MEASURING CORE INFLATION IN IRAN

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Abstract

The present study aimed to introduce nuclear inflation and evaluate its measurement methods. To this aim, monthly data during 2004-2017 were used by focusing on 344 items from the sub-sections of the price index. Previous studies were conducted based on foods and beverages, tobacco, clothing and footwear, housing, water, electricity and gas burning, furniture, appliances and services used in home, health and treatment, transportation, communications, entertainment and cultural affairs, education, restaurant and hotel, and other miscellaneous services, while the present study focused on the subgroups of these 12 groups. The reason for choosing 2004 as starting the year is that no fluctuation and instability occurred in exchange rate during this year. In this study, the common methods used by central banks were used to calculate core inflation in 2004, and finally co-fuzzy, median, volatile component elimination, trimmed mean, and variance contrast methods had better prediction for inflation. However, the variance contrast method is slightly correlated with inflation.

Keywords: Core Inflation, Central Bank

JEL classification: E31

1. INTRODUCTION

So far several central banks have issued headline inflation after eliminating food and energy components, which has been frequently called “core inflation”. This is because food and energy affect the most unstable, supply shock-driven features which are believed to be apart from the control of a central bank. Accordingly, some other definitions were suggested aiming at identifying more precise trend inflation. More systematically, these definitions seek for variable and steady parts in measured inflation. Considering a definition of core inflation as the

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permanent element of inflation, individual price alterations can be evaluated by their ability to predict future inflation. On the other hand, by considering core inflation as a signal extraction problem, future inflation is viewed as the issue about which one seeks information by current signals. Therefore, core inflation is explained in terms of its ability to forecast future headline inflation.

Section 2 reviews the study background, and Sections 3 and 4 deal with study data and method. In Section 5, the estimation results are presented, followed by discussing the findings and drawing a conclusion in Sections 6 and 7.

2. BACKGROUND

The central bank is responsible for measuring core inflation in different countries and plays a key role in designing the measure in order to guarantee that it serves the needs of monetary policy formulation. Further, the central bank is probably responsible for analytical calculations.

The exclusion-based measure is considered as a proper weighting pattern which can evaluate the costs by the effectiveness or quality of the underlying inflation "signal" they provide. More precisely, this technique implicitly underlies the extensively applied "ex. food and energy" or "ex. indirect taxes" approach for estimating core inflation. Furthermore, zero weight is linked to some prices on the (unstated) grounds that they carry zero information regarding core inflation.

Different studies in economic literature introduced several methods or techniques for measuring core inflation (e.g., Roger, 1998; Core inflation rates as a tool of price analysis, 2000; Wozniak, 1999; Cutler, 2001; Kearns, 1998; Clark, 2001; Johnson,1999, Cockerell, 1999). These methods were categorized into three main groups including exclusion, statistical, and econometric techniques. As regards exclusion and statistical methods, core inflation is developed by eliminating those price indicators that represent high volatility (at a point of time or over some time periods), which are treated as "non-representative or idiosyncratic movements". Additionally, econometric methods include inflation modelling (i.e., measuring core inflation based on the interrelationship between prices and other economic indices. Wynne (1999) proposed several favourable features of core inflation measures as follows.

Timeliness: The practical utility of the measure would be restricted if it was unavailable onetime or subject to modifications over extended periods.

Robustness and un-baseness: The measure should identify the type of the required distortion while not demonstrating a different trend from that of the series from which it is derived. Failure to fulfil these two features leads to undesired biases in performing the monetary policy and thus the loss of the required credibility from the public.

Forward-looking: Success in forecasting future inflation trends is regarded as a major component of core inflation measures.

3. DATA AND METHOD

In this study, monthly data during 2004-2017 were used by focusing on 344 items from the sub-sections of the price index. Previous studies were conducted based on foods and beverages, tobacco, clothing and footwear, housing, water, electricity and gas burning, furniture, appliances and services used in home, health and treatment, transportation, communications, entertainment and cultural affairs, education, restaurant and hotel, and other miscellaneous services. While the present study focused on the subgroups of these 12 groups. The reason for choosing 2004 as starting the year is that no fluctuation and instability occurred in exchange rate during this year.

3.1. EXCLUSION-BASED METHODS

The exclusion-based techniques or those from the "central-bank view" (Apel, 1999) exclude the price changes of certain goods and services or the effect of several macroeconomic indices or administrative measures on prices. The role of macroeconomic indices may essentially misrepresent the key direction of price variations although this modification of price movements has its disadvantages. The above-mentioned elements only include part of the supply factors which affect the price level. According to Roger (1998), price wars between the competitors or monopolists' uncontrollable behaviours have parallel effects on prices and should be considered for exclusion accordingly.

However, considering the above-mentioned drawbacks, no study has focused on eliminating the effect of macroeconomic parameters or administrative measures on prices in Iran in the calculated core inflation.

Due to the fact that the price of energy or the price of energy carriers such as gasoline, electricity, and gas does not change much and the price of energy carriers usually experiences slight changes due to some considerations and the existence of rich oil resources and oil revenues, unlike the methods available in most countries, highly-fluctuated energy items such as natural gas, and gasoline energy have not been eliminated in Iran.

The exclusion of the price changes of certain goods and services relies on the fact that such goods and services are seasonal or "primarily supply-determined" or their price movements are assumed to be volatile enough to conceal long-term inflation movements. The choice of items for exclusion essentially relies on the viewpoints of different central bankers regarding core inflation. For example, some countries exclude food and energy, government charges, interest costs, and rents from the consumer basket when calculating the core inflation indices (e.g., Core

inflation rates as a tool of price analysis, Wozniak, 1999; Cecchetti, 1997; Cutler, 2001).

These are the simplest and most extensively applied measures of core inflation. Certain parts of aggregate price indices are considered extremely prone to short-term supply-side shocks or strong seasonal movements which have a negligible impact on the long-term perspective for inflation and thus can be excluded altogether. In this respect, food and energy items are regarded as the most frequent suspects.

Office for National Statistics issues several consumer price indices in which some special aggregates are eliminated although they are not referred to as core inflation measures. On the other hand, they are normally known as "CPI-X" where X indicates the removed item or items and can be found in the monthly focus on consumer price indices release. In general, 344 goods and services exist in the CPI. As extensively discussed by Laflèche (1997) and Hogan, Johnson, and Laflèche (2001), these goods and services can be classified into 54 elements for which data are present on a comparable basis back to 1986 and 1979 for all (n=54) and most components, respectively. In addition, these elements are themselves as sub-indices for the categories of goods and services such as "bakery and other cereal products," "food purchased from the restaurants," "paper, plastic, and foil supplies," and "home entertainment equipment and services." The new core CPI measure (hereafter simply "core CPI") removes the eight most volatile of these 54 components from the total CPI and then modifies the remaining factors to eliminate the impact of alterations in indirect taxes. The eight excluded elements include fruit, vegetables, gasoline, the fuel oil, natural gas, intercity transportation, tobacco, and mortgage-interest costs.

As shown in Table 1, six components were excluded from core CPI, including fruits, vegetables, meat, as well as fish and other seafood, bakery and other cereal products, and dairy products and eggs.

Table 1. *Components Excluded from Core CPI*

Component	weight in total CPI	Standard deviation
Fruit	5.51	14.2
Vegetables	3.46	8.5
Meat	5.31	6.7
Fish and other seafood	0.61	5
Bakery and other cereal products	0.26	18.6
Dairy products and eggs	2.96	5.5

Figure 1 displays the method of removing the volatile items and the realized inflation together. As shown, the realized inflation has more fluctuations than the core inflation.

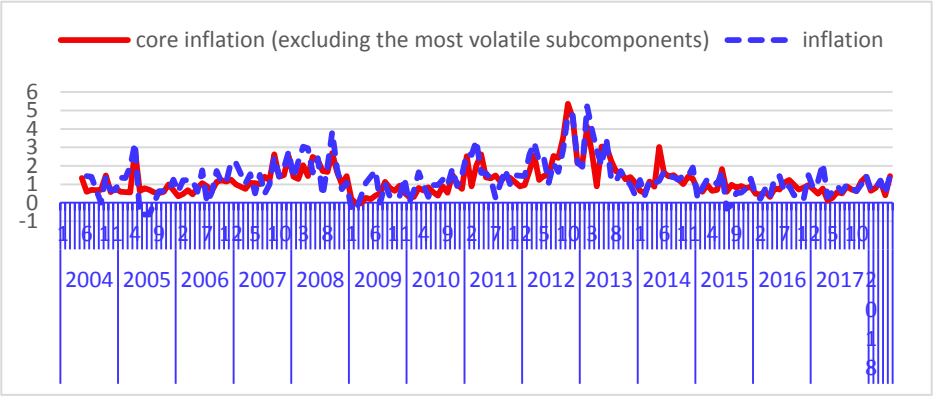

Figure 1. *Inflation and core inflation (excluding the most volatile subcomponents)*

3.2. THE TRIMMED MEAN TECHNIQUE: A LITTLE OFF THE TOP (AND BOTTOM)

Then, how decisions are made regarding excluding or including items more rigorously. In their study on the CPI and PPI, Bryan, Cecchetti (1993) made a statistical case for using trimmed means as a technique for calculating core inflation. The concept of a trimmed mean is simple despite the arcane-sounding name. In other words, trimmed means should be familiar with any follower of the international figure skating. Following contradictions regarding judging at the 2002 Winter Olympics, the International Skating Union adopted a scoring system in which a skater's highest and lowest marks were moved before computing his/her average score.

This section summarizes the process of calculating inflation measures by the symmetrically- and asymmetrically-trimmed-mean techniques that are centred on the 50^{th} percentile of the distribution and percentile different from the 50^{th}, respectively. The well-known symmetrical truncation method essentially includes arranging sample variations, removing (truncate) the tails of the distribution, and averaging the remainder.

Regarding data which run from 2004M5 through 2017M12, the value of trimming that decreases the distance between the inflation rate of the trimmed mean and the proxy for the actual core inflation rate becomes substantial. The optimal trim reduces severely the top 15% of elements (as a fraction of expenditures) and the bottom 15%. More precisely, 15 and 15% of expenditure

components, whose prices increased and decreased (or increased the least) the most, respectively, are discarded from the data of each month.

Figure 2 displays trimmed mean method and realized inflation together. As shown, the realized inflation has more fluctuations than the core inflation.

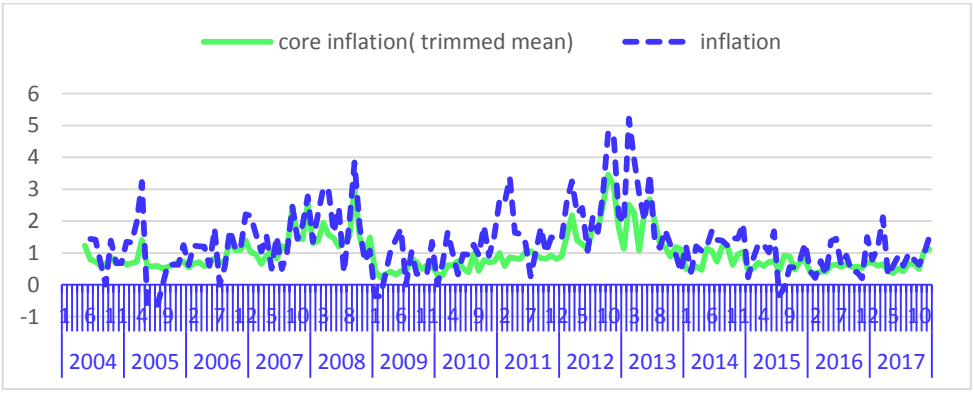

Figure 2.*Inflation and core inflation (trimmed mean)*

3.3. WEIGHTED VARIANCE METHODS

Exclusion techniques eliminate an entire group of items from the price indices based on previous judgment indicating that their effect on inflation rates is changeable and non-lasting. The refinement of these methods to simply recalculate the price indices based on volatility measure. Thus, non-volatile components within a group of otherwise excluded components can still be allowed to affect core inflation measurement. In addition, the influence of variable components may decrease in other non-excluded item categories. A downside is normally less simplistic and clear-cut method although the involved computations are merely complicated.

Weighting individual elements based on previous volatility can be performed by several methods although a commonly known technique is to assign weights inversely associated with the standard deviation of individual prices. Accordingly, the respective weight for each of the 85 item categories constituting the CPI is represented by the following formula.

$$w_{i,t} = \frac{\frac{1}{\sigma_{i,t}^2}}{\sum_{i=1}^{N} \frac{1}{\sigma_{i,t}^2}} \qquad (1)$$

Where σ denotes the standard deviation of monthly inflation rates for each item over the last five years.

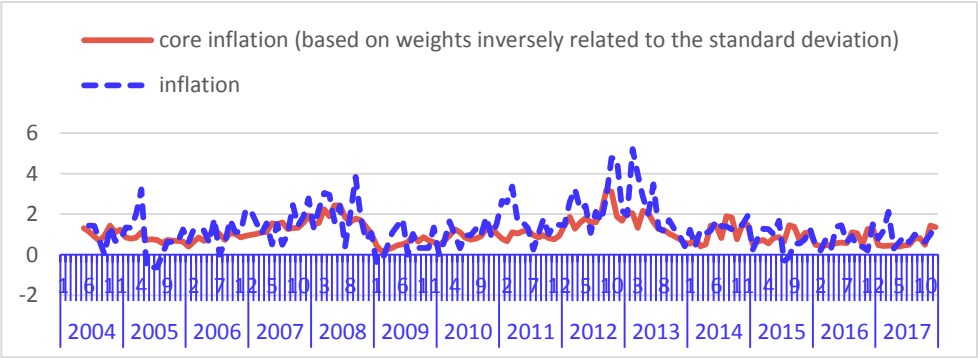

Figure 3.*Inflation and core inflation (based on weights inversely to standard deviation)*

3.4. WEIGHTED MEDIAN METHOD

The weighted median technique considers the median price movement of the subcomponents of the official measure (the CPI) for a certain month. Then, each movement is weighted based on its significance within the basket for the intended month.

Bryan and Pyke first proposed this technique in 1991. Given that this idea is not a new one (dates back to 1922), Fisher suggested that an index be computed by employing weighted medians.

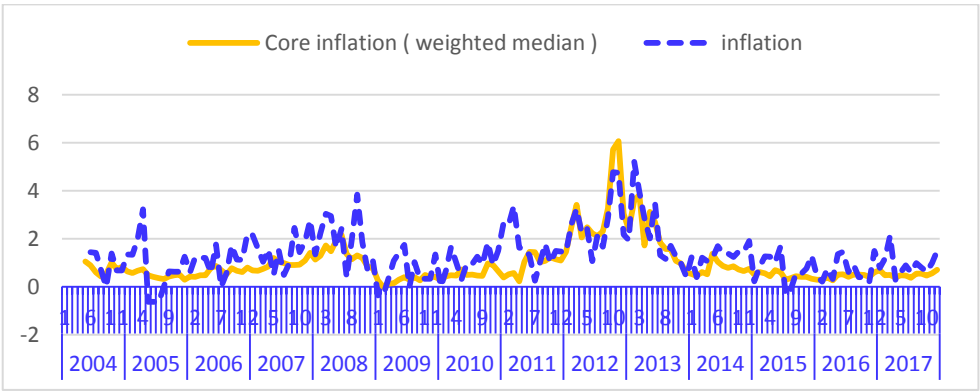

Figure 4.*Core inflation (weighted median)*

4. Economic model-based methods

Two main approaches are available for measuring core inflation. The first and more technical technique calculates a VAR model and then utilizes the long-

run constraints implicit in the definition of core inflation in order to determine core inflation. The interesting aspect of this approach is the endeavour to create a connection between core inflation and its fundamental economic determinants, most essentially monetary policy variables.

Quah and Vahey (1995) supposed that inflation movements are described by two structural shocks that are categorized by their impact on the output.The first shock may influence the output level in the long run compared to the second or cross shock. Thus, their structural model is presented as follows.

$$\begin{bmatrix} \Delta lnY_t \\ \Delta \pi_t \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} + \sum_{j=0}^{\infty} \begin{bmatrix} \alpha_{11,j} & \alpha_{12,j} \\ \alpha_{21,j} & \alpha_{22,j} \end{bmatrix} \begin{bmatrix} e_{1,t-j} \\ e_{2,t-j} \end{bmatrix} \quad (2)$$

where inflationπ_t and output $lnY_t$are I (1) but not cointegrated and the assumption that a core shock represents output neutral indicates that the cumulative impact of the second shock on output is equal to zero. Considering the economic theory, core inflation is defined as theelement of the measured inflation which is output neutral in the long run, namely, the part which corresponds to the impact of the second shock.

$$\Delta {\pi_t}^c = v_2 + \sum_{j=0}^{\infty} \alpha_{22,j} e_{2,t-j} \quad (3)$$

In this regard, it should be mentioned that, in this framework, core inflation is only identified up to a constant,and only the alteration in core inflation is calculated by the identification scheme instead of its level.

5. CORE MEASURES USING DATA TIME-SERIES PROPERTIES

The first branch seeks to determine the transitory elements of inflation (“noise”) which normally demonstrates seasonal movements, volatile supply shocks, or once-and-for-all relative price shocks. Then, it eliminates these components from headline inflation in order to obtain core inflation. However, the identification of such elements depends on hindsight or from practice in other countries that have adopted this technique. Accordingly, the implicit supposition of this approach indicates that, in the future, inflation components represent parallel behaviours as in the past. Therefore, this technique is extensively employed by monetary authorities worldwide.

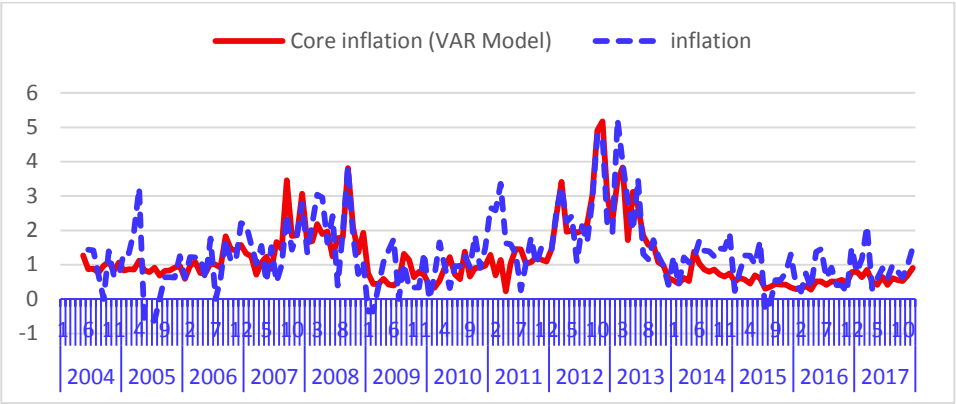

Figure 5. *Inflation and core inflation (VAR Model)*

6. TESTS FOR THE MEASURES OF CORE INFLATION

Marques et al. (2000) proposed the following required conditions, indicating that the measures of core inflation π^* should be met for them in order to be beneficial indicators of the future path of target inflation.

1. Target and core inflation should be co-integrated with the unit coefficient, which is checked in two stages. In this regard, an ADF test was performed to establish the stationary of $(\pi_t - \pi_t^*)$, followed by testing the null hypothesis that $\alpha = 0$ is in the static regression considering that $(\pi_t - \pi_t^*)$ is stationary.

$$(\pi_t - \pi_t^*) = \alpha_i + \varepsilon_t \quad (4)$$

2. Core inflation should be an attractor of target inflation. Thus, the following error correction model was computed to test this condition.

$$\Delta\pi_t = \sum \alpha_i \Delta\pi_{t-i} + \sum \beta_i \Delta\pi_{t-i}^* - \gamma(\pi_{t-1} - \pi_{t-1}^*) \quad (5)$$

Next, the hypothesis of $\gamma = 0$ was tested by applying conventional t-statistics. Hypothesis rejection demonstrated that π_i^* is an attractor of target inflation and that target inflation converges core inflation in the long term.

3. Target inflation should not be an attractor of core inflation. Therefore, the following error correction model was estimated to check this condition.

$$\Delta\pi_t^* = \sum \delta_i \Delta\pi_{t-j}^* + \sum \theta_i \Delta\pi_{t-j} - \lambda(\pi_{t-1} - \pi_{t-1}^*) \quad (6)$$

Then, the hypothesis of $\lambda = 0$ was examined by utilizing conventional t-statics, and the failure to reject the hypothesis indicated that π is not an attractor of π_t^* and core inflation fails to describe target inflation in the long run.

Marques et al. (2000) suggested the following testable conditions when the targeted and candidate rates of core inflation are found to be non-stationary.

I. Targeted (π_t) and core inflation (π_t^*) should be co-integrated with unit coefficient;

II. Core inflation should be an 'attractor' of the targeted inflation;

III. Targeted inflation should not be an 'attractor' of core inflation (i.e., core inflation should be weakly exogenous). The test attraction implies that it should seek to formalize the connection between targeted and core inflation by employing data which are included in the differential between the two elements.

Cointegration techniques should only be applied to series which are I (1). The application of cointegration tests for evaluating the measures of core inflation is valid, at least statistically, since RPIX inflation and the measures themselves are found to be I(1) in standard unit root tests. The finding that RPIX inflation and different measures of core inflation are not I (0) is not remarkable considering that inflation has fallen over the sample of the tests.

Table 2. *Results*

Column	1	2	3	4
Statationary of $(\pi_t - \pi_t^*)$		$\alpha = 0$ Given stiationary	$\gamma = 0$	$\lambda = 0$
Excluding the most volatile subcomponents	Yes(-2.96)	NO(0.00)	NO(0.00)	NO(0.00)
Based on weights inversely related to the standard deviation	Yes(-2.90)	NO(0.00)	NO(0.00)	NO(0.00)
Trimmed mean	Yes(-3.56)	NO(0.00)	NO(0.00)	NO(0.00)
weighted median	Yes(-3.05)	NO(0.00)	NO(0.00)	NO(0.00)
VAR Model	Yes(-2.66)	NO(0.00)	NO(0.00)	NO(0.00)

Columns 1 and 2 report the results of the tests of condition (i).In addition, columns 3 and 4 present the results related to the tests of conditions (ii) and (iii), respectively.

Column 1: Reports the ADF statistics of the unit root tests of the stationary of (πt - πt*) and Yes/No represents that the series is/is not stationary.

Column 2: Provides the p-value on the null hypothesis that $\alpha = 0$ in the regression **(C1)** and Yes/No indicates that α is not/is significantly different from zero.

Column 3: Presents the p-value on the null hypothesis that $\gamma = 0$ in regression **(C2)** and Yes/No indicates that γ is not/is meaningfully different from zero.

Column 4: Demonstrates the p-value on the null hypothesis that $\lambda = 0$ in regression **(C3)** and Yes/No implies that λ is not/is significantly different from zero.

7. CONCLUSION

In general, estimating the current level of inflation is considered as one of the most important inputs for monetary policymakers, while controlling core inflation has not been emphasized in monetary policy. However, it seems that controlling core inflation is the goal of monetary policy due to the frequency and emphasis on core inflation in the United States.

Basically, a lot of the discussion on monetary policy, even within the assemblies of many central banks, is related to changes in subsets of prices instead of observing and measuring changes in total prices, the most famous of which is called core inflation including all prices except those related to food and energy. In addition, some important criticisms are related to the criterion of core inflation. Fase and Folkertsma (1996) have serious criticisms of the elimination or low weighting of highly volatile sectors for monetary policy purposes because they believe that there is no convincing reason for limiting our attention to the changes in consumer final price. There is no change in the prices received by the producers or changes in the prices of intermediate goods or changes in the prices of the assets because all contain information about monetary inflation.

In this study, core inflation was calculated by using common methods used in central banks. Based on the results, coa-fuzzy, median, volatile component elimination, trimmed mean, and variance contrast methods had respectively better prediction for inflation in Iran during 2004-2017. However, the variance contrast method is slightly correlated with inflation.

After collecting the monthly data during 2004M5-2017M12, the results indicated that the core inflation calculated through the trimmed mean method performed better than other methods in predicting actual inflation, and had lower bias, as well as co-integration tests. The cointegration test showed that core inflation obtained by the trimmed mean method follows the realized inflation better in the long run.

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