Economic and Finance statistics

Price and Volume Measures in National Accounts

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Volume measures - what is it about?

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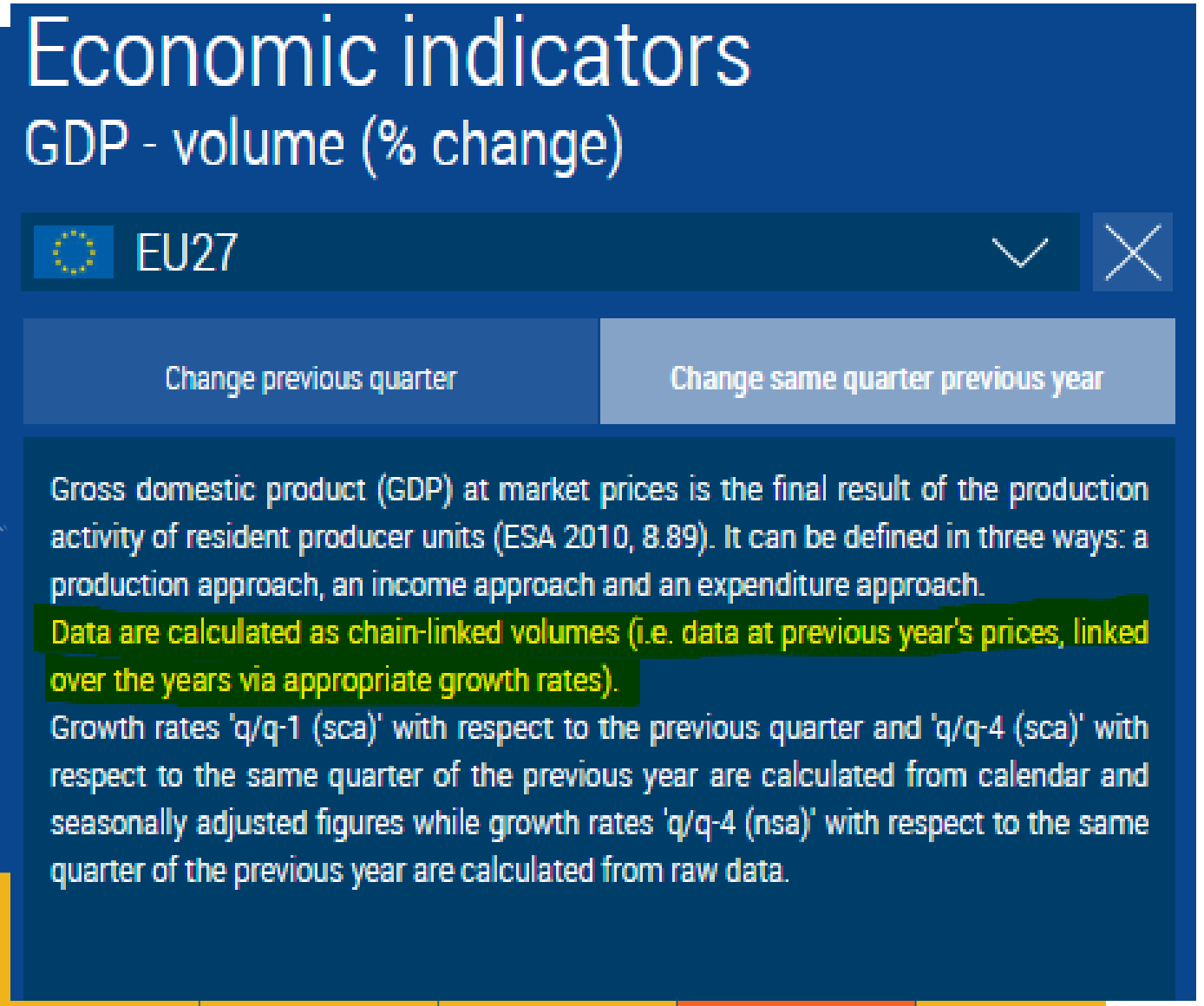
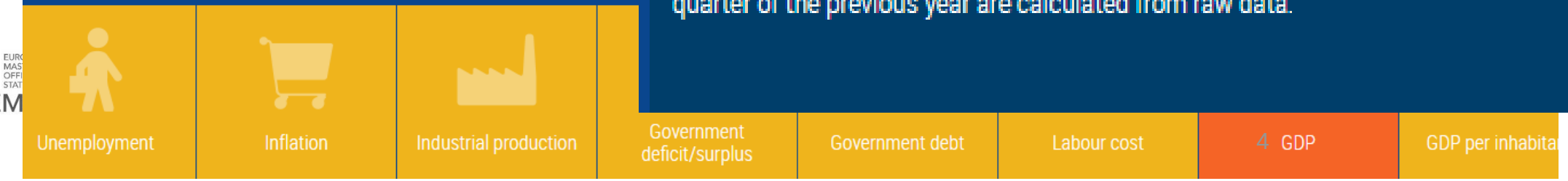




Price and volume measures

- Separate changes of NA aggregates in current price values into
  - its **price component** and
    - changes solely from ‘pure’ price changes (general price level)
  - its **volume component**
    - changes in quantity
    - changes in quality
    - compositional changes

Uses of volume data

- Comparing economies over time → **price and volume measures**

- Comparing different economies (countries) at the same time → **purchasing power parities**

Prices

- Determined by a market
- Non-market products?
- Different types of prices:
  - Basic prices
  - Producer prices
  - Purchaser prices
  - Published price indexes (CPI, PPI, SPPI)

Value and quantity

- Value, price and quantity are linked by the fundamental equation:

$$v = p \cdot q$$

- This equation is valid only for homogeneous products

Homogeneous products

- Homogeneous products are 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
- A homogeneous product consists of units of the same quality

Volumes

- Seems easy when the product is simple - just a physical quantity (e.g. one ton of coal or one cup of coffee….)
- But ‘volume’ also includes quality component: more “value for money”
- Heterogeneous products, aggregates

Decomposing values

- $\boldsymbol{Value = Price \cdot Volume}$
- We can also express this as:

$$\boxed{Volume = \frac{Value}{Price}}$$

➔ **deflation**

Previous year's prices / Base year's prices

- The notion of volume is introduced to eliminate the effect of ‘pure’ price changes on a set of products
- This effect can be offset by calculating what the value of the set of products would have been if there had been no changes in prices
  - Use of prices in base year / or in previous year
- Better speak of **previous year's prices** or "in prices of year x" (instead of "constant prices")

Comparing base and current periods

- The value of a set of products in the current period is:

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

- The volume can be defined as: $$Vol = \sum_i p_i^0 \times q_i^1$$

- The **volume index** is: $$VolI = \frac{\sum_i p_i^0 \times q_i^1}{\sum_i p_i^0 \times q_i^0}$$

Volume indices
The Laspeyres philosophy

- time periods 0 and t
- quantity (volume) relatives qt/q0
- weights : share in total value of period 0
- **Laspeyres volume index**

(weighted arithmetic mean of quantity relatives)

$$Q_L = \frac{\sum p_0 q_t}{\sum p_0 q_0} = \frac{\sum v_0 \cdot \frac{q_t}{q_0}}{\sum v_0}$$

Price indices
The Laspeyres philosophy

- time periods 0 and t
- price relatives pt/p0
- weights of period 0
- Laspeyres price index

$$P_L = \frac{\sum p_t \cdot q_0}{\sum p_0 \cdot q_0} = \frac{\sum v_0 \cdot \frac{p_t}{p_0}}{\sum v_0}$$

Paasche price index

- time periods 0 and t
- price relatives pt/p0
- weights of period t
- Paasche price index

$$P_P = \frac{\sum p_t \cdot q_t}{\sum p_0 \cdot q_t}$$

Laspeyres, Paasche and Fischer

- Laspeyres: weights of period 0
- Paasche: weights of period t
- Fischer: geometric mean of Laspeyres and Paasche

Relations between Laspeyres, Paasche and Fischer

- **Value index**
- =

  Laspeyres volume index * **Paasche price index**

- =

  Paasche volume index * Laspeyres price index

- =

  Fischer volume index * Fischer price index

Example

- Value in 2005: 120
- Paasche price index 2004-2005: 125
- Volume 2005 in prices of 2004: 96
- Laspeyres volume index 2004-2005: 120
- Value in 2004: 80

- Value Index = 120% * 125% = 150%

Laspeyres volume index

- $Laspeyres\ volume\ index\ = \frac{Value\ index}{Paasche\ price\ index}$

- $Q_L = \frac{\sum p(0) \cdot q(t)}{\sum p(0) \cdot q(0)} = \sum \frac{v(0)}{\sum v(0)} \cdot \frac{q(t)}{q(0)}$

Weights of the products in the base year

Volume changes of the products

Price indices in practice

- CPIs (HICP), PPIs, SPPIs: all Laspeyres price indices
- Define precise bundle of goods and services & obtain their value shares in base year (for weighting)
- Different qualities: physical characteristics, accompanying services, location, timing
- Techniques in price statistics to deal with quality changes of products (matched models, option pricing, overlapping, expert judgement, hedonics)

Representativeness of weights

- Laspeyres fixed weights not representative over time

  → can create bias in index

- Paasche and Fischer more representative but difficult in practice because current weights are required (→ challenge for timeliness)

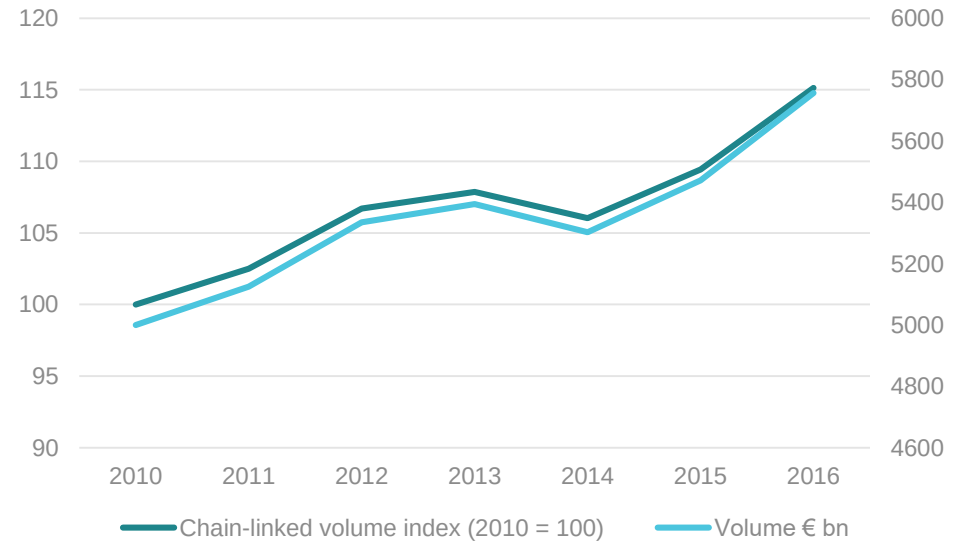
Chaining

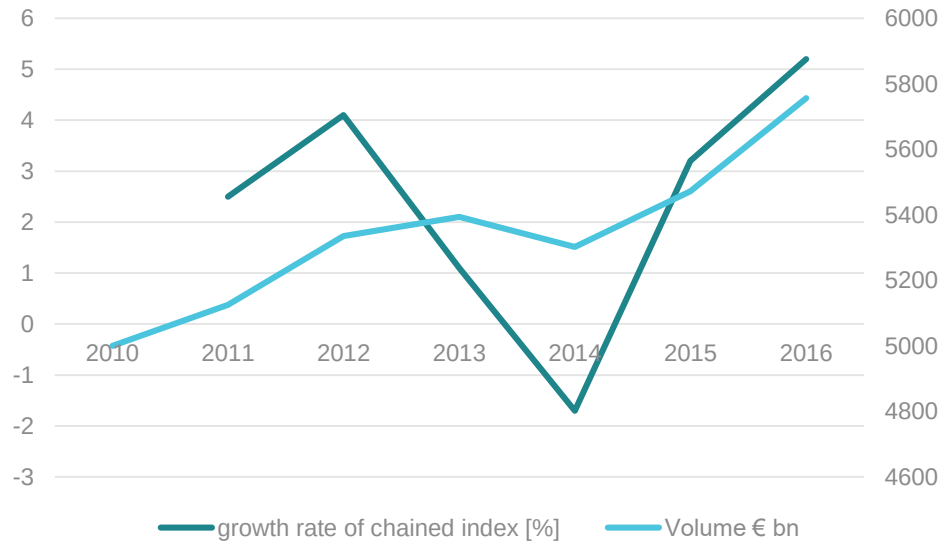
- No fixed base year but moving base year: always use weights of previous year to calculate growth rates
- Chain year-on-year growth rates together to obtain “constant price” data
- Commission Decision requires chaining using Laspeyres method
- Non-additivity will occur in “constant price” series

Chain-linked volumes, example

Year	Volume index (py = 100)	V. growth rate %	Chain-linked volume index (2010 = 100)	growth rate of chained index [%]	Volume € bn
2010			100		5000
2011	102.5	2.5	102.5	2.5	5125
2012	104.1	4.1	106.7	4.1	5335
2013	101.1	1.1	107.9	1.1	5394
2014	98.3	-1.7	106.0	-1.7	5302
2015	103.2	3.2	109.4	3.2	5472
2016	105.2	5.2	115.1	5.2	5756

- Base period = previous year
- Reference period = 2010
- data at previous year's prices, linked via growth rates





Methods for estimating volumes

- Deflation
- Input method
- Output method

Deflation – market output

- Dominant method
- Use of specific and suitable price indices, taking into account quality changes
- CPI (HICP), PPI, SPPI, export PI, import PI, …
- At most detailed level (all are Laspeyres PI)
- For market output, intermediate consumption, HFCE, GFCF, EX, IM

Input method – non-market output

- For collective services (non-market output, administration, police, defence,…)
  - No market prices available
  - Output measured as sum of costs
- Inputs in previous year's prices
  - Intermediate consumption
  - Compensation of employees
  - Consumption of fixed capital
  - Estimated separately, take care of quality changes
- Problem: changes in productivity

Output method

- For individual non-market services
- In particular non-market **education** and **health services**
- In deepest possible breakdown
  - Kindergarten, schools, school types, tertiary education, subjects
  - Types of medical treatment in hospitals
- **Output indicators**
  - One definition “quantity of teaching received by students … for each type of education”
  - Number of children in childcare, number of pupils or students educated, hours of teaching provided
  - One definition “the quantity of health care received by patients … for each type of health care”
  - Number of medical treatments for each type

Output method II

- **Cost weights**
  - (costs per unit of output in previous year)
- Difficulty: different qualities

- COVID-19
  - New and additional medical treatments → increase in output
  - Waiting for treatments → decrease in ouput
  - Other medical treatments suspended → decrease in output
  - Quality of remote teaching of pupils or students?

Volume of value added

- Best method: double deflation (output, IC)
- Alternative method: single deflation

What are Purchasing Power Parities

- Indicators of price level differences across countries:
  they tell us how many currency units a given quantity of goods and services costs in different countries
- Currency converters: PPPs are used to convert values (e.g. GDP) into a common currency that neutralises prices differences, thereby enabling a pure volume comparison
- Reflect the relative purchasing powers of currencies in their national markets
- Deflation by PPPs (and not exchange rates) → comparison between countries (in one same year)

Resources

- Eurostat 2016, Handbook on price and volumes measures in national accounts, European Union 2016
  - https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-14-005 -
- ESA 2010, chapter 10 and 2
  - Publication: https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-02-13-269
  - ESA interactive: https://ec.europa.eu/eurostat/esa2010/
- 2008 SNA, chapter 15
  - https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

Thank you! ☺

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