

WEIGHT SYSTEMS IN A CPI ANALYSIS

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—Abstract—

There are several methods for calculation of inflation. One of them is the consumer price index. Its value depends of the weight system arising from the model of consumption. The main aim of this paper is the analysis of the CPI index using different weight systems.

Key Words: *consumer price index, inflation, model of consumption, weight system*

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1. INTRODUCTION

Inflation is a phenomenon occurring in almost every country, regardless of the level of socio-economic development. At the turn of the decades of 1970's and 1980's the governing groups realized that a constant, relatively high level of inflation is not beneficiary for economy because of the costs it generates. This approach led to reorientation of economic policies in developed countries in such a way that their new goal was to prevent increase of prices. The effect of these efforts was bringing the inflation index down to one digit values and keeping this level, practically unchanged, until this moment.

Excessive inflation is strenuous for economy, it adversely influences production processes, exchange of goods and also quality of life of the public. Therefore,

counteraction against inflation is included into governmental programs and central banks' strategies. Although there are various ways of realizing these programs, the most popular solution is to establish a compromise between providing economic growth and stable cost of living for the society. Different social groups, however, are not subject to effects of inflation to the same extent. Measuring inflation with reference to average structure of consumption, differentiates households according to their type and, accordingly, to volume of available income. Structure of consumption generates arrangement of weights, which cause occurrence of disparities within the price indices of consumer goods and services calculated according to different rules of weight updating and for different types of households.

2. NOTION AND MEASUREMENT OF INFLATION

The term inflation derives from Latin *inflatio*, which means swelling, bulging; and in the initial period of its use in economic terminology the term was adequate to its popular meaning. Inflation was perceived at that time as too great quantity of money in circulation that resulted in increase of prices of goods. Subsequently, the term inflation referred to the process of increase of prices. J. Tarajkowski, J. Wolniak, J. Polowczyk (1995)).

Nowadays, definitions of inflation formulated in literature particularly stress the significance of increase of overall level of prices. Authors generally agree that inflation is a process of price increase (D. Laidler, M. Parkin (1975), Kołodko (1987), D. Kamerschen, R. McKenzie, C. Nardinelli (1991)). The word "process" indicates the fact that the researchers emphasise sustained quality of this phenomenon. When mentioning the definition of increase of price level, in most cases it is referred to as "general." It is done in order to eliminate from the debate about inflation changes in price structure. For the sake of simplicity, if prices of some goods increase and other decrease, there is no inflation. It has to be stressed, however, that perceptions of some social groups can be different. These disparities can result from different structure of commodity basket used to calculate CPI.

Enhancing approach in the understanding of inflation of price levels, enables us to formulate axiomatic definitions of indices used to measure this phenomenon (W. Eichhorn (1978)). Axioms provided by this author allow many solutions, among which classic indices of Laspeyres'

$${}^L I_p = \frac{\sum_{j=1}^n p_{j1} q_{j0}}{\sum_{j=1}^n p_{j0} q_{j0}}$$

and Paassche's

$${}^P I_p = \frac{\sum_{j=1}^n p_{j1} q_{j1}}{\sum_{j=1}^n p_{j0} q_{j1}}$$

where:

p_{j1} – is the price of one item of j goods in measured period,

p_{j0} – is the price of one item of j goods in base period,

q_{j1} – quantity of j foods in measured period,

q_{j0} – quantity of j foods in base period.

Taking on the correct indications after transformations we can present them in the following manner:

$${}^L I_p = \frac{\sum_{j=1}^n i_{j_p} p_{j0} q_{j0}}{\sum_{j=1}^n p_{j0} q_{j0}} = \frac{\sum_{j=1}^n i_{j_p} w_{j0}}{\sum_{j=1}^n w_{j0}}$$

and accordingly

$${}^P I_p = \frac{\sum_{j=1}^n p_{j1} q_{j1}}{\sum_{j=1}^n \frac{p_{j1} q_{j1}}{i_{j_p}}} = \frac{\sum_{j=1}^n w_{j1}}{\sum_{j=1}^n \frac{w_{j1}}{i_{j_p}}},$$

where:

i_{j_p} individual price index,

$\sum_{j=0}^m w_{j1}$ – value of the analyzed goods basket in measured period,

$\sum_{j=0}^m w_{j0}$ – value of the analyzed goods basket in base period.

Difference between them is about the choice of time, in which the arrangement of weights is established. In the first case it is an earlier period – base period, and in the second the current year consumption is analyzed. Paasche's indices are of little practical use. Indices constructed upon average household consumption, that is all types of indices of price fluctuations in consumer goods and services, usually make use of Laspeyres' formula. However, their construction can differ from one another in reference point, i.e. the choice of base period, according to which the comparisons are drawn. In Poland the weight system in Laspeyres' formula, used to calculate price index of consumer goods and services, is updated annually. The basis of its compilation is the structure of public expenditures on consumer goods and services from the year preceding the reference year.

3. BORTKIEWICZ'S EQUALITY

Nowadays the most popular formula for calculating the price index of consumer goods and services is Laspeyres' formula. As a matter of fact, since 1996, that is since Boskin's report was published (R.M. Boskin, S.G. Leaver (1996)), imperfections in the construction of this index, have been widely accepted. Among elements that were pointed out in the report the most concerning is the issue of invariability of weight system. Lack of current update of the consumption model results in the fact that the index calculated in this way does not include the reaction of consumers to price changes for particular goods and services. The consumers often react in the following way: more expensive goods are replaced with less costly substitutes. This leads to a situation in which an officially published inflation index provides an exaggerated view of the level of the phenomenon treated as a cost of living index. In the quoted report the overestimation has been defined at a level of 1.1 percentage point. The effect of product substitution was not only one of the elements presented in the report, but its position in the report was crucial.

Similar in effect was an interpretation of Bortkiewicz's equality, which showed a relation between Laspeyres' and Paasche's indices (M. Okólski, I. Timofiejuk (1981)).

$${}^pI_p: {}^L I_p = 1 + rV_qV_p,$$

where:

r – is the linear correlation factor between particular indices of quantity and prices,

V_q – variability factor of particular quantity indices,

V_p – variability factor of particular price indices.

If we assume that consumers behave rationally, the correlation factor in this formula has negative value. Along with price increase the quantity of consumed goods should decrease. Therefore Paasche's index should have lower values than Laspeyres'. The scale of the discrepancy is among others numeric substitution effect. It is arguable which of the indices reflects inflation processes more accurately, however taking into account CPI as the cost of living index, there is no doubt that more accurate information is provided by the index whose weight system of reflecting consumer reaction is more up to date. In this way it is possible to measure consumer reaction to price fluctuation and susceptibility to change of consumption model.

4. CPI IN POLAND IN YEARS 2001-2008

In this part of the study subject to analysis was data on consumption model and price changes in Poland in years 2001-2008. The data that constitutes the basis of the elaboration comes from publications of Central Statistical Office (GUS) and includes Statistical Yearbook of the Republic of Poland (2001-2010), Concise Statistical Yearbook of Poland (2001-2010). The data scrutinized concerns price indices of particular product groups and weight systems divided into three main types of households. Consumer goods and services price indices have been calculated regarding weights that use household expenditures structure and price indices divided into the following groups: food and non-alcoholic beverages, alcoholic beverages and tobacco, clothing and footwear, housing, water,

electricity, gas and other fuels, furnishings, household equipment and routine maintenance of the house, health, transport, communication, recreation and culture, education, restaurants and hotels, other goods and services.

First of all, research was done on the influence of weight system updates on CPI value in years 2001 – 2008. Narrowing the time period was done to provide comparable data for the entire period of research. Two indices were calculated. In the first case, the weights have been constructed on the basis of consumption from the year preceding the research, namely, the methodology that was used was the standard practice methodology. In the second case the account was taken of the current consumption, that is, weight arrangement used to calculate the index was built on the basis of the household expenditures from the reference year. This means that there have been calculated for the same period, the indices of Laspeyres' and Paasche's.

Table 1. Annual price indices of consumer goods and services

CPI indices according to the Laspeyres' and the Paasche's formula	2001	2002	2003	2004	2005	2006	2007	2008
Price indices of consumer goods and services in the years 2001- 2008 (system of weights from the year preceding the year of research)	1,055	1,019	1,008	1,035	1,021	1,011	1,026	1,043
Price indices of consumer goods and services in the years 2001- 2008 (system of weights from the reference year)	1,054	1,019	1,008	1,034	1,021	1,010	1,024	1,041

Source: own research on the basis of data provided by GUS

The results presented in table 1 are in line with the intuition of equality of Bortkiewicz. The value of the index constructed on the basis of the most up to date model of consumption did not exceed the value of the CPI calculated in the standard way in any of the given years.

In other words, the Paasche's index values were less than the value of the Laspeyres' index. This points to the rational behavior of consumers who match their consumption model in accordance to changing prices in such a way that they

in place of more and more expensive goods look for cheaper alternatives. It is worth stressing that the difference between indices did not exceed two-tenths of a percentage point in any of reference years.

A similar study in the same years was carried out divided by the types of households. Among the recognized households were: households of employees, farmers, self-employed persons, retirees and pensioners. This time there is no full regularity. Twice in forty cases Laspeyres' index was about one tenth of a percentage point lower than the Paasche's index. This concerned farmers and self-employed persons in different years.

Table 2. Annual price indices of consumer goods and services divided by the type of households

Specification	Price indices	2001	2002	2003	2004	2005	2006	2007	2008
households of employees	Laspeyres	1,054	1,019	1,008	1,034	1,021	1,009	1,024	1,041
	Paasche	1,053	1,019	1,008	1,033	1,020	1,008	1,023	1,040
households of farmers	Laspeyres	1,050	1,016	1,008	1,036	1,020	1,009	1,024	1,040
	Paasche	1,049	1,017	1,006	1,035	1,020	1,008	1,022	1,040
households of the self-employed	Laspeyres	1,051	1,019	1,008	1,033	1,021	1,008	1,022	1,038
	Paasche	1,050	1,019	1,009	1,033	1,020	1,007	1,020	1,038
households of retirees	Laspeyres	1,059	1,022	1,010	1,036	1,022	1,013	1,028	1,047
	Paasche	1,059	1,022	1,010	1,036	1,021	1,012	1,027	1,046
households of pensioners	Laspeyres	1,060	1,020	1,008	1,038	1,022	1,013	1,029	1,049
	Paasche	1,058	1,020	1,008	1,037	1,021	1,013	1,028	1,048

Source: own research on the basis of data provided by GUS

It can be therefore assumed that generally the effect of the substitution occurs in the case of Polish households. Minor derogations may be due to the rounding of data at several levels of aggregation. Differences between the analyzed indices do not exceed two-tenths of a percentage point, i.e. volume, which has been observed in the case of general indices. This indicates a low diversification of substitution,

regardless of the type of household. It is worth to mention that the smallest differences occur in the case of pensioners, as they have the lowest incomes at their disposal. Lack of differences between the Laspeyres' and Paasche's indices may arise, therefore, in the absence of the possibility of replacing the already consumed goods and services because they are the cheapest.

You can also notice that these households are the most vulnerable to the effects of inflation. In each analyzed year the largest indicator is noted for this particular type of households. Moreover, the difference between the largest and the lowest index in a given year for different types of households reaches up to one percentage point. This difference is even more important, as it is unfavorable for the economically weakest groups of the population. This is largely due to negative weight system resulting from the structure of consumption.

Table 3. The structure of expenditure of particular types of households for certain categories of consumer goods and services

Specification	households of employees	households of farmers	households of the self-employed	households of retirees	households of pensioners
Food and non-alcoholic beverages	23,0	25,3	18,4	30,1	32,8
Alcoholic beverages and tobacco	6,6	5,6	5,7	2,7	3,1
Clothing and footwear	5,9	6,2	6,3	3,7	3,6
Housing, water, electricity, gas and other fuels	17,6	17,2	15,7	25,3	26
Furnishings, household equipment and routine maintenance of the house	5,3	5,9	5,4	5,0	5,0
Health	3,7	4,1	3,5	9,1	8,9
Transport	10,1	12,0	12,0	6,3	4,4
Communication	4,8	5,2	4,8	5,0	5,4
Recreation and culture	8,2	5,6	8,8	6,3	5,5
Education	1,5	1,2	1,5	0,3	0,3

Source: own research on the basis of data provided by GUS

Two categories products constitute more than half of consumer expenditure, namely, food and beverages, and the premises usufruct and energy carriers. Not without significance is also the largest among all types of household expenditures - health, that is to say, a category whose price index, especially in the first years of the research period, substantially increased. All of the above results in an unfavourable situation of pensioner households from the standpoint of the response to the inflation.

5. CONCLUSIONS

When analyzing the situation in Poland in the years 2001-2008 there can be observed differences in the size of the CPI in relation to both the period and type of household, whose consumption model serves to establish weight system. In the first case, the relation described by equality of Bortkiewicz is confirmed. When rational behaviour of consumers to replace more and more expensive goods and services in their sales baskets with cheaper alternatives occurs, the index calculated on the basis of the weight system for the current model of consumption is lower than the index built using the earlier volumes of consumption. This relation generally can be observed in Poland and in the overall index and indices calculated for different types of households.

Different types of households suffer from the effects of inflation in different way. This is because of the discrepancies in the pattern of consumption of consumer goods and services. Characteristic of poor societies is the fact that a substantial part of income is devoted to buying food and keeping a place of stay. Therefore, the most vulnerable groups of the population will share this model of consumption. In Poland, this applies to pensioners. Price indices of consumer goods and services calculated for these groups reach the largest values and, moreover, most difficultly submit to the effect of substitution. For these groups, the differences between the Laspeyres' and Paasche's indices are the least.

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