Theoretical Elements on the Use of Price Indices for Inflation Measurement

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Abstract   *In this article, the authors aim to highlight the main theoretical elements that are required when using price indices to measure inflation. It is known that inflation is changing prices over a period of time. In common terms, inflation appears simplified as a consumer price index. Of course, the consumer price index is an index that, taking into account the price change for the three groups of goods and services (food, non-food or services), gives a size that is close to the inflation index. Inflation, however, measures the evolution of all products and services in a country. That is why we take into account the change in the prices of the national economy in ensuring a true inflation calculation. The indices calculated for price changes are important because they are used in the deflation operation that determines the actual expression of the indicators. Deflatory indices as a measure of inflation are, in fact, price indices, although they are calculated in different forms and normally have a different content. In this article, the authors study the key elements of calculating and then applying the index or inflation rate to deflating the macroeconomic outcomes indicators. On this basis, deflated indices ensure real comparability both internally and comparability by obtaining another set of indicators internationally. The elements to be considered are outlined in this article and are edifying from the point of view of how price indices reflect the magnitude of inflation.*

Key words   Value indicator, deflation, controlled prices, consumer price index, harmonized price index, inflation

1. Introduction

In this article, the authors sought to express more clearly how economic values expressed in terms of value can be expressed in current prices, real prices or deflated prices. The main indicators or statistical indicators for inflation measurement, such as consumer goods price index, industrial production price index, unit value index, cost of living or the harmonized index of consumer prices, are summarized. In fact, the harmonized consumer price index calculated is the one used to deflate gross domestic product, and thus internal and international comparability is ensured. In fact, inflation is the key element to ensure that all macroeconomic indicators obtained in real time, in current prices, deflate in real terms on a basis of comparison (prices of the base period) and thereby ensure realistically analyzing how the economy evolved in real and real terms from one period to the next. Only deflated macroeconomic clues can be the basis for international real comparability to provide suggestively the evolution of one country with another and thus be able to represent how a country's evolutionary level has reached a certain standard.

2. Literature review

Anghelache (2009) has presented a group of indicators for comparison analysis on the space dimension. Anghel *et al.* (2016a) have evaluated the dynamics of the inflation phenomenon in Romania. a

previous research by Anghel (2015) followed similar coordinates. Fuhrer (2012) has outlined some characteristics of inflation dynamics. Malmendier and Nagel (2016) outline the role of experience in enhancing knowledge about inflation. Anghel et al. (2016b) have measured the role of fiscal policies in the evolution of prices describing the population's consumption. Paunica et al. (2010) have approached the use of data warehouses in economic and performance analyses.

Anghelache et al. (2013) are a reference work in measurement and analysis of the inflation phenomenon. King and Watson (2012) have approached the correlation between inflation and unit labor cost. Anghelache et al. (2012) have approached the consumer price index, as instrument used in measurement of the inflation, Anghelache et al. (2016), Anghelache et al. (2015) develop on the same topic. Biji et al. (2010), Anghelache (2008), Biji et al. (2002), Newbold et al. (2010), Anghelache et al. (2007) emphasize the role of statistics in economic analyses.

Corbore et al. (2006) present the econometric instruments as tools of economic research. Aruoba and Diebold (2010) develop on the principles of real-time monitoring in macroeconomics. Anghelache et al. (2007), Capanu et al. (2004) have analyzed the system of national accounts. Del Negro and Eusepi (2011) evaluate some characteristics of inflation measurement. Anghel (2014) presents the usefulness of econometric instruments in correlation analyses at macroeconomic level, Anghelache and Manole (2015, 2016) use similar instruments in measurement of relationship between specific macroeconomic indicators.

Anghelache and Sacală (2015) have approached the theoretical foundation of the inflation. Ascari and Ropele (2009) analyze some aspects of trend inflation. Paunica et al. (2008) debate on the role of foresight in strategic planning. Anghelache and Capanu (2003), Capanu and Anghelache (2000) present the indicators as statistical instruments for analysis and management at the microeconomic and macroeconomic levels. Trehan (2015) approaches the survey-based measurement of inflation. Hamilton et al. (2007) develop on normalization in econometrics.

3. Research methodology and data. Results and discussions

The economic indicators expressed in money (or in value) are obtained and expressed in current prices, also called nominal indicators. For comparisons over time it is necessary to deduce factors 'contributions': the influence of changes in physical volume or prices (or 'deflation') leads to the "real" expression. Deflation indicators, as a measure of inflation, are, in fact, price indices, different forms of calculation and content. From a conceptual point of view, inflation is the expression of a macroeconomic imbalance of monetary and material nature and is perceived by the population as a general and sustained increase in prices.

"Imposed" or "controlled" prices have not been long-term safe against inflation, so it has also emerged in the command economy.

Inflation can be determined by excess money supply - currency inflation, excess solvency demand - demand inflation, excess nominal demand - credit inflation, excess in costs - cost inflation, more rarely due to insufficient production - inflation by offer. For statistics, it is a question of finding a measure of the level of inflation through indicators of good accuracy, obtained in a shorter period of time and with minimal expenses. Specialists appreciate the level of inflation expressed as annual percentage rate as follows: subnormal inflation (between 0 and 3%); normal (3 and 5%); moderate (between 5 and 10%); maintained (10 and 20%); persistent (between 20 and 100%); energetic (between 100 and 200%); accelerated (between 200 and 300%); excessive (over 300%).

The price indices are used more frequently to measure inflation.

The composition of price indices is achieved by some deviations from the "classical methodology" where the synthetic price index is obtained as the harmonic mean of the individual price indices, mainly because of the difficulties of obtaining the necessary information in a timely manner and at reasonable costs.

• The most used statistical indices in inflation measurement are: Consumer Goods Price Index - IPBC. It measures the overall evolution of prices of purchased goods and service tariffs used by the population. He considers the main instrument for assessing inflation; IPPI - Industrial Production Price Index. It expresses the evolution or average price changes of the products manufactured and delivered by the domestic producers actually practiced at the first stage of their marketing. It is used both to deflate

industrial production valued at current prices and to determine inflation in the wholesale price sphere; IVU - The Export/Import Unit Value Index characterizes the price dynamics of export/import contracts, expanding the variation in commodity prices considered representative, and allowing deflation through it of indicators that characterize foreign exchange and even the calculation of the "exchange ratio"; ICV - The cost of living measure measures the cost of market prices in the current period to maintain the standard of living reached in the base period. It is calculated as the ratio between this hypothetical cost and the actual (consumption) cost of the base period. It is mainly used in determining wages and actual earnings. A special relationship exists between IPBC and ICV. It can be succinctly characterized as follows: IPBC is an approximation of ICV as a tool that estimates "consumption costs"; IPBC (through the "Laspeyres formula") provides an upper limit for ICV (ICV < IPBC); IPBC and ICV measure the change in spending, not the change in revenue needed to maintain the standard of living; The ICV computation relation in advanced economies, based on the Paasche formula, is used to verify or counter the weighting coefficients of the base period during the current period:

$$I^{ICV} = \frac{\sum v_1}{\sum \frac{1}{i^p} v_1}$$

(1)

Where:
v_1 = sales during baseline period;
i^p = individual price indices.

We also mention: IPAM - The Retail Price Index measures the price change for goods sold through the retail network; ICC - Building cost index measures appraisal of housing prices; IPPA - The agrifood product price index measures the evolution of agri-food products' prices on the "peasant market". It is used both distinctly and in IPBC determination; the evolution of the "leu/euro" average exchange rate can be used as a measure of the evolution of inflation; IPBC and ICV are not affected by changes in income taxes, but include sales taxes through actual price and other indirect taxes.

Until 1990, the Consumer Price Index was calculated as a Paasche type index, thus as a weighted harmonic average of individual price indices. Weights used - production values in current prices. This was possible due to the controlled way of the evolution of prices in the economy (an authority was functioning - the State Committee of Prices), but also the possibility of tracking the full volume of sales from the state trade through the "Reporting System". For the prices practiced on the "unorganized market", the peasant agro-food market, records were organized, but the first-mercurial prices were recorded, not the ones actually practiced.

After 1990 (since 1 November, the price liberalization action triggered by the reform process), this method could no longer be applied, both because of changes in the ownership structure of trade and as a consequence of changing the way data is being collected, As well as the diversification of prices in the outlets. It went to the system of sampling, system applied in market economy countries. The National Institute of Statistics proceeded to apply the Eurostat methodology, with some particularities for the possibilities of collecting data from us.

The characterization of the methodology for the consumer goods price index has as main elements: definition, advantages and disadvantages of use, coverage, data sources, and samples used in construction, weighting system, actual calculation, inflation calculated as IPBC rhythm, specific indicators of Inflation, and uses of the CPI and the purchasing power of the national currency.

IPBC is statistical tool that measures changes of prices for purchased goods and tariffs of services used by the population in a given period (current) compared with previous period (basic). Frequently, IPBC is also called the general price index.

CPI is timeliness main advantages better compared to that of "GDP deflator" site and wider coverage compared to that of PPI's, and as the main disadvantages smaller scope and relatively lower accuracy, both against the "GDP deflator".

Scope of coverage. Targeting only the elements used in direct consumption, excluding own consumption or consumption from own resources, expenditures for investment and accumulation, interest

on loans, fines, taxes and expenses for the agricultural production of households according to the methodology annual calculation published National Institute of Statistics (INS) in the "Statistical Bulletin of prices".

The registration of prices and tariffs by commercial units or service providers is done through a survey conducted by the NIS. The collection of data, provided by statistically specialized personnel, is carried out on the basis of questionnaires corresponding to the groups of goods (food, non-food) and services. Statistical survey on consumer prices uses three samples:

a) The sample of localities, established with respect to the representativeness restrictions according to the number of inhabitants and the volume of sales of goods and services. It comprises 42 urban areas from which 68 research centers have been selected.

b) Sample of observation units, comprising shops and service units to the population of research centers. The survey was based on the need to ensure representativeness in terms of volume of sales of goods and services. The units in which prices/tariffs are recorded are kept in the sample, as long as possible, for a longer period to ensure the continuity and comparability over time of the data series. The sample comprises about 6,000 units, of which 80% are privately owned. Single country prices/tariffs set out in normative acts or negotiation notes (electricity and heat, methane gas, rail, air, river, mail and courier services, radio-TV subscriptions) are recorded on the basis of official information;

c) Sample of goods and services - includes assortments that have a significant share in population consumption. The nomenclature used is structured on three levels of aggregation: groups, posts and assortments, as follows: the food commodity group comprises 54 positions with 347 assortments; the non-food goods group comprises 112 stations with 932 assortments; the service group comprises 50 posts with 409 assortments.

Assortments are individualized on the ground through varieties of goods and services.

The information gathered through this research is complemented by the research on the prices of the main agricultural products sold by private producers on the agri-food markets, thus ensuring that the main sources of supply to the population are covered.

The weights used for the calculation of consumer price indices were initially obtained through the Integrated Household Survey (AIG) and currently in the Family Budget Survey (ABF) and result from the structure of monthly average expenses incurred by a household for the purchase of goods and services Necessary to meet the needs of living. Periodically the structure of the expenditures of the population is analyzed, and when the mutations are significant, the weights are updated. Thus, as of January 2005, the IPBC calculation uses the weights resulting from the structure of average household expenditure in 2003.

The Consumer Price Index is calculated as a Fixed Base Laspeyres index.

Starting with January 2005, monthly indices with a fixed base will be calculated with average prices in 2003 (2003 = 100) and the same year's weights based on average family budget expenditure.

In order to ensure the continuity of the series of indices built with different bases, a "connection coefficient" was used which allows the connection of the series of monthly indices from 2005 to base 2003 = 100 to the base index series 2002 = 100. The connection coefficient Determined as a ratio between the Laspeyres-type index calculated for December 2004 in the old base (2002 = 100) and another of the same type and for the same month in the new base (2003 = 100). Comparison of two calculated indices in different bases is done by comparing the index to be compared in the new base multiplied by the comparison coefficient to the comparison index computed in the old base.

The IPBC computation relation is:

$$\text{IPBC} = \frac{\sum I^P (p_0 q_0)}{\sum (p_0 q_0)} \tag{2}$$

Where:

$$\frac{(p_0 q_0)}{\sum (p_0 q_0)} = C_p$$

and:

I^p = price index of the specific aggregation level (for the item or group of goods and services);
C_p = specific weighting factor (post or group of goods and services).

The calculation relation is used:

$$\bar{P}_t = \frac{\bar{P}_1 + \bar{P}_2 + \bar{P}_3}{3}$$

(3)

$\bar{P}_t, \bar{P}_{1,2,3}$ = Average monthly (t) or decadal (1, 2, 3).

The applied computation relation is:

$$\bar{I}^{ps}_{t/2003} = \sqrt[n]{\prod i^{pv}},$$

Where:
i/2003 = average level index at month t compared to 2003.

The actual calculation of the consumer price index assumes, firstly, the calculation of the average price at the varietal level as a simple arithmetic mean of the average price of the three decades.

Following is the calculation of the individual indices of the variety as a ratio between the average price and the average price for the year corresponding to AIG or ABF, from which the weighting coefficients have been extracted.

The second practical calculation step consists, as of 2001, of the calculation of the average stock-level index as a simple geometric mean of the individual indices of the varieties in the "n" observation centers (n_{max} = 68).The applied calculation relation is:

$$\bar{I}^{ps}_{t/2003} = \sqrt[n]{\prod i^{pv}},$$

(4)

Where:
i/2003 = average level index at month t compared to 2003.

The third computation stage is aggregate, leading to the calculation of the post, group or general level index, according to the Laspeyres index formula. The calculation relation used is:

$$I^p_{t/2003} = \frac{\sum I^p_{t/2003} \times (p_0 q_0)}{\sum (p_0 q_0)},$$

(5)

Where:

$$\frac{(p_0 q_0)}{\sum (p_0 q_0)} = C_p$$

and

$I^p_{t/2003}$ = post, group or general level index in month t relative to 2003;
C_p = specific weighting (assortment, post or group) according to the base year established by ABF.

In conclusion, IPBC is a synthetic or group index calculated with a weighted arithmetic mean of indices on various lower aggregation levels (group, post, assortment). The average annual inflation rate is as follows:

$$\bar{R}_{ANt/AN(t-1)} = \frac{\overline{IPC}_{ANt}}{\overline{IPC}_{AN(t-1)}} \times 100 - 100$$

(6)

For Romania, it is important in analyzing the transition and the comparison between the prices of each month and the level recorded in October 1990, since November, as part of the reform process, triggered the "liberalization" of prices. The calculation relation is:

$$IPCMN = \frac{1}{IPBC} \qquad (7)$$

Use of IPC: real wage calculation (Sr = Sn/IPBC · 100), actual pension (Pr = Pn /IPC · 100), indexation of wages and pensions, determination of real consumption etc. The national currency purchasing power (IPCMN) is the inverse of the CPI value, promptly reporting the loss of purchasing power of the national currency over a certain period of time. The IPC calculation methodology in Romania is generally harmonized with the methodology used by the European Statistical Office (EUROSTAT) at the level of classifications, nomenclatures, sampling and calculation methods. The COICOP (Classification of Individual Consumption by Destination) classification agreed by CEE/EUROSTAT/OECD ensures the comparability of European-level indices. The latest version of this classification, adopted in July 1999, is structured on 12 divisions detailed in 39 groups and 93 classes of goods and services and has been used since January 2000.

Consumer price indices by commodity groups and services COICOP results from the aggregation of the assortments and items included in the Nomenclature for the calculation of the consumer price index at national level in the structure and content provided in this classification.

Harmonizing price indices at European level requires the adoption and enforcement of the following regulations:

- 1995 - EC Regulation 2494/95, timetable and harmonization rules. Consumer price indices are comparable when reflecting only differences between price variations or national consumption patterns.

- 1996 - Regulation EC, 1749/96 established: the scope of coverage (comparable lists of products and services); Minimum quality adjustment rules; IPBC computation formula for elementary aggregates.

- 1996 - Regulation 2214/96 established the mode of data transmission.

IPBC can also be calculated as a mobile base index:

$$IPC_{t/t-1} = \frac{IPC_{t/2003}}{IPC_{t-1/2003}} \qquad (8)$$

Inflation calculated as the IPBC rhythm is a unanimously accepted solution as a means of statistical expression.

When IPBC is calculated as a coefficient, the inflation rate is:

$R_{inf} = IPBC \times 1 - 1$

When IPBC is calculated in percentage terms, the inflation rate is:

$R_{inf} = IPBC - 100$

The specific inflation indicators are the monthly inflation rate or the price increase in a month "t" compared to the previous month "t-1" (the formula is: $R_{t/t-1} = IPBC_{t/t-1} \times 100 - 100$), the monthly average inflation rate or The geometric mean of monthly increases for a certain period and expresses the average of monthly price increases (the calculation relation used is: $\overline{R} = (\sqrt[n]{\prod IPBC}) \times 100 - 100$), the rate of inflation at the end of the period (The year) or the increase in consumer goods prices in December of this year compared to December of the previous year, the annual inflation rate measures the average price increase in a year compared to the previous year, calculated as a ratio between the average price index Of one year and the previous year, both determined as simple arithmetic averages of the monthly indices of each year, calculated against the same basis (October 1990 = 100), in this case the indicator is calculated by applying the relation: $R_{t/decembrie} = IPBC_{t/decembrie} \times 100 - 100$.

- *Industrial Product Price Index – IPPI*

This index measures the overall evolution of prices of industrial products and services manufactured and delivered by domestic producers in a given period (current compared to an earlier basic period) in the

first stage of marketing of products and services (according to the methodology published in the "Bulletin Monthly prices" (INS). Its scope is made up of all products manufactured and marketed internally by industrial enterprises whose commercial activity falls within the specific industrial CAEN divisions [10, 11, 13, 14, 15-29, 31-36, 40 -41].

For the construction of the industrial production price index, only the transactions corresponding to the first stage of the marketing of the products, i.e. when they leave the production enterprises, are taken into account. The observed variance is the price associated with these transactions, which will be determined by the seller (the economic agent), the specificity of the product being traded, the type of buyer and other characteristics of the transaction.

The large number of transactions carried out by the industrial economic agents in the national economy makes them impossible to track entirely. Therefore, the observation and collection of the sales prices of the industrial products that are included in the industrial production price index are made on a sample of representative economic agents within each NACE activity class, based on a unique nomenclature of industrial products.

The industrial production price index covers almost all sectors of the mining and processing industry as well as the energy sector. IPPI calculations do not include: extraction and preparation of radioactive ores; Industrial production with a long manufacturing cycle; Ship and aircraft production; The production of weapons and ammunition; Production of unique parts of the machine building industry; Production produced and delivered within the same enterprise (domestic consumption).

The products manufactured by the sampled economic operators are treated differently according to their main destinations, the domestic market and export.

The main nomenclatures used in the calculation of the industrial production price index are:

- Classification of National Economy Activities, elaborated on the one hand by the necessity of reflecting the new economic relations and, on the other hand, ensuring the alignment with the European Community Nomenclature of Activities. According to this classification, the economic and social activities are structured on five levels (division, subsection, division, group and class), constituted on the principle of homogeneity, classification structures comparable to those existing in the European statistics (NACE Rev. 1.1) and the world CITI/ISIC) used in UN statistics.

The tracking and registration of the prices of the varieties manufactured and delivered by the economic agents in the sample can be based on a unique industrial product nomenclature - PRODROM, which comprises about 2,700 physical products that characterize the D, E and F activities of CAEN rev. 1. The product in the nomenclature represents the first level of aggregation of the component assortments that characterize the movement of industrial products prices. It is, in fact, a family of homogeneous varieties possessing common technical, functional and physico-unique characteristics.

Assortment is a good material resulting from a well-defined manufacturing process with specific technical-functional characteristics. Assortment is the elementary level at which the transaction price is traced. The assortment nomenclature is not unique in the country; it is carried out at the level of each economic agent by the statistical specialists together with the business specialists.

The main data source for the construction of the sample of economic agents is the statistical survey "Annual Statistical Survey (ASA) in 2000". On the basis of the data from this statistical survey, the economic agents are ordered in decreasing order of turnover of each NACE activity class, taking into account the economic agents whose turnover represents at least 60% of the total NACE class. The degree of coverage is between 60% and 100%, and the total industry is over 75%. The industrial production price index is Laspeyres type, using a constant weighting system for the successive aggregation of data on the value of industrial production traded per destination in 2000.

The weighting system used to calculate the industrial production price index shall be established separately by destination as it is used for the calculation of the industrial output price index delivered to the domestic market or the industrial output price index delivered for export. Weights of weights by destination for all aggregation levels were determined from the Annual (Structural) Statistical Survey in enterprises in 2000.

Agricultural price indices measure the overall price evolution of agricultural products sold by domestic agricultural producers over a given period (commonly referred to as "current") compared to an

earlier period (referred to as the base or reference). The observation and collection of the prices that are included in the calculation of average prices and price indices shall be carried out on a sample basis, on the representative sales channels, depending on the nature of the product, using a sample of 100 agri-food markets, 50 stocks, 101 processors, Wholesalers and 54 agricultural companies and agricultural research and production units. The sample of products includes the representative varieties for each product, chosen on the basis of specific characteristics: quality, variety, size, weight, age, etc. And the most common trading conditions.

Pricing is recorded at weekly frequency in the agro-food and lunar markets for food, processors, wholesalers and agricultural commercial companies. Prices have the following characteristics: they reflect the first stage of marketing the products; Do not include transportation, storage etc.; Do not include subsidies on the product as well as VAT. Average prices of products sold in agri-food markets at the locality level are determined as a simple arithmetic mean of weekly prices. The calculation system is based on Laspeyres. The weighting system for aggregate indices is based on the information obtained from the Economic Accounts in Agriculture (version 2001) and represents the value share of a product in the total value of agricultural production. At the product weighting level, the information from the Statistical Survey of Plant Production (Agr. 2b) and Livestock (Agr. 6b) from 2001.

- *Construction costs index*

The Construction Cost Index is a statistical indicator that measures the evolution of the costs incurred in carrying out construction works performed over a given period compared to a reference period. The construction of the indices uses the nomenclature of the construction works for the main categories of construction works and objects: new construction works; Capital repairs; Maintenance and repair work.

Each category of work is divided into three types of building objects: residential buildings; Non-residential buildings; Engineering construction. It is not included in the construction activity: capital repairs of equipment included in industry, assembly of equipment and metal constructions executed by "industrial" enterprises. In the price survey are included units that perform the works in the enterprise.

The cost index is calculated as a Fixed Base Laspeyres index. The determination is carried out quarterly, the weights being of the year 2000, determined by categories and building objects. Weights are the specific weights of each item of expenditure versus total. The main items of expenditure are: materials, labor, equipment, transport costs, indirect costs. On expenditure items, the Laspeyres type price indices are: industrial output price index for construction materials; Labor cost index in construction; Industrial property price index for construction machinery; Index of industrial production prices for means of transport in construction; Consumer price index.

The construction cost index is calculated by aggregating the cost indices by category of works. For each category of works, the index results from the aggregation of the indices by object categories, which in turn is determined on the basis of the expenditure items and their price indices.

4. Conclusions

In the article "Theoretical Elements on the Use of Price Indices for Inflation Measurement," the authors sought to capture the key elements underpinning the use of price indices in inflation calculations. As a rule, we say inflation measurement, but this is synonymous with the calculation because, based on inflation, we can calculate the inflation rate that becomes a key indicator in bringing macroeconomic data in real terms with possibilities for domestic and international comparability. From this article a series of theoretical conclusions with practical applicability are revealed. Firstly, the consumer price indices calculated by the uniform statistical methodologies established by Eurostat are elements of inflation measurement. Secondly, inflation calculated as a consumer price index or a harmonized price index is the way in which the inflation rate is calculated. Scientifically, the following conclusion is that the calculated inflation rate is used to deflate macroeconomic indicators of results that become expressed in realistic terms comparable and usable in dynamic and international comparisons. Only on the basis of the correct use of price indices in inflation measurement we are guaranteed that the results at national level are comparable in dynamic time series and are certainly more usable in international comparisons.

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