

VOLUME MEASURES AND REBASING OF NATIONAL ACCOUNTS

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Outline of Presentation

- **Current-price VS Volume measures of GDP**
- **What is rebasing?**
- **Why is rebasing needed?**
- **How is rebasing done?**
 - **Periodic rebasing**
 - **Annual rebasing (annual chain-linking)**
- **What are the main effects of rebasing?**
- **Conclusion**

Current-price vs Volume Measures of GDP

GDP data are expressed at current prices, i.e., prices of the prevailing accounting period (also known as nominal GDP)

- Useful for structural analysis

Changes in current-price GDP over time arise from two effects

- Price effect (inflation)
- Volume effect (quantity of goods and services)

Current-price vs Volume Measures of GDP

Proper assessment of economic growth requires removal of price effect

This is done by calculating GDP for each year at the prices of a particular year (base year)

Base year is the year to which the weights relate in the construction of a volume or price index

GDP measures with the price effect removed are known as volume measures of GDP

Changes in volume measures of GDP are referred to as real GDP growth

Current-price vs Volume Measures of GDP

Volume measures of GDP can be obtained through various methods

- Deflation
 - Divide current-price value of the transaction (output, intermediate consumption, final consumption, etc) by an appropriate price index
- Quantity revaluation
 - Multiply base period prices by actual quantity data
- Volume extrapolation
 - Extrapolate base period value by appropriate quantity indicator

Current-price vs Volume Measures of GDP

Deflation is preferred because

- Prices usually show less variation than quantities
- Sampling errors associated with price indexes tend to be smaller
- Price indexes can capture quality changes better than quantity revaluation and volume extrapolation methods

What is rebasing?

Prices used to calculate volume measures of GDP need to be frequently updated

Process of replacing present price structure (base year) to compile volume measures of GDP with a new (more recent) base year is known as rebasing

- Changing price and quantity base for individual price and quantity relatives
- Updating weights used in aggregating individual quantity relatives into sub-indexes and aggregating these sub-indexes into more aggregated indexes (for example, GDP)

Why is rebasing needed?

Continually changing economic environment

- Production side
 - Structural changes in production patterns over time
 - Continuous developments and innovations
 - Obsolescence of many products
- Demand side
 - Structural changes in consumption patterns
 - Structural changes in acquisition of capital goods
 - Changes in openness of economy to rest of the world

Implies relative prices change over time

Why is rebasing needed?

Price structure less representative of base year structure as time progresses

Products with relatively higher volume growth tend to have relatively weaker price increases – substitution effect

Why is rebasing needed?

But, they tend to comprise larger share of GDP at present base year (prices of distant past)

Volume measures of GDP will become misstated because of substitution bias

- Less useful for economic analysis

Need to update base year to more recent one to ensure weights used to calculate volume measures of GDP are more representative of economic reality

How is rebasing done?

Rebasing (update of base year) can be carried out as follows:

- Periodic rebasing
- Annual rebasing (annual chain-linking)

Rebasing is often carried out in conjunction with the incorporation of data for a new benchmark year

Current-price data between benchmark years will need to be revised before rebasing is carried out

How is rebasing done?

Periodic rebasing

Update base year every 5 years

Need to select appropriate new base year which should be normal year without dramatic economic changes

Price structure for new base year should be applied from new base year onwards

Price structure for previous base years should be applied before new base year

How is rebasing done?

Periodic rebasing

For volume measures of transactions which are obtained by deflation

- Change reference year of deflator at most detailed level possible to new base year (i.e., divide value of deflators in old base year by value of deflator for new base year)
- Deflate current-price value using the new deflators
- Alternatively, extrapolate most detailed current-price value of transaction at new base year using real growth rates of previous base year

How is rebasing done?

Periodic rebasing

For volume measures of transactions which are obtained by quantity revaluation

- Replace prices for revaluation with those for new base year

For volume measures of transactions which are obtained by volume extrapolation

- Change the year from which level is being extrapolated to new base year

How is rebasing done? Periodic rebasing

Aggregate volume measures of transactions to calculate volume measures of GDP from new base year onwards using price structure of new base year

Volume measures of GDP before new base year are calculated using price structure of previous base years

Join volume measures of GDP at new and previous base years so that they are expressed in terms of the prices of a specific year (i.e., reference year)

This process is known as linking

How is rebasing done? Periodic rebasing

Reference year is usually the same as new base year in practice so that the GDP volume measures for recent years are close to corresponding current-price measures

Reference year is assigned index value of 100

At the reference year, current-price and volume measures of GDP and its components are the same

Linking is done by extrapolating backward separately the volume measures of GDP and its components at the most detailed level possible at the reference year using the real growth rates of GDP and its components which are calculated using the previous base years

Apply same process to index values at reference year to obtain Laspeyres volume indexes

How is rebasing done?

Periodic rebasing – Main effects

Products with relatively higher volume growth and relatively weaker price increases will tend to have lower weight in new base year

Real GDP growth rates will be revised from new base year onwards (tend to be lower)

Real GDP growth rates of previous base years will not be revised

Real GDP growth rates are calculated using weights which are more representative of each base year

Consistent time series of volume measures of GDP expressed at prices of a specific (reference) year

Volume measures of GDP are chained at the reference year

How is rebasing done? Periodic rebasing – Main effects

But, volume measures of GDP before reference year will not be additive due to linking of GDP and its components separately

Statistical agency will need to explain clearly in its methodology notes and metadata why volume measures of GDP are not additive

How is rebasing done? Annual rebasing (Annual chain-linking)

Update base year (weights) every year (2008 SNA recommendation)

For volume measures of transactions which are obtained by deflation

- Change reference year of deflators annually
- Alternatively, extrapolate most detailed current-price value of transaction using corresponding deflated value

For volume measures of transactions which are obtained by quantity revaluation

- Change prices for revaluation annually

For volume measures of transactions which are obtained by volume extrapolation

- Change the year from which level is being extrapolated annually

How is rebasing done? Annual rebasing (Annual chain-linking)

Aggregate volume measures of transactions to calculate annually-chained volume indexes of GDP and components using index number formula

- Annually-chained Laspeyres volume indexes

$$\begin{aligned}
 Q_L &= \left(\frac{\sum p^0 q^1}{\sum p^0 q^0} \right) \left(\frac{\sum p^1 q^2}{\sum p^1 q^1} \right) \left(\frac{\sum p^2 q^3}{\sum p^2 q^2} \right) \cdots \left(\frac{\sum p^t q^{t+1}}{\sum p^t q^t} \right) \\
 &= \left(\frac{\sum p^0 q^0 \left(\frac{q^1}{q^0} \right)}{\sum p^0 q^0} \right) \left(\frac{\sum p^1 q^1 \left(\frac{q^2}{q^1} \right)}{\sum p^1 q^1} \right) \left(\frac{\sum p^2 q^2 \left(\frac{q^3}{q^2} \right)}{\sum p^2 q^2} \right) \cdots \left(\frac{\sum p^t q^t \left(\frac{q^{t+1}}{q^t} \right)}{\sum p^t q^t} \right) \\
 &= \left(\frac{\sum p^1 q^1 \left(\frac{p^0}{p^1} \right)}{\sum p^0 q^0} \right) \left(\frac{\sum p^2 q^2 \left(\frac{p^1}{p^2} \right)}{\sum p^1 q^1} \right) \left(\frac{\sum p^3 q^3 \left(\frac{p^2}{p^3} \right)}{\sum p^2 q^2} \right) \cdots \left(\frac{\sum p^{t+1} q^{t+1} \left(\frac{p^t}{p^{t+1}} \right)}{\sum p^t q^t} \right)
 \end{aligned}$$

where $\frac{\sum p^n q^{n+1}}{\sum p^n q^n}$ is unchained Laspeyres volume index

How is rebasing done?

Annual rebasing (Annual chain-linking)

- Annually-chained Paasche volume indexes

$$\begin{aligned}
 Q_p &= \left(\frac{\sum p^1 q^1}{\sum p^1 q^0} \right) \left(\frac{\sum p^2 q^2}{\sum p^2 q^1} \right) \left(\frac{\sum p^3 q^3}{\sum p^3 q^2} \right) \cdots \left(\frac{\sum p^{t+1} q^{t+1}}{\sum p^{t+1} q^t} \right) \\
 &= \left(\frac{\sum p^1 q^1}{\sum p^1 q^1 \left(\frac{q^0}{q^1} \right)} \right) \left(\frac{\sum p^2 q^2}{\sum p^2 q^2 \left(\frac{q^1}{q^2} \right)} \right) \left(\frac{\sum p^3 q^3}{\sum p^3 q^3 \left(\frac{q^2}{q^3} \right)} \right) \cdots \left(\frac{\sum p^{t+1} q^{t+1}}{\sum p^{t+1} q^{t+1} \left(\frac{q^t}{q^{t+1}} \right)} \right) \\
 &= \left(\frac{\sum p^1 q^1}{\sum p^0 q^0 \left(\frac{p^1}{p^0} \right)} \right) \left(\frac{\sum p^2 q^2}{\sum p^1 q^1 \left(\frac{p^2}{p^1} \right)} \right) \left(\frac{\sum p^3 q^3}{\sum p^2 q^2 \left(\frac{p^3}{p^2} \right)} \right) \cdots \left(\frac{\sum p^{t+1} q^{t+1}}{\sum p^t q^t \left(\frac{p^{t+1}}{p^t} \right)} \right)
 \end{aligned}$$

where $\frac{\sum p^{n+1} q^{n+1}}{\sum p^{n+1} q^n}$ is unchained Paasche volume index

How is rebasing done? Annual rebasing (Annual chain-linking)

- Annually-chained Fisher volume indexes

$$\begin{aligned}
 Q_F &= \sqrt{Q_L \times Q_P} \\
 &= \sqrt{\left[\left(\frac{\sum p^0 q^1}{\sum p^0 q^0} \right) \left(\frac{\sum p^1 q^2}{\sum p^1 q^1} \right) \cdots \left(\frac{\sum p^t q^{t+1}}{\sum p^t q^t} \right) \right] \left[\left(\frac{\sum p^1 q^1}{\sum p^1 q^0} \right) \left(\frac{\sum p^2 q^2}{\sum p^2 q^1} \right) \cdots \left(\frac{\sum p^{t+1} q^{t+1}}{\sum p^{t+1} q^t} \right) \right]} \\
 &= \sqrt{\left(\frac{\sum p^0 q^1}{\sum p^0 q^0} \right) \left(\frac{\sum p^1 q^1}{\sum p^1 q^0} \right)} \sqrt{\left(\frac{\sum p^1 q^2}{\sum p^1 q^1} \right) \left(\frac{\sum p^2 q^2}{\sum p^2 q^1} \right)} \cdots \sqrt{\left(\frac{\sum p^t q^{t+1}}{\sum p^t q^t} \right) \left(\frac{\sum p^{t+1} q^{t+1}}{\sum p^{t+1} q^t} \right)}
 \end{aligned}$$

where $\sqrt{\left(\frac{\sum p^n q^{n+1}}{\sum p^n q^n} \right) \left(\frac{\sum p^{n+1} q^{n+1}}{\sum p^{n+1} q^n} \right)}$ is unchained Fisher volume index

Chaining and data coverage

One major practical problem in the construction of index numbers is the fact that products are continually disappearing from markets to be replaced by new products as a result of technological progress, new discoveries, changes in tastes and fashions, and catastrophes of one kind or another. Price and volume indices are compiled by comparing the prices or quantities of goods of the same characteristics or quality over time. This is not easy in products areas such as personal computers where quality changes rapidly.

Chaining helps ameliorate the problems of such constant quality comparisons since the likelihood of an overlap of a product in two consecutive price period is almost bound to be greatest and the chain indices can accommodate the changes in weight that accompany a new and a disappearing product.

How is rebasing done? Annual rebasing (Annual chain-linking)

Use unchained volume indexes to derive chained volume measures of GDP and its components at the prices of a specific reference year

Linking is done by extrapolating forward and backward separately the volume measures of GDP and its components at the reference year using the real growth rates of GDP and its components which are calculated using the unchained volume indexes

Apply same process to index values at reference year to obtain chained volume indexes

How is rebasing done? Annual rebasing (Annual chain-linking) – Main effects

Products with relatively higher volume growth and relatively weaker price increases will have lower weight

Price structure to calculate volume measures of GDP is updated annually

Real GDP growth rates are calculated using weights of previous year (Laspeyres), current and previous years (Fisher)

Real GDP growth rates are calculated using weights which are more representative than those under periodic rebasing (tend to be lower)

Volume measures of GDP are chained at the reference year

Consistent time series of volume measures of GDP expressed at prices of a specific (reference) year

How is rebasing done? Annual rebasing (Annual chain-linking) – Main effects

But, volume measures of GDP are mostly not additive

Statistical agency will need to explain clearly in its methodology notes and metadata why volume measures of GDP are not additive

More calculations needed, especially for Fisher

More demanding data requirements

solve non-additivity problem

- Statistical agency will need to explain clearly in its methodology notes and metadata why volume measures of GDP are not additive
- Calculate contributions to real GDP growth which are additive
- Contributions to real GDP growth measure how much each component contributes to the percentage change in real GDP

Conclusion

2008 SNA recommends calculation of annually-chained volume estimates of GDP

But, this is a resource-intensive and computationally-demanding exercise with many steps

Countries which are not in a position now to compile annually-chained GDP may consider periodic rebasing in the interim

Base year should be updated every 5 years

At the earliest convenience, countries should switch to computing annually-chained volume measures of GDP

Conclusion

Periodically-rebased and annually-chained volume measures of GDP are mostly non-additive when expressed at the prices of a particular reference year

Countries should explain clearly to users why the linked volume measures of GDP are not additive

Countries can also consider calculating contributions to growth which are additive

Thank You