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Aggregates in Real Expression and Price Indices by Deflation

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Abstract
In this article, the authors have proposed to briefly present theoretically how macroeconomic aggregates can be expressed in real expression. It also shows that price indices are the basis for deflation. Deflation is the process by which an aggregate is converted into monetary expression, from current prices into real prices. In the simplest way, transformation is an arithmetic operation of dividing the nominal aggregate into a price index corresponding to the analyzed period. The simplicity of expression has the complexity of how aggregates turn into real expression indicators. Actual expression indicators ensure the possibility of comparability at the level of a state in time when data are brought to the same common denominator by reference to the price index of a base period in that comparison. In other words, the central problem of deflation refers to the construction of a price index to ensure the transformation of an aggregate expressed in nominal prices, aggregated in real prices, in order to determine the level and especially the way in which that indicator was recalculated. In other words, mathematically we express the computational relations so as to arrive at aggregates expressed in real prices or in comparable real values. The deflation of a nominal aggregate with a physical structure implies the transformation of the aggregate primarily into its structural elements so as to ensure comparability in the study both globally and in the structure of macroeconomic output indicators (GDP) elements. We know that gross domestic product can be analyzed structurally according to several criteria from the point of view of sources used, use of gross domestic product, ownership forms, investment/consumption ratio, or wider structure of sectors Contributed to the achievement of the indicators. Therefore, before ensuring any such comparability, there is the question of expressing aggregates in prices or realistically comparable values.

Key words Macroeconomic aggregates, price indices, nominal/real aggregate, deflation, method

1. Introduction

Deflation means the transformation of an aggregate into monetary expression, nominal in a real one. Transformation is usually accomplished by dividing the aggregate at a corresponding price index. The price index to be used must be based on the prices of goods relevant to the typology of the national economy and measure them appropriately. When building the price index, a distinction must be made between monetary aggregates with and without physical consistency (volume). From this point of view, three situations may arise: aggregates that measure streams or stocks corresponding to a set of goods (e.g. private consumption, export of goods), in which case the aggregate has a volume and a price component; (i.e. income from transfers, taxes, taxes etc.) and aggregates that can be interpreted in both aspects (for example, wage income is a purely monetary flow, but At the same time, means the value of labor factor services, i.e. a quantity of labor factor services).

The central methodological issue of deflation refers to the construction of a price index to ensure the transformation of a nominal aggregate into a real one corresponding to the objective of knowledge sought by deflation (modification of an actual volume of goods, modification of a potential volume of goods, change of aggregates in value expression "cleaned" by inflation). Corresponding to the objectives of knowledge, it opts for a particular.

2. Literature Review

Atkeson, Andrew, and Kehoe (2004) discuss on the existence of an empirical link between deflation and depression. Anghelache, Gheorghe, and Voineagu (2013) have approached the complex methodology dedicated to inflation measurement and analysis. Guidolin and Timmermann (2006) were preoccupied with the application of econometric models in the study of joint distribution of stock and bond returns.

Kilian and Manganelli (2007) have developed on the measurement of deflation-related risk. Crawford, Costa-Gomes, and Iriberri (2013) evaluated the nonequilibrium stragic thinking, based on a model centered approach. Anghelache (2004), Anghelache, Isaic-Maniu, Mitruţ, and Voineagu (2007) present the System of National Accounts, which describes the macroeconomic aggregates at the level of a national economy, we outline also the research of Anghelache and Anghel (2016), Anghelache (2008), Anghelache, Manole *et.al*. (2007), Biji *et.al*. (2010), which are reference works on macroeconomic statistics. Anghel (2015) has analyzed the evolution of the inflation indicators for the Romanian economy. Capanu and Anghelache (2000) have presented a set of indicators that can be applied in micro- and macroeconomic management. Campbell, Sunderam, and Viceira (2013) approach the inflation risk, in the context of nominal bonds dynamic risk. Goodwin (2008) presents the macroeconomic principles in the context of the 21st century economy.

Anghelache *et.al*. (2012, 2011) have analyzed the consumer price index within the system of indicators dedicated to inflation and price evolution measurement. Anghel (2015) presents the fundamentals of financial and monetary analysis, from both theoretical and practical

viewpoints. Buraschi and Jiltsov (2007) develop on the macroeconomic models of term structure of interest rates. Campbell, Shiller and Viceira (2009) describe the role of inflation in the bond markets. Calvo (2016) analyzes the behavior of inflation in the post-war period. Bansal and Shaliastovich (2013) develop on the risks and predictability associated with bond and currency markets. Ang, Bekaert, and Wei (2008) analyze the correlation between real rates and expected inflation. Müller (2011) describes some concepts regarding the efficient tests under a weak convergence assumption. Bordo and Filardo (2005) comment on the historical perspectives of deflation. Cochrane (2011) develops on the Taylor rules.

3. Research Methodology and Data. Results and Discussions

The deflation of a nominal aggregate with a physical structure implies the transformation of the nominal aggregate $A_{i(1)} = \sum p_{i1}q_{i1}$ into a real one $A_{i(0)} = \sum p_{i0}q_{i0}$ (i=$\overline{1,m}$ groups) is not achieved explicitly based on the expression $p_{i0} \cdot q_{i1}$, but by dividing the nominal aggregate $A_{i(1)}$ at a price index measuring the average change in the prices of the goods constituting that aggregate. The appropriate price index in this case is a weighted harmonic average of price indices $\left[p_{i1} / p_{i0}\right]$, the weight being $\left(p_{i1}q_{i1}\right)$, ie a Paasche price index (IPP), of the form:

$$A_{i(1)} : IPP = \sum_{i=1}^{m} p_{i1}qi1 : \frac{\sum_{i=1}^{m} p_{i1}qi1}{\sum_{i=1}^{m} \frac{p_{i0}}{p_{i1}} \cdot p_{i1}qi1} = \sum_{i=1}^{m} p_{i0}q_{i1} = A_{i(0)} \quad (1)$$

The ratio $A_{i(1)}$:$A_{i(0)}$ is a Laspeyres volume index that isolates the change of the volume component in case of a time series. In practice, the physical structure of the available price index is, in most cases, not identical to the physical structure of $A_{i(1)}$. It is appreciated that it is sufficient that the available price index represents a better approximation of the "exact" index of the prices of the aggregate Aj(i).

No Paasche "pure" indices are available for the current (quarterly, semester, yearly) calculation of macroeconomic aggregates. As a rule, the statistical information required for calculating Laspeyres indices is available. This material admits a good solution. If the aggregate is broken down analytically on groups of goods and the partial aggregates deflate ($A_{il(i)}$) with corresponding Laspeyres price indices, the sum of the deflated partial aggregates represents a good approximation for the deflated aggregate by a The Paasche index "pure".

The calculation relation is:

$$\sum_{i=1}^{k} \frac{A_{il(1)}}{IPL} = A^{*}_{1(0)} \approx A_{1(0)} = \frac{A_{1(1)}}{IPP} \quad (2)$$

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Volume-oriented deflation leads to clearly interpretable results if the price structure has not changed significantly, so that price changes are mainly driven by the overall change in price levels. If the price structure fundamentally changed, there is no real economic justification for assessing quantities q_{i1} at prices p_{i0}.

- Deflating a nominal aggregate without a physical structure. If it is intended to measure the change in the purchasing power of an income (salary, pension, dividends, etc.) on the basis of the price evolution of a set of goods to be bought or usually purchased with that amount of money, then the appropriate deflator is the price index Of that set of goods - the deflation starts from the use, not the creation of the aggregate. If the set of goods to be purchased includes the quantities qi means that their value is in the base period and in the current period. The price index is Paasche type and, as such, the actual aggregate is:

$$Ai(0) = Ai1(1): \frac{\sum p_{i1}q_i}{\sum p_{i0}q_i} \quad (3)$$

The quantities set to be purchased (qi) may be those actually purchased during the base period, in which case a Laspeyres price index results. This option is used to deflate salary, pension, income, etc.

- Deflation as a method of eliminating price changes from a nominal aggregate is used to eliminate the inflation component is achieved by dividing the nominal aggregate at a price index considered as an appropriate measure of inflation. Building such an index can be based on the idea that the inflation factor is estimated at all prices or a generalized basket of goods and services is used. There are arguments - in terms of economic interpretation and statistical practice - in favor of using the price index for the final domestic use of goods (final consumption + gross investment).

By using such a Paasche type, we get a real aggregate (A1(1):IPP). According to this method, all nominal units are deflated by this price index.

- Double deflation is a special deflation procedure applied in macroeconomic calculations when Ai(1) is the difference (balance) between two aggregates with a physical structure. Such aggregates are, for example, Gross Value Added and Gross Domestic Product.

This procedure attempts to deflate a hive aggregate according to the rules applied to aggregates with a physical structure. This test fails because the hip aggregate does not have a physical structure, so it cannot be highlighted as: $\sum p_{i1}q_{i1}$. An output (A*1(0)) that is compatible with the unit volume can be obtained indirectly:

$$\frac{A_{1(1)\cdot 1}}{IPP_1} - \frac{A_{1(1)\cdot 2}}{IPP_2} = A_{1(1)\cdot 1} - A_{1(1)\cdot 2} = A^*_{1(0)} \quad (4)$$

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The difference between the volumes of the two aggregates is, by definition, declared as the real aggregate. This process is, at first glance, plausible and simple in statistical terms. But the economic interpretation of the outcome is problematic. The real gross value added calculated by this method does not even mean the value of an actual or potential set of goods that is the result of production, no real input of inputs or gross value added "cleaned" by inflation. The default deflator $A_{1(1)}$ /$A_{1(0)}$ is not an average of IPP_1 and IPP_2. The double deflation mixes unjustifiably in terms of content pure price changes and changes in price structure. At the level of the economy, double deflation leads to the fact that GDP in constant prices maintains at the level of the base period the price relations between export and import. As a result, the rate of change of GDP in constant prices is not an adequate measure of the change in the result of the distributable output in the interior, i.e. of the real distributable income.

So double deflation is a method by which we remove from the nominal level of an aggregate in value expression, which cannot be directly decomposed into a volume (physical) component and a price variation, the price variation. Applies to macroeconomic calculations for indicators measured in current prices, resulting in a balance between two flows of goods. This may include gross value added, gross domestic product and net exports. The constant price evaluation for such indicators is made by independently deflating the two indicators from which the size of the balance.

The price index corresponding to the size of the balance is derived from the balance sheet in current and constant prices. The resulting implicit price change may take unpredictable values if the prices of the two sizes involved in the difference change very differently. The double deflation method corresponds to the revised SNA recommendations.

- In macroeconomic calculations, only deflation designed to know the volume of aggregates with a physical structure and double deflation is currently practiced. Aggregates that are not accessible to these processes are presented as nominal aggregates only. The revised SCN introduces a deflation oriented towards knowing the real values. The actual macroeconomic revenue derives from the recommendation of deflation by the end-use price index of goods.

This type of deflation is only recommended for Gross National Income and Net National Income, but not for Gross Domestic Product and Domestic Product, for which double deflation will continue to be used. The difference between the proposed deflation methods is explained by the fact that in the revised system, the domestic product essentially measures output, while national income (gross or net) is essentially a distributed revenue share

- IPGDP measures the average price variation of end products and services produced by domestic economic subjects. It is also called the GDP deflator. It is a default price index, Paasche type ($I_P^{GDP(p)}$), because it is not explicitly determined based on the quantities and prices claimed by the calculation of this index, but as a ratio between the nominal GDP index ($I^{GDP}_{nominal}$) and the physical volume index of Laspeyres GDP ($I_L^{GDP(q)}$). It has the calculation relation:

$$IPGDP = \frac{\sum_i q_{i1}p_{i1}}{\sum_i q_{i0}p_{i0}} : \frac{\sum_i q_{i1}p_{i0}}{\sum_i q_{i0}p_{i0}} = \frac{\sum_i q_{i1}p_{i1}}{\sum_i q_{i1}p_{i0}} \quad (5)$$

In order to determine the Paasche price index, the relationship between the nominal GDP index and the Laspeyres real GDP index is mainly used due to the costs involved in obtaining the information required by the Paasche price index (q_{i1} and p_{i1}). For the calculation of Laspeyres physical volume index are known from previous records p_{i0} and q_{io}.

Determining real GDP ($\sum q_{i1}\ p_{i0}$) involves deflating GDP as homogeneous components (C_j; j = $\overline{1,k}$ components) and expressing them in constant or comparable prices. Such components are, when using end products and services: private consumption; State consumption; gross investments in fixed capital; stock changes; net export.

For each component (C_j) a default Paasche (I^p_{Cj}) price index is calculated which serves to deflate the respective component. This Paasche price index results from the ratio between the nominal component index ($I_{Ci\ nominal}$) and the Laspeyres physical volume index of that component ($I^q_{cj,\ l}$):

$$I^p_{Cj} = \frac{I_{Cj\ nominal}}{I^q_{Cj,L}} \quad (6)$$

Each real component is determined as a ratio between the nominal component and the corresponding price index:

$$C_{j\ reală} = \frac{C_{j\ nominal}}{I^p_{Cj}} \quad (7)$$

Ultimately, real GDP results as a sum of actual components (i.e. deflated).

4. Conclusions

In this article based on the study of the possibilities of converting the aggregate nominal expression in real terms, the authors sought to highlight how statistical and mathematical that these indicators provide the content and expression in real prices data base of comparison. The article reveals some aspects that conclude about the need for deflation and the methodology of applying the deflagration process. Deflating a nominal aggregate without a physical structure or deflating an aggregate with a value structure. In both cases there is a need to measure the purchasing power of an income in other words to bring the data as close as possible to the need for comparability. Otherwise, the statistical methods of weighting of the indicators used, usually by the consumer price index, are analyzed in turn to highlight the calculation method and then convert them into real prices that ensure comparability. This article expresses a number of aspects that can be used in concrete analyzes by simply applying them. Given that Gross Domestic Product is expressed in real terms, we deduce that this is a sum of the deflated actual components of the structural elements.

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