Volume measures in national accounts

IMF Statistics Department

Outline of this lecture

- Why volume measures?
- Volume measures in SNA – main principles
- Methods for deriving volume measures by transaction category
- Specific volume measure methods by industry
- Specific techniques for QNA volume measures

Why Volume Measures?

- When volume measures are applicable?
  - GDP by production
  - GDP by expenditure
- Difference between volume measures and real income measures
- Scope of this lecture – goods and services and GDP measures

Volume Measures - Main Principles

- **(1) Level of aggregation**
  - Detailed level of aggregation
    - GDP by activity - at least 2 digits by ISIC, NACE
      - For output as well as intermediate consumption
    - GDP by expenditure
      - HH consumption – as detailed as possible
      - GG consumption – from production side GDP
      - Inventories – by activity and by type
      - GFCF – by activity and by type
      - Imports and exports – detailed HS level, separate for goods and services

Volume Measures - Main Principles

- (2) Choice of index formula
  - Fisher volume (and Fisher price indices)
  - Alternatively, Laspeyres volume (and Paasche price indices)
  - Price indices should be Paasche type indices
    - However, at a very detailed level one can assume that Paasche is closer to Laspeyres

Volume Measures - Main Principles

- (3) Choice of base year
  - What is base year?
    - The year of price and quantity ratios or the pricing year of the NA
  - What is weight year?
    - The year from which weights are taken
  - What is reference year?
    - The year used for presentation of time series of constant price data, the year equal to 100
  - Rebasing or re-referencing?

Volume Measures - Main Principles

- (3) Choice of base year
  - SNA recommends moving from fixed base year to previous year prices and chain-linking
    - Use Fisher volume and price indices
    - Alternatively, use Laspeyres volume and Paasche price indices
  - Time series – chain-linking
    - Non-additivity

Volume Measures - Main Principles

- (4) Methods – deflation, extrapolation, quantity revaluation
  - Deflation of current year value with a price index or extrapolation base year value with a volume index – not equivalent entirely in practice
    - A sample of price observations is normally more representative than a sample of quantity observations
    - It is more difficult to control quality changes in volume indicators than in price indicators
  - Assessing price and volume indicators - 4 criteria
    - Coverage of products, valuation basis, quality changes, conceptual consistency

Volume Measures - Methods

- By transaction category
  - Market and non-market output
  - Intermediate consumption
  - Value added
  - Final consumption expenditure
  - Gross fixed capital formation
  - Changes in inventories
  - Exports and imports of goods and services
  - Taxes and subsidies
- By industry – agriculture, mining, manufacturing, etc.

Volume Measures - Methods

◆ Classification of methods

- ⊞ Best methods – most appropriate methods
- ⊞ Second best methods
- ⊞ Methods to be avoided

Volume Measures - Methods

- Market output and output for own final use
  - Price deflation
    - PPIs – if Laspeyres, the most detailed level of aggregation; however if huge fluctuations PPI should be recalculated as Paasche
    - Model and specification prices – rapid product change, construction
    - Hourly rates (price charged per hour) – productivity and quality changes?
    - CPIs – personal services (no distribution margin, no change in tax or subsidy rates, and households consume most of the output)
    - Unit value indices – heterogeneity, quality issues
    - Input prices – should be avoided

Volume Measures - Methods

- Market output and output for own final use (cont)
  - Volume extrapolation
    - Output volume indicators
      - Collected at a detailed level, homogeneous products
      - Representative for all output
    - Input volume indicators – should be avoided
  - Quantity revaluation – usually agricultural output

Volume Measures - Methods

- Market output and output for own final use (cont)
  - Best methods - deflation with PPIs or extrapolation with volume index which is fully representative
  - Second best methods – less appropriate PPIs (no quality adjustment), CPIs, less representative output volume index
  - Methods to be avoided – input methods, secondary indicators, overall CPI

Volume Measures - Methods

- Non-market output
  - Best methods
    - Sum of 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)
  - Second best - input indicators could be used if the volume of each input is estimated separately (possibly taking quality changes of the inputs into account)
  - To be avoided - outcome indicators, input indicators

Volume Measures - Methods

◈ Intermediate consumption

- Best method
  - Deflation product by product
  - Separate deflation of domestically produced and imported products
- Second best – might not distinguish between domestically produced and imported products
- To be avoided – deflation of intermediate consumption at aggregated level, with no product detail

Volume Measures - Methods

- Value added

  - Double indicator methods – best methods

    - Separate volume measure estimates for output and intermediate consumption

  - Single indicators method

    - Extrapolation with volume indicators – second best method

    - Direct deflation – should be avoided

Volume Measures - Methods

- Household final consumption expenditure
  - Best method – deflation using appropriate CPIs
    - Follows same concepts as the national accounts
    - Takes into account quality changes
  - Second best – if CPIs do not meet criteria above
  - Methods to be avoided – using an index that does not correspond to all products, deflation with overall CPI

Volume Measures - Methods

🔸 Gross fixed capital formation

  ▪ From supply side usually for construction works; valuation is an important issue – purchaser prices

  ▪ Structure of GFCF is important; domestic and imported goods; detailed level by product as possible

  ▪ Best methods – deflation with investment price indices or PPIs adjusted to purchasers prices and imports price indices

  ▪ Second best – if no imports price indices, use partner country price indices (adjusted for exchange rates)

  ▪ UVIs for imports should be avoided

Volume Measures - Methods

- Changes in inventories
  - Calculations of current and constant prices are interlinked
  - Derive first data at constant prices from bookkeeping data
  - Then derive data at current prices
  - Holding gains and losses – the difference between bookkeeping data and current price data

Volume Measures - Methods

- Exports and imports of goods
  - Price indices – actual exports and imports prices, UVIs, price indices of a partner country
  - Best method – deflation using actual (transaction prices) imports and exports price indices
  - Second best – UVIs for homogeneous group of goods, price indices of partner countries adjusted for exchange rates (for non-homogeneous groups)
  - All others, including UVIs for non-homogeneous groups, should be avoided

Volume Measures - Methods

◆ Exports and imports of services

    ❖ Exports of services – deflation by type of services using PPIs/CPIs or other price indices

    ❖ Imports of services

        • Breakdown by type and by country

        • Deflation using price indices from partner countries adjusted for exchange rate changes

Volume Measures - Methods

- Taxes and subsidies on products – never deflate!
    - Levied on quantities of products – volume measures are equal to the volume index of the product
    - Levied on values of products – use extrapolation of base year current price values with volume index of products subject to taxes/subsidies or apply tax margin from base year
    - New taxes are recorded as price changes, collection rate increase is also a price change

Volume Measures – Methods by Industry

- ❖ Agriculture and forestry
  - ▪ Important issues:
    - • Production process may be spread over more than one accounting period
    - • Agricultural prices are very seasonal
    - • Subsidies
  - ▪ Double indicator method
    - • Output – quantities from current year multiplied by previous year prices (quantity revaluation)
    - • Intermediate consumption – deflation by products/services

Volume Measures – Methods by Industry

- Mining and quarrying
    - Important issues:
        - Industry usually concentrated in large companies
        - Subsidies or special taxes which might affect prices
    - Double indicator method - best method
        - Output – deflation by PPIs or extrapolation using volume index
        - Intermediate consumption – deflation by products
    - Single extrapolation – second best method

Volume Measures – Methods by Industry

- Manufacturing
  - Double indicator method - best method
    - Output – deflation by PPIs or extrapolation using volume index
    - Intermediate consumption – deflation by products
  - Single extrapolation – second best method
  - Any method based in input costs should be avoided
  - Large equipment goods?

Volume Measures – Methods by Industry

- Electricity, gas, steam and hot water
  - Products are relatively homogeneous, industries are generally concentrated, but price discrimination??
  - Double indicator method - best method
    - Output – deflation by PPIs or extrapolation using volume index
    - Intermediate consumption – deflation by products
  - Single extrapolation – second best method
  - Any method based on input costs should be avoided
  - Distribution – if net recording, only the margin (see trade)

Volume Measures – Methods by Industry

- Construction
  - Broad mix of output – residential, non-residential buildings, civil engineering, repair and maintenance, own account construction by households
  - Output price indices – the best option but not widely available
    - Actual prices method, model pricing, hedonic models
  - Extrapolation with hours of work – second best method
  - Input price indices, other volume indicators (square meters, number of building permits) – should be avoided
  - Use of PPPs program for construction works?

Volume Measures – Methods by Industry

- Trade margin
  - Ideally, by deflating sales and purchases with corresponding price indices
  - In practice, most often using volume of sales or margin rate
    - Assuming the volume of margin follows the volume of sales
    - Deriving volume index of sales (by deflating sales at detailed level)
    - Extrapolating previous year trade margin with the volume index
    - Or applying the margin-to-sales ratio to deflated sales

Volume Measures – Methods by Industry

- Transportation
  - Breakdown of transportation – freight and passenger; then by type - railway, land, water, air, pipeline, etc.
  - Deflation of output by PPIs – best method
  - Volume indicators or CPI adjusted for basic prices – second best methods
  - Any other indicators – should be avoided
- Communication
  - Postal services – CPI usually available or volume indicators
  - Telecommunications – wide range of products
    - PPIs, CPIs, UVIs, volume indicators

Volume Measures – Methods by Industry

- Financial services
  - Not well covered by price indices
  - Charges from fees and commissions separate from FISIM
  - For FISIM – no direct price or quantity
    - Use of volume indicators (FISIM broken down by activity) – number of bank accounts, number of checks processed, volume index of loans
    - Base period interest margin on loans and deposits to the stocks of loans and deposits re-valued to base period prices
  - Insurance
    - Volume indicators by type of insurance and by products

Volume Measures – Methods by Industry

- Other services **–** business, public administration, education, healthcare, community, social, personal services
  - Market output
  - Non-market output
  - Depending on the price and volume indicators available
    - Double indicator methods preferred
    - If not, single extrapolation

Volume Measures – QNA

- Principles should follow the annual national accounts

- Specific issue – chain-linking - SNA recommends changing the base period <u>annually</u>

- Choice of index number formula

  - Annually chain-linked quarterly **Fisher** index **does not** aggregate to the corresponding direct annual index, while annually chain-linked quarterly **Laspeyres** index linked by annual overlap technique **does** aggregate!

  - Annually chain-linked Laspeyres volume measures in monetary terms are additive in the reference year and the subsequent year, while the Fisher ones are not.

  - Laspeyres formula is simpler to work and explain

Volume Measures – QNA

- 2 alternative techniques:
  - Annual overlap
    - Compiling estimates for each quarter at the weighted annual average prices of the previous year
    - Subsequent linking using the correspondent annual data to provide linking factors

Volume Measures – QNA

- 2 alternative techniques: (cont)
  - One-quarter overlap
    - Compiling estimates of each quarter of year t at the weighted average prices of previous year
    - Compiling estimates for the overlap quarter (4th quarter of year t-1) at the weighted average prices of the same year t-1
    - The ratio between the estimates for the linking quarter at the average prices of year t-1 and average prices of year t-2 provides the linking factor to scale down (to the prices of t-2) the quarterly estimates of year t at prices of year t-1.

Volume Measures – QNA

- Which technique to choose?
  - Chain-linking using the one-quarter overlap technique, combined with benchmarking gives the best results.
  - In many cases annual overlap technique gives similar results.
  - The over-the-year technique should be avoided! (distorted seasonal pattern in the linked series)
- Additivity - consistency in aggregation for index numbers
  - Chain-linked volume measures are nonadditive