

**An Introduction to System of National Accounts
– Integrated Transaction Accounts**

Lesson: VIII - Part 1

Price and Volume Measures

**Second Intermediate-Level e-Learning Course on
2008 System of National Accounts**

October - December 2013

Contents

- Price and Volume Measures – Underlying Concepts
- Value, price and volume
 - Implicit Price Deflator
- Estimates at constant prices - Basic techniques

Price and Volume Measures – Underlying Concepts

GVO at current and constant prices

For an SNA aggregate, such as example **GVO**

- at current price is represented as $\sum_i p_{it} q_{it}$ and
- at constant price is represented as $\sum_i p_{i0} q_{it}$,

where

p_{it} : price of i^{th} item at the period t

q_{it} : volume or quantity of i^{th} item at period t

p_{i0} : price of i^{th} item at the base period 0

q_{i0} : volume or quantity of i^{th} item at period 0

Growth rates

Find out the growth rates for a homogenous product, for which [try yourself]

	Period 0	Period t	Growth rate
Quantity (q)	18	20	?
Prices (p)	4	5	?
q*p	72	100	?

Find out

$$[1 + \text{growth rate (p)}] * [1 + \text{growth rate (q)}] = ?$$

$$= [1 + \text{growth rate (q*p)}]$$

Growth rates – how related?

Thus, for a product :

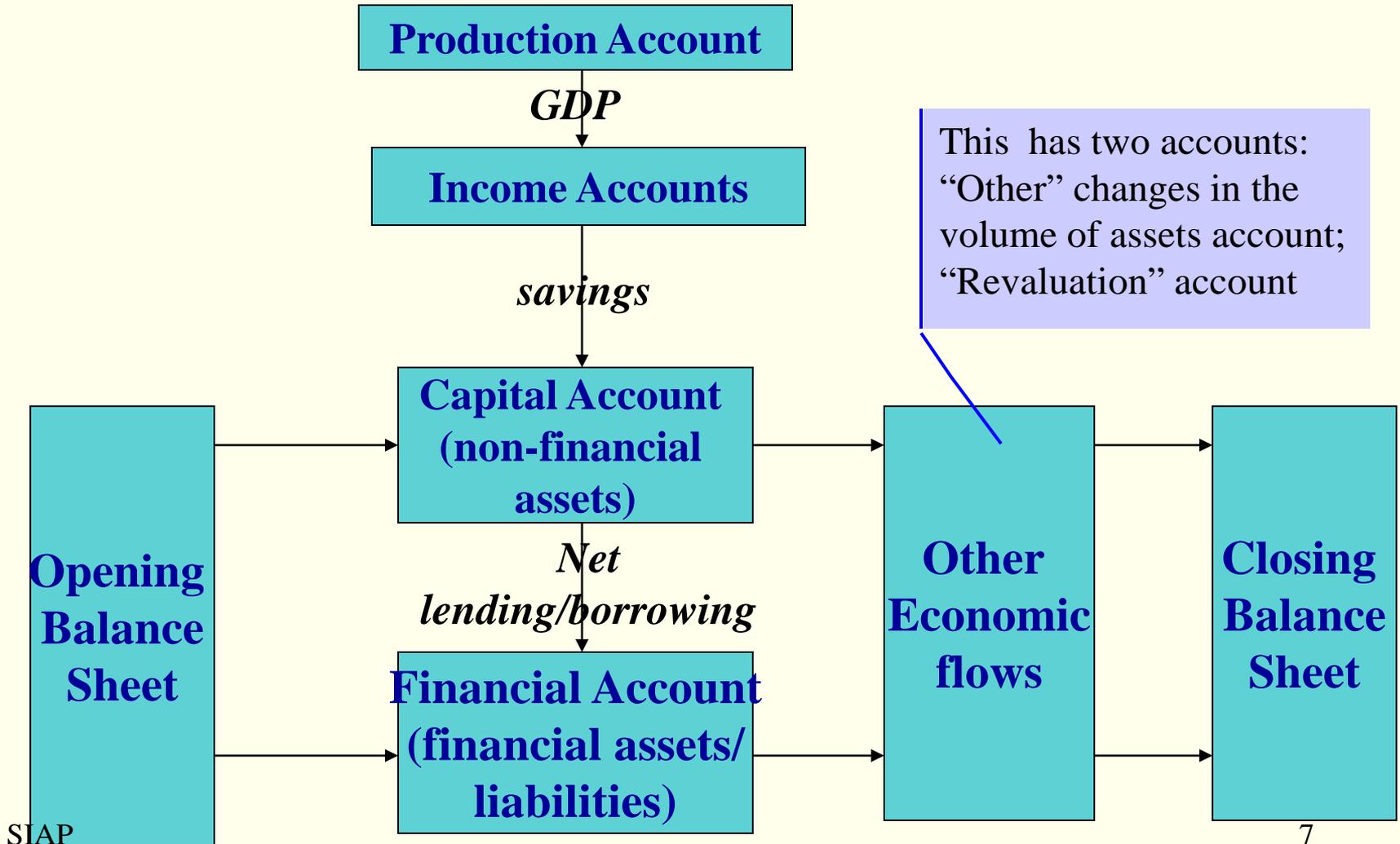
$$\begin{aligned} & [1 + \text{growth rate of the value of a product at current prices}] \\ & = \quad [1 + \text{growth rate of the quantity of output}] \\ & \quad \times [1 + \text{rate of change in price of the product}]. \end{aligned}$$

and for an aggregate:

$$\begin{aligned} & [1 + \text{growth rate of the aggregate at current prices}] \\ & = \quad [1 + \text{growth rate of the aggregate in volume}] \\ & \quad \times [1 + \text{rate of change in an appropriate price index}]. \end{aligned}$$

Links between the Accounts

Recall the accounting structure:



Price changes in the SNA Structure

Nominal holding gains or losses: Changes over time in the monetary values of assets and liabilities caused by changes in **their own prices** constitute.

➔ Captures the effect of price changes

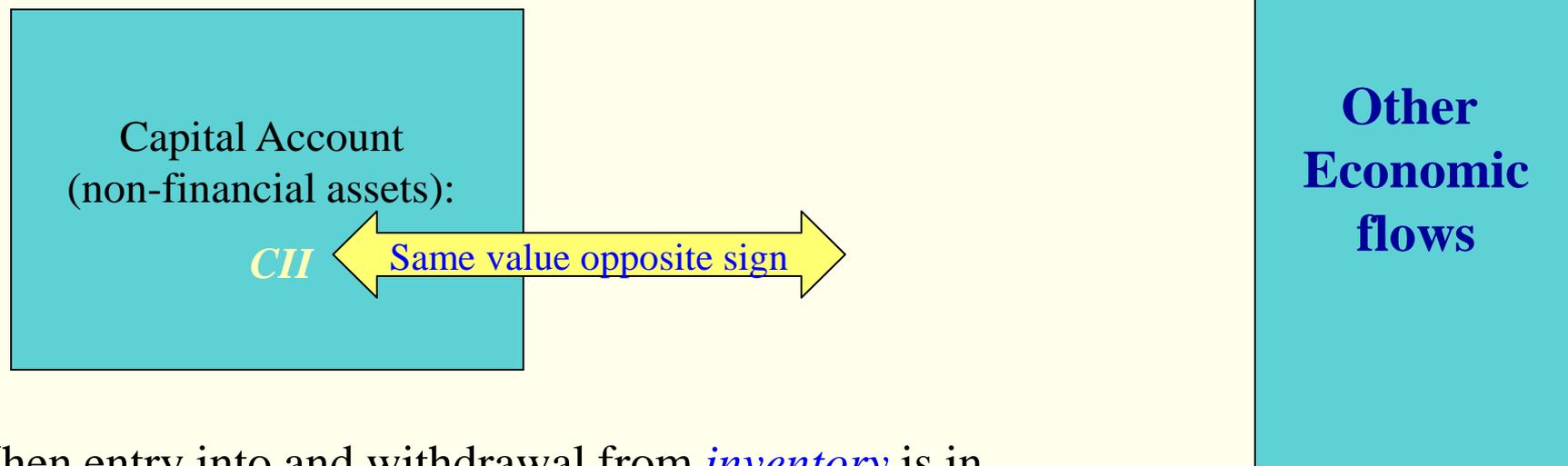
The value of the nominal holding gain on quantity q of an asset between times 0 and t , owing to change in price from p_0 to p_t is

$$(p_t - p_0) \cdot q$$

For example, if $p_t = 20$, $p_0 = 15$ and $q = 5$,
then *nominal holding gain* = 25

Effect of Price changes in Accounts

All **nominal holding gains and losses** – the effect of price changes - are recorded in the **Revaluation account**



When entry into and withdrawal from *inventory* is in the same accounting period,

CII = entry price - withdrawal price,

Nominal holding gain = withdrawal price - entry price.

Effect of Price changes – within accounting period

Thus, if the basic price of a quantity q of finished goods entered into inventories in the **first** quarter is p_1 and

and its basic in the **fourth** quarter – when it is sold - is p_4

The value of the *nominal holding gain* on the quantity of finished goods in the annual account would be $(p_4 - p_1) \cdot q$

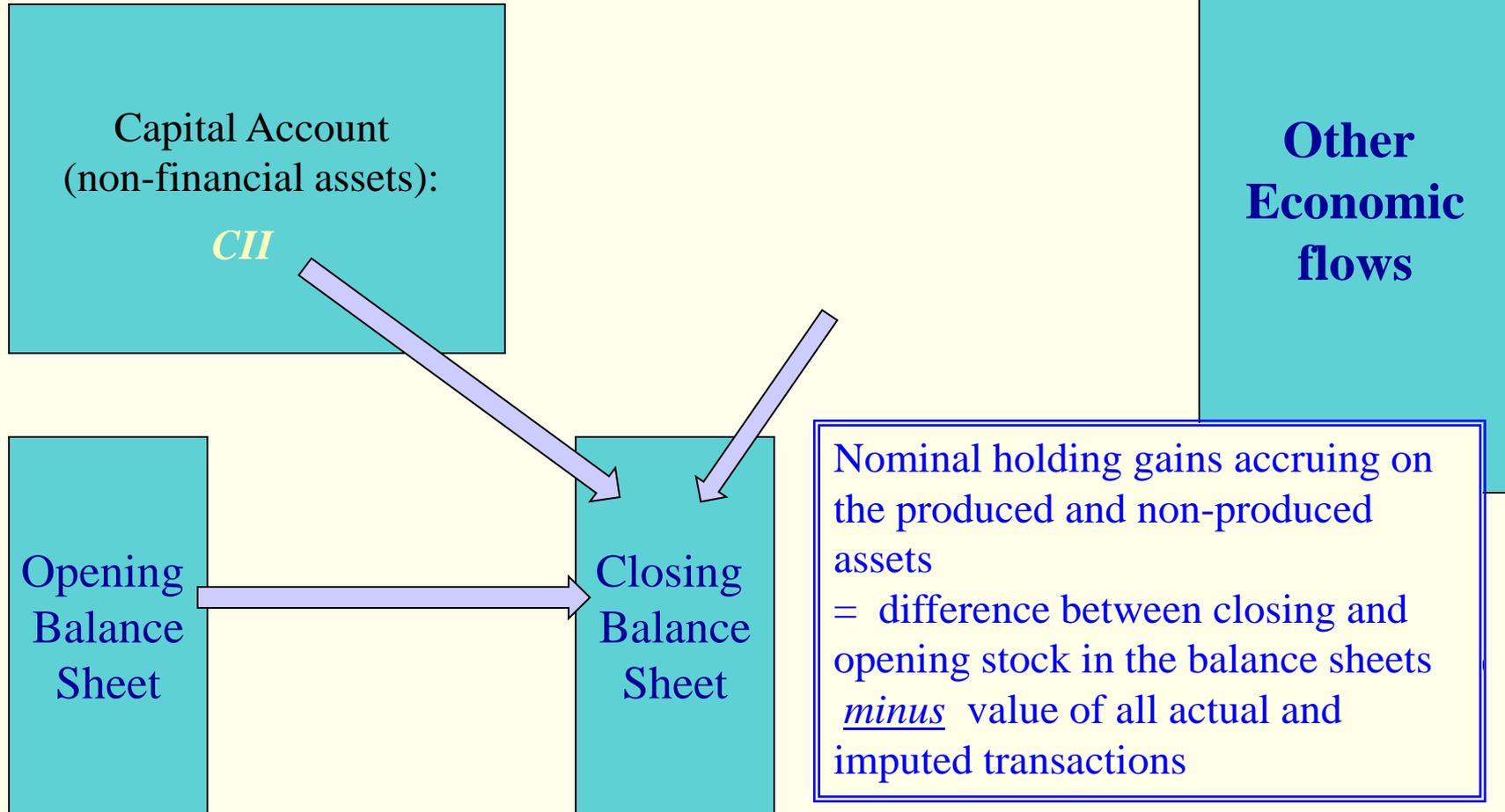
and *CII* would be $(p_1 - p_4) \cdot q$ [see Box 8.2 of Reading Material]

Clearly, price change does not contribute towards difference between closing and opening annual balance sheets, but will affect annual *GDP*.

This factor is important for reconciling the quarterly and annual accounts.

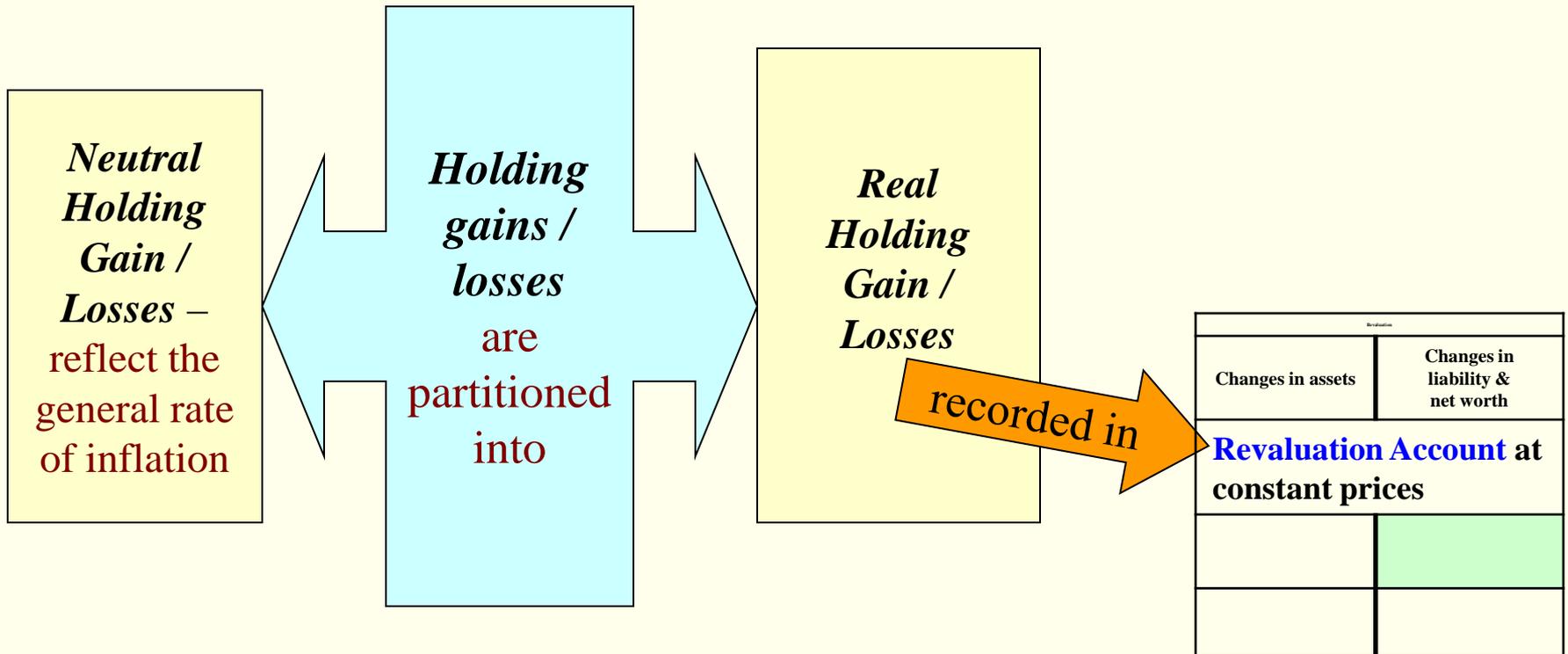
Effect of Price changes over periods

When entry and withdrawal takes place in different accounting period:



Holding gains / losses at constant price

- Negative gains are described as holding losses.



Measure of General Price Level

- There is no measure of *general price level* that can serve as a all-purpose deflator for converting current-price estimates to constant-price estimates.
- For different transaction types, constant-price estimates are thus derived using appropriate price or volume indices – with the accounting base year = 100.
- Thus, accounts at constant prices describe an economic situation of the **current year** in the prices of **another year** – the *base year*.

Value, price and volume

Quantity, Quality and Volume

Prices and values in 000' units of currency

No change in prices

Car production	High priced model	Low priced model	Total
Price per unit	20	15	
Production in Year 1	10	20	30
Production in Year 2	20	10	30
Total value of production in Year 1	200	300	500
Total value of production in Year 2	400	150	550

Quantity, Quality and Volume (Contd.)

- Unit value in year 1 =
 - Unit value in year 2 =
 - Change in volume =
 - Change in quantity =
 - Change in prices =;
- because prices remain unchanged**
- Change in unit values =

Quantity, Quality and Volume (Contd.)

Conclusions:

- Unit values are affected by the change in the product mix
- Change in product mix = change in average quality
- The term “VOLUME” is preferred to “QUANTITY”
- Change in “QUALITY” is regarded as change in “VOLUME”, not as change in “PRICE”

Price and Volume Indices – Points to Note

- Volume measures are obtained by valuing each individual quantity at its own prices in an earlier period – base year.
- Change of volume measures constitutes a Laspeyres volume index.
- Quality change regarded as change in "volume" not a change in price
- Thus, at the aggregated level, the term **volume** is preferred to the term **quantity**.

Measures at Constant prices and Volume Index

Denoting:

$Q_{0,t}$ the total value in period t measured at the prices of period 0

$LQ_{0 \rightarrow t}$ a (fixed-base)

Laspeyres volume index with period 0 as the base period

w_{i0} the base period weight, that is, item i 's share in the total value in the base period.

The *measure of change* from the base year in the constant price time series is:

$$LQ_{0 \rightarrow t} = \frac{Q_{0,t}}{Q_{0,0}} = \frac{Q_{0,t}}{V_0} = \frac{\sum_i p_{i,0} * q_{i,t}}{\sum_i p_{i,0} * q_{i,0}}$$



the **Laspeyres (fixed-base) Volume Index**

Which is one of the several volume index formulas

Implicit Price “Deflator”

For an aggregate, the relationship between a measure at constant prices and a measure at current prices is

$$PP_{0 \rightarrow t} = \frac{V_t}{Q_{0t}} = \frac{\text{Current prices}}{\text{Constant prices}} = \frac{\sum_i p_{i,t} * q_{i,t}}{\sum_i p_{i,0} * q_{i,t}}$$

an *implicit price ‘deflator’*

Also called *GDP deflator*

GDP Deflator and other NAS-based deflators

What kind of price index is the *GDP deflator*?

- a (fixed base) Paasche Price Index implicitly derived

This is one of several alternative formulas for aggregated price measures in general.

It provides an economy-wide measure of price change, with a coverage much wider than CPI.

In terms of coverage, it is similar to PPI.

Price measures derived implicitly from the estimates of *household consumption expenditure* has a coverage same (or nearly the same) as the CPI.

Need for dis-aggregated level Accounting

- The implicit price index / deflator
(= value at current prices / value at constant prices)
is a **Paasche's Price Index**.
- Thus, the value at current prices should be deflated by Paasche's price index to obtain value at constant prices.
- But, in most countries only Laspeyres price indices are compiled and available.
- Thus, it is essential to prepare national accounts at constant price (using Laspeyres indices) at the **most disaggregated level**.

Level of Compilation

The practical solution is thus to:

- conduct the deflation/extrapolation at the *most detailed level possible* (*Elementary Level of Aggregation*)
- express all price and volume indices with the same reference period (base year),
- ignore the index number errors introduced
- do the aggregation from the detailed level and up to the main national accounts aggregates.

**Estimates at constant prices -
Basic techniques**

Three Basic Methods of Constant Price Estimation (1)

Revaluation:

physical quantities of *output and intermediate consumption* are both revalued at the corresponding prices of the base year.

Deflation:

each period's current price value divided by an appropriate price index.

Volume extrapolation:

Base year's value multiplied by an appropriate quantity/volume index/indicator.

Three Basic Methods of Constant Price Estimation (2)

- The price relatives vary less than quantity relatives and thus more accurately measured - survey estimates of prices more efficient.
- Thus, “deflation” is expected to produce more accurate results than extrapolation with quantity indicators.
- But, this too does not hold good under hyperinflationary situations.

Revaluation

$$Q_{0,t} = \sum_i p_{i,0} * q_{i,t}$$

That is to revalue current quantities by multiplying with prices of base year

It requires

- quantity and price data at the product level
- homogeneity of physical quantities for each product
- complete coverage of the quantities transacted

Thus, adopted for agricultural and livestock products.

Volume extrapolation

$$Q_{0,t} = V_0 * LQ_{0 \rightarrow t}$$

That is to update the base year's value according to the movement in an appropriate volume index (**volume indicator**)

- difficult to incorporate new products properly when constructing volume indices directly
- difficult to properly adjust for changes in quality
- for many products it is difficult to define the unit of quantity



in general not the preferred technique (except under hyper inflation)

Deflation

$$Q_{0,t} = V_t / PP_{0 \rightarrow t}$$

That is to deflate by a suitable price indicator

- easy to incorporate new products and new activities when collected current price data
- easier to properly adjust for changes in quality when constructing price indices
- prices for related products may show similar movements: the idea of representative prices



in general the **preferred technique**

End of Part-1
Lesson VIII

**An Introduction to System of National Accounts
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Lesson: VIII - Part 2

Price and Volume Measures

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Contents

- **Volume measures in national accounts**
- **Rebasing national accounts**

Volume measures in national accounts

Which SNA Aggregates?

- Constant-price GDP estimates are the most commonly used measures of *real* growth. But can be estimated by
 - *production, expenditure and income approach*
 - all of which are required to be the same.
- Direct measurement of all aggregates at constant prices not always possible. Thus,
 - only a restricted set of aggregates
 - ‘income’ aggregates only at the ‘total economy’ level and
 - selected items of external transaction accountsare usually attempted.

Common Practice

- At constant prices, GDP can be measured directly from ‘production’ and ‘expenditure’ sides.
- One unique measure of GDP volume requires full consistency between them.
- Normally, the measurement of GDP volume growth is based heavily on only one of the two approaches.
- In most countries, data on household consumption expenditure are regarded as less reliable, thus ‘production’ approach is preferred.
- The GDP by production approach is usually compiled from the estimates of GVA of very detailed groups of economic activities.

Measuring GDP at Constant Prices

➔ Through the price and volume measures for its components

From the production approach

for Value added (at basic prices) by industry

Plus for taxes less subsidies on products

From the expenditure approach

for Government final consumption expenditures

Plus for Households final consumption expenditures

Plus for NPISH's final consumption expenditures

Plus for capital formation (including changes in inventories)

Plus for exports *minus* for imports

Integrated current supply and use tables, the optimal framework for price and volume measurements in the national accounts

Production Approach – Main Aggregates Involved

- Output (P.1)
- Intermediate consumption (P.2)
- (Taxes-subsidies) on products & imports (D.21 – D.31)
- Value added / **GDP** (B.1) – **main interest**
- Compensation of employees (D.1)
- Mixed income (B.3) + Operating surplus (B.2)

Value Added at Constant Prices – the Concept

- *Production approach* $GDP = \sum GVA$, over industries – the main aggregate of interest.
- GVA - balancing item of “production account” - not observable - change in current-prices GVA not decomposable into price and quantity components.
- GVA at constant prices is defined and measured as (GVO at constant prices) minus (IC at constant prices).

Methods of Estimating GVA at Constant-Price

- Different methods of constant-price estimation are characterized by the use of the techniques and the number of indicators:
 - (i) extrapolation or deflation technique
 - (ii) double or single indicator.
- Also depends on the choice of indicators and the variables used for the purpose:
 - (i) whether the indicator relates to output or input and
 - (ii) type of variable on which the indicators are based.
- Theoretically, double indicator methods are generally superior.

Practical problems of using double indicator methods:

- More demanding in terms of data.
- When GVA is a small portion of output and when the relative prices change drastically, the double indicator method sometimes gives erratic result (even negative value added).
- Thus, double indicator methods are not uniformly recommended.

Double Deflation

- **Double deflation:** The derivation of value added at constant prices as a difference between *output at constant prices* and *intermediate consumption (IC) at constant prices*
- ✓ Double deflation requires reliable volume and price measurements of both output and intermediate consumption
 - requires a breakdown of output and intermediate consumption by product
- ☹ Double deflation is not recommended when value added accounts for only a small proportion of output
- Constant price estimate may take negative values.

Volume Measures for Value Added Alternative Methods

Double deflation - double extrapolation

- Separate estimates for output and intermediate consumption at constant prices, value added as the difference
- Requires current information regarding:
 - intermediate consumption shares
 - the structure of intermediate consumption

Volume Measures for Value Added Alternative Methods (Contd.)

Single extrapolation of value added

- Extrapolation with output
 - Assumes fixed input output coefficients
 - Price measures for intermediate consumption implicitly given
- Extrapolation with employment data
 - Adjustments for normal increases in labor productivity?

Volume Measures for Value Added Alternative Methods (Contd.)

Single deflation of value added

- Deflation with the output deflator
 - Assumes parallel price movements for output and intermediate consumption
 - Changes in input output coefficients implicitly given
- Deflation with a wage index
- Deflation with a general measure of inflation such as the total CPI
 - Do not result in a volume measure
 - Provides a measure of a different concept, real income

Preferred Methods of Output Measurement at Constant Prices

- In Production account, the balancing **GVA** is derived from *output, intermediate consumption* and (*Taxes - subsidies*) on products & imports.
- The double-indicator and output-related single indicator methods of estimating **GVA** at constant prices involve measurement of output at constant prices.
- Generally, turnover / sales deflated by an appropriate price index is considered as the conceptually appropriate method.

Preferred Methods of Output Measurement at Constant Prices (2)

- The EUROSTAT *Handbook on price and volume measures in national accounts (2001)* classifies methods of estimating output at constant prices into three categories: A, B and C.
- It recommends ‘A’ methods for each industry and considers the ‘C’ methods undesirable.

‘Preferred’, ‘Alternative’ and ‘Other’ Methods – OECD *Manual*

- The “A” methods of the EUROSTAT *Handbook* are the theoretical best for each industry.
- But, it is not always practical to follow them.
- Thus, the “preferred” measures for services, as recommended in the OECD’s *Compilation Manual for an Index of Services Production (2007)*, are suggested for estimating output of services at constant prices.
- The *Manual* also presents “alternative” and “other” indicators for compilation of Services production index.

Trade Margin – output of distributive trade

- Output of trading activities is the trade margin.
- In theory, constant-price GVA: Difference between deflated sales and deflated purchases.
- But, the required data are not available.
- The OECD *Manual* suggests methods based on the assumption
 - margin-to-sales ratios are constant at constant prices.
- This provides the basis for the prescribed method of deflating gross turnover by appropriate quality adjusted price indices.

Output of Non-Market Services

- At current prices, output of non-market production = sum of production costs.
- For constant price estimates for non-market outputs, deflation by market-prices based price index should **not** be used.
- Preferred approach: extrapolation of base year value with directly compiled output volume indicators.
- In practice, has to rely on simplified methods based on input measures to approximate the value of output at constant prices.

Taxes at Constant prices

- In general, taxes on products at constant prices can **not** be estimated by deflation.
- The 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 by **extrapolating with volume indices** for the relevant transactions.
- Only in the case of an *ad valorem* tax with no changes in the tax rate, the method deflating can be adopted.

Constant-price GDP – by Expenditure

- For most of these expenditure items, a constant price estimate is derived by deflating the current price estimates rather than by volume extrapolation.
- For *CII*, product-groupwise estimates at constant prices are recommended to be derived
 - as a part of the procedure of estimating changes in inventories at current prices and the adjustment for holding gains.

HFCE at Constant Prices

- The total household consumption expenditures should NOT simply be deflated by the total CPI
- Recommended method: The estimates of household consumption expenditures at constant prices at the most disaggregated level possible using the detailed components of the CPI as deflators.

GFCE and *GFCF* at Constant Prices

GFCE:

- The main component – output of non-market goods & services.
- For this, should be the same as production approach.

GFCF:

- Should be compiled at the most detailed level possible.
- As a minimum, separate estimates should be made for fixed capital formation in
 - buildings and other construction works,
 - machinery and equipment, and
 - motor vehicles and other transport equipment.

Rebasing national accounts

Why Rebasing?

- For Constant price estimates, weights used for combining different volume components depend on their relative prices in the base year.
- Thus, estimates of ‘real growth rate’ depends on the choice of base year.
- Constant-price estimates tend to become less relevant progressively, with changing pattern of relative prices.
- Thus, rebasing is necessary to adopt more current weights.

How often should base year be changed?

- Most countries do it once in 10 years, some every year – annual chain-linking.
- Users sometimes chain-link the published unlinked quarterly price & volume indices – resulting in quarterly base change
- The 1993 / 2008 SNA recommends an annual change of base year and publication of annual chain-linked volume indices.
- Under hyper inflationary situation with large changes in relative prices, frequent base year change desirable.
- At least, annual chain-linking, if not quarterly, required under hyper inflation.

Choice of Base Periods in the National Accounts and Chaining

Main Recommendations

- Do frequent change of base year and chain-linking
- Do not change the base period more frequently than annually
(Years - not quarters as base period)
- Do not chain link over periods with substantial price/volume oscillation
- Base years should be as normal as possible

**End of
Lesson VIII**

Thanks