METHODS FOR CALCULATION OF CONSUMER PRICE INDEX

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---ABSTRACT--
This article delves into the comprehensive understanding of various methods and formulas utilized for calculating the consumer price index (CPI). Furthermore, it sheds light on the distinctive characteristics of these approaches. Additionally, the article examines the prospects and feasibility of employing these indices in the context of Uzbekistan.
KEYWORDS: *consumer price index, Laspeyres index, Paasche index, Young index, Fisher index, Lowe index, seasonality, prices.*--

INTRODUCTION

Understanding the mechanisms of price indices and their susceptibility to seasonal fluctuations is an integral part of macroeconomic analysis. Price indices serve as valuable tools for tracking changes in prices over time, providing key information for economic forecasting and policy decisions. These indices, such as the Lowe, Laspeyres, and Paasche indices, are each unique in their calculation methods and their sensitivity to various market conditions, including the seasonal availability of goods.

However, the introduction of new goods and services, coupled with the dynamic nature of domestic and international markets, poses challenges for these traditional indices. These complexities are exacerbated when considering seasonal goods, whose availability and prices can fluctuate drastically throughout the year, significantly affecting the calculated price index.

Moreover, the choice of a price index for calculating the Consumer Price Index (CPI), a key economic indicator, is largely dependent on each country's unique market conditions. The mechanisms of domestic price formation, the influence of seasonal goods on the overall CPI, and other local economic characteristics are all crucial factors in this decision.

Despite the widespread use of these indices, there remains considerable debate among economists and policymakers about which index most accurately reflects real-world price changes. This debate is particularly relevant in today's globalized economy, where new goods and services are introduced rapidly and market conditions can change unexpectedly.

Therefore, this study aims to explore the nature and functioning of price indices, their response to seasonal factors, and the implications of these phenomena for economic analysis and policy making. Through a comprehensive review of relevant literature and an in-depth analysis of different price indices, we hope to shed light on these complex issues and contribute to the ongoing dialogue in this field.

LITERATURE REVIEW

The concept of "inflation" took root during the North American Civil War between 1861 and 1865, marking a circumstance of an unbalanced surge in the quantity of circulating paper money in comparison to the actual goods supply (Cecchetti, 2008). Nevertheless, this initial description of inflation does not encapsulate the entirety of its effects, which chiefly entail a disturbance in macroeconomic stability and demand-supply equilibriums due to an excess of money in circulation (Mankiw, 2019).

Several international organizations such as the International Labor Organization, International Monetary Fund, Economic Cooperation and Development Program, Eurostat, United Nations, and the World Bank have collaboratively developed a robust method for calculating the Consumer Price Index (CPI) detailed in the manual, "Consumer Price Index Manual: Theory and Practice" (International Labour Organization, 2004). This manual acts as a cornerstone guide for national statistical bodies in determining the CPI on a global scale.

As per this manual, a variety of government bodies are charged with the responsibility of collecting price data and determining the inflation rate within their respective nations. For instance, in the United States, this role is assumed by the Ministry of Labor, whereas in Germany, the Ministry of Internal Affairs shoulders this duty,

and in Commonwealth of Independent States (CIS) countries like Uzbekistan, state statistical organizations take up this task (International Monetary Fund, 2004).

Tracing the origin of the CPI, its functionality has varied over different eras. The calculation of CPI can be tracked back to the 17th century, with the Paasche and Laspeyres indices—now commonly utilized by many countries to calculate inflation rates—were established in the 1970s (Afriat, 1977). The primary objective of computing the inflation rate across all periods has been to buffer the loss of income for salaried workers by pegging their wages to the inflation level (Bryan & Venkatu, 2001).

Internationally, the CPI possesses three salient characteristics that have led to its widespread use as an economic tool. Firstly, the CPI is frequently published, usually on a monthly or quarterly basis, and in some countries, even weekly. Secondly, the CPI is typically readily available in open information sources for public use shortly after calculation. Lastly, unlike other macroeconomic indicators, the CPI is not subject to recalculations; once it is computed at the end of each month or quarter, it remains unchanged (International Monetary Fund, 2004).

ANALYSIS AND RESULTS

Several indices are employed internationally for CPI computation, one of which is the Lowe index**. Lowe's index** represents the change in the cost of a predefined "basket" of goods and services across two comparable periods. Named after its founder, Lowe, who established the theoretical foundation for this index in 1823 (Diewert, 1995).

Let there be n products in the basket with prices **pi** and quantities **qi**, and let the two periods compared be 0 and t. Then the Lowe index can be expressed in the following form:

$$P_{Lo} = \frac{\sum p_i^t q_i}{\sum p_i^0 q_i}$$

The Lowe index is unique in that it uses either the arithmetic or geometric mean of quantities from the base or current period as a weight, denoted as q0 and q1.

In contrast**, the Laspeyres index**, formulated by German scholar E. Laspeyres in 1871, relies on the quantity of the base year as a weight in price index calculation. Thus, within the theory of indices, these are referred to as Laspeyres indices.

The Laspeyres index is calculated as follows:

$$I_p^{Ласпей} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \quad (q_0\text{-quantity in the base period})$$

Paasche Index . Over time, significant shifts have been noted in the circumstances that govern the occurrence of events and processes. This evolution has resulted in the emergence of new goods and services, subsequently diminishing the clarity and comparability of the base period. Consequently, the Laspeyres index, given its reliance on base period quantities as a weight, is unable to account for the introduction of these new goods and services in the current period.

Recognizing this limitation, German scientist G. Paasche proposed a different approach to aggregate index compilation in 1874. His method relied on using current weights. In honor of his contribution, these indices are now referred to as Paasche indices.

The Paasche index is calculated as follows:

$$I_p^{Пааше} = \frac{\sum p_1 q_1}{\sum p_0 q_1} \quad (q_1\text{-quantity in the current period})$$

Young Index. In some cases, instead of holding constant the quantities of period (as in the Paasche and Laspeyres indices), a statistical office may calculate a CPI as a weighted arithmetic average of the individual price relatives.

This index is called **the Young index** after one of the most famous index pioneers Young, and it is calculated as follows:

$$I_Y = \sum s_i^b \left(\frac{p_i^t}{p_i^0}\right), here \ s_i^b = \frac{p_i^b q_i^b}{\sum p_i^b q_i^b} \quad (3)$$

Symmetric Indices. Symmetric indices are those where the quantitative measures employed as weights hold equal significance for both the base and the current periods. These indices are utilized to offer a more precise depiction of price alterations over a specific period. Symmetric indices are also known as geometric mean indices.

Three types of symmetric indices are used in international practice. We will consider them below.

Fisher index . Neither the Paasche index nor the Laspeyres index can accurately indicate changes in consumer prices for the period under study. Because these indices do not reflect changes in the composition of goods and services observed (because physical volume is taken as a weight in both indices).

In addition, in the Laspeyres and Paasche indexes, the base or current period indicators are taken as weights. In these two cases, the calculation of price indices may not give accurate results.

Therefore, the Fisher index is used to calculate the CPI. This index is equal to the geometric mean of the Paasche and Laspeyres indices and allows for a more accurate assessment of consumer price changes.

$$I_{фишер} = \sqrt{I_p^{Paasche} \cdot I_p^{Laspey}} \quad (3)$$

Walsh index. When calculating this index, the geometric mean value of the quantity of the base and current periods is taken as a weight, and it is calculated based on the following formula:

$$I_w = \frac{\sum p_i^t \sqrt{q_i^t q_i^0}}{\sum p_i^0 \sqrt{q_i^t q_i^0}} \quad (3)$$

Tornquist index. This index is equal to the geometric mean value of the prices of goods and services included in the basket and is calculated based on the following formula:

$$I_T = \prod \left(\frac{p_i^t}{p_i^0}\right)^{\delta_i} , here \ \delta_i = \frac{s_i^t + s_i^0}{2} \ and \ s_i^b = \frac{p_i^b q_i^b}{\sum p_i^b q_i^b} \quad (3).$$

Rothwell index . If the basket of goods and services includes seasonal goods or services, the Rothwell index is used to calculate the CPI.

Seasonal goods mean the following two types of products:

- products that are not available on the market in certain seasons of the year (mainly agricultural products, such as melons, watermelons, pumpkins, strawberries, raspberries, etc.);

- products that are available throughout the year, but whose prices change depending on the season or seasons (tomatoes, cucumbers, cabbage, clothes, shoes, etc.).

Rothwell index also uses the prices of the base period. Prices in the base period are calculated based on the following formula:

$$P_0 = \frac{\sum p_n^{0,m} \cdot q_n^{0,m}}{\sum q_n^{0,m}} , here \ n = 1, 2 \dots \dots, 5 \ (3)$$

Based on this, the Rothwell index can be expressed as follows:

$$I_{Rot} = \frac{\sum p_n^{t,m} \cdot q_n^{0,m}}{\sum p_n^0 \cdot q_n^{0,m}} , here \ m = 1,2, \dots \dots, 12 \ (3).$$

Thus, as the month changes in this index, the quantity weight of the index also changes.

Based on the recommendations of the International Monetary Fund, the International Labor Organization, Eurostat, the United Nations and the International Bank for Reconstruction and Development, the Organization for Economic Cooperation and Development, 20 criteria are used to evaluate price indices. Based on whether the price indices correspond to these criteria, conclusions are given on their practical use.

The main criteria are listed below:

1. Indices always have a positive value - according to it, the price index and its components, calculated price and quantity indicators, always take a **positive value.**

Note that the price index assumes a value greater than 1 when the price change has an upward trend, and less than 1 when the price change has a downward trend (a positive value in both cases).

2. Similarity criteria. If the prices in the base and current periods are the same, then the price index **is equal to 1, regardless of the weighted quantity index.**

3.The criteria of proportionality to **the prices of the current period**. According to it, if certain t-period prices are multiplied by a fixed number "a" and price index is calculated, the value of this price index **is equal to the number "a".**

4. Criteria of independence of measurement units. According to it, the change in the units of measurement of goods and services (for example, from kg to tons or from meters to kilometers) **does not affect the value of price index.**

5. Time reversibility criteria. According to it, if the current and base periods are calculated interchangeably, the value of the price index will be equal to the opposite of its value.

6. Average value criteria for the price index. According to it, the value of the price index is between the lowest and the highest price changes in the set.

7. Criteria of limit values of Paasche and Laspeyres indices. According to him, the value of the real price index lies between the Paasche and Laypeyres indices.

8. Monotonicity criteria for current period prices. According to it, if the prices in the current period increase (decrease) without changing the prices in the base period, the value of the price index will also increase (decrease).

It should be noted that not all types of price indices may meet all of the abovementioned 20 criteria. However, this situation should not limit the possibilities of using these indexes in practice.

In international practice, the only price index that meets all 20 price index criteria is the Fisher index, which is calculated on the basis of the geometric mean of the Paasche and Laypeyres indices.

Other indices meet some of these criteria and not all of them.

CONCLUSION

Drawing conclusions from price indices and determining which index to use depends on a variety of factors.

Initially, it's important to note that in countries like Uzbekistan, and globally, when seasonal goods are not readily available in the domestic market, price data relies on prior information. This reality heightens the influence of seasonal factors on price indices.

Furthermore, when seasonal goods are involved, the Rothwell index tends to exhibit a lower value compared to the Lowe index. This indicates that the Rothwell index is less susceptible to variations arising from seasonal influences compared to the Lowe index.

Internationally, organizations such as the International Monetary Fund suggest that when a basket of goods and services includes seasonal items, many countries' statistical authorities opt for the Lowe index. This preference arises because the Lowe index more accurately reflects changes in seasonal goods, closer mirroring real-world figures.

However, it's essential to acknowledge that no single index has been universally endorsed by international organizations for the application of price indices. Each nation possesses the autonomy to select an index that aligns with its domestic characteristics, the mechanisms of price formation within its domestic market, and the impact of seasonal goods on its overall CPI.

The choice of a price index can differ from one country to another based on the unique characteristics of each domestic market, the proportion of imports contributing to domestic consumption, export volumes, and other factors.

For instance, European countries often establish long-term futures contracts for agricultural products, such as bananas, to mitigate abrupt price fluctuations within the domestic market. Conversely, in countries without such contracts, banana prices can vary dramatically between summer and winter months.

Therefore, international experts and financial organizations conclude that each country must consider its unique national characteristics when selecting price indices for CPI calculation.

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