "volume" index and Laspeyres "price" index are as under:

Paasche "volume" index for value added in industry j

$$PQVA_{j,0,t} = \frac{\sum_i p_{O,i,t} \cdot O_{ij,t} - \sum_i p_{in,i,t} \cdot in_{ij,t}}{\sum_i p_{O,i,t} \cdot O_{ij,0} - \sum_i p_{in,i,t} \cdot in_{ij,0}} \quad (17)$$

Laspeyres "price" index for value added in industry j

$$LPVA_{j,0,t} = \frac{\sum_i p_{O,i,t} \cdot O_{ij,0} - \sum_i p_{in,i,t} \cdot in_{ij,0}}{\sum_i p_{O,i,0} \cdot O_{ij,0} - \sum_i p_{in,i,0} \cdot in_{ij,0}} \quad (18)$$

## *2.3. Concept of GDP expenditure at constant prices*

GDP itself, through the expenditure approach, can, in contrast to value added, be expressed as an aggregate of actual transactions that can be observed and recorded independently of the accounting framework. Thus GDP itself can conceptually be looked upon as having a physical counterpart in the real world and be factored into a price and a quantity component—the corresponding price and quantity index in principle being a weighted average of observable price and quantity relatives.

# 3. Alternative Methods of Obtaining Constant Prices GVA through Production Approach

A number of alternative methods of obtaining GVA at constant prices through production approach have been devised by countries particularly for goods and services producing sectors depending upon the choice of (a) the use of double or single indicator method, (b) the use of output or input related indicator, (c) the use of extrapolation or deflation and (d) the type of variable on which the indicators are based. T. P. Hill ( The Measurement of Real Product, Organisation for Economic Cooperation and Development, 1971) studied these alternatives at length and the OECD in its Handbook on Services measuring real annual Value Added, 1996 have summarised the practices followed by the OECD member countries.

Basically the alternative methods are variants of double indicator or single indicator methods. Double indicator methods take into account changes in both the outputs and the inputs (intermediate consumption) of goods and services and GVA is derived as a residual by subtracting constant price estimates of intermediate consumption from constant price estimates of gross output. On the other hand the single indicator methods consists in estimating constant price GVA using a single variable, the movement of which is assumed to be correlated with that of GVA. Double indicator methods from theoretical angle are generally superior but are more demanding in terms of data and therefore not always practical. Also, when GVA accounts for a small portion of output and when there are large changes in relative prices from the base year the double indicator method sometimes gives erratic result (negative value added). Thus, such methods are not uniformally recommended.

## *3.1. Double Indicator Methods*

The technique of deriving GVA at constant prices as the difference between a direct estimate of output at constant prices and a direct estimate of intermediate consumption at constant prices (each of which can be derived either by revaluation, deflation or volume extrapolation) is termed as double indicator method. Alternative double indicator methods are:

(i) *Revaluation of output and intermediate consumption*: In this double indicator method current price series of gross output and intermediate consumption are both revaluated at the corresponding prices in the base year. This requires quantity and price data at item level in all the years. This of course, demands large amount of data. The countries mostly adopt this method for the sectors of agriculture and livestock products where generally information on quantities and prices are available at the item level.

(ii) *Double deflation*: In the double deflation method current price series of gross output and intermediate consumption are both deflated by price indices which measure the change in price of output on the one hand and of inputs of goods and services on the other hand. This method is considered preferable to others from a conceptual point of

view because not only the constant price value added is obtained as a residual, but also because price relatives tend to be more stable over time than corresponding quantity relatives. This approach takes into account new products as they appear on the market and progressively eliminate obsolete ones as they disappear without creating breaks in time series. Quantity alternatives on the other hand may take extreme values as new commodities appear and old ones disappear causing erratic movements in GVA.

(iii) *Double extrapolation*: In the double extrapolation method, the base year elements of gross output and of intermediate consumption are extrapolated using volume or physical quantity indicators and constant price value added is then derived by subtraction. This method has advantage of taking into account both elements, which are used to define value added. On the other hand it has disadvantage that quality changes are not captured with a use of physical quantity indicators.

(iv) *Deflation and extrapolation, combination* : Under this alternative constant price value added is derived from a extrapolated series of base year estimates of gross output using volume or physical quantity indicators and a deflated series of current price intermediate consumption using price indices. Another alternative of this method could be reversing of the technique i.e. deflating the output and extrapolating base year estimates of the intermediate consumption

It may be mentioned that in practice the information needed for obtaining independent and reliable constant price estimates of output and intermediate consumption are generally not available and if available these are not of desirable quality. More so for deriving a proper deflator for intermediate consumption for each commodity, detailed data on intermediate consumption by commodity in current period is needed. In view of these too data demanding problems, in practice simplified approximation methods are adopted. One such simplified method is single indicator method

## *3.2. Single Indicator Methods*

Single indicator methods are based on an underline assumption of a constant relationship between output, intermediate consumption and value added at constant prices. Different single indicator methods depend upon the choice of (a) the indicator, whether output or input related, (b) adopting deflation or extrapolation technique and (c) variable as a proxy for measuring volume changes in the GVA. Various alternative single indicator methods are single output related, single input related and others:

*(i)* *Single Output related indicator methods*: Three alternatives under this category are:
(a) Direct deflation of current price value added by a gross output price index, a consumer price index or its relative components.
(b) Direct extrapolation of base year value added using a gross output volume index. The gross output volume index could be obtained deflating current price gross output by an output price index or by extrapolating base year gross output volume index.
(c) Direct extrapolation of base year value added using indices based on physical quantity output measures. This approach is different from (b) in that the basic data

used to construct the extrapolator are expressed in physical units of output and not in deflated monetary units.

*(ii)* *Single input related indicator methods*: There are eight alternatives approaches of this method indicated below:

(a) Direct deflation of current price GVA by a price index by intermediate consumption.
(b) Direct deflation of current price GVA by a wage rate index.
(c) Direct extrapolation of base year GVA by a volume index of intermediate consumption.
(d) Direct extrapolation of base year GVA using an index of deflated compensation of employees by a wage rate index.
(e) Direct extrapolation of base year GVA by an index based on physical quantities of inputs other than labour.
(f) Direct extrapolation of base year GVA by an index of numbers employed.
(g) Direct extrapolation of base year GVA by an index of man hours worked.
(h) Direct extrapolation of base year GVA by an index of hours and man-hours worked adjusted for change in labour productivity.

*(iii)* *Other methods*: The other method of obtaining constant price value added which do not fall into any of the above categories. For example, measurement of constant price value added may combine output and input indicators.

Let us discuss a little bit about the issues relating to the reliability of alternative measures of real product i.e., the methods discussed above for obtaining GVA at constant prices. For it, let the base weighted version of the index of real product or Laspeyres value index for value added be denoted as $\theta$ , Laspeyres output volume index as $\xi$, Laspeyres input volume index as $\gamma$, and $\lambda$ as the ratio of output to value added in the base year. Thus,

$$\theta = LQIVA_{j,0,t} = \frac{\sum_i p_{O,i,0} \cdot O_{ij,t} - \sum_i p_{in,i,0} \cdot in_{ij,t}}{\sum_i p_{O,i,0} \cdot O_{ij,0} - \sum_i p_{in,i,0} \cdot in_{i,0}}$$

$$\xi = \sum_i p_{O,i,0} \cdot O_{ij,t} \Big/ \sum_i p_{O,i,0} \cdot O_{ij,0}$$

$$\gamma = \sum_i p_{in,i,0} \cdot in_{ij,t} \Big/ \sum_i p_{in,i,0} \cdot in_{i,0}$$

$$\lambda = \sum_i p_{O,i,0} \cdot O_{ij,0} \Big/ (\sum_i p_{O,i,0} \cdot O_{ij,0} - \sum_i p_{in,i,0} \cdot in_{i,0}) = \frac{\text{output at base price}}{\text{GVA at base price}} \geq 1$$

Then it can be shown that

$$\theta = \lambda\xi - (\lambda - 1)\gamma$$

Through a little mathematical derivation T.P. Hill (1971) showed that double deflation estimate is an unbiased estimate, whereas use of output/input as a single indicator give biased estimate, the bias being equal to $-(\lambda\text{-}1)(\xi\text{-}\gamma)$, when output is the single indicator and is $-\lambda(\xi\text{-}\gamma)$ when input is the single indicator.

Further, let us consider $\tau$ as an estimator of $\theta$ which is defined as

$$\tau = \omega x - (\omega\text{-}1)\, c$$

Where $\omega$ is any real number and x and c are observed for measured values of the output and input indices. The total range spanned by $\omega$ can be subdivided into three parts to choose among the alternative methods.

(1) Double deflation is preferred when

$$(\lambda + 1)/2 < \omega \leq \lambda$$

(2) Output as a single indicator is preferred when

$$1/2 \leq \omega < (\lambda + 1)/2$$

and

(3) Input as a single indicator is preferred when

$$0 \leq \omega < 1/2$$

The main disadvantage of using input as a single indicator is simply that the bias involved is necessarily greater that for output. Thus if the output and input indices themselves are equally reliable, it follows that the output index must always be preferred as a single indicator. Only if the input index is distinctly more reliable than the output index it can possibly be considered as a single indicator. Since, in general, input indices tend to be less, rather than more accurate than output indices, it is clear that only in exceptional circumstances are input likely to be used as single indicator. In practice, there are likely to be only two kinds of situations in which input should be used in preference to output as a single indicator. The first is when the amount of bias involved is negligible. In these circumstances the choice between the output and input index should be based on their relative reliabilities. The second is when there is little or no information on output. Formally this may be treated as the case in which the variance of the errors in the output index is extremely large. There is one final point worth nothing in this context, namely, that if circumstances are such that the input index should be used as a single indicator in preference to the output index it can be shown that it should also be used in preference to double deflation.

In theory, the results will be identical provided that the "correct" index number formulas are used. If price deflation is used, it can be shown fairly simply that using a Paasche (or current-weighted) price index as the deflator will lead to the same result as that obtained by quantity revaluation. In practice, as is usually the case with national accountants,

life is somewhat more difficult. While quantity revaluation is used extensively by most countries in deflating GVA from agriculture and livestock activities or GDP components of final consumption expenditures and foreign trade in goods, the price deflation approach; is the more common method used to obtain constant price estimates for most components of the GVA from services sectors and GDP expenditure aggregates. However, in practice it is virtually impossible to calculate Passche price Indexes for all parts of the national accounts because of the very detailed data, both prices and quantities, which would be required for every period. The compromise solution used for many years in most countries has been to deflate current price values at the most detailed level possible using Laspeyres deflators. The outcome is an approximation of the results which would have been achieved by using Passche deflators.

The compromise solutions, i.e., resorting to using deflation of current price values at the most detailed level possible using Laspeyres deflators are generally satisfactory provided that the relative quantities and/or relative prices of each item do not change significantly over time. However, it is rare for such conditions to be met in practice. In particular, several countries currently use hedonic price indexes to deflate expenditures on computers. These indexes record very large declines in computer prices over the past couple of decades, while prices for most other commodities have been increasing. Also, the volumes of computers purchased have been rising much more rapidly than those for most other items in the accounts. To deal with the specific situation, one possible solution could be that computers be revalued separately from all other commodities so that the price deflators have the most up-to-date weights possible and therefore approximate a Passche price index formula reasonably closely. Another important point which is much more serious for keeping in mind is that the commonly-used Laspeyres volume formula produces distorted estimates of real growth.

## 4. Practices Adopted for Estimating GVA at Constant Prices

Gross value added (GVA) at constant prices is measured from production side as the GVA by industry i.e. the sum total of value added of all the economic activities at constant prices plus net indirect taxes on products at constant prices. The constant price estimates of GVA for various economic activities are compiled adopting one or the other alternative methods described in the earlier section.

*Estimates of GVA from various economic activities (market goods services):* Mostly the estimate of agricultural and livestock sectors where item-wise information on quantity and price is generally available, are compiled following double indicator method either by revaluation or deflation technique. The estimates in respect of other industries engaged in producing goods in the organised sector are compiled either by double indicator or single indicator method using available price deflators to derive the constant price estimates from the current price estimates. For industries engaged in production of goods in the unorganised sectors and those engaged in production of services, generally single extrapolation technique is used by the countries depending upon the availability of the information on related variables.

The practices followed by various countries for obtaining GVA at constant prices for individual sectors differ depending upon the available information on quantities, prices, price

indices and physical indicators. It is not always possible to adopt the best techniques for want of the requisite data and of course of reasonable quality. For example in India, the estimates of GVA at constant prices of mining are obtained by revaluating the current output of each mineral at the base year pit-head price and assuming input-output ratios the same as that at the current prices; constant price organised sector manufacturing estimates by deflating the current price estimates of value added with the help of index number of wholesale prices at the disaggregated (industry group) level of the industrial classification; constant prices unorganised manufacturing estimates by extrapolation i.e. carrying forward the base year estimates at disaggregated (industry group) level by relevant physical indicator; constant prices electricity estimates through extrapolation of the base year value added by the quantity of energy produced/sold; the constant price estimate of construction value added is derived from value of output at constant prices and applying base year proportion of GVA to output. The output of construction at constant prices is obtained by deflating the output category by the investment cost index number, specially prepared for the kind of construction. In case of services such as transport, storage and communication, the constant price estimates are derived by single extrapolation technique, i.e., moving the base year estimate with the help of a physical indicator, for example, for railways with the help of weighted index of passenger and goods traffic, for mechanised road transport with the help of number of transport vehicles; for cold storage with the help of number of workers; for communication with the help of a combined indicator of postal articles, money order, telegrams and telephones etc. For the purpose of estimating GVA at constant prices besides market goods and services we also need to compute constant price estimates for the output of non-market services, trading and taxes which are discussed below.

*Constant price estimates for output of non-market services:* The current price value of output of non-market services is by convention measured as equal to the sum of production costs (intermediate consumption, wages and salaries, consumption of fixed capital, and taxes on production). This output consists mainly of services delivered to households as social transfers in kind or collective services provided to the community as a whole. Most non-market output consists of unique services for which no parallel market exists. Thus, for non-market services, constant price estimates cannot be constructed by revaluating output directly or by deflating output at current prices by a representative price index for output based on observable prices. Thus, constant price estimates for non-market outputs can be derived by extrapolation with direct compiled output volume indicators. However, for a large number of the non-market services the physical unit of output is either obscure or continually changing. In practice, thus one often is forced to rely on simplified methods based on input measures to approximate the value of output and value added at constant prices.

*Trade margins at constant prices*: Traders produce distributive services, which are treated as a separate product in the national accounts. However, the amount and value of this service is not directly observable because the distributive service is consumed indirectly through the trade margins incorporated in the purchasers' value of the goods sold. The current price value of this service (the trade margins) is obtained as the difference between the value of the goods sold valued at current purchasers' prices and at current producers' prices. In principle, trade margins at constant prices cannot be estimated by deflating the trade margins at current prices directly. Thus a concept of trade margins at constant prices can be defined as the difference between the

value of the goods sold valued at constant purchasers' prices and at constant producers' prices. In practice generally trade margin at constant prices is obtained by many countries by simply extrapolating total trade margins in the base year with a volume index for trade turnover, termed as Gross Trading Income.

*Taxes and subsidies on products at constant prices:* Indirect taxes or subsidies do not obviously have price and quantity components. For this reason taxes on products at constant prices can in general not be estimated by deflation. However, a concept of taxes less subsidies on products at constant prices can be defined as the base year tax rate on the product multiplied by the value of the product at constant prices. Thus taxes on products at constant prices have to be estimated either by applying the implicit base year tax rates on the relevant transactions at constant prices or, alternatively, by extrapolating the base year value with volume indices for the relevant transactions. In practice, however, many countries follow approximate method and obtain constant price estimates of taxes and subsidies by deflating the current price value with the help of an appropriate producer's or wholesale price index (WPI).

## 5. Practices Adopted for Estimating GDP at constant prices from the expenditure approach

GDP at constant prices from the expenditure side is equal to the sum of the constant prices estimates of (a) household consumption expenditure; (b) non-profit institutions serving households (NPISHs) consumption expenditure; (c) government consumption expenditure; (d) fixed capital formation; (e) changes in inventories; and (f) net exports. For most of these expenditure items, the common practice is to derive a constant price estimate by deflating the current price estimates rather than by volume extrapolation. Practices commonly adopted by countries to derive constant price estimates of these final use categories are discussed below.

*Household consumption expenditure at constant prices*: Mainly two alternative approaches are followed by countries to compile household or private (when household and NPISHs are considered together as a residual category through the commodity flow approach) final consumption expenditure. The estimates for various components of private final consumption expenditure at constant prices are either obtained by revaluating the current year quantities with base year prices or deflating the current value of consumption by appropriate price deflators. The price deflators are either wholesale prices of the relevant groups or implicit price deflators obtained from current and constant price estimates of the domestic product (which is in fact Pasche Index). Many a times countries use appropriate components of the Consumer Price Index (CPI) as the deflator. But the problem in using the CPI, as the price deflator is that it is normally compiled using the Laspeyres formula and not the Paasche formula which should be preferred for use for the national accounts deflators. The difference between a Laspeyres formula and a Paasche formula can be significant, particularly in cases of rapid structural or seasonal changes in consumption patterns. Moreover, the consumption basket used in constructing the CPI often differs from the definition and coverage of household consumption expenditures in the national accounts, particularly with respect to services. It is important to keep in mind that it is advisable that the total household consumption expenditures should not be deflated by the total CPI. The estimates of household

consumption expenditures at constant prices should be prepared at the most disaggregated level possible using the detailed components of the CPI as deflators.

*Government and NPISH's consumption expenditure at constant prices*: The consumption expenditure of the General Government and Non-Profit Institutions Serving Households (NPISH) is equal to their output of non-market goods and services less their receipts from the sales. A constant price estimate of government final consumption expenditure which is output of non-market goods and services is derived as part of the derivation of estimates for output and value added at constant prices for government and NPISH producers. Output of non-market services at constant prices is estimated either by volume extrapolation using total observed input of production factors at constant prices as the volume indicator (that is, compensation of employees at constant prices, intermediate consumption at constant prices, and consumption of fixed capital at constant prices) or by deflating output at current prices by a compound price index for total observed input of production factors. Constant price estimates of compensation of employees for government employees are obtained by adjusting pay and allowances resulting in changes in pay scales and allowances due to increase in cost of living. In some instances where dearness allowance is paid to government employees totally neutralising the price rise on the basis of CPI, the compensation of employees is simply deflated by the CPI. The estimates of intermediate consumption (purchase of commodities and services net of sales) are obtained by deflating the current price figures by weighted price indices of items of expenditure. For commodities price data are obtained from appropriate index numbers of purchase prices. Price indices for services are normally the same as used for preparation of constant price estimates of value added of the respective sectors.

*Fixed capital formation at constant prices:* It is important to compile the constant price estimates of fixed capital formation at the most detailed disaggregated level as possible. Separate estimates are made for fixed capital formation in buildings and other construction works, machinery and equipment, and motor vehicles and other transport equipment. Fixed capital formation in buildings and other construction work at constant prices is derived as part of the derivation of estimates for output and value added at constant prices for the construction industry. Output at constant prices is derived by extrapolation, using volume indicators based on square meters of finished construction work. Some countries construct output price indices for buildings that are used as deflators. Also many countries compile construction costs indices that are used as deflators, in the absence of proper output price indices. As an alternative, some national accountants do construct their own cost based deflators as the sum of compensation of employees, intermediate consumption, and consumption of fixed capital at current prices divided by the sum of compensation of employees, intermediate consumption, and consumption of fixed capital at constant prices. For machinery and equipment and motor vehicles and other transport equipment, appropriate price deflators are constructed by weighting together relevant components of the producer price index and price indices or unit value indices for imports of capital goods. Appropriate weights are the domestic supply to the domestic market and the import shares of total supply to the domestic markets of each type of capital good. The estimates of machinery and equipment are deflated separately by domestic production net imports. This is done at disaggregated level for different types of machinery equipment and transport equipment.

*Changes in inventories at constant prices:* Changes in inventories for individual groups of goods at constant prices are normally derived as an integrated part of the estimation of changes in inventories at current prices and nominal holding gains on inventories when these are derived from opening and closing balance sheet values. Alternatively, when supply and use tables are being used as the integrating framework for compiling GDP from the production and expenditure side at current and constant prices simultaneously, changes in inventories at current as well as at constant prices commonly are derived residually.

*Export and import at constant prices:* Separate estimates are made for exports and imports (by products) at constant prices. Because importers and exporters are required to declare the value and quantity of shipments, it is a relatively straightforward procedure to construct unit-value indices by dividing value by quantity to derive an estimate of the price. In many countries the exports and imports constant price estimates are based on these unit-value indices. However, several problems exist with the use of unit value method. The primary problem with unit-value indices is that, even at the finest level of commodity detail, they reflect not only price changes but also may reflect changes in the quality of the product or changes in the type of product traded. An alternative is to calculate true price indices or use the finest level of commodity detail available and disaggregated by country of origin/destination before calculating the elementary unit-values. This procedure increases the homogeneity of the resulting calculation units and thus better approximates a true price index. The countries usually obtain constant price estimates exports and imports by deflating with the unit price method.

*Level of compilation for easing index number problem*: We follow from above and concepts and principles discussed in Section 2, that for consistent price and volume measures in the national accounts, a substantial number of price and volume indices are needed. As per concepts we do appreciate that ideally all price deflators should be Paasche price indices (that require current weights) and also that all price and volume indices should have the same price or quantity base. Further, that the volume indices to be used as volume extrapolators should be Laspeyres volume indices with a quantity base period and a weighting base period equal to the period used as base year for the national accounts constant price estimates. However in reality for most countries, these data requirements happens to be too large. Most price indices available for the national accountants are compiled using the Laspeyres formula (for example, CPI, WPI, etc.), and often with base periods that differ among price indices and that differs from the base year chosen for the national accounts. The practices followed by countries to overcome the index number problems, as a working practical solution to the problem includes: (i) adopting the deflation/extrapolation at the most detailed level possible, (ii) expressing all price and volume indices with the same reference period, and (iii) ignoring the index number errors (e.g., deflating with Laspeyres price indices) introduced and treating the resulting estimates as regular additive constant price data. This in a way results in adopting *approximate* Laspeyres volume indices and approximate Paasche price indices for the aggregates.

However, to secure that the errors introduced are sufficiently small, this requires that the compilations are carried out at an aggregation level where the difference between the

available price and volume indices, and the required Paasche price and Laspeyres volume indices can be assumed to be relatively small. This of course requires the availability of sufficient detailed current price data (directly or as a price index multiplied by a volume index at a sufficient detailed level). It can be seen that the difference between the Paasche price and volume indices, and the Laspeyres price and volume indices, for a product group will be small when (i) either the price movements for all individual items constituting the product group are approximately the same, or (ii) when the corresponding volume movements are approximately the same. Also we understand that when the price movements are approximately the same, normal economic behavior tends to result in the corresponding volume movements being approximately the same. In brief we infer that by properly choosing the compilation level, the index number errors introduced by the compilation procedure (deflating with Laspeyres price indices) would be relatively small. More importantly if the weights used in compiling the available Laspeyres price indices are updated on a regular basis, the difference between these and the required Paasche price indices should be further reduced.

## 6. Rebasing of National Accounts Series

Constant price estimates use the price relatives of a particular year to weight together the volume components. Each base year gives a different perspective resulting from those weights. While constant price data have the advantage of being additive, over time the pattern of relative prices in the base period tends to become progressively less relevant. Therefore it is necessary to update the base period to adopt weights that are more consistent with current conditions.

It is a matter of fact that structural change does take place in production structure in the economy over a period of time. Also structural changes do take place in relative prices of various products in the economy over a period of time. Besides on account of continuous developments and innovations a lot of new products appear in the market. On the other hand due to obsoleteness many old products disappear from the market. Larger quality changes also result in the non-comparability of goods and services between far apart periods. Furthermore on the final demand side as well structural changes do appear in the consumption patterns and utilisation and acquisition of capital goods. All these factors justify that it is absolutely desirable to rebase the national accounts series periodically. As the changes in structure of production or consumption appear almost continuously, it is all the more further desirable to do more frequent rebasing.

In principle, a change of base year in the national accounts implies (a) changing the price and quantity base for the individual price and quantity relatives, and (b) updating the weights used in aggregating the individual quantity relatives into sub-indices and to aggregate these sub-indices into more aggregated indices. It may be mentioned that re-basing Paasche price indices do not involve any change in the weights (being a weighted harmonic average of price relatives, where the weights are the shares in the current period); only a change in the base period for the price relatives is required. However, in practice it is not possible to construct a set of Paasche price indices and Laspeyres volume indices from observed micro data, and aggregated using appropriated current (for the price indices) and bases period (for

the volume indices) weights. Thus the national accountants are forced to construct *approximate Paasche price indices* and *approximate Laspeyres volume indices* for the national accounts aggregates, by making the compilations at a possible detailed level, and performing the aggregation from this detailed level to the main national accounts aggregates. Thus a rebasing of the national accounts in practice means (at the detailed compilation level) (i) changing the reference period for the individual price and volume indices used from being equal to the old base year to being equal to the new base year, and (ii) performing the aggregation from this detailed compilation level to obtain the national accounts aggregates.

As an illustration for rebasing a national accounts series with existing base year of 1980 to a new base year 1990 in practice at the detailed compilation level the following steps are involved:

(1) For the economic activities or aggregates for which the constant price estimates are obtained by *revaluation*, a change of base year involves replacing the 1980 prices currently used with 1990 prices for the same items (that is replace $Q_{80,t} = \sum_i p_{i,80} \cdot q_{i,t}$ with $Q_{90,t} = \sum_i p_{i,90} \cdot q_{i,t}$ ).

(2) For the economic activities or aggregates for which the constant price estimates are obtained through *deflation*, a change of base year involves changing the reference period from 1980 to 1990 for the deflators used at the most detailed level. Change of reference period is made by simply dividing the original index with it's level in 1990, ($Q_{90,t} = V_t/(P_{0,t}/P_{0,90})$).

(3) For the economic activities or aggregates for which the constant price estimates are obtained through *volume extrapolation*, a change of base year involves changing the period from which the level are being extrapolated. Volume extrapolation is commonly done either by:

(i) Multiplying the current price value in the base period with a volume index (with the base period as reference period) showing the change from base period ($Q_{80,t} = V_{80} * I_{80,t}$), or
(ii) Multiplying the constant price estimate for the previous year with a volume indicator showing the change from the previous year ($Q_{80,t} = Q_{80,t-1} * I_{t-1,t}$).

A change of base year involves changing the reference period of the volume index from 1980 to 1990, and multiplying the re-referenced volume index with the current price level in 1990 ($Q_{90,t} = V_{90} * (I_{80,t}/I_{80,90})$).

For obtaining an estimate for 1991 at 1990 prices one would be required to extrapolate the 1990 current price value ($Q_{90,91} = V_{90} * I_{90,91}$). The constant prices estimates for the later years can then be obtained by multiplying the constant price estimate for the previous year with an volume indicator showing the change from the previous year ($Q_{90,t} = Q_{90,t-1} * I_{t-1,t}$).

Rebasing of national accounts series is desirable for several reasons, as mentioned earlier, including for capturing the structural changes in the economy and thus for reaching

near to truth. An important question is how often the base period should be changed. Practices in this respect vary considerably, with some countries keeping the same base period for as many as 10 years or 5 years, and some changing the base period every year. It is desirable to change base periods frequently, especially in times of large changes in relative prices and rapid economic development. However, it may be mentioned that changing the base too frequently also can sometimes cause problems. It has been seen that if individual prices and quantities fluctuate in a way so that the changes in relative prices occurring in earlier periods are reversed in later periods, a period-to-period chain-linked index[1] in general will not return to its initial level. (i.e., no transitivity). It is not advisable to go for rebasing more frequently than a year.

It is important to note that change of base year has an impact on the growth rates of GDP. Normally relative prices tend to change in a way that is inversely related to changes in relative volumes (i.e. the commodities for which prices become cheaper tend to have a higher volume growth). As a result, the overall measure of growth based on a Laspeyres fixed-base formula will tend to overstate the growth in years after the base year compared with the growth rate which would be calculated if a more up-to-date set of relative prices were used. Thus when constant price estimates are rebased, the growth rates observed for major aggregates will change from those, which were based on, earlier base year and previously published. Sometimes the changes can be very significant, which can lead to problems for national accountants in trying to explain why the constant price GDP growth rates have been "revised" compared with those previously published. The SNA, 1993 has recommended compilation of chain volume indices[1] to overcome this problem. However, most countries in the Asian region are still using system of fixed base years on which they compute their constant price growth rates. Generally the base years are changed after 5 years or 10 years and the estimates for earlier years are obtained by chaining growth rates expressed in terms of previously used base years on to the front of the latest set of estimates. To form consistent time series the old series need to be linked to the series based on the new base year, resulting in a set of chain-linked time series[1].

## 7. Linking of National Accounts Series

National accounts aggregates at constant prices provide important indicators for measuring growth in the activity or economy. All countries are compiling national accounts aggregates at current and constant prices. They also update the base year periodically. However, in the Asian region several countries have breaks in their national accounts series resulting from the changes in base year. These breaks in the series have resulted in incomparability of the series based on different base years and therefore the users of the data find difficulties in measuring growth or improvements of output over a period of time

1 Chain linking means to construct a volume index series by multiplying together the indices with different base and reference periods. For example, let $I_{2,3}$ be a Laspeyres volume index measuring the volume change from period 2 to period 3 with weights from period 2, then an annual chain-linked Laspeyres index series from period 0 to period t can be constructed as $I_{0,t} = I_{0,1} * I_{1,2} * I_{2,3} * I_{3,4} \ldots I_{t-1,t} = \prod_{\tau=1}^{t} I_{\tau-1,\tau}$

covering more than one base year. In the Asian region, the countries that have been regularly updating their national accounts series fall into three groups. The first group comprising of Bangladesh, Cambodia, India, Indonesia, Republic of Korea, Nepal, Sri Lanka, Thailand and Vietnam who have rebased their series once or twice since 1980s but not linked the different series, or if they have, these perhaps are not being officially released. The resulting breaks in the constant price series significantly reduce the usefulness of the data to analysis. The second group consists of countries that have linked their constant price GDP series for example, Hong Kong, China, Philippines, Singapore, and Taipei China. The third group consists of those countries that have long overdue need to rebase their series for example Bhutan, Malaysia and Pakistan.

The linking exercises of the national accounts aggregates or components of GDP by expenditure approach should be conducted taking into account carefully the alternative methods adopted by the countries for the various components for valuation in the new base series. In case the adopted alternative is revaluation, then it is a question of multiplying quantities at the product level for a given year with the prices of the new base year. If the alternative method used is the price deflation then it involves changing the reference period for the deflators (link price deflators) used at the most detailed level. It needs to be emphasised that the exercise has to be done at most disaggregated level following the same method as was used in the rebasing of the series. In case for a sector where double deflation is used, the back series is also to be obtained by double deflation and if a single indicator method has been used, the back series has also to be obtained through the link single indicator.

The life of the national accountants is not, however, that simple in reality in so far as their task in linking of national accounts series is concerned. It is because in most countries while revising the base of the national accounts series the national accountants also simultaneously attempt the following: (i) review the methodologies adopted; (ii) review the existing database and alternative data sets available in the economy and make choices of data sets which are superior in technical sense or which are more recent ones and become available in the meanwhile; (iii) review the coverage of the various aggregates to reckon with the emergence of new economic activities in the economy and to incorporate changes on account of possible omissions or duplications and (iv) attempt to adopt the important recommendations pertaining to new international standards provided by the latest International System of National Accounts. When all this is done a simple chain linking of the series may not give the correct picture of the economy measured for the past years. It therefore becomes necessary for the countries to look into various details of all the individual aspects carefully. For example, in case the coverage review revealed that some activity was missing in the earlier series then numbers relating to this activity have to be seen in the right perspective and then plugged into the back series. If a review of existing data base reveals that another alternative set of data captures the activity more adequately, then change in data base need to be made for the current period as also for the possible past years. Splicing or a simple linking will not do justice in such situations.

In the Indian national accounts, for example, in the last rebasing exercise, it was found while reviewing the various aspects mentioned above that in the old series certain activities

(e.g., quasi-government bodies) were missing; production of certain goods produced and used for self-consumption (production of fruits, vegetables, etc. in the backyard/foreyard of the rural residential houses) was not included; an alternative source of data (National Sample Survey based numbers on workforce instead of the workforce numbers based on Population Census) captured the activity more adequately, etc. In such circumstances the back series has to be computed with care for all individual activities by taking into account the specifics of the changes incorporated rather than conducting mere splicing or linking with the help of link price deflator. Thus, full care should always be taken while obtaining the estimates of various national accounts aggregates for the back series. Sometimes an alternative source of data gives a jerk i.e., value or number for a specific year as per new source is very markedly different than the one which was obtained by extrapolation of earlier survey based number. For example, an Enterprise Survey on service activity might give a GVA per worker figure, which might be very low or very high as compared to the one, which was available from earlier survey relating to an earlier period. It is advisable that the new results be used with caution because changes in productivity do not take place over night. The process of change is normally gradual whereas the data collection from periodic surveys is available only with a gap of few years. In such cases instead of simply linking, some kind of smoothening may be called for i.e. super imposing the growth rates of the earlier series on the new numbers observed from the new set of data. In conclusion, no single solution exists for all types of problems. Countries need to consider each of the problem issues with proper care and determine solutions keeping general principles in mind and best practices at hand.

# BASIC PRINCIPLES AND PRACTICES IN REBAING AND LINKING NATIONAL ACCOUNTS SERIES

By
A.C. Kulshreshtha

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