

METHODS OF MEASURING CORE INFLATION IN INFLATION TARGETING COUNTRIES

Ion PARTACHI

PhD, University Professor,
Academy of Economic Studies, Kishinev, Moldova

E-mail: ipartachi@ase.md



Vitalie MOTELICA

Academy of Economic Studies, Kishinev, Moldova



Abstract:

This article tackles the issue of the transitory effects on growth of prices and the main methods for the calculation of monetary policy relevant inflation in inflation targeting countries. In order to have an indicator which would capture the medium term inflation pressures, several measures of core inflation are considered. Besides that this article mentions the main advantages and disadvantages of the different measures of medium term inflation pressures. Most of the central banks which are implementing the inflation targeting regime are using core inflation indicators based on the exclusion of certain components, however there are several central banks which are using statistical measures of core inflation such as the trimmed mean and weighted median. This article also describes the existing core inflation indicators as well as the main features of the trimmed mean and weighted median for the Republic of Moldova. Even though the obtained indicators of core inflation have different values, they have similar trajectories.

Key words: core inflation, statistical measures, trimmed mean, weighted median, monetary factors

1. Introduction

Within the process of achieving their main objective of price stability, central banks are usually monitoring, analyzing and forecasting the dynamics of the Consumer Price Index, even though there are many other indicators which can provide information about the change of prices such as Producer Price Indices, GDP and consumption deflators etc. The reason behind this is the fact that the CPI has several advantages such as the fact that it is known to the public, it is based on the expenditures made by the households and it is disseminated on a monthly basis just several days after the end of the reference period. Besides its advantages, CPI has several shortcomings. It doesn't reveal the growth of prices which is caused by monetary factors. In other words, some price changes might be

determined by some sectorial shocks. These have transitory effects on the general price level and are not considered a part of the inflationary process. In this way, food prices might grow due to some bad weather conditions which determined a bad harvest or the fuel prices might grow once the fiscal authority increases the excise taxes. The direct effect of these changes is temporary and is not a part of the general inflation trend.

A solution for detecting the trend of the inflation in the economy which would reveal the monetary inflation and which would provide value added to the decision makers would be the elimination of the high frequency data and keeping just the low frequency data, in other words calculation of trends. However this procedure would decrease the timing and the relevancy of the recent information and it wouldn't be of much use for the decision makers[2].

Another way to tackle this information is by excluding some volatile components from the overall index. For example, the food and energy prices are determined to a great extent by supply shocks caused by weather conditions and the decrease of supply of oil when some conflicts in Middle East arise. So, by excluding these components from the overall index, it can be obtained an index which would reflect better the inflation trends in the economy. However, this method involves some shortcomings as well. There is no certainty that changes in food prices do not contain useful information on inflation trends in the economy. The removal could result in the removal of valuable information for decision makers. Furthermore, there are other factors other than food prices and fuel prices that could compromise attempts to measure the increase in prices due to monetary factors. The resulting index does not necessarily have a clear picture of inflationary trends.

In order to overcome these issues, there have been developed new approaches that are based more on statistical procedures rather than on the characteristics of certain components, such as the trimmed mean and weighted median. These methods have the advantage of eliminating of different irregularities in data while still keeping the important information which was eliminated by traditional approaches.

In this article we will present the main ways to handle the transitory effects on inflation by investigating what types of core inflation are used by some other central banks in the region as well as by calculating and analyzing the dynamics of the core inflation excluding the food, fuel and regulated prices as well as the core inflation determined using statistical methods such as the trimmed mean and weighted median on CPI data for Republic of Moldova.

The paper is organized as follows. Section 2 provides a brief literature review highlighting some important findings of other authors regarding core inflation measures. In section 3 we present some insight on the data and the main methodology in addressing core inflation measures in our study. Section 4 presents the main results of our research. The paper ends with section 5 where conclusions are provided.

2. Literature review

The main shortcomings of the CPI in addressing the monetary policy relevant inflation was tackled in M.F. Bryan and S. G. Cecchetti paper "Measuring core inflation" (1993) [2]. They state that it is difficult to measure the monetary inflation as a monetary phenomenon because of the non-monetary events that can temporarily produce noise in the data. They list some alternative solutions to this issue such as low-frequency trends or excluding certain components from the overall CPI index based on the assumptions that they are most affected by the noise. They also come with some statistical measures of core

inflation such as median and the trimmed mean. They state that these measures are robust to the presence of many types of noise. Besides that they tried to evaluate the usefulness of their proposed measures of core inflation for monetary policy by assessing which of them is mostly correlated with the money growth. They find that the statistical methods are superior to CPI in several respects such as the fact that they have higher correlations with past money growth and provide improved forecasts for future inflation.

M. Silver [9] outlined the many approaches and methods to the measurement of core inflation and the many approaches to judging the preferred measure. His research shows that different measures of core inflation yield different results, that is, that choice of measure matters. Furthermore, he states that different approaches to the choice of measure yield different results and, even for the same approach to choice, the preferred measure may differ across countries, and even within a county for different time periods. Choice of measure should, in principle, be data-driven for each country based on appropriate criteria. According to his paper, exclusion-based methods are found to be not optimal according to the criteria selected by the monetary authorities. The choice of the method should be data driven, so that the methods adopted are tailored to the features of the evolution of that country's economy and so that the choice of measures can be justified on an objective, transparent basis.

After evaluating several candidate series that have been proposed as core measures of consumer price index (CPI) inflation and personal consumption expenditure (PCE) inflation for the United States, R. Rich and C. Steindel [8] concluded that policy would be best served by recognizing that core measures differ in the quality and nature of the insights they can provide about the dynamics of inflation and to draw from this varied information for guidance.

M. A. Wynne also reviews various approaches to the measurement of core inflation that have been pro-posed over the years using the stochastic approach to index numbers as a unifying framework [12]. According to his paper, there is no theoretical ideal for a monetary measure of core inflation. He concludes that before choosing a measure of core inflation one needs to specify what it is one wants the measure for. Depending on the reason behind it, different methods would be appropriate.

According to B. Meyer and G. Venkatu [6] trimmed-mean inflation statistics diagnose the most volatile monthly price changes as noise and "trim" them from the price-change distribution, leaving a clearer inflation signal behind. These measures systematically remove sources of noise on a monthly basis, rather than ad hoc exclusionary measures such as the ex food and energy ("core") CPI. They tried to find whether median CPI was the appropriate measure of trimmed - mean inflation statistic to use as a measure of underlying inflation. Besides the symmetric trims, they also tried to use the asymmetric ones. They conclude that median CPI is generally a better forecaster of future inflation over policy-relevant time horizons than the headline and core CPI.

3. Data and Methodology

3.1 Data

For calculating different types of core inflation we use the monthly data concerning change of prices and CPI component weights starting from 2009 until September 2014 available from the statistical authority. The weights of the CPI components are determined by the statistical authority on a yearly basis based on the Survey concerning income and expenditures of households in the previous year.

3.2 Core inflation by exclusion of certain components

Core inflation can be calculated by excluding certain components of the CPI which are considered to have volatile behavior, are determined by central or local governments or are subject to frequent supply shocks. In other words, the excluded items are believed to be beyond the control of the monetary policy. The resulting index can be obtained using the formulae below:

$$CII = \frac{\sum_{i=1}^n w_i * iw_i - \sum_{j=1}^m w_j^{ex} * iw_j^{ex}}{\sum_{i=1}^n w_i - \sum_{j=1}^m w_j^{ex}} \quad (1)$$

where:

- CII – core inflation index;
- w_i – the weight of the item in the CPI basket;
- iw_i – price index of an item in the CPI basket;
- w_j^{ex} – the weight of the item excluded form the CPI basket;
- iw_j^{ex} – price index of an item excluded from the CPI basket;
- i – goods and services included in the CPI index;
- j – goods and services that are excluded from the CPI index for calculation the CII;
- n – number of goods and services that are part of CPI basket;
- m – number of goods and services that are excluded from the CPI during calculation of the CII.

3.3. Statistical measures of core inflation –trimmed mean and weighted median

The trimmed mean of α - percent is calculated by the formula nr. 2:

$$\bar{x}_\alpha = \frac{1}{1 - 2 \frac{\alpha}{100}} \sum_{i \in I_\alpha} w_i x_i, \quad (2)$$

where

$$I_\alpha \text{ is } \frac{\alpha}{100} \triangleleft W_i \triangleleft (1 - \frac{\alpha}{100})$$

$$W_i \equiv \sum_{j=1}^i w_j$$

w is the weight of the component, x is the monthly price change of the component

In general, the method involves:

- ranking ascending price increases for each period with corresponding weights.
- then, we add the previous weights for each price increase previously ordered.
- next, the monthly increases for which the sum of their weights is less than α will be excluded,
- the same thing will happen with monthly increases for which the sum of the corresponding weights is greater than $100 - \alpha$.

- the trimmed mean will be calculated then as a weighted average of the remaining components.

The **weighted median** is an extreme case of the trimmed mean, so it represents the growth of the component which is situated in the middle of the increasingly ordered distribution. Thus, half of the weighted monthly increases are above the weighted median and half are below. Therefore, the median is calculated according to the previous procedure, except that it is the first price change whose cumulative weight is greater or equal to 50 %.

3.4. Determining the optimal level of exclusion of information for the trimmed mean approach

In order to determine the optimal level of exclusion of information from both ends of the distribution for a given time, several indicators according to the formulae nr. 2 will be calculated using various exclusion rates (0 percent which is actually CPI until the median - which excludes all items except the observation in middle of the distribution). For each of these indicators we will determine the root mean squared error against the trend of inflation (RMSE, formulae nr. 3). The optimal index is considered the one for which the error is the smallest. To determine the trend of CPI inflation we will apply the Hondrick-Prescot Filter on CPI data ($\lambda = 16600$) (figure nr. 4).

$$RMSE(\alpha) = \sqrt{\frac{\sum_{t=1}^k (T_t(\alpha) - \bar{\pi})^2}{k}}, \quad (3)$$

where

$T_t(\alpha)$ - the index of the trimmed mean α % at time t

$\bar{\pi}$ - trend of CPI inflation determined by using the Hondrick Preskot filter on CPI

k - number of observations

4. Results

4.1. Measures of core inflation in other central banks that target inflation

In international practice, usually the objective of monetary policy is price stability which implies a moderate amount of inflation as measured by CPI. Thus, central banks assess and communicate the effectiveness of their actions depending on whether the overall inflation is close to the proposed level in the medium term. However, given the aforementioned problems on this index, the monetary policy authorities monitor various measures of core inflation when taking decisions in a timely way and with the desired impact in order to contain inflation. These are supposed to allow exclusion of transitory effects and to identify the trends of inflation due to monetary factors. The diversity of the measures of core inflation can be observed by studying inflation reports published by central banks in other countries in the region.

Czech Republic switched to inflation targeting regime in December 1997. From January 2010 the target is $2\% \pm 1$ percentage point [5]. The Inflation Report published by the Czech National Bank denotes that CPI includes Net inflation and regulated prices. The net inflation is decomposed in food prices, fuel prices and Adjusted net inflation [15].

Central Bank of England adopted the IT strategy in October 1992. The current target is point target of 2% annual rate of inflation. Central Bank of England, similarly, practice exclusion method to identify the transitory effects on inflation. Thus, in the inflation reports published by the bank, CPI inflation is decomposed in food prices, fuel prices, the prices of services, education, energy and gas prices and the component other. Previously, in

some older editions of the Bank of England inflation reports one can find the dynamics of other measures of core inflation such as median and trimmed mean of 15% [13].

The National Bank of Poland adopted the IT regime in 1998. Since 2004 it has a target of $2.5\% \pm 1$ percentage point. NBP considers several measures of core inflation in its reports. In addition to the traditional method of exclusion of some default volatile components (inflation without the volatile prices, without food and energy prices, without regulated prices) volatile, it also uses the trimmed mean of 15% [16].

The National Bank of Romania switched to inflation targeting in 2005. Starting from 2013 it has a $2.5\% \pm 1$ percentage point. In the Inflation Reports published by the National Bank of Romania, there are shown three measures of core inflation. The component CORE 1 is the difference between total inflation and administered prices. Component CORE 2 also excludes volatile prices and the component adjusted CORE2 results from the exclusion of volatile prices, the regulated and the tobacco and alcoholic beverages from total inflation. The volatile prices components include vegetables, fruits and eggs [14].

4.2. Core inflation measures in Republic of Moldova

In late 2009 the National Bureau of Statistics of the Republic of Moldova adopted the methodology of the calculation of core inflation index [7]. According to it, core inflation index is calculated using the method of exclusion. The NBS calculates four measures of core inflation:

1. Total CPI excluding food and beverages
2. Total CPI excluding products and services with regulated prices
3. Total CPI excluding fuel prices
4. Total CPI excluding food and beverage products and services with regulated prices, fuel prices.

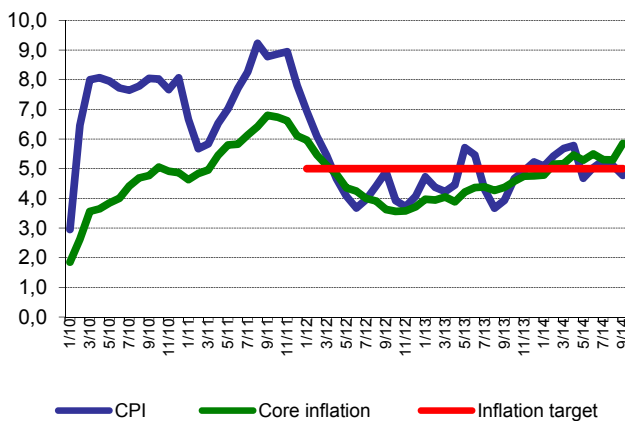


Figure 1. CPI and core inflation, yoy, %

Although the National Bureau of Statistics publishes several measures of core inflation, the Inflation Reports published by NBM reveal the dynamics of the core inflation index that is excluding regulated prices, prices of food and fuel prices.

In 2010 the National Bank started to create the necessary pre-conditions for implementing the inflation targeting regime. The inflation reports published by the bank reveal the dynamics of core inflation index which is calculated by excluding from total inflation prices of food and drinks, regulated prices and fuel prices.

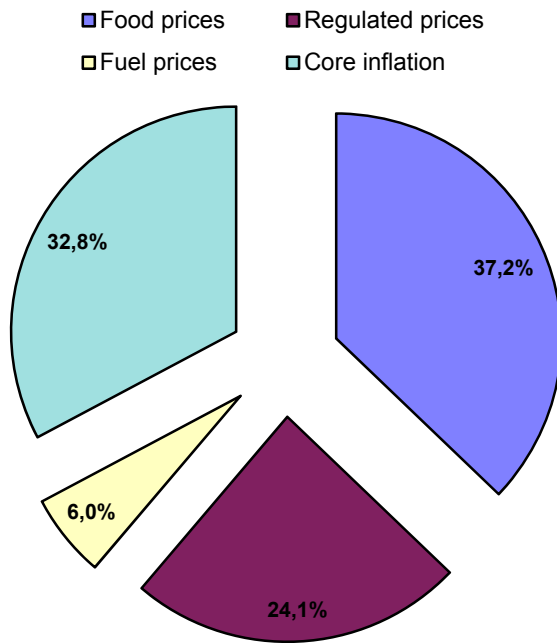


Figure 2. CPI structure in Moldova (2014)

Since 2010, the annual evolution of the above-mentioned core inflation indicator was characterized by a significantly lower volatility than that of the overall inflation (figure 1). At the same time it oscillated closer to the medium-term inflation target of 5.0 percent \pm 1.5 percentage points, its average being 4.7 percent in the period. Core inflation has seen an upward trend with business recovery after the crisis of 2009. In the end of 2011, along with the slowdown in economic activity, it reversed its previous trend decreasing from 6.8 percent in September to 3.6 percent in October 2012. Starting from the beginning of 2013, core inflation recorded a slightly upward trend increasing up to a value of 5.8 percent in September 2014, driven mostly by monetary policy measures undertaken to prevent annual inflation from leaving the target range.

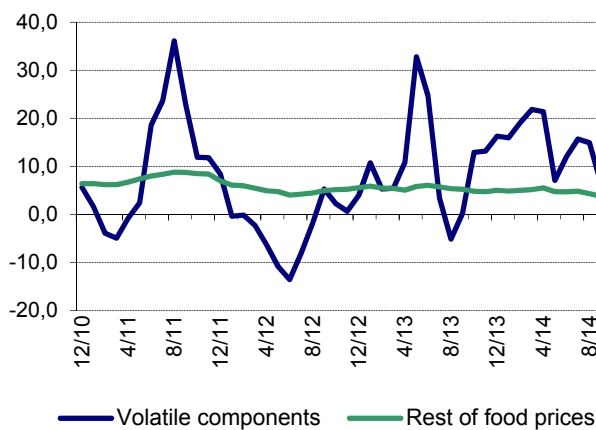


Figure 3. Food prices, yoy, %

However, the core inflation measure presented above has several drawbacks. It excludes, in addition to regulated prices and fuel prices, completely the component food and drinks. As a result, the core inflation component has a weight of about 32.8 percent of the

total CPI (in 2014) (figure 2) which is quite low compared with core inflation indexes monitored in other countries with similar regimes. So, according to the above mentioned procedure more than two thirds of the information is excluded from core inflation measure analyzed in the Inflation Report

The exclusion of the food prices from the core inflation is usually justified by the fact that they have a high volatility driven largely by supply-side factors and not the medium-term inflation trend. However, in the structure of the food price component can be identified very volatile subcomponents such as prices of vegetables, fruits, eggs which dynamics is indeed mostly caused by transitory effects. The structure of the food prices also contains some less volatile components which includes most of the processed foods and are not as sensitive to agro-meteorological conditions. These might be largely influenced by aggregate demand (see figure 3). Thus, they might present useful information about medium-term inflation trends in the economy and might not be excluded from the measure of core inflation. Also, in this way the share core inflation in CPI structure would significantly increase.

4.3. The trimmed mean and weighted median measure for CPI data from Moldova

Given the fact that most core inflation indicators published by the statistical authority in Moldova are calculated by the method of exclusion of pre-determined components and at the moment there is not an alternative core inflation index, next we will provide the trimmed mean and weighted median for the consumer prices in Moldova based on the formulae nr. 2.

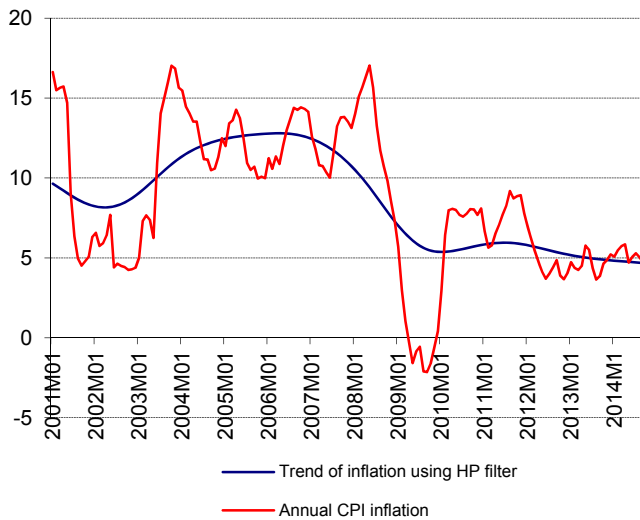


Figure 4. CPI inflation and the trend of inflation

The information on the RMSE suggests that the optimal measure of the trimmed mean, i.e. the closest to the trend of inflation is the one for which 10 % from each end is truncated. This means that at the upper and at the lower end of the distribution we will exclude 10 percent of observations on price changes (figure no. 5).

The annual dynamics of the trimmed mean (figure 6) is slightly different from the annual growth rate of core inflation calculated by the method of exclusion. Thus, although in early 2010 they had similar values, the trimmed mean recorded a faster increase in the first quarter of 2010 which determined a higher trajectory than that of the traditional core

inflation index. suggesting higher inflationary pressures form the aggregate demand compare to the second indicator.

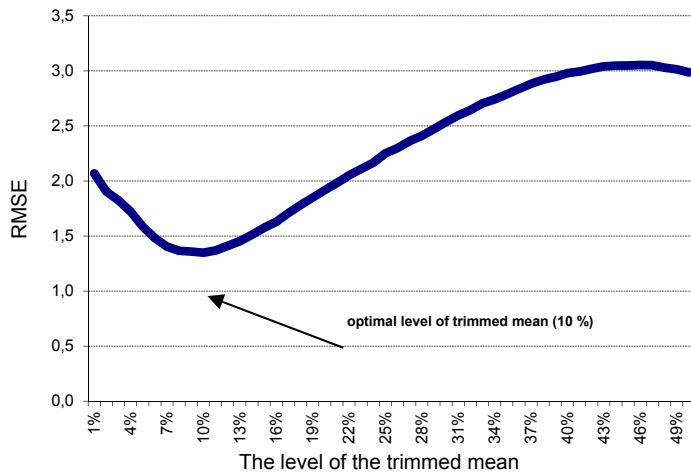


Figure 5. RMSE

In the first quarter of 2011 the trimmed mean experienced a pronounced downward evolution, while the traditional core inflation had a stable dynamics. After this episode, by the end of 2011 both indicators had similar increasing dynamics signaling pressures from increasing demand on prices. However, the overall path of the trimmed mean was lower than that of the core inflation calculated by the exclusion method(aprox. 1 percentage point). In 2012, both indicators had a downward trajectory due to decrease in the economic activity and the difference between core inflation calculated by the truncated mean method and calculated by the method of exclusion had been maintained. In late 2012, both above mentioned indicators started a moderate increasing path which lasted till the end of the sample (3rd quarter 2014). However the difference between the two recorded a slight increase.

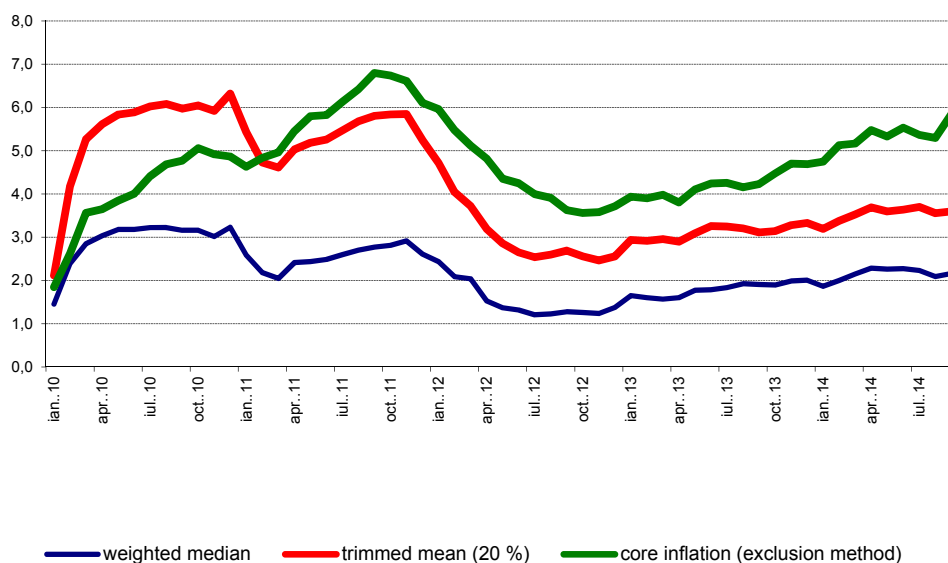


Figure 6. Core inflation measures using exclusion method and statistical methods

In case of the weighted median (figure 6) in 2010, it had a similar pattern to that of core inflation calculated by the method of exclusion. After significant reduction in first quarter of 2011, and a more modest increase to the end of the year, the weighted median trajectory was significantly lower than that of the other indicator. Towards the end of 2011, the difference between the two measures of core inflation was about 4.0 percentage points. This difference, however, decrease in 2012 and early 2013 to approx. 2.5 percentage points. The weighted median started a moderate upward trend in early 2013 similar to the core inflation calculated by the exclusion method and similar to the trimmed and by the end of the 3rd quarter 2014 it reached 2 %. The basic idea of the 2 alternative core inflation indicators is that they suggest lower pressures on inflation coming from the aggregate demand compare to the traditional core inflation measure.

5. Conclusion

This article tackles some of the main issues the policymakers face when monitoring the price dynamics within the inflation targeting regime. The Consumer Price index, besides important information on medium term inflation trends, might still contain information determined by transitory effects or some measurement errors. Therefore, it is of high interest to have a so called core inflation index that would be useful for taking the right decisions to contain inflation within the medium term target.

The measures of core inflation calculated by the method of exclusion of certain pre-determined components whose dynamics is mostly driven by external factors, by the decisions of authorities or which exhibited a very volatile behavior over the history are more commonly used by central banks implementing inflation targeting regime. However, these indicators have several drawbacks and the most important of them were mentioned within the article such as the fact that these methods might exclude important information from the CPI data. The index which is left after the exclusion can be in the end a small part of the initial CPI index. Furthermore, this index can also still include some components which are not a part of the medium term inflation process and are not relevant for policy makers. In this way it can sometimes provide an inaccurate view on inflationary pressures caused by monetary factors.

This article suggests that there are alternative methods to the traditional exclusion procedures, such as statistical methods for determining core inflation, the trimmed mean and weighted median. According to these measures, the excluded components differ in each period, and their exclusion criterion is determined by certain statistical properties, in this case how far the respective component is from the central tendency in a certain period, and does not contain any economic reasoning.

Given the fact that the inflation reports published by the National Bank of Moldova denote the dynamics of a core inflation index which is determined by the exclusion of the food prices, fuel prices and regulated prices form the CPI index, the trimmed mean and the weighted median of inflation might be an important additional source of information for policymakers in Republic of Moldova. Even though these indicators of core inflation have different values, they have similar trajectories over the sample analyzed in the article compare to the traditional core inflation indexes calculated for Moldova .

As a conclusion, the trimmed mean and the weighted median for Moldova could present useful information about inflationary trends that might be missed by traditional core

inflation measures and should be considered as an additional source of information to guide decision making in the process of keeping the overall inflation in the inflation target band.

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