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A brief overview of the COLI and the CPI as the COGI

• The theory of measuring the cost of living index initially was developed by Konus (1924); Further expanded later by significant contributions of Pollak (1989) and Diewert (1976).

• “a COLI measures the change in the *minimum* cost of maintaining a given level of utility, or welfare, that results from changes in the prices of the goods and services consumed.” - the CPI manual (ILO et al. 2004)
A brief overview of the COLI and the CPI as the COGI (1)

• The COLI allows substitution of items when their relative prices change;
• The COLI is bounded by the Laspeyres and the Paasche price indices;
• Using superlative indices is considered as good approximation to the COLI;
• The COLI may be affected by factors other than prices, such as environmental factors: like weather, lack of public goods provisioning and so on;
• The index covering all the comprehensive reasons of cost of living change is called the unconditional COLI, while the conditional COLI – takes into account only price changes;
A brief overview of the COLI and the CPI as the COGI (2)

• The CPI – is the cost of goods index, which measures changes of expenditures needed to purchase the fixed basket of goods and services.

• Because of large similarities with the conditional COLI the CPI is considered as a guide to measure the COLI;

• Measures of the CPI:
  • The Laspeyres index – challenging to calculate in practice;
  • The Paasche index – challenging to calculate in practice;

• Modified Laspeyres indices frequently used in practice are the Young index and the Lowe index.
A brief overview of the COLI and the CPI as the COGI (3)

• Laspeyres index - \( I_L^{0:t} = \frac{\sum_i p_i^t q_i^0}{\sum_i p_i^0 q_i^0} \) - Practical challenges in calculation;

• Paasche index - \( I_P^{0:t} = \frac{\sum_i p_i^t q_i^t}{\sum_i p_i^0 q_i^t} \) - May be calculated retrospectively;

• Young index - \( I_Y^{0:t} = \sum_i \frac{p_i^t}{p_i^0} * \frac{p_i^b q_i^b}{\sum_i p_i^b q_i^b} \) - Used in practice;

• Lowe index - \( I_L^{0:t} = \frac{\sum_i p_i^t q_i^b}{\sum_i p_i^0 q_i^b} \) - Used in practice.
A brief overview of the COLI and the CPI as the COGI (4)

• Elementary aggregate formulas:

  • Jevons index $I_J^{0:t} = \frac{\left(\prod_i p_i^t\right)^{1/n}}{\left(\prod_i p_i^0\right)^{1/n}}$ - Preferable;

  • Dutot index $I_D^{0:t} = \frac{\sum_i p_i^t/n}{\sum_i p_i^0/n}$ - Good enough;

  • Carli index $I_C^{0:t} = \frac{\sum_i p_i^t/p_i^0}{n}$ - Not suggested;

• Comparable items should be of the same quality!
Methods of the CPI construction, used by the National Statistics Office of Georgia (Geostat) and its purposes

The main purposes of the CPI:

1. To measure the monetary inflation;

2. Indexation of different kind of monetary amounts – income, other allowances;

3. Deflator for the National Accounts;
Methods of the CPI construction, used by the National Statistics Office of Georgia (Geostat) and its purposes (1)

• Elementary aggregate index – Jevons index;

• Upper level aggregation – Young index;

• Annually updating consumer basket;

• Main source of weights - National Accounts data of t-2 year;

• Regional CPI-s for 6 regions;
Methods of the CPI construction, used by the National Statistics Office of Georgia (Geostat) and its purposes (2)

Precise specifications are defined at the price reference period;

Missing data:
  - Strongly Seasonal – 12 months keeping period;
  - Ordinary item - 3 months keeping period;

Imputation method – class mean imputation;

Quality adjustment method:
  - Overlap method – prices of the old and the new items are observed in the same period, difference in prices is considered as quality change;
  - Linking method – similar to overlap method but the price for the old item is the imputed one;
  - Direct quality adjustment – used mainly when the package size is different;
Significant methodological changes since 2012 promising to minimize the bias

• Annual consumer basket updating;

• Change of elementary aggregate formula from Dutot to Jevons;

• Using National Accounts as a primary source for weights;
Sources of bias in the CPI

• The CPI bias in the context of the COLI is a difference between the CPI and the true COLI.

Estimates of the total CPI bias:

• Boskin et al. (1996) – Annual average CPI bias in the USA 1.1%;

• Crawford (1998) - Annual average CPI bias in Canada 0.7%;

• Cunningham (1996) – Annual average CPI bias in the UK 0.35-0.8%;
Sources of bias in the CPI (1)

1. Upper-level substitution bias;
2. Elementary aggregate bias;
3. Outlet substitution;
4. New products;
5. Quality change;
6. The bias caused by inseparable property of item characteristics;
Upper-level substitution bias

- **Upper-level substitution bias** appears as the Laspeyres index uses a fixed basket of goods and service and does not allow substitution of items notwithstanding the changes of their relative prices;
- Frequently calculated as the difference between the Laspeyres and the Fisher indices.

USA
- Boskin et al. (1996) – 0.15%

United Kingdom
- Cunningham (1996) – range 0.08-0.25 %
Elementary aggregate bias

- **Elementary aggregate bias** may be related to either formula bias or to the substitution within the elementary aggregate.

- Formula bias may be appear when the Carli index is used in the elementary aggregate.
Outlet substitution bias

- **Outlet substitution** bias is generated when consumers tend to shift to the discounted outlets, not covered by the CPI;

- Outlet substitution bias estimated by Lequiler (1997) ranges between 0.05-0.15 percent.
New products bias

- **New products** bias is related to the belated inclusion of new items in the consumer basket;
- Examples: Mobile phones, Digital cameras, TV set with LED screens;

New products bias estimated by Crawford (1998) for Canada amounts to 0.3 percent.
Quality change bias

- **Quality change** bias is related to improper adjustment of prices, when the quality change is not identified and separated from the price change.

Quality change bias estimated by Diewert and Lawrence (1999) for New Zealand varies between 0.35 and 0.6 percent;
Quality change bias (1)

The mostly used quality adjustment methods:

• Explicit quality adjustment – requires identifying monetary value of quality improvement;

• Overlap or linking – prices for old and new items are observed simultaneously and the difference is assigned to the quality change;

• Hedonic regression model is constructed to identify an impact of changed characteristics/features on the price;
Quality change bias (2)

• Each of the method discussed above consider that the improved quality provide proportional utility increase to the consumer, while the law of diminishing marginal utility not taken into account.

• Overestimation of welfare change may be a source of the downward bias in the CPI;

• Examples:
  • internet – additional unit of data transfer speed does not bring the same utility as the already existed same unit;
  • Digital camera - Additional 5 mega pixel after certain point does not bring same utility as the first 5.

• Because of rapid technological changes quality of goods improve faster than the price changes for many goods, which causes an upward bias in the CPI.

• Example: Technology
The Bias caused by inseparable property of characteristics

• The core conceptual pillar of the COLI framework is, that the consumer is able to substitute goods and services when their relative prices change, in order to keep the utility level unchanged.

• Substitution of goods is not always possible or desirable.

Reasons:
  • Perfectly inelastic demand;
  • Leontief preferences;
  • Monopolistic market;
The Bias caused by inseparable property of characteristics (1)

• The producer frequently improves quality/or increases package and changes minimum price for obtaining the product;

• Because of inseparable property of characteristics user needs to accept the full package of improved characteristics;

• In case of prices increase related to the quality/quantity improvement/increase, the consumer needs to get compensated in order cover the required expenses and to reach the same utility level.
The Bias caused by inseparable property of characteristics (2)

• CPI framework requires quality adjustment;

• Marginal cost of attaining the same welfare level increases;

• CPI shows no change because of quality adjustment;

• The consumer gets no compensation if he/she is guided by the CPI;

**Conclusion:** The CPI underestimates the COLI and fails to serve compensating purposes;

**Solution:** Direct price comparison should be considered instead of comparing quality adjusted prices.
Estimation of upper-level substitution bias for Georgia using the Fisher ideal index

• Retrospective calculation of the fisher index;

• Data set of 310 elementary aggregates for 2012-2016 with the base period of 12.2011;

• Data set for annual average indices for elementary aggregates.
Estimation of upper-level substitution bias for Georgia using the Fisher ideal index

The formula used to calculate the Fisher index was provided by Boldsen Hansen (2007) to analyze the CPI of Denmark:

$$I_{Fisher}^{0:t} = \left( \left( \sum_i w_i^0 \frac{p_i^t}{p_i^0} \right) \left( \sum_i w_i^t \frac{p_i^0}{p_i^t} \right)^{-1} \right)^{1/2}$$

Where:

$$w_0 = \frac{p_i^0 q_i^0}{\sum_i p_i^0 q_i^0} \quad w_t = \frac{p_i^t q_i^t}{\sum_i p_i^t q_i^t}$$

$$\frac{p_i^t}{p_i^0}$$ is the ratio of annual average indices for the elementary aggregate i.
Estimation results

• Annual average difference between the Young index the Laspeyres index amounts to 0.18 percentage points;

• Annual average Upper-level substitution bias for Georgia amounts to 0.22 percentage points;

• The point estimate may be considered as quite high, if we take into account implemented methodological changes, promising to minimize the bias;

• Substitution bias for Denmark estimated by Boldsen Hansen (2007) amounts to 0.05 percentage points;
Quality adjustment bias estimates

The quality adjustment bias in the CPI of Georgia may appear because of using overlap and linking methods, when there is no exact evaluation of quality and price change relationship.

To evaluate the quality change bias the formula proposed by Diewert is used:

\[ B_Q = \frac{(1 + i)se}{1 + e} \]

Where:

• i is an official inflation rate;
• s is a share of items that have been replaced;
• e is a percentage increase in efficiency of new models which was missed;
Quality adjustment bias estimates (1)

• In order to evaluate the quality change bias, durables and semi durable commodities were identified in the consumer which could be prone to quality adjustment bias for the period 2012-2017. Estimation does not include cloths and services;

• The group comprises of household appliances, automobiles, mobile phones and audio-visual, photographic and information processing equipment.

• Range of missed quality improvement was defined from 30 to 70 percent;

• Inflation rate in 2017 compared to 2012 equals 14 percent. While the share of changed items varies between 4 to 6 percent;

• Results show that the quality adjustment bias for Georgia varies between 0.05-0.11 percent range.
Conclusions/Results

• The CPI may underestimate the true COLI by disregarding the diminishing rate of marginal utility obtained from the extra unit, as it uses the quality adjustment methods;

• The CPI fails to serve compensating purposes, when the demand function of the product is perfectly inelastic and the price increase is caused because of item improvement. Using the quality adjustment methods the CPI shows no change, while the consumer needs to pay increased price.

• The COLI is underestimated because of inseparable property of item characteristics. (The consumer is unable to chose only these ingredients which keeps his/her utility level unchanged);

• The Young index for Georgia overestimates the true Laspeyres index by 0.18 percent;

• Upper-level substitution bias for Georgia, calculated as a difference between the Laspeyres index and Fisher indices amounts to 0.22 percent;

• Quality change bias ranges between 0.05-0.11 percent;
Thank you for your attention