



United Nations Economic Commission for Africa

E-Training on GDP Rebasing

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Session 5: Annual Rebasing – Chain linking

Economic Statistics and National Accounts Section
ACS, ECA

Content of the Presentation

- Why Chain Link?
- Nature of Chain Volume Measures
- Calculating Chain Volume Measures



Why Chain Link?

- National accounts provide comprehensive and coherent data which can be used for analysing and evaluating the performance of an economy, and serving as inputs for formulating economic policy.
- The national accounts are normally laid out in “nominal” terms in the currency of the country; however, because prices are constantly in flux, the dollar (for example) is an elastic ruler, representing different amounts of purchasing power at different points in time.
- To address this fact, the national accounts also provide decompositions of some value series into distinct price and volume components.
- The volume and price decomposition accounts are a vital component of the macroeconomic accounts because they “pull aside the veil of money” to reveal underlying changes in the real economy. They also provide a picture of relative price change by product category, and measures of aggregate price inflation.



Why Chain Link?

- Up until the beginning of the twenty first century, almost all countries derived volume estimates of aggregates by holding prices constant in a particular base year, i.e. constant price estimates.
- In effect, constant price estimates are a sequence of Laspeyres indices from the base year to the current period multiplied by the current price value in the base year. Over time, price relativities change and when estimating volume growth from one period to another it is best to use prices at or about the contemporary period.
- With a long time series it is as inappropriate to use the most current weights for a date long in the past as it is to use the weights from a long time in the past for the current period.
- The 2008 SNA recommend the abandonment of constant price estimates in favour of chain-linked volume estimates.



Why Chain Link?

- In terms of accuracy, the constant price methodology is not ideal, as it assumes the value shares of goods in the economy did not change between rebasing years (5-10+ years).
- Economies are dynamic with products changing in importance over short periods of time (for example, fast-moving electrical goods such as computers, cameras and mobile phones). It is likely that the assumption of goods having fixed values over five+ years is flawed.
- Consequently, a methodology that would update the weights more frequently is desirable, so the output and expenditure measures truly reflected what was happening in the changing economy.
- Annual chain-linking is a method for aggregating the volume measures on a more frequent basis. It can be thought of as rebasing every year. Instead of referring back to value shares from the most recent base year, volume measures for each year are produced in prices of the previous year. These volume measures are then 'chainlinked' together to produce a continuous time series.



Nature of chain volume measures

Common formula:

- A Laspeyres volume index is a weighted arithmetic average of quantity relatives using the values of the earlier period as weights
- A Paasche volume index is the harmonic average of volume relatives using the values of the later period as weights.
- Fisher's Ideal volume index is the geometric mean of the Laspeyres and Paasche volume indices.



Nature of chain volume measures

Index Number Theory:

- Several mathematical property tests exist to evaluate formulas – Proportionality test, Symmetric treatment, Monotonicity test etc etc
- Fishers Ideal passes all of these (hence the ‘ideal’ in the name)

Economic Theory:

- Can also tie the formula back to underlying economic theory of behavior – Laspeyres index assumes zero elasticity of substitution; Paasche index assumes complete elasticity of substitution



Nature of chain volume measures

Terminology:

- The base period for an elemental volume index is the period for which the prices are fixed. The Laspeyres volume index is equal to the constant price value for period t divided by the current price value for period 0. When elemental volume indices are aggregated, the current price values in the base period are used to form the weights for combining the elemental volume.
- The reference period is the period for which an index series is set equal to 100 or the period for which a volume index series may be set equal to the current price value in order to express the index series in terms of currency units.
- For constant price estimates the base period and the reference period coincide. For chain-linked volume indices there is only one reference period, but there are many base periods



Nature of chain volume measures

Additivity and Chaining:

- Although desirable from an accounting viewpoint, additivity is actually a very restrictive property. A single link in a chain index is sufficient to destroy additivity.
- There is a general tendency for the discrepancies from chaining to become larger the further a period is away from the reference year.
- Periods in and around the reference period are additive or close to additive (dependent on index formula used).



Nature of chain volume measures

Reference Period and Additivity:

- Chain volume measures can be published in monetary terms (by using the index to extrapolate the values of the base period) or as indices (through setting the base period to equal 100, 1000 etc).
- Publishing in monetary terms has the advantage of showing relative size of component in and around the reference period, but is potentially misleading further away in the time series
- Publishing in index terms is simpler (users are familiar with this practice in CPIs etc) but doesn't contain any information about relative size of components.



Calculating chain volume measures

- Joining together two indices that overlap in one period by rescaling one of them to make its value equal to that of the other in the same period, thus combining them into single time series.

Step 1

- Fixed-base expenditure – calculate the values for each year using the base year prices. In the year before a base change, calculate values for both the old and new base prices.
- Annual chain-linking – calculate the values for each component series in current prices and previous years' prices.



Calculating chain volume measures

Step 2

- Fixed-base expenditure – aggregate for all components for the old and new base years.
- Annual chain-linking – aggregate for all components for current and previous years' prices.

Step 3

- Fixed-base expenditure – use the link year to reference all the previous values to the new base year.
- Annual chain-linking – link each year to the previous year and reference all values to a chosen year or to equal a value (i.e. 100.0)



Calculating chain volume measures

- Simple example for an economy with two products (A & B)
- Value shares are shown as are volumes in 2005 prices. These volumes would be calculated by deflating products A and B with an appropriate price index (PPI, CPI etc)

	Volumes				Value Shares		
	In 2005 prices				Current Prices		
	A	B			A	B	AB
2000	1002	262			1253	241	1494
2001	1100	267			1320	248	1568
2002	1213	269			1395	256	1651
2003	1345	271			1480	263	1743
2004	1534	273			1611	270	1881
2005	1722	275			1722	275	1997



Calculating chain volume measures

- Step 1 - calculate the values for each component series in current prices and previous years' prices

Step 1	Values in Previous Years Prices					
	2000 Prices	2001 Prices	2002 Prices	2003 Prices	2004 Prices	2005 Prices
	A	A	A	A	A	A
2000	1253					
2001	1375	1320				
2002		1456	1395			
2003			1547	1480		
2004				1687	1611	
2005					1808	1722
	2000 Prices	2001 Prices	2002 Prices	2003 Prices	2004 Prices	2005 Prices
	B	B	B	B	B	B
2000	241					
2001	246	248				
2002		250	256			
2003			257	263		
2004				268	270	
2005					272	275



Calculating chain volume measures

- Step 2 – aggregate for all components for current and previous years' prices.
- (Have also calculated a volume index series based off these results)

Step 2	Aggregation of values in previous year prices					
	2000 Prices	2001 Prices	2002 Prices	2003 Prices	2004 Prices	2005 Prices
	AB	AB	AB	AB	AB	AB
2000	1494					
2001	1621	1568				
2002		1706	1651			
2003			1804	1743		
2004				1955	1881	
2005					2080	1997
Index Series	0.922	0.919	0.915	0.892	0.904	1.000



Calculating chain volume measures

- Step 3 - link each year to the previous year and reference all values to a chosen year

	Step 3	Chain Linking
	Referenced to 2005	% change
	AB	AB
2000	1248	
2001	1354	8.5%
2002	1473	8.8%
2003	1610	9.3%
2004	1806	12.2%
2005	1997	10.6%



Calculating chain volume measures

- Challenges
 - Variables that change sign (for example change in inventories). Index numbers are generally not applicable to time series that can move between positive, negative and zero values.
 - Contributions to growth. May need to adopt more sophisticated methods for calculating contributions to growth in circumstances where there is a loss in additivity.



Additional Resources

- The 2008 SNA (Chapter 15 –Price and volume measures) European Commission, IMF, OECD, UN, World Bank, 2009;
- Handbook on price and volume measures in national accounts- Eurostat, Office for Official Publications of the European Communities, Luxembourg 2016;
- The 2008 SNA -compilation in brief, World Bank, 2014
- National Accounts: A practical introduction, Studies in Methods, Serie F, No.85, UN 2003; chapter XV: Price and volume measurement;
- ESA 2010, Chapter 10 –Price and Volume Measures -Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 on the European system of national and regional accounts in the European Union



Suggested reading material

- The 2008 SNA (Chapter 15 – Price and volume measures) European Commission, IMF, OECD, UN, World Bank, 2009;
- Handbook on price and volume measures in national accounts- Eurostat, Office for Official Publications of the European Communities, Luxembourg 2016;
- The 2008 SNA - compilation in brief, World Bank, 2014
- National Accounts: A practical introduction, Studies in Methods, Serie F, No.85, UN 2003; chapter XV:Price and volume measurement;
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