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Various Core Inflation Estimates for Kazakhstan

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Orlov K., Seidakhmetov A.

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Orlov, Konstantin[1]
Seidakhmetov, Ansar[2]

Abstract

Central banks pursuing the inflation targeting policy need to monitor current trends in the development of price processes and highlight key changes that are of a permanent nature. In this regard, in addition to the CPI, central banks closely monitor other price changes, among other things often building separate core inflation indices that characterize stable trends and are related to other macroeconomic indicators. In this paper, we make estimates of core inflation using several methods from different classes, evaluate and compare them with each other, and study the relationship between core inflation and other macroeconomic variables.

Key Words: inflation, core (trend) inflation, factor models, state space models.

JEL-Classification: C19, C32, E31, E37

[1]Konstantin Orlov – Deputy Head, Macroeconomic Forecasting and Research Division, Monetary Policy Department, National Bank of the Republic of Kazakhstan. E-mail: Konstantin.Orlov@nationalbank.kz

[2]Ansar Seidakhmetov – Leading Specialist-Analyst, Macroeconomic Forecasting and Research Division, Monetary Policy Department, National Bank of the Republic of Kazakhstan. E-mail: Ansar.Seidakhmetov@nationalbank.kz

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1. Preamble

Central banks adhering to the principles of inflation targeting, in the course of monetary policy implementation need a full understanding of the dynamics of inflation as a process of sustainable price growth. Usually, the consumer price index (CPI) acts as the main benchmark and target, but this value is often subject to various temporary shocks of individual goods and services and may not reflect the current price trend as well as possible future trends. Core inflation (or trend inflation) should have such properties – a theoretical concept that macroeconomists try to evaluate using various methods. At the moment, in order to analyze the current situation, the National Bank of the Republic of Kazakhstan uses several methods, which are presented in the study (Orlov, Yerzhan, 2019).

In addition to the National Bank, currently only the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan ("the ASPR BNS RK") deals with the estimation of core inflation on a permanent basis. However, the ASPR BNS RK uses only few methods of elimination[3], without seasonal adjustment, which may be insufficient for a comprehensive view on inflationary processes (The Methods for Computing the Base Consumer Price Index, 2016).

In this regard, the purpose of this study was to expand the range of methods used in the National Bank, as well as to compare them according to various criteria. Thus, the methodology for estimating core inflation with the help of methods from various classes such as methods of elimination, truncation, weight alterations, filtering, and applying state space models, is presented. At the same time, many estimates were considered in each class in order to broadly cover the approaches to estimating core inflation that are currently available in the literature. This fact was based on that often one or another method of estimating core inflation does not have all the properties that economic theory imposes on it.

The work consists of several parts. The first section provides a review of the literature describing the application of various methods for estimating core inflation, the second section describes the data used and the estimation methodology, and the third section based on the obtained time series examines their statistical properties as well as their relationship with the traditional CPI and other macroeconomic indicators. Finally, the fourth section presents findings and recommendations for future research.

2. Literature Review

By virtue of the fact that the CPI as a measure of inflation that is most understandable to the general public and the most popular can be influenced by various temporary noises and changes in relative prices, economists have thought about determining such price change that would have the properties of stability, generality

[3] Since 2021, the ASPR BNS RK has ceased to publish estimates of core inflation by truncation methods, leaving only methods of elimination of a fixed set of goods and services (as of the end of January 2023)

(that is, would reflect the general price change) and could serve as a benchmark for future inflation. Understanding the dynamics of such value is necessary, first of all, for central banks whose mandate is the price stability, since the impact of monetary policy on changes in prices for goods and services is of a general and long-term nature (1-2 years) and does not extend to their relative change. In this regard, almost all central banks of the world, for example, in Canada, the USA, Norway, Japan, Korea, the Czech Republic, and emerging markets, monitor and in some cases publish individual series of core inflation.

At present, there is no generally accepted definition of core inflation, but Eckstein (1981) interpreted core inflation as "the rate that would occur on the economy's long-term growth path provided that the path were free of shocks and the state of demand were neutral." According to this paper, the CPI without food and energy-related goods was the first such measure. As defined in (Bryan and Cecchetti, 1994), core inflation is "the long-term or persistent component of a measurable price index that is related in some way to the growth in money supply". In the work of (Quah and Vahey, 1995), core inflation is "as that component of measurable inflation that has no medium or long-term effect on real output." Since the monetary policy is assumed to be output-neutral in the long run, core inflation will be the portion of inflation that can be influenced by the monetary policy.

Later, the works of (Roger, 1998) and (Wynne, 1999) presented a number of required features of core inflation such as:

- unskewness (that is, the same average) relative to the CPI;
- stability over time, when new data becomes available. The problem refers mainly to filtration methods and methods based on model estimates;
- ability to predict future inflation;
- the understanding by the central bank top management and the public at large when the central bank uses such indicators in its communication policy (internal and external);
- relationship with macroeconomic variables.

As the experience with core inflation estimates shows, no single indicator can fully satisfy these criteria, and therefore the use of a variety of different estimates is recommended (Mankikar and Paisley, 2004). When these methods show generally the same results, we can talk about the good quality of core inflation estimate (Silver, 2007; Laflèche T. et al, 2006). At the same time, if these estimates differ, this can provide additional insight into inflationary processes.

The paper of (Silver, 2007) presents a classification of existing methods for estimating core inflation. Thus, the methods are divided into methods of elimination, truncation, weight alteration, filtering (trend extraction) and the use of various modeling techniques. To one degree or another, central banks use all of the above methods.

Methods of Elimination

These methods are viewed as the simplest and understandable to the general public and may serve as an operating benchmark for inflation (Laflèche et al, 2006). In their simplest form, they represent an exclusion of the most volatile and manageable components of inflation from the computation; in the United States, in particular, these are food and energy products (Eckstein, 1981). There is also an exception for transportation services, utilities, mortgage payment services and the impact of indirect taxes, for example, CPIX for Canada with an exception of 8 components in operation (Laflèche et al, 2006).

The main disadvantage of these classes of methods is the exclusion of components that may contain future price trends, and, conversely, the possible ignoring of the exclusion of components containing noise. In this regard, in addition to this traditional method, central banks pay attention to other methods of elimination. For example, in (Pedersen, 2005) and (Deryugina et al., 2015), the most volatile components for a certain moving period acted as excluded components. This approach enables to only partially eliminate the listed shortcomings and achieve the desired results.

Truncation Methods

Another common method of computing core inflation is to truncate at each month the ordered distribution of price changes in the CPI components. The truncation refers to extremes of the price change, which mainly reflect relative price change and, in theory, should not be related to core inflation. Subsequently, the remaining components are combined into a new measure proportionally with the new weights, summing up to 1. An extreme case would be the median of the distribution, where a 50% truncation applies at both ends.

This method was first proposed in (Bryan and Ceccehetti, 1994), where a 15% trimmed mean and median were calculated for the US data. The results showed that the median had the best ability to predict future inflation and had a high correlation with lagging money supply. Later, due to its simplicity and generally acceptable properties, this method became firmly established in the core inflation estimation toolkit of almost all central banks and individual researchers.

With regard to recent work, Alsabban et al. (2022) examined the properties of the 25% trimmed mean in the case of Saudi Arabia in the context of phasing out oil dependence by 2030. It was confirmed that this measure of core inflation has a close relationship with the inflation trend, has the capability to predict future inflation and is thus free of supply shocks in the context of economic restructuring.

It is worth mentioning that the main problem when using this method is to determine the size of truncation and its symmetry, since a certain level of truncation may not lead to the desired properties of unbiasedness, closeness with the inflation trend and predictive power (Rich et al., 2022). So, in the works (Tsyplakov A. et al., 2004), (Meyer, Venkatu, 2014), (Deryugina et al., 2015), asymmetric filters and their properties were considered. In addition, in (Rather et al., 2016) a method to obtain truncation sizes, minimizing the skewness of the remaining distribution was provided.

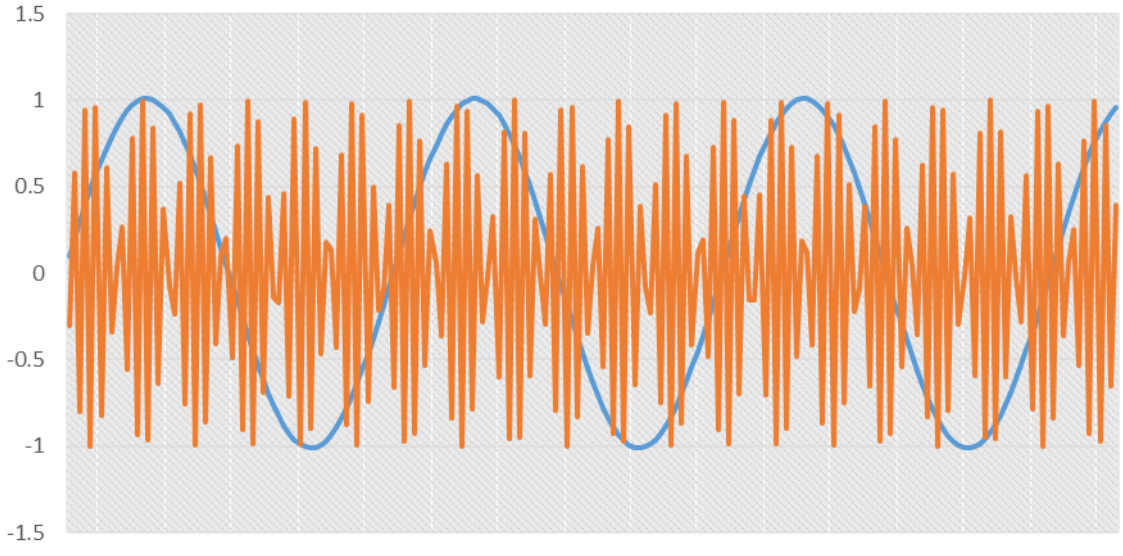
Methods of Weight Alterations

This class of methods appeared and developed as a result of attempts to overcome the shortcomings of elimination methods, when certain components are not removed, but they are given less weight. (Laflèche et al, 2006) estimated core inflation by weighing each component as the product of its CPI weight and a reciprocal of the component's volatility. This value turned out to be unskewed, less volatile than the CPI, and contained information about future inflation. In (Çeliku, 2009) and (Deryugina et al., 2015), this approach was also considered as one of the methods for estimating core inflation used in central banks.

In addition to volatility, the concept of persistence is often used as a weight criterion. The persistence of the time series characterizes the duration of a certain trend and characterizes the degree of absence of noise, thereby proving the need for core inflation to have such a property. At the same time, the concept of persistence does not coincide with volatility (Figure 1). Therefore, excluding or giving less weight to volatile but stable components can lead to misleading conclusions about the dynamics of core inflation. Thus, (Silva et al., 2015), using the example of oil prices behavior from 1999 to 2012, showed that changes in relative prices can be quite long-term and have secondary effects in the form of an increase in prices for other goods and services, which demonstrates the need to take into account oil prices in the dynamics of core inflation, regardless of its volatility.

Figure 1

Two Time Series with Equal Variance (Volatility) but Different Persistence



Source: the authors' computations

Persistence of the CPI components may be computed by using different methods but the most common would be the sum of autoregressive coefficients of the following type of equation

$$\pi_t^i = \alpha_j + \sum_{k=1}^{q_i} \rho_{t-k}^i \pi_{t-k}^i + \varepsilon_t^i, \quad (1)$$

where π_t^i – i–th CPI component versus the preceding month, q_i – the value of maximum lag, which is either initially set or estimated using the Schwartz information criterion. Moreover, if the persistence of the component turned out to be negative, then its new weight will be equal to 0.

This method of estimating core inflation was used for the UK in (Cutler, 2001), for EU countries – (Bilke, Stracca, 2007), for Albania - (Çeliku, 2009), for Brazil - (Silva et al., 2015), for the USA - (Gamber, 2016) and generally showed its viability in comparison with other methods. In addition, (Silva et al., 2015) and (Gamber, 2016) looked at weights that take into account both the persistence and initial weights of the components. Moreover, in (Silva et al., 2015), core inflation that takes into account both volatility and persistence, and the initial weights of the components was constructed.

Finally, in (Bilke and Stracca, 2007), correlations of components with the general CPI index were used as new weights.

Thus, as a result of applying the methods of weight alterations, we obtain a new ordered distribution of price changes. We can apply, as in (Gamber, 2016), truncation methods to such distribution, for example, the computation of the median.

Filtering Methods

According to the fundamental work (Eckstein, 1981), "core inflation is the trend rate of increase of the price of aggregate supply". At the same time, in the economic literature, various smoothing and filtering methods are often used to find a trend in time series, which enable to clear the series of excessive noise. Having such advantages initially, these things can be subject to significant revision due to the addition of new points and are usually used less frequently than other methods (Silver, 2007). The use of such methods can be found in recent works for the USA (exponential smoothing – Rich, 2007) and Russia (spectral filter – Deryugina et al., 2015). At the same time, in the study of (Bashar, 2011) for Bangladesh, the decision was made to abandon the use of filtering methods (moving average, exponential smoothing, HP filter, BP filter) since the resulting time series did not meet the required criteria.

However, the smoothed nature of the dynamics of such series enables to use them as a retrospective estimate of core inflation, and the amount of deviation from them as a criterion for evaluating the properties of one or another estimate of core inflation (Shiratsuka et al, 2015). Moreover, the method of data filtering by means of wavelets has proven its worth in a number of works on the estimation of core inflation.

The essence of the method lies in the fact that any time series can be decomposed into components in terms of time and frequency and, in this regard, they can take into account the properties of the time series both in time and in different fluctuation frequencies (that is, to distinguish from short-term noise to a long-term trend). This approach allows solving the problems of the Fourier transform, when the frequency decomposition is applied to the entire time interval and can be distorted because of the presence of various local shocks.

Among recent works, the positive experience of applying this principle in New Zealand (Baqaee, 2010), the USA (Dowd et. al, 2011), South Africa (Du Plessis et. al, 2015), and Pakistan (Hanif, 2020) can be pointed out. These studies make a point that such approach is at least as good as traditional estimates of core inflation and surpasses them in terms of some criteria.

An illustrative review of using wavelets in the estimation of core inflation is presented in the study by (Baqaee, 2010).

Methods of Models Application

The use of the model toolkit in constructing core inflation estimates is intended to take into account elements of the economic theory. Thus, the first such approach is to build a SVAR model. In (Quah and Vahey, 1995), the view of core inflation as neutral with respect to output in the long run was implemented through factoring appropriate constraints on shocks into the model. Despite a solid theoretical foundation, this approach contains a number of such complexities as sample dependence, model specification, and the problem of obtaining up-to-date estimates. Among recent works that used the approach of a structural vector model, it is worth mentioning the work (Martel, 2008) of the Bank of Canada, where the model included the price of oil and labor (Deryugina et al., 2015), and where structural constraints were imposed on the shocks of the factor model.

Another approach for estimating core inflation is to use state space models estimated by applying the Kalman filter. The advantage of these models is their economic interpretation, and the disadvantage is the limited number of variables used without imposing additional prerequisites. Thus, the work (Dementiev, Bessonov, 2012) provides a specification that can be used to estimate core inflation

$$\pi_t^* = \pi_{t-1}^* + u_t \quad (2)$$
$$\pi_t^i = \pi_{t-1}^* + \varepsilon_t^i,$$

where π_t^* – a general component, π_t^i – a change in prices of *i*-th component, u_t – general noise of all components, ε_t^i – specific noise. A similar specification is presented in the components, and the second reflected the relative change in prices. In addition to price variables, other macroeconomic variables were also used in (Amstad et al., 2014) to estimate the general component.

In addition, (Reis et al., 2010) proposed to isolate a general component from the price changes of the components, called “net inflation”, which equally (the coefficient is 1) affects all components and does not correlate with changes in relative prices in any period of time. This approach was looked at in (Brzoza-Brzezina et al., 2009) for Poland, (Humala et al., 2012) for Peru, (Deryugina et al, 2015) for Russia.

Finally, the general component tool can also be used to validate stylized facts about the economy. Thus, in (Guðlaugsdóttir et al., 2018) it was shown that the dynamics of core inflation in Iceland estimated using the factor model is determined by imported inflation, which is not surprising for the island country.

3. The Data and Methodology Used

3.1 Data Description

To apply various methods of core inflationestimation, time series of the monthly price growth rate of 66 CPI subgroups (Appendix 1) were used, which were previously seasonally adjusted according to the methodology presented in (Orlov, Yerzhan, 2019). Deseasonalization is necessary to obtain a smoother series so that the time series does not have excessive volatility due to the seasonal factor alone and there is comparability between components with and without explicit seasonality. The deseasonalization procedure is used by many central banks, for example, in the Russian Federation (Deryugina et al, 2015), Turkiye (Tekatli, 2010), the ECB (Bilke, Stracca, 2007), Korea (Kim et al., 2009), Saudi Arabia (Alsabban, 2022), Canada (Khan et al, 2015).

In turn, the above-mentioned groups of goods and services are used in forecasting inflation at the National Bank of Kazakhstan (Tuleuov O., 2017). Thus, this breakdown aligns the procedures for deseasonalization, core inflation estimation and forecasting, thereby improving the analysis of inflationary processes. At the same time, in order to further implement regular and efficient procedures for core inflation estimation, updated price data on goods and services and their groups are downloaded from the Taldau information and analytical system ("the Taldau"). Due to the lack of price data in the Taldau for all groups of goods and services until January 2011, it was decided to use the data from January 2011 until present. All algorithms for estimating core inflation presented in this paper as well as procedures for their comparison with each other and their pseudo-real estimates, were implemented in the Eviews 12 statistical package.

3.2 Methodology for Constructing Various Core Inflation Estimates

Methods of Elimination

Several methods of elimination were used in this work. First of all, this is a deseasonalized CPI without 7 components, similar to the indicator computed by the ASPR BNS RK without deseasonalization. The second method was to exclude the 8 most volatile components over the past 2 years, similar to the approach used by the Bank of Canada (Laflèche et al, 2006) and the Bank of Russia (Deryugina et al, 2015). Additionally, similar indicators were computed for the 13 and 25% most volatile components over the past 2 years, which is generally consistent with the ASPR BNS RK method of elimination in terms of the number of excluded groups (7 ASPR BNS RK components turn into 13 components, taking into account the breakdown into 66 groups) and the share of excluded groups (about 30% by weight and about 20%=13/66 by quantity). Historical results of the elimination are presented in Appendix 2 and Appendix 3.

Finally, a hybrid method was used to exclude components, which showed the least cooperativeness with the general component when applying the state space model, similar to the work of (Dementiev, Bessonov, 2012). The results of assessing the natural logarithms of the standard deviation of each component from the general

component are presented in Appendix 4. As can be seen from the results, the groups of fruits and vegetables, fuel and lubricants, food products with a predominance of imports, education services and utility services were excluded.

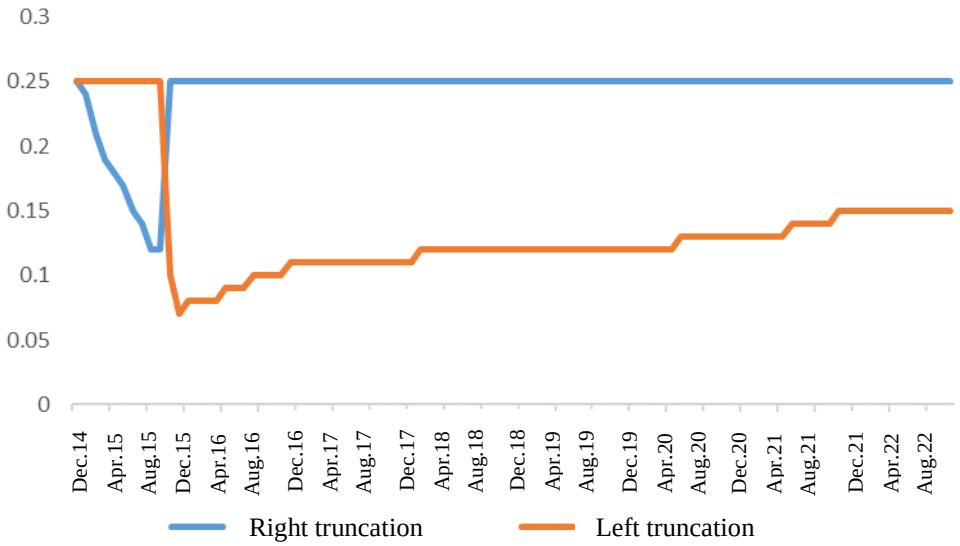
Sample Truncation Methods

In this class of methods, a truncation of 10% at both ends of the ordered distribution of monthly price changes, a weighted median as well as a method for determining the optimal truncation were looked at. The latter method chooses a truncation level at both ends in the range from 1% to 25% in 1% steps (625 options in total) in search of such option that would minimize the mean squared error between the modified core inflation computed for this truncation and the centered moving average of the deseasonalized CPI similarly to (Deryugina et al, 2015). The selected truncation options apply to the entire sample. Below are the results of optimal truncation in pseudo-real time (Figure 2), and Appendix 5 and Appendix 6 contain the historical results of applying these methods.

Finally, an optimal truncation method was used in the range from 1 to 25% at both ends (here, each month a different truncation scheme is selected) in order to minimize the bias of the remaining price distribution, similar to the work of (Rather et al., 2016). Historical estimation results are shown in Appendix 7.

Figure 2

Optimal Levels of Left Truncation and Right Truncation of the Ordered Monthly Price Change Distribution in Pseudo-Real Time Computations



Source: the authors' computations

Methods of Weight Alterations

Methods used in this section are similar to the works presented in the respective part of the Literature Review. Core inflation estimates were looked into, where new component weights had been defined as:

- the product of the reciprocal of component volatility for the last 2 years and the initial weight in the CPI;
- the reciprocal of component volatility for the last 2 years;
- the product of component persistence (one lag was taken for the computation) in the landmark window and the initial weight in the CPI;
- the reciprocal of component volatility (one lag was taken for the computation) in the landmark window, the reciprocal of component volatility for the last 2 years;
- the product of component persistence (one lag was taken for the computation) in the landmark window, and the initial weight in the CPI;
- the product of component correlation (henceforth with the lag of 6 months) with the CPI in the landmark window and the initial weight in the CPI;
- the reciprocal of RMSE component and the CPI trend expressed by a 24-month moving average;
- the product of the reciprocal of RMSE component and the CPI trend expressed by a 24-month moving average, and the initial weight in the CPI;

Since the new weight assignment results in a different price distribution, various truncation methods can be applied to it. Thus, for all distributions obtained above, the median was computed. In addition, the median was computed also for those price distributions where new component weights were based on persistence only[4].

Correlation of components with the CPI and their persistence are shown in Appendices 8 and 9, and the results of new weight assignments to the CPI components for October 2022 – in Appendix 10.

Filtering Methods

Exponential Smoothing

Unlike the moving average method, where all observations are weighted equally, with exponential smoothing, the "older" the observation, the exponentially less weight is assigned to it. The one-parameter exponential smoothing method is suitable for series that randomly move around a constant mean without a trend or seasonal patterns:

$$\hat{y}_t = \alpha \sum_{l=0}^{t-1} (1-\alpha)^l \, y_{t-l}, \quad (3)$$

where $0 < \alpha \leq 1$ – smoothing coefficient. This study used coefficient α, which is estimated recursively with the help of Single Smoothing procedure in Eviews12; in doing so, the smoothing per se was performed for each of 66 groups of goods and services, and then the series obtained were combined in one series based on their weight in the CPI (an indirect method).

Hodrick-Prescott Filter

[4] Due to the fact that in some periods this series was strongly isolated from the CPI dynamics and other estimates of core inflation, it was decided to take it into account only with reference to the initial weights

The Hodrick-Prescott Filter (HP) — is a smoothing method, which is widely used by macroeconomists to obtain a smoothed-curve estimate of the component of a long-term trend in a time series. This method was used for the first time in the work of Hodrick-Prescott (1997) to analyze the post-war cycles of business activity in the US.

The HP filter is a two-sided linear filter that computes a smoothed series *s* of variable *y* by minimizing the variance *y* around *s*, taking into account parameter λ that limits the second-order difference s. In its general form, the HP may be presented as:

$$\sum_{l=1}^{T}(y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1}((s_{t+1} - s_t) - (s_t - s_{t-1}))^2 \quad (4)$$

Parameter λ controls smoothness of a time series. As λ approaches infinity, *s* approaches a linear trend. The value λ=1 was used in this study. As in the case of exponential smoothing, filtering was applied to each of the 66 groups of goods and services, and then from the resulting series, taking into account their weights in the CPI, an estimate of core inflation was obtained (indirect method).

Bandpass Filter (BP-Filter)

Bandpass (frequency) filters are used to isolate the cyclic component of the time series by specifying the range of its duration. Therefore, in order to use bandpass filters, it is necessary to determine the periodicity of cycles. In the case of core inflation, the current trend of the inflationary background should be taken as the cycle. The cycle range is predetermined by the parametersP_L and P_U, presented as the quantity of leads and lags. In this study, the asymmetric full-sample band pass filter described by Christiano-Fitzgerald (2003) is implemented. Cycle ranges vary from min(P_L, P_U) = (3,6) to max(P_L, P_U) = (18.96). As before, filtering is applied to each of the 66 groups of goods and services, and then the resulting series are combined based on their weights in the CPI (indirect method).

Wavelets

The computation by this method was carried out in the context of various approaches. First, the chosen filtering procedure was applied only to the CPI series (direct method) or to all 66 components and then combined into one series based on the weights in the CPI (indirect method), and second, the transform method or the threshold method was used. For both methods, the maximum frequency was taken equal to 6, since the number of monthly observations was 142 ($2^{6+2} > 142$), and the type of transformation took into account the maximum overlap: for transforms – MOMRA (maximum overlap multiresolution analysis), and for thresholds – MODWT (maximum overlap discrete wavelet transform), so that to use series of any length without additional assumptions and not necessarily the length equal to the power of 2.

In our case, the transform method is a decomposition of a time series at different frequencies, with its help one can select a trend, a cycle and discard the noise:

$$\pi_t = S_t^6 + \sum_{j=1}^{6} D_t^j, S_t^0 = \pi_t, S_t^j = S_t^{j+1} + D_t^{j+1}, \quad (5)$$

where S_t^6 – is a trend component, D_t^j – a component with the period of motion within the range $[2^j, 2^{j+1}]$, S_t^j – a de-noised time series j with growth (from $S_t^0 = \pi_t$ to trend S_t^6). S_t^2, and S_t^3 were also looked at as a core inflation estimate. Moreover, the search was performed for all types of wavelets available in Eviews12 (Haar, Daubechies, Least asymmetric) based on the criteria of minimum deviation from the inflation trend expressed through a 12, 24- monthly moving average and HP14400-filter, minimum variance and minimum mean absolute deviation. The resulting value met all criteria; therefore, 4 core inflation estimates were obtained by using the transform method (direct or indirect method, S_t^2 *or* S_t^3).

In turn, the threshold method is the elimination of some wavelet coefficients. As in the case of the transform method, the search was performed according to the same criteria in the context of wavelet types, as well as all kinds of ways to compute the threshold values. Besides, cases were additionally considered when the wavelet length was limited to 12 and limited to 20 (for Daubechies, Least asymmetric). As a result of the search, the criteria for minimum deviation from the CPI trend, minimum variance and minimum deviation from the CPI itself gave three different estimates of core inflation, whereby 12 estimates of core inflation were obtained using the threshold method (direct or indirect method, a limitation for a wavelet length of 12 or 20, which of the 3 selection criteria was chosen).

Methods of Model Usage

State Space Model

This study assessed a state space model (unobservable components) similarly to the work by (Dementiev, Bessonov, 2012) with the following specification

$$\pi_t^* = \pi_{t-1}^* + u_t, var(u_t) = \exp(c(11)) \qquad (6)$$
$$\pi_t^i = \pi_t^* + \varepsilon_t^i, var(\varepsilon_t^i) = \exp(c(i)), i = 1, \dots, 10$$

where π_t^* – general component, π_t^i – a monthly change in prices of i-th component, u_t – composite noise of all components, ε_t^i – specific noise, $c(i)$ – parameters of variances estimated by using the Kalman filter. The estimation was made on 10 aggregated groups of goods and services, while this model was also used in estimating core inflation using the method of elimination described above. The results of this model are presented in Appendix 4.

Another model we estimated was similar to the first one, except that instead of 10 components (indirect method) we took the entire CPI versus the preceding month (direct method).

Dynamic Factor Model

A factor model is a statistical technique that converts the variances in a set of variables into the sum of one or more unobservable factors that reflect interrelated trends in the dynamics of these variables (Stock and Watson, 1989; Forni et al. 2000).

An obvious area of application of the factor model in macroeconomics is measuring core inflation. Thus, it can be assumed that the dynamics of individual components of the consumer price index in Kazakhstan are determined by both general factors of the economy and unrelated own shocks. Thus, it is supposed that with the help of factor decomposition it is possible to single out a general component of individual subgroups that constitute the CPI, which reflects the monetary nature of inflation. The factor model can be expressed in the general form as:

$$\pi_{i,t} = \Lambda_i F_t + \varepsilon_{i,t} \qquad (7)$$
$$\tilde{\pi}_t = \Lambda_i F_t$$

Each CPI sub-group ($\pi_{i,t}$) is related to the general factor (F_t), via factor loadings (Λ_i), and ($\varepsilon_{i,t}$) is a vector of idiosyncratic factors reflecting unrelated intrinsic shocks that are not correlated with F_t. Therefore, following the definition, core inflation in equation (7) is presented as $\tilde{\pi}_t$ (Khan et al., 2013). Besides, in order to reflect the dynamics of general component, it is assumed that the general factor follows some autoregressive process $AR(L)$. In this paper, L was taken equal to 1, and the general component was extracted from 66 time series of Kazakhstan's CPI. The number of factors that were taken to estimate the general component was 1, since the proportion of the explained variance of the factors following the first one was quite small. The results of such an analysis are given in Appendix 11.

Appendix 12 shows the values of correlation between the general factor and 66 CPI sub-indices, which were used to derive this factor as well as values of R^2 – the proportion of variation in group prices explained by the general factor. As can be seen, the general component is most "related" to imported goods (furniture, household goods, fish and seafood, clothing and footwear, etc.) and is less related to those goods whose pricing is regulated by the non-market methods (regulated utility services, fuel and lubricants, communication).

Hybrid Model

This method combines the truncation method and the use of adjustments obtained with the help of modeling techniques. For example, Rich et al. (2022) studied the relationship between the inflation gap (that is, the difference between core inflation and the CPI) and the skewness of price distribution, and found a significant negative linear relationship. At the same time, if we proceed from the criterion of the minimum deviation of core inflation from the trend, then a long, either positive or negative, gap means that core inflation strongly deviates from the inflation trend, which is well approximated by a moving average. This means that the median of price distribution, which is close in value to the symmetrical truncated averages of core inflation, systematically deviates from the mean of the price distribution (and that is the CPI!). Then, if the price distribution is constantly skewed in a certain direction (that is, the bias is different from 0), then the median and mean will deviate significantly, which will also apply to the constant deviation of core inflation from the CPI. In this regard,

the authors of the study propose to make an adjustment for the magnitude of skewness in estimates of core inflation computed by the truncation of the mean.

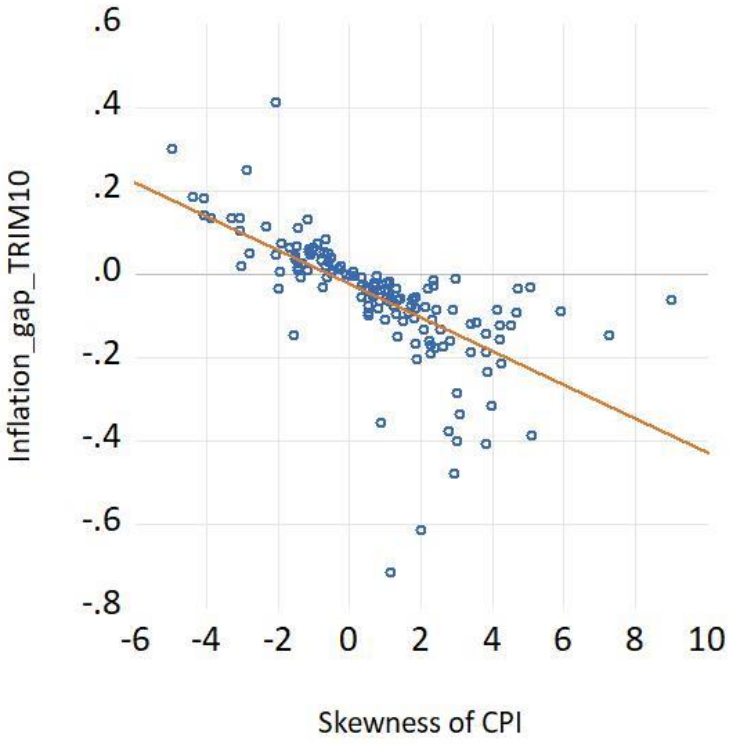
In turn, such dependence also is present in the case of Kazakhstan. For example, the figure below shows the relationship between the inflation gap computed using the 10% trimmed mean and the magnitude of skewness of price distribution (Figure 3).

This dependence was estimated using a standard linear model with one variable. The obtained coefficients are used to adjust the core inflation estimate by the method of trimmed mean (Rich et al., 2022).

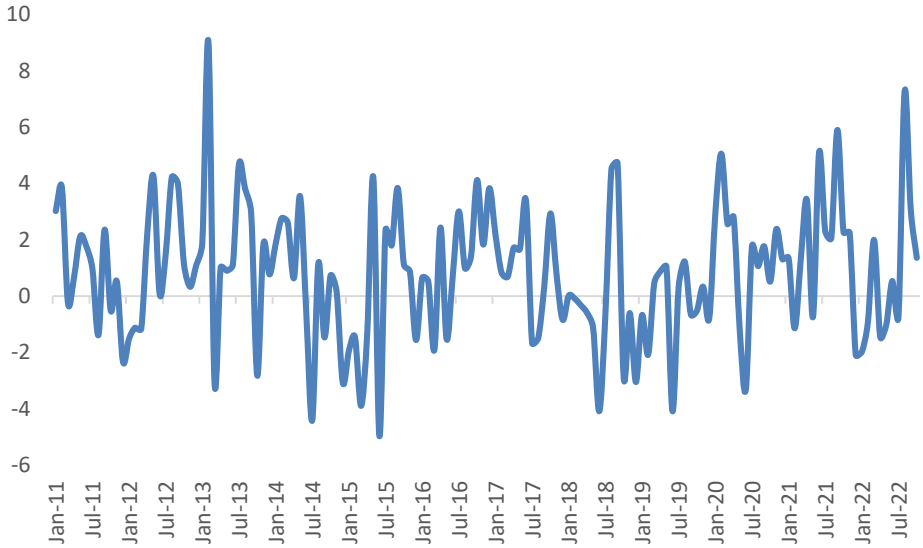
Figure 3

Linear Relationship between the Inflation Gap Computed Using the 10% Trimmed Mean and the Magnitude of Skewness of Price Distribution (a) and Skewness of Price Distribution (b)

(a)



(b)



4. Discussion of Outcomes

In total, 63 core inflation estimates in different classes have been computed. Detailed explanation of abbreviations henceforth used in the text and appendices is presented in Appendix 13.

Assessment Based on the Core Inflation Indicators

To select optimal core inflation indicators, we applied a set of necessary selection criteria based on the work of (Marques et al., 2003). Thus, according to the conclusions made by the authors, the optimal indicator of core inflation should satisfy the following conditions:

I. The difference between a core inflation indicator and the headline inflation presented as $\pi_t - \pi_t^*$, must be a stationary variable with a zero mean.

II. There is an error correction model that is defined as follows $z_{t-1} = (\pi_{t-1} - \pi_{t-1}^*)$ for $\Delta\pi_t$, which can be defined as:

$$\Delta\pi_t = \sum_{j=1}^{m} \alpha_j \Delta\pi_{t-j} + \sum_{j=1}^{m} \beta_j \Delta\pi_{t-j}^* - \gamma(\pi_{t-1} - \pi_{t-1}^*) + \varepsilon_t \quad (8)$$

III. π_t^* is exogenous for parameters in equation of condition II.

Condition I implies that inflation and core inflation cannot show a systematically divergent trend, otherwise the latter is likely to give false signals about the trend inflation. According to Kalra et al. (2018), in order to fulfill condition I, passing the $\pi_t - \pi_t^*$ of ADF stationarity test will be an insufficient condition. Even if $u_t = (\pi_t - \beta\pi_t^*)$ is stationary but $\beta \neq 1$, the headline inflation and underlying indicators tend to diverge. One of the ways to check this property is to perform the Wald test with $\beta = 1$ and $\alpha = 0$ in the following equation:

$$(\pi_t - \pi_t^*) = \alpha + (1 - \beta)\pi_t^* + \varepsilon_t \quad (9)$$

According to condition II, the trend inflation indicator should behave as a leading indicator of inflation. That is, Condition II implies that core inflation indicators provide some information about a future headline inflation. However, here Marques et al. depart from other literature on computing core inflation and argue that this condition does not mean that the optimal indicator of core inflation should have good predictive qualities. Therefore, coefficient γ in equation (8) must significantly differ from zero. It is worth mentioning here that the analysis of unobserved components following from the methodology of its construction, meets the first two conditions automatically (Bashar, 2011).

Finally, according to condition III it is important to get convinced that the second condition is not met conversely, that is, so that π_t would not be an attractor for π_t^*, and also so that π_t^* would not be sensitive to observed shocks π_t in the recent past:

$$\Delta\pi_t^* = \sum_{j=1}^{m} \delta_j \Delta\pi_{t-j}^* + \sum_{j=1}^{m} \theta_j \Delta\pi_{t-j}^* - \lambda(\pi_{t-1} - \pi_{t-1}^*) + \varepsilon_t \quad (10)$$

Thus, criterion III of the selection would be the condition that the coefficient λ in the equation (10) must slightly differ from zero or must be negative.

Resulting from the use of the above described procedures on the sample from 2016 through 2022[5], we examined 63 core inflation estimates (series in monthly terms) and selected those 15 (Table 1) that met all the criteria (complete table in Appendix 14).

At the same time, it should be noted that the extension and inclusion of the full period up to 2011 into the sample would lead to a significant deterioration in meeting these criteria. This confirms that significant price shocks (as it happened in Kazakhstan in 2015 due to a dramatic exchange rate depreciation) can significantly undermine core inflation estimates and their usefulness for a central bank (Pincheira-Brown, 2019).

Economic Meaningfulness.

The analysis of economic meaningfulness of computed core inflation indicators was performed in the form of a comparative analysis on several parameters. Thus, we apply several criteria for evaluating information content indicators. Criteria are mainly used to understand how much information each core indicator provides in relation to some macro variables.

Correlation with Macro Variables

The most obvious indicator of the economic meaningfulness of core inflation estimates is their relationship (correlation) with macro variables. The trend increase in prices of aggregate supply, i.e. trend inflation must be explained by fundamental factors (Eckstein, Otto 1981). The estimation was made on monthly data from January 2011 to October 2022. The results are provided in Appendix 15. The following variables were chosen as the fundamental factors in this study[6]:

- Broad money growth *M3*

[5] The sample shows the period after the transition to inflation targeting within the free floating exchange rate regime

6 Lags of macro variables are presented in the form of (n)

- Retail sales gap *Retail_gap*
- Exchange rate of the tenge against the US dollar *ER*
- Nominal income of the population *Nominal_income*
- Average nominal wage *Nominal_wage*
- TONIA Index *IR*

Table 1.

Selection of Core Inflation Estimates based on the Criteria of Optimality[7]

		1	2	3	4	5	6	7	8	9	10	11
1	Excl_8_sa	0.00	0.96	0.24	0.70	0.16	0.42	0.44	-0.83	0.03	0.19	0.39
2	Excl_13_sa	0.00	0.74	0.52	0.77	0.16	0.12	0.45	-0.84	0.03	0.19	0.41
3	Excl_25%_sa	0.00	0.98	0.40	0.70	0.11	0.08	0.48	-0.89	0.03	0.20	0.40
4	Persistance_one_mediana	0.00	0.41	0.68	0.45	0.05	0.03	0.22	-1.10	0.00	0.20	0.44
5	Persistance_volatility_mediana	0.00	0.16	0.25	0.38	0.06	0.01	0.26	-0.98	0.00	0.21	0.35
6	Wavelet_min_std_transform_direct	0.00	0.76	0.44	0.58	0.37	0.28	0.25	-0.30	0.47	0.14	0.37
7	Wavelet_min_std_transform_inderect	0.00	0.08	0.08	0.74	0.26	0.61	0.43	-0.72	0.02	0.20	0.37
8	Wavelet_min_std_transform_S3_direct	0.00	0.73	0.43	0.74	0.32	0.23	0.14	-0.62	0.12	0.12	0.33
9	Wavelet_transform_min_std_S3_indirect	0.00	0.18	0.10	0.75	0.22	0.54	0.51	-0.75	0.02	0.18	0.33
10	Wavelet_dev_thresh_direct	0.00	0.98	0.29	0.14	0.16	0.25	0.32	0.08	0.81	0.14	0.45
11	Wavelet_dev_tresh_short_direct	0.00	0.98	0.29	0.14	0.16	0.25	0.32	0.08	0.81	0.14	0.45
12	HP_smoothing	0.00	0.90	0.60	0.09	0.11	0.33	0.31	0.32	0.16	0.15	0.40
13	BP_12_24	0.00	0.99	0.77	0.42	0.09	0.02	0.06	-1.01	0.04	0.20	0.45
14	DFM_2stage	0.00	0.46	0.59	0.62	0.08	0.31	0.29	-1.01	0.01	0.23	0.45
15	Unobserved_components	0.00	0.70	0.24	0.09	0.23	0.37	0.33	0.30	0.52	0.14	0.39

Source: the authors' computations based on the data from the ASPR BNS RK

Notes:

1 - P-value ADF-test for difference between core inflation and the CPI in 2016-2022.

2 - P-value of a constant in the regression of difference between core inflation and the CPI over the constant in 2016-2022.

3 - P-value of the Wald test for cointegration between core inflation and the CPI in 2016-2022.

4 - P-value of the Wald test for predictive capability of core inflation in 6 months in 2016-2022.

5 - P-value of the Wald test for predictive capability of core inflation in 12 months in 2016-2022.

6 - P-value of the Wald test for predictive capability of core inflation in 18 months in 2016-2022.

7 - P-value of the Wald test for predictive capability of core inflation in 24 months in 2016-2022.

8 – Coefficient responsible for weak exogeneity of core inflation

9 - P-value of the preceding coefficient

10 - RMSE between core inflation and a 24-month moving average CPI in 2016-2022.

11 – A standard deviation of core inflation estimates in 2016-2022.

7 Significance estimates were obtained by estimating the Newey-West covariance matrix, which takes into account the autocorrelation and heteroscedasticity of residuals

Based on the results, on average there is the strongest relationship of core inflation with the exchange rate of the tenge against the US dollar (*ER*) as well as with the growth in money supply (M3).

A study by (Deryugina et al, 2015) suggests alternative methods of assessing the economic meaningfulness. Thus, in order to test the relationship with fundamental indicators, the authors proposed to use a simple model[8]:

$$w_t = \mu + \lambda\pi_{t-1} + \sum_{j=1}^{L} \Theta_j X_{t-j} + \sum_{j=1}^{L} \Omega_j w_{t-j} + e_t, \quad (11)$$

where w_t – is a quarterly rate of growth in nominal income of the population; π_t – an indicator of annual growth rates of core inflation; X – output gap.

Estimates were made based on the quarterly data for 2016-2022 with L=1. The meaningfulness of the inflation indicator for the income dynamics is characterized by the significance of coefficient λ, provided it is positive. The estimation results for all 63 core inflation indicators are shown in Appendix 16.

Estimate Stability in Real Time

The last and rather important criterion for evaluating core inflation indicators is the stability of its estimates over time. This problem is relevant for filtering methods and in applying the models. As shown in Appendix 17, the mean absolute difference for most indicators quickly reaches small values, which indicates the presence of stability in core inflation estimates by these methods for Kazakhstan.

Therefore, based on consideration of all 63 core inflation estimates, one can conclude that generally various core inflation estimates have sense and possess all necessary properties.

At the same time, given that Kazakhstan's economy is exposed to external shocks, due to its weak diversification, it is difficult to predict the behavior of inflation in Kazakhstan, which is also confirmed by the weak predictive capability of most of core inflation estimates in this paper. This is related to the fact that the coefficient of determination in the forecast equation for different periods does not look large enough to predict future inflation dynamics with confidence.

This problem is generally more typical for countries with emerging markets than for developed countries, when the economies of the former are more exposed to various shocks and contain a larger share of food products in their consumer baskets. This conclusion was reached, for example, in the study by (Pincheira-Brown, 2019), which considers the countries of Latin America. In the work of (Wiesiołek et al., 2009) for the countries of Eastern Europe (Czech Republic, Poland, Hungary), the weak predictive capability of some core inflation estimates was also observed, especially of the traditional estimates that are the easiest to explain to the general public.

In this regard, the shaping of inflation expectations and, consequently, the finding of an inflation target at low values in Kazakhstan is difficult, since the dynamics

[8] For detailed information and the reasons to use such models, see the study by Deryugina et al. (2015)

of sustainable price growth components assessed using a wide range of methods may not always unambiguously “predict” future inflation.

It is also impossible to univocally assert that one indicator will be an estimate of core inflation and a benchmark for monetary policy. World experience shows that all central banks analyze several indicators of core inflation to form an outlook on future policies. For this reason, we also recommend taking into account various methods as an assessment of the stable dynamics of price changes in the economy.

Thus, from 63 estimated time series of core inflation, we arranged into separate groups the methods of weight alterations without a median, weight alterations with a median, wavelets, BP filters, 3 estimates from the hybrid method of adjustment for skewness. In each of these groups, we find the median and then add the resulting series to the remaining core inflation series. The final estimate will also be the median of the reviewed series, and the maximum and minimum values will be the range of core inflation values. A similar trend is also used in the Bank of Russia (Deryugina et al, 2015).

Appendices 18-23 provide core inflation estimates as well as its estimates in pseudo-real time in monthly and annual terms.

5. Findings

In this paper, we provide an estimation of core inflation for Kazakhstan using several methods from different classes, evaluate and compare them with each other, and study the relationship of core inflation with other macroeconomic variables.

As a result, 63 estimates of core inflation were constructed using the methods of elimination, truncation, weight alterations, filtering, and the use of modeling techniques. The consistency of such estimates in the context of criteria accepted in the literature, the relationship with other variables (money supply, exchange rate, interest rate, nominal wage) was shown, and stability over time was proved. Nonetheless, the predictive capability of estimates deteriorated when considering the full data sample, including 2015 that was the peak year for monthly inflation; this is in line with other developing countries in the presence of price shocks. This result indicates that it is difficult to shape inflation expectations in Kazakhstan at low levels.

Finally, it was recommended to compute core inflation by combining individual indicators into one group, finding the median in this group, followed by inclusion into the final set of indicators to find the range of core inflation estimates.

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Appendix 1

List of 66 CPI Components (with Weights in 2022) Used to Compute the Deseasonalized CPI

#	Name of the Group of Goods or Services	Weight
1	Bread and bakery and cereals	6.75%
2	Meat	10.71%
3	Fish and seafood	1.49%
4	Dairy products, cheese and eggs	5.05%
5	Oils and fats	2.29%
6	Fruits	3.21%
7	Vegetables	2.94%
8	Sugar, jam, honey, chocolate and confectionery	2.75%
9	Food products not included in other categories	1.33%
10	Coffee, tea and cacao	1.44%
11	Mineral water, soft drinks, fruit and vegetable juices	0.80%
12	Alcohol beverages	1.18%
13	Tobacco products	0.77%
14	Materials for manufacturing of clothing	0.02%
15	Upper garments	6.27%
16	Other items of clothing and accessories	0.29%
17	Boots, shoes and other footwear	3.18%
18	Materials for maintenance and repair of residential premises	1.58%
19	Solid fuel	1.72%
20	Furniture, household goods, carpets and other floor coverings, their repair	1.69%
21	Textile products used in household	0.60%
22	Household appliances	1.02%
23	Glass ware, cutlery and housewaress	0.36%
24	Tools and implements used at home and in horticulture	0.16%
25	Goods and services used in housekeeping	1.47%
26	Medications, therapeutic equipment and instrumentation	1.66%
27	Purchase of motor vehicles	0.99%
28	Spare parts and accessories for personal motor vehicles	0.42%
29	Fuel and lubricants for personal motor vehicles	2.98%
30	Audio-visual equipment, photographic equipment and information processing equipment	0.69%
31	Other large-size durable goods for recreation and cultural activities	0.02%
32	Other goods and equipment for recreation, sports and gardening and home pets	0.33%
33	Newspapers, books and stationery	0.20%
34	Electric appliances of personal use	0.06%
35	Other articles, devices and personal goods	3.22%
36	Personal care items not included into other categories	0.56%
37	Clothing cleaning, repair and rental	0.22%
38	Footwear repair and rental	0.08%
39	Actual housing rental payment	2.78%
40	Services for maintenance and repair of residential premises	0.93%
41	Water supply	0.56%
42	Garbage disposal	0.28%
43	Sewage	0.20%
44	Other services related to upkeep of residential premises and not included into other categories	1.15%
45	Electricity	2.41%

46	Gas	1.28%
47	Thermal power	1.71%
48	Outpatient services	2.87%
49	In-patient services	1.32%
50	Maintenance and repair of personal motor vehicles	0.32%
51	Other services related to personal motor vehicles*	0.00%
52	Transport services	2.93%
53	Communication	4.28%
54	Services in the field of recreation, entertainment and culture	0.71%
55	Arranging all-inclusive leisure	0.08%
56	Pre-school and elementary education	0.83%
57	Secondary education	0.09%
58	Post-secondary education	0.21%
59	Higher education	0.78%
60	Education not subdivided into stages	0.02%
61	Public catering services	0.73%
62	Hotel service	0.01%
63	Services of hairdressers and personal service establishments	2.19%
64	Insurance	0.23%
65	Financial services not included into other categories	0.21%
66	Other services not included into other categories	0.42%

Source: ASPR BNS RK

** – starting from 2021, this category is excluded from the consumer basket*

Appendix 2

CPI Components Most Frequently Excluded from Computation of Core Inflation by the Authors Using the Method of Elimination of 13 Most Volatile Components in a Moving Two-Year Window (as % of 119 Observations)

#	**Name of the Group of Goods or Services**	**Frequency, %**
1	Vegetables	100
2	Fuel and lubricants for personal motor vehicles	81
3	Garbage disposal	80
4	Sewage	71
5	Fruits	65
6	Water supply	55
7	Sugar, jam, honey, chocolate and confectionery	55
8	Electricity	49
9	Arranging all-inclusive leisure	49
10	Thermal energy	48
11	Purchase of motor vehicles	38
12	Tobacco products	35
13	Solid fuel	31
14	Gas	30
15	Other large-size durable goods for recreation and cultural activities	29
16	Communication	29
17	Higher education	29
18	Electric appliances of personal use	28
19	Insurance	26
20	Other services not included into other categories	23
21	Transport services	22
22	Upper garments	21

23	Other items of clothing and accessories	21
24	Materials for manufacturing of clothing	20
25	Boots, shoes and other footwear	20
26	Furniture, household goods, carpets and other floor coverings, their repair	20
27	Textile products used in household	20
28	Household appliances	20
29	Glass ware, cutlery and housewaress	20
30	Services for maintenance and repair of residential premises	20
31	Other services related to personal motor vehicles	18
32	Materials for maintenance and repair of residential premises	17
33	Post-secondary education	16
34	Oils and fats	15
35	Audio-visual equipment, photographic equipment and information processing equipment	14
36	Pre-school and elementary education	14
37	Footwear repair and rental	13
38	Coffee, tea and cacao	9
39	Other services related to upkeep of residential premises and not included into other categories	9
40	Personal care items not included into other categories	7
41	Education not subdivided into stages	4
42	Dairy products, cheese and eggs	3
43	Newspapers, books and stationery	3
44	Financial services not included into other categories	3
45	Actual housing rental payment	2
46	Medications, therapeutic equipment and instrumentation	1
47	Bread and bakery and cereals	0
48	Meat	0
49	Fish and seafood	0
50	Food products not included into other categories	0
51	Mineral water, soft drinks, fruit and vegetable juices	0
52	Alcohol beverages	0
53	Tools and implements used at home and in horticulture	0
54	Goods and services used in housekeeping	0
55	Spare parts and mountings for personal motor vehicles	0
56	Other goods and equipment for recreation, sports and gardening and home pets	0
57	Other articles, devices and personal goods	0
58	Clothing cleaning, repair and rental	0
59	Outpatient services	0
60	In-patient services	0
61	Maintenance and repair of personal motor vehicles	0
62	Services in the field of recreation, entertainment and culture	0
63	Secondary education	0
64	Public catering services	0
65	Hotel service	0
66	Services of hairdressers and personal service establishments	0

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 3

Frequency of Appearance of Each of the 66 CPI Components in the Course of Core Inflation Computation by the Authors Using the Method of Elimination of 25% Most Volatile Components in a Moving Two-Year Window (as % of 119 Observations)

#	Name of the Group of Goods or Services	Frequency, %
1	Vegetables	0
2	Fuel and lubricants for personal motor vehicles	9
3	Garbage disposal	20
4	Sewage	20
5	Fruits	26
6	Arranging all-inclusive leisure	33
7	Electricity	42
8	Sugar, jam, honey, chocolate and confectionery	42
9	Water supply	45
10	Thermal energy	45
11	Tobacco products	51
12	Higher education	52
13	Gas	59
14	Purchase of motor vehicles	60
15	Other large-size durable goods for recreation and cultural activities	60
16	Other services not included into other categories	61
17	Household appliances	69
18	Transport services	69
19	Solid fuel	69
20	Communication	71
21	Electric appliances of personal use	72
22	Footwear repair and rental	74
23	Insurance	74
24	Oils and fats	76
25	Furniture, household goods, carpets and other floor coverings, their repair	76
26	Upper garments	79
27	Materials for manufacturing of clothing	80

28	Other items of clothing and accessories	80
29	Boots, shoes and other footwear	80
30	Textile products used in household	80
31	Glass ware, cutlery and housewares	80
32	Services for maintenance and repair of residential premises	80
33	Other services related to personal motor vehicles	82
34	Pre-school and elementary education	82
35	Post-secondary education	82
36	Materials for maintenance and repair of residential premises	83
37	Other services related to upkeeping of residential premises and not included into other categories	83
38	Audio-visual equipment, photographic equipment and information processing equipment	85
39	Actual housing rental payment	85
40	Personal care items not included into other categories	91
41	Coffee, tea and cacao	91
42	Education not subdivided into stages	92
43	Dairy products, cheese and eggs	95
44	Other articles, devices and personal goods	95
45	Maintenance and repair of personal motor vehicles	97
46	Newspapers, books and stationery	97
47	Financial services not included into other categories	97
48	Medications, therapeutic equipment and instrumentation	98
49	Goods and services used in housekeeping	99
50	Bread and bakery and cereals	99
51	Services in the field of recreation, entertainment and culture	100
52	Meat	100
53	Fish and seafood	100
54	Food products not included into other categories	100
55	Mineral water, soft drinks, fruit and vegetable juices	100

56	Alcohol beverages	100
57	Tools and implements used at home and in horticulture	100
58	Spare parts and mountings for personal motor vehicles	100
59	Other goods and equipment for recreation, sports and gardening and home pets	100
60	Clothing cleaning, repair and rental	100
61	Outpatient services	100
62	In-patient services	100
63	Secondary education	100
64	Public catering services	100
65	Hotel service	100
66	Services of hairdressers and personal service establishments	100

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 4

Groups of Goods and Services and the Degree of their Cooperativeness with Core Inflation Estimated by Using the State Space Model

Name of the Group of Goods or Services	Coefficient	Value	Weight
Fruits; Vegetables	C(1)	1.18E-05	6.1%
Solid fuel; Fuel and lubricants for personal motor vehicles	C(6)	1.03E-05	4.7%
Food products not included into other categories; Fish and seafood; Mineral water, soft beverages, fruits and vegetable juices; Coffee, tea and cacao; Alcohol beverages; Sugar, jam, honey, chocolate, confectionery; Tobacco products	C(2)	-5.34E-06	9.8%
Pre-school and elementary education; Secondary education; Post-secondary education; Higher education; Education not subdivided into stages	C(8)	-5.63E-06	1.9%
Water supply; Garbage disposal; Wastewater disposal; Other services related to residential premises and not included into other categories; Electricity; Gas; Thermal energy; Communication; Transport services	C(7)	-6.44E-06	14.8%
Materials for manufacturing of clothing; Upper garments; Other items of clothing and accessories; Boots, shoes and other footwear; Textile products used in household	C(4)	-9.83E-06	10.4%

Household appliances; Goods and services for housekeeping; Medications, therapeutic equipment and instrumentation; Audio-visual equipment, photographic equipment and information processing equipment; Electric appliances of personal use; Other articles, devices and personal goods; Personal care items not included into other categories; Other large-size durable goods for recreation and cultural activities; Other goods and equipment for recreation, sports and gardening and home pets; Books and stationery; Materials for maintenance and repair of residential premises; Furniture, household goods, carpets and other floor coverings, their repair; Glass ware, cutlery and housewares; Instruments and devices used at home and in horticulture; Purchase of motor vehicles; Spare parts and mountings for personal motor vehicles	C(5)	-1.47E-05	14.4%
Actual housing rental payment; Services for maintenance and repair of residential premises; Services in the field of recreation, entertainment and culture; Public catering services; Hotel service; Financial services not included into other categories; Arranging all-inclusive leisure; Insurance; Other services not included into other categories	C(9)	-1.56E-05	6.1%
Meat; Dairy products, cheese and eggs; Bread and bakery and cereals; Oils and fats	C(3)	-3.71E-05	24.8%
Cleaning and repair of clothing; Footwear repair and rental; Outpatient services; Maintenance and repair of personal motor vehicles; Other services related to personal motor vehicles; Services of hairdressers and personal service establishments; In-patient services	C(10)	-5.37E-04	7.0%

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 5

Frequency of Appearance of Each of the 66 CPI Components in the Course of Core Inflation Computation by the Authors Using the Method of Truncation of 10% from Both Ends of the Ordered Price Change Distribution (as % of 142 Observations)

#	Name of the Group of Goods or Services	Frequency, %
1	Vegetables	20
2	Fuel and lubricants for personal motor vehicles	50
3	Garbage disposal	54
4	Sewage	56
5	Fruits	57
6	Sugar, jam, honey, chocolate and confectionery	60
7	Tobacco products	62
8	Water supply	63
9	Thermal energy	64
10	Gas	67
11	Arranging all-inclusive leisure	68
12	Other services related to personal motor vehicles	68

13	Oils and fats	68
14	Transport services	69
15	Pre-school and elementary education	74
16	Communication	74
17	Financial services not included into other categories	74
18	Electricity	76
19	Purchase of motor vehicles	76
20	Actual housing rental payment	79
21	Other services related to upkeep of residential premises and not included into other categories	79
22	Footwear repair and rental	79
23	Coffee, tea and cacao	80
24	Electric appliances of personal use	82
25	Dairy products, cheese and eggs	82
26	Maintenance and repair of personal motor vehicles	82
27	Audio-visual equipment, photographic equipment and information processing equipment	83
28	Other services not included into other categories	84
29	Other large-size durable goods for recreation and cultural activities	85
30	Solid fuel	85
31	Education not subdivided into stages	85
32	Services for maintenance and repair of residential premises	85
33	In-patient services	86
34	Household appliances	86
35	Secondary education	86
36	Insurance	86
37	Medications, therapeutic equipment and instrumentation	86
38	Bread and bakery and cereals	87
39	Meat	87
40	Hotel service	87

41	Outpatient services	88
42	Higher education	88
43	Clothing cleaning, repair and rental	89
44	Services in the field of recreation, entertainment and culture	91
45	Mineral water, soft drinks, fruit and vegetable juices	91
46	Textile products used in household	91
47	Post-secondary education	91
48	Other items of clothing and accessories	91
49	Materials for manufacturing of clothing	92
50	Spare parts and mountings for personal motor vehicles	92
51	Food products not included into other categories	93
52	Services of hairdressers and personal service establishments	93
53	Goods and services used in housekeeping	93
54	Fish and seafood	93
55	Alcohol beverages	93
56	Glass ware, cutlery and housewares	93
57	Furniture, household goods, carpets and other floor coverings, their repair	93
58	Public catering services	93
59	Boots, shoes and other footwear	93
60	Materials for maintenance and repair of residential premises	94
61	Newspapers, books and stationery	94
62	Other articles, devices and personal goods	94
63	Tools and implements used at home and in horticulture	94
64	Other goods and equipment for recreation, sports and gardening and home pets	94
65	Personal care items not included into other categories	96
66	Upper garments	97

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 6

Frequency of Appearance of Each of the 66 CPI Components in the Course of Core Inflation Computation by the Authors Using the Method of Variable Truncation up to 25% at Both Ends of the Ordered Price Change Distribution (as % of 142 Observations)

#	Name of the Group of Goods or Services	Frequency, %
1	Vegetables	13
2	Tobacco products	29
3	Garbage disposal	31
4	Fuel and lubricants for personal motor vehicles	31
5	Fruits	38
6	Sugar, jam, honey, chocolate and confectionery	40
7	Sewage	41
8	Gas	44
9	Oils and fats	45
10	Water supply	45
11	Thermal energy	47
12	Communication	51
13	Arranging all-inclusive leisure	52
14	Financial services not included into other categories	53
15	Pre-school and elementary education	53
16	Dairy products, cheese and eggs	53
17	Footwear repair and rental	54
18	Transport services	55
19	Other services related to personal motor vehicles	56
20	Purchase of motor vehicles	58
21	Bread and bakery and cereals	58
22	Electricity	59
23	Electric appliances of personal use	60
24	Coffee, tea and cacao	60
25	Outpatient services	61
26	Meat	61
27	Medications, therapeutic equipment and instrumentation	61

28	Solid fuel	62
29	Actual housing rental payment	62
30	Maintenance and repair of personal motor vehicles	63
31	Hotel service	64
32	Other services related to upkeep of residential premises and not included into other categories	65
33	Other services not included into other categories	67
34	Other large-size durable goods for recreation and cultural activities	68
35	Mineral water, soft drinks, fruit and vegetable juices	68
36	Household appliances	68
37	Fish and seafood	68
38	In-patient services	69
39	Public catering services	69
40	Textile products used in household	69
41	Services of hairdressers and personal service establishments	69
42	Services for maintenance and repair of residential premises	71
43	Food products not included into other categories	71
44	Insurance	72
45	Audio-visual equipment, photographic equipment and information processing equipment	72
46	Education not subdivided into stages	72
47	Clothing cleaning, repair and rental	73
48	Materials for manufacturing of clothing	74
49	Spare parts and mountings for personal motor vehicles	75
50	Materials for maintenance and repair of residential premises	75
51	Higher education	76
52	Other items of clothing and accessories	76
53	Services in the field of recreation, entertainment and culture	77
54	Secondary education	77
55	Other articles, devices and personal goods	77

56	Newspapers, books and stationery	77
57	Boots, shoes and other footwear	77
58	Alcohol beverages	78
59	Post-secondary education	78
60	Glass ware, cutlery and housewares	79
61	Furniture, household goods, carpets and other floor coverings, their repair	79
62	Tools and implements used at home and in horticulture	79
63	Personal care items not included into other categories	81
64	Goods and services used in housekeeping	81
65	Other goods and equipment for recreation, sports and gardening and home pets	83
66	Upper garments	86

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 7

Frequency of Appearance of Each of the 66 CPI Components in the Course of Core Inflation Computation by the Authors Using the Method of Variable Truncation up to 25% at Both Ends of the Ordered Price Change Distribution with an Aim to Minimize the Skewness of Residual Distribution (as % of 142 Observations)

#	**Name of the Group of Goods or Services**	**Frequency, %**
1	Vegetables	18
2	Fuel and lubricants for personal motor vehicles	47
3	Tobacco products	48
4	Garbage disposal	49
5	Fruits	51
6	Sewage	55
7	Gas	59
8	Sugar, jam, honey, chocolate and confectionery	59
9	Water supply	60
10	Oils and fats	60
11	Thermal energy	62
12	Pre-school and elementary education	62

13	Transport services	65
14	Communication	65
15	Other services related to personal motor vehicles	65
16	Arranging all-inclusive leisure	67
17	Electricity	68
18	Financial services not included into other categories	68
19	Actual housing rental payment	68
20	Maintenance and repair of personal motor vehicles	71
21	Other services related to upkeep of residential premises and not included into other categories	73
22	Dairy products, cheese and eggs	74
23	Footwear repair and rental	74
24	Purchase of motor vehicles	75
25	Solid fuel	75
26	Meat	76
27	Bread and bakery and cereals	76
28	In-patient services	77
29	Hotel service	77
30	Coffee, tea and cacao	77
31	Outpatient services	78
32	Medications, therapeutic equipment and instrumentation	78
33	Household appliances	79
34	Electric appliances of personal use	79
35	Education not subdivided into stages	79
36	Other services not included into other categories	80
37	Audio-visual equipment, photographic equipment and information processing equipment	80
38	Insurance	82
39	Public catering services	83
40	Services of hairdressers and personal service establishments	83

41	Other large-size durable goods for recreation and cultural activities	84
42	Services for maintenance and repair of residential premises	84
43	Services in the field of recreation, entertainment and culture	84
44	Textile products used in household	84
45	Fish and seafood	84
46	Spare parts and mountings for personal motor vehicles	85
47	Clothing cleaning, repair and rental	85
48	Higher education	85
49	Materials for maintenance and repair of residential premises	85
50	Furniture, household goods, carpets and other floor coverings, their repair	85
51	Materials for manufacturing of clothing	86
52	Post-secondary education	86
53	Alcohol beverages	86
54	Mineral water, soft drinks, fruit and vegetable juices	86
55	Boots, shoes and other footwear	87
56	Secondary education	87
57	Other items of clothing and accessories	87
58	Food products not included into other categories	88
59	Other articles, devices and personal goods	88
60	Tools and implements used at home and in horticulture	89
61	Newspapers, books and stationery	89
62	Other goods and equipment for recreation, sports and gardening and home pets	89
63	Goods and services used in housekeeping	90
64	Glass ware, cutlery and housewares	90
65	Personal care items not included into other categories	93
66	Upper garments	95

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 8

Correlation of Each of the 66 CPI Components (a Deseasonalized Price Change versus the Preceding Month) with the Specified Lag with the Corresponding Current CPI, January 2011-October 2022

#	Name of the Group of Goods or Services	6 months	9 months	12 months
1	Actual housing rental payment	20.36%	10.04%	14.67%
2	Maintenance and repair of personal motor vehicles	18.92%	5.49%	-7.53%
3	Alcohol beverages	18.56%	6.86%	-7.65%
4	Higher education	18.08%	7.66%	6.39%
5	Services for maintenance and repair of residential premises	16.87%	6.61%	-1.93%
6	Sugar, jam, honey, chocolate and confectionery	16.12%	3.10%	-4.31%
7	Food products not included into other categories	13.25%	-1.43%	-1.18%
8	Personal care items not included into other categories	12.78%	0.93%	-5.97%
9	Household appliances	12.18%	7.58%	-8.72%
10	Mineral water, soft drinks, fruit and vegetable juices	12.09%	2.73%	-3.67%
11	Other articles, devices and personal goods	11.56%	-0.63%	-10.22%
12	Education not subdivided into stages	11.34%	0.01%	-6.19%
13	Post-secondary education	11.28%	1.22%	8.37%
14	Electric appliances of personal use	11.15%	2.19%	-4.93%
15	Goods and services used in housekeeping	11.12%	-1.45%	-5.97%
16	Fish and seafood	10.02%	0.15%	-7.86%
17	Tools and implements used at home and in horticulture	9.58%	1.78%	-5.00%
18	Furniture, household goods, carpets and other floor coverings, their repair	9.56%	5.29%	-3.40%
19	Footwear repair and rental	9.49%	-4.06%	1.03%
20	Vegetables	9.36%	16.40%	2.51%
21	Public catering services	9.35%	-2.64%	-0.67%
22	In-patient services	8.95%	3.37%	6.27%
23	Bread and bakery and cereals	8.67%	2.66%	5.63%
24	Outpatient services	6.93%	-11.31%	-9.77%
25	Tobacco products	5.89%	12.05%	2.10%
26	Fruits	5.72%	-0.07%	-5.55%
27	Fuel and lubricants for personal motor vehicles	5.70%	-23.09%	-1.72%
28	Arranging all-inclusive leisure	5.47%	3.52%	-5.41%
29	Services in the field of recreation, entertainment and culture	5.00%	-5.18%	-9.51%
30	Clothing cleaning, repair and rental	4.82%	4.68%	-5.70%
31	Other services not included into other categories	4.65%	-0.75%	-1.74%
32	Insurance	4.26%	8.86%	5.68%
33	Materials for maintenance and repair of residential premises	4.07%	0.67%	-6.41%
34	Medications, therapeutic equipment and instrumentation	4.05%	2.84%	-1.34%
35	Textile products used in household	3.92%	1.67%	-7.55%
36	Glass ware, cutlery and housewares	3.88%	1.92%	-5.29%
37	Solid fuel	3.76%	1.76%	-5.52%
38	Purchase of motor vehicles	3.49%	-7.78%	-4.46%
39	Coffee, tea and cacao	3.43%	1.34%	-0.38%
40	Dairy products, cheese and eggs	3.35%	-15.57%	-21.37%
41	Other large-size durable goods for recreation and cultural activities	3.27%	4.21%	-3.51%
42	Services of hairdressers and personal service establishments	3.11%	-10.13%	-4.99%
43	Spare parts and mountings for personal motor vehicles	2.90%	1.46%	-7.67%

44	Other items of clothing and accessories	2.23%	5.44%	-3.85%
45	Other goods and equipment for recreation, sports and gardening and home pets	2.01%	1.67%	-3.66%
46	Oils and fats	2.01%	7.12%	0.25%
47	Newspapers, books and stationery	1.73%	-3.61%	-8.01%
48	Boots, shoes and other footwear	1.45%	2.05%	-5.85%
49	Upper garments	0.90%	1.65%	-2.93%
50	Materials for manufacturing of clothing	0.85%	4.43%	-4.21%
51	Communication	0.74%	5.77%	-6.31%
52	Financial services not included into other categories	0.13%	-10.44%	11.50%
53	Hotel service	-0.25%	-6.83%	-5.33%
54	Other services related to upkeeping of residential premises and not included into other categories	-0.90%	11.78%	1.37%
55	Audio-visual equipment, photographic equipment and information processing equipment	-1.61%	9.00%	-16.13%
56	Secondary education	-3.49%	0.79%	-14.16%
57	Pre-school and elementary education	-5.70%	-11.09%	5.85%
58	Water supply	-6.27%	-11.88%	-2.99%
59	Electricity	-6.30%	19.02%	-1.38%
60	Sewage	-7.24%	-7.42%	6.63%
61	Thermal energy	-8.26%	-9.89%	-9.36%
62	Garbage disposal	-9.07%	-5.98%	-4.12%
63	Meat	-9.10%	-13.05%	-6.09%
64	Transport services	-28.11%	7.01%	-14.49%
65	Gas	-28.67%	-3.63%	-0.18%
66	Other services related to personal motor vehicles	omission	omission	omission

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 9

Stability of Each of the 66 CPI Components (a Deseasonalized Price Change versus the Preceding Month), January 2011-October 2022

#	Name of the Group of Goods or Services	Value
1	Bread and bakery and cereals	79.80%
2	Food products not included into other categories	77.89%
3	Goods and services used in housekeeping	74.11%
4	Other articles, devices and personal goods	72.54%
5	Coffee, tea and cacao	70.60%
6	Medications, therapeutic equipment and instrumentation	64.37%
7	Mineral water, soft drinks, fruit and vegetable juices	64.24%
8	Spare parts and mountings for personal motor vehicles	61.46%
9	Fish and seafood	61.35%
10	Meat	60.26%
11	Other goods and equipment for recreation, sports and gardening and home pets	59.68%
12	Alcohol beverages	59.48%
13	Actual housing rental payment	57.13%
14	Dairy products, cheese and eggs	53.99%
15	Materials for maintenance and repair of residential premises	52.22%
16	Purchase of motor vehicles	51.53%
17	Oils and fats	50.89%
18	Sugar, jam, honey, chocolate and confectionery	50.73%
19	Tools and implements used at home and in horticulture	46.48%

20	Fruits	44.20%
21	Glass ware, cutlery and housewares	41.67%
22	Upper garments	41.60%
23	Electric appliances of personal use	41.37%
24	Other services related to upkeep of residential premises and not included into other categories	40.59%
25	Materials for manufacturing of clothing	38.95%
26	Other items of clothing and accessories	37.99%
27	Furniture, household goods, carpets and other floor coverings, their repair	37.79%
28	Public catering services	37.39%
29	Boots, shoes and other footwear	35.57%
30	Footwear repair and rental	34.53%
31	Other services not included into other categories	34.27%
32	Services of hairdressers and personal service establishments	34.14%
33	Fuel and lubricants for personal motor vehicles	33.85%
34	Textile products used in household	32.88%
35	Water supply	32.18%
36	Personal care items not included into other categories	28.46%
37	Outpatient services	28.16%
38	Gas	27.77%
39	Other large-size durable goods for recreation and cultural activities	27.12%
40	Sewage	26.87%
41	Vegetables	26.25%
42	Financial services not included into other categories	25.94%
43	Solid fuel	24.30%
44	Thermal energy	21.58%
45	In-patient services	20.34%
46	Tobacco products	19.15%
47	Clothing cleaning, repair and rental	18.66%
48	Electricity	18.21%
49	Services for maintenance and repair of residential premises	18.09%
50	Maintenance and repair of personal motor vehicles	15.90%
51	Services in the field of recreation, entertainment and culture	15.82%
52	Newspapers, books and stationery	13.57%
53	Post-secondary education	11.27%
54	Audio-visual equipment, photographic equipment and information processing equipment	8.66%
55	Transport services	8.06%
56	Garbage disposal	6.84%
57	Hotel service	3.87%
58	Pre-school and elementary education	2.73%
59	Household appliances	1.15%
60	Education not subdivided into stages	0.96%
61	Higher education	-2.17%
62	Secondary education	-3.67%
63	Communication	-8.29%
64	Arranging all-inclusive leisure	-12.58%
65	Insurance	-20.65%
66	Other services related to personal motor vehicles	omission

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 10

New Weights of Groups of Goods and Services Resulting from the Use of Weight Alteration Methods in October 2022

#	Name of Group of Goods and Services	0	1	2	3	4	5	6	7	8
1	Bread and bakery and cereals	6.75%	5.24%	1.22%	1.11%	4.70%	12.52%	2.94%	10.23%	10.74%
2	Meat	10.71%	14.74%	2.17%	2.15%	14.46%	15.01%	3.93%	21.75%	0.00%
3	Fish and seafood	1.49%	1.60%	1.68%	1.56%	1.46%	2.13%	3.11%	2.40%	2.75%
4	Dairy products, cheese and eggs	5.05%	3.55%	1.11%	1.08%	3.42%	6.34%	1.80%	4.69%	3.10%
5	Oils and fats	2.29%	1.50%	1.03%	0.80%	1.15%	2.71%	1.58%	1.87%	0.84%
6	Fruits	3.21%	1.37%	0.67%	0.67%	1.34%	3.29%	0.90%	1.48%	3.37%
7	Vegetables	2.94%	0.58%	0.31%	0.31%	0.58%	1.79%	0.25%	0.38%	5.05%
8	Sugar, jam, honey, chocolate and confectionery	2.75%	0.91%	0.52%	0.48%	0.83%	3.24%	0.80%	1.13%	8.13%
9	Food products not included into other categories	1.33%	1.09%	1.29%	1.16%	0.97%	2.41%	3.03%	2.08%	3.24%
10	Coffee, tea and cacao	1.44%	1.33%	1.46%	1.47%	1.33%	2.36%	3.10%	2.30%	0.91%
11	Mineral water, soft drinks, fruit and vegetable juices	0.80%	0.69%	1.35%	1.26%	0.63%	1.20%	2.61%	1.08%	1.78%
12	Alcohol beverages	1.18%	1.47%	1.96%	2.04%	1.51%	1.63%	3.50%	2.14%	4.02%
13	Tobacco products	0.77%	0.80%	1.64%	1.40%	0.67%	0.34%	0.95%	0.37%	0.83%
14	Materials for manufacturing of clothing	0.02%	0.02%	1.60%	1.67%	0.02%	0.02%	1.88%	0.02%	0.00%
15	Upper garments	6.27%	9.98%	2.51%	3.23%	12.69%	6.06%	3.14%	10.16%	1.03%
16	Other items of clothing and accessories	0.29%	0.29%	1.59%	1.81%	0.33%	0.26%	1.82%	0.27%	0.12%
17	Boots, shoes and other footwear	3.18%	4.46%	2.21%	2.66%	5.31%	2.63%	2.36%	3.89%	0.85%
18	Materials for maintenance and repair of residential premises	1.58%	1.41%	1.40%	1.39%	1.38%	1.92%	2.20%	1.80%	1.18%
19	Solid fuel	1.72%	2.48%	2.27%	2.37%	2.55%	0.97%	1.66%	1.47%	1.19%
20	Furniture, household goods, carpets and other floor coverings, their repair	1.69%	1.02%	0.95%	0.98%	1.04%	1.48%	1.08%	0.94%	2.96%
21	Textile products used in household	0.60%	1.10%	2.87%	3.66%	1.38%	0.46%	2.84%	0.88%	0.43%
22	Household appliances	1.02%	0.30%	0.47%	0.47%	0.30%	0.03%	0.02%	0.01%	2.29%
23	Glass ware, cutlery and housewares	0.36%	0.49%	2.17%	2.28%	0.51%	0.35%	2.73%	0.50%	0.25%
24	Tools and implements used at	0.16%	0.18%	1.74%	1.89%	0.19%	0.18%	2.44%	0.21%	0.29%

	home and in horticulture									
25	Goods and services used in housekeeping	1.47%	0.86%	0.92%	0.88%	0.81%	2.53%	2.06%	1.56%	3.00%
26	Medications, therapeutic equipment and instrumentation	1.66%	2.67%	2.52%	3.23%	3.37%	2.49%	4.89%	4.20%	1.24%
27	Purchase of motor vehicles	0.99%	0.80%	1.28%	1.21%	0.75%	1.18%	1.99%	1.01%	0.63%
28	Spare parts and mountings for personal motor vehicles	0.42%	0.40%	1.50%	1.57%	0.41%	0.59%	2.77%	0.60%	0.22%
29	Fuel and lubricants for personal motor vehicles	2.98%	1.79%	0.94%	0.93%	1.73%	2.35%	0.96%	1.48%	3.12%
30	Audio-visual equipment, photographic equipment and information processing equipment	0.69%	0.29%	0.66%	0.68%	0.29%	0.14%	0.17%	0.06%	0.00%
31	Other large-size durable goods for recreation and cultural activities	0.02%	0.03%	2.71%	3.19%	0.03%	0.01%	2.21%	0.02%	0.01%
32	Other goods and equipment for recreation, sports and gardening and home pets	0.33%	0.47%	2.26%	2.79%	0.57%	0.46%	4.07%	0.69%	0.12%
33	Newspapers, books and stationery	0.20%	0.03%	0.27%	0.27%	0.03%	0.06%	0.11%	0.01%	0.06%
34	Electric appliances of personal use	0.06%	0.03%	0.83%	0.84%	0.03%	0.05%	1.04%	0.03%	0.11%
35	Other articles, devices and personal goods	3.22%	2.05%	1.00%	0.97%	1.96%	5.42%	2.19%	3.64%	6.83%
36	Personal care items not included into other categories	0.56%	0.20%	0.56%	0.56%	0.20%	0.37%	0.48%	0.14%	1.31%
37	Clothing cleaning, repair and rental	0.22%	0.24%	1.71%	1.78%	0.25%	0.10%	0.96%	0.11%	0.20%
38	Footwear repair and rental	0.08%	0.04%	0.87%	0.86%	0.04%	0.06%	0.91%	0.04%	0.14%
39	Actual housing rental payment	2.78%	0.93%	0.53%	0.48%	0.84%	3.70%	0.91%	1.31%	10.40%
40	Services for maintenance and repair of residential premises	0.93%	0.91%	1.55%	1.54%	0.89%	0.39%	0.84%	0.40%	2.87%
41	Water supply	0.56%	0.70%	1.97%	1.49%	0.52%	0.42%	1.91%	0.55%	0.00%
42	Garbage disposal	0.28%	0.15%	0.85%	0.72%	0.12%	0.04%	0.18%	0.03%	0.00%
43	Sewage	0.20%	0.25%	1.92%	1.62%	0.21%	0.13%	1.56%	0.16%	0.00%
44	Other services related to upkeep of residential premises and not	1.15%	0.87%	1.20%	1.34%	0.97%	1.08%	1.46%	0.87%	0.00%

	included into other categories									
45	Electricity	2.41%	1.64%	1.07%	1.14%	1.72%	1.02%	0.59%	0.73%	0.00%
46	Gas	1.28%	0.71%	0.87%	0.86%	0.69%	0.83%	0.73%	0.48%	0.00%
47	Thermal energy	1.71%	1.86%	1.71%	1.31%	1.41%	0.86%	1.11%	0.98%	0.00%
48	Outpatient services	2.87%	3.32%	1.83%	1.96%	3.53%	1.88%	1.55%	2.29%	3.65%
49	In-patient services	1.32%	2.15%	2.57%	2.44%	2.02%	0.62%	1.57%	1.07%	2.17%
50	Maintenance and repair of personal motor vehicles	0.32%	0.67%	3.29%	2.62%	0.53%	0.12%	1.58%	0.26%	1.12%
51	Other services related to personal motor vehicles	0.00%	0.00%	0.05%	0.02%	0.00%	0.00%	0.16%	0.00%	0.00%
52	Transport services	2.93%	4.63%	2.48%	2.26%	4.15%	0.55%	0.60%	0.91%	0.00%
53	Communication	4.28%	7.29%	2.68%	2.10%	5.64%	0.00%	0.00%	0.00%	0.58%
54	Services in the field of recreation, entertainment and culture	0.71%	0.96%	2.14%	2.45%	1.09%	0.26%	1.02%	0.37%	0.65%
55	Arranging all-inclusive leisure	0.08%	0.05%	0.94%	0.98%	0.05%	0.00%	0.00%	0.00%	0.08%
56	Pre-school and elementary education	0.83%	0.98%	1.87%	2.14%	1.11%	0.05%	0.15%	0.07%	0.00%
57	Secondary education	0.09%	0.16%	2.78%	2.75%	0.16%	0.00%	0.00%	0.00%	0.00%
58	Post-secondary education	0.21%	0.11%	0.86%	0.90%	0.12%	0.05%	0.29%	0.03%	0.43%
59	Higher education	0.78%	0.37%	0.75%	0.76%	0.37%	0.00%	0.00%	0.00%	2.60%
60	Education not subdivided into stages	0.02%	0.02%	1.34%	1.42%	0.02%	0.00%	0.04%	0.00%	0.05%
61	Public catering services	0.73%	0.63%	1.35%	1.36%	0.62%	0.63%	1.52%	0.57%	1.25%
62	Hotel service	0.01%	0.01%	1.26%	1.38%	0.01%	0.00%	0.15%	0.00%	0.00%
63	Services of hairdressers and personal service establishments	2.19%	3.21%	2.31%	2.43%	3.33%	1.74%	2.37%	2.68%	1.25%
64	Insurance	0.23%	0.07%	0.48%	0.49%	0.07%	0.00%	0.00%	0.00%	0.18%
65	Financial services not included into other categories	0.21%	0.56%	4.11%	2.31%	0.31%	0.13%	3.21%	0.35%	0.00%
66	Other services not included into other categories	0.42%	0.26%	0.99%	1.06%	0.28%	0.33%	1.03%	0.22%	0.36%
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

#	**Short Name**	**Explanation to the Corresponding Column No. in the Table**
0	CPI	CPI weighting
1	Volatility double	Weighting based on volatility for the last 2 years and initial weights
2	Volatility_one	Weighting based on volatility for the last 2 years
3	Rmse_trend_one	Weighting based on deviation from the CPI trend
4	Rmse_trend_double	Weighting based on deviation from the CPI trend and initial weights
5	Persistence_double	Weighting based on persistence and initial weights
6	Persistence_volatility	Weighting based on persistence and volatility for the last 2 years
7	Persistence_volatility_triple	Weighting based on persistence, volatility for the last 2 years and initial weights

8	Correlation_double	Weighting based on the CPI correlation with the change in price of the corresponding component 6 months ago and initial weights

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 11

Eigen Values in Ascending Order and Contribution of Each Factor to the Percent of Explanation of Variance of 66 Groups of Goods and Services

No. of the Factor (Own Vector)	Eigen value	Eigen Value to the Next Value	Percent of Explanation of Variance of All Components
1	24.3	5.4	37.1%
2	4.5	1.2	6.8%
3	3.7	1.4	5.6%
4	2.6	1.1	4.0%
5	2.4	1.3	3.6%
6	1.8	1.1	2.7%
7	1.7	1.1	2.6%
8	1.5	1.0	2.3%
9	1.5	1.1	2.2%
10	1.3	1.0	2.0%
11	1.3	1.1	2.0%
12	1.2	1.1	1.9%
13	1.1	1.1	1.7%
14	1.0	1.0	1.6%
15	1.0	1.0	1.6%
16	1.0	1.0	1.5%
17	1.0	1.1	1.5%
18	0.9	1.0	1.4%
19	0.9	1.2	1.3%
20	0.7	1.0	1.1%
21	0.7	1.1	1.1%
22	0.7	1.0	1.0%
23	0.6	1.1	1.0%
24	0.6	1.0	0.9%
25	0.6	1.2	0.9%
26	0.5	1.0	0.8%
27	0.5	1.1	0.8%
28	0.5	1.0	0.7%
29	0.4	1.1	0.7%
30	0.4	1.1	0.6%
31	0.4	1.0	0.6%
32	0.4	1.1	0.6%

33	0.3	1.1	0.5%
34	0.3	1.1	0.5%
35	0.3	1.1	0.4%
36	0.3	1.1	0.4%
…	…	…	…
65	0.0	1.2	0.0%
66	0.0		0.0%
Sum	**65.5**		**100%**

Appendix 12

Correlation of Core Inflation Estimated Using the Dynamic Factor Model with the Groups of Goods and Services and the Percent of Their Variance Explained by the Model Individually

#	Name of the Group of Goods or Services	Correlation with Core Inflation	Percent of Explanation of Variance
1	Tools and implements used at home and in horticulture	0.95	0.91
2	Glass ware, cutlery and housewares	0.93	0.86
3	Furniture, household goods, carpets and other floor coverings, their repair	0.93	0.86
4	Fish and seafood	0.92	0.85
5	Electric appliances of personal use	0.91	0.82
6	Spare parts and mountings for personal motor vehicles	0.91	0.82
7	Other goods and equipment for recreation, sports and gardening and home pets	0.90	0.82
8	Materials for manufacturing of clothing	0.89	0.80
9	Upper garments	0.89	0.79
10	Boots, shoes and other footwear	0.89	0.79
11	Textile products used in household	0.88	0.78
12	Other items of clothing and accessories	0.88	0.77
13	Other articles, devices and personal goods	0.86	0.74
14	Other large-size durable goods for recreation and cultural activities	0.85	0.73
15	Food products not included into other categories	0.85	0.72
16	Goods and services used in housekeeping	0.84	0.70
17	Medications, therapeutic equipment and instrumentation	0.84	0.70
18	Personal care items not included into other categories	0.84	0.70
19	Oils and fats	0.82	0.67
20	Mineral water, soft drinks, fruit and vegetable juices	0.80	0.65
21	Public catering services	0.74	0.55
22	Materials for maintenance and repair of residential premises	0.74	0.54
23	Bread and bakery and cereals	0.72	0.52
24	Fruits	0.70	0.48

25	Alcohol beverages	0.69	0.48
26	Purchase of motor vehicles	0.68	0.46
27	Clothing cleaning, repair and rental	0.66	0.44
28	Household appliances	0.66	0.44
29	Services in the field of recreation, entertainment and culture	0.62	0.38
30	Sugar, jam, honey, chocolate and confectionery	0.60	0.36
31	Dairy products, cheese and eggs	0.59	0.35
32	Maintenance and repair of personal motor vehicles	0.59	0.34
33	Services for maintenance and repair of residential premises	0.56	0.32
34	Coffee, tea and cacao	0.56	0.31
35	Education not subdivided into stages	0.55	0.30
36	Footwear repair and rental	0.54	0.30
37	Outpatient services	0.53	0.28
38	Audio-visual equipment, photographic equipment and information processing equipment	0.50	0.25
39	Services of hairdressers and personal service establishments	0.49	0.24
40	In-patient services	0.38	0.14
41	Hotel service	0.34	0.12
42	Secondary education	0.31	0.09
43	Other services not included into other categories	0.30	0.09
44	Vegetables	0.29	0.08
45	Meat	0.28	0.08
46	Newspapers, books and stationery	0.28	0.08
47	Solid fuel	0.27	0.07
48	Actual housing rental payment	0.25	0.06
49	Arranging all-inclusive leisure	0.20	0.04
50	Other services related to upkeep of residential premises and not included into other categories	0.19	0.03
51	Pre-school and elementary education	0.17	0.03
52	Financial services not included into other categories	0.16	0.03
53	Tobacco products	0.14	0.02
54	Post-secondary education	0.10	0.01
55	Higher education	0.08	0.01
56	Transport services	0.07	0.00
57	Insurance	0.04	0.00
58	Thermal energy	0.03	0.00
59	Communication	0.03	0.00
60	Electricity	0.02	0.00
61	Garbage disposal	0.01	0.00
62	Water supply	-0.01	0.00
63	Gas	-0.02	0.00
64	Fuel and lubricants for personal motor vehicles	-0.05	0.00
65	Sewage	-0.06	0.00
66	Other services related to personal motor vehicles	-0.23	0.05

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 13

Explanations to Symbols of Core Inflation Estimates

#	Notation	Description
1	BCPI_sa	Seasonally adjusted CPI excl. fruits and vegetables, gasoline, coal, diesel fuel and utility services, railway transport and communication
2	Excl_8_sa	Seasonally adjusted CPI excl. 8 most volatile components for the last 2 years
3	Excl_13_sa	Seasonally adjusted CPI excl. 13 most volatile components for the last 2 years
4	Excl_25%_sa	Seasonally adjusted CPI excl. 25% most volatile components for the last 2 years
5	Trim_10_sa	Seasonally adjusted CPI with the 10% truncation at both ends of an ordered monthly price change distribution
6	Trim_2525_sa	Seasonally adjusted CPI with truncation for the entire time series from 1% to 25% at both ends of an ordered monthly price change distribution based on the minimum mean square error between the computed modified core inflation for a given truncation and the centered moving average of the deseasonalized CPI for 24 months
7	w_mediana_SA	Median of an ordered distribution of the seasonally adjusted monthly price change
8	Overweight_sa	Seasonally adjusted CPI with new component weights determined by the product of the reciprocal of component volatility for the last 2 years and the initial weight in the CPI
9	Volatility_one	Seasonally adjusted CPI with new component weights determined by the reciprocal of component volatility for the last 2 years
10	Rmse_trend_one	Seasonally adjusted CPI with new component weights determined by the reciprocal of RMSE of the component and the CPI trend expressed by 24-month moving average
11	Rmse_trend_double	Seasonally adjusted CPI with new component weights determined by the product of the reciprocal of RMSE of the component and the CPI trend expressed by 24-month moving average and the initial weight in the CPI
12	Persistence_double	Seasonally adjusted CPI with new component weights determined by the product of the component persistence (one lag was taken for the computation) in the landmark window and the initial weight in the CPI
13	Persistence_volatility	Seasonally adjusted CPI with new component weights determined by the product of the component persistence (one lag was taken for the computation) in the landmark window, the reciprocal of component volatility for the last 2 years
14	Persistence_volatility_triple	Seasonally adjusted CPI with new component weights determined by the product of the component persistence (one lag was taken for the computation) in the landmark window, the reciprocal of component volatility for the last 2 years and the initial weight in the CPI
15	Correlation_double	Seasonally adjusted CPI with new component weights determined by the product of the component correlation (with the lag of 6 months) with the CPI in the landmark window, and the initial weight in the CPI
16	Volatility_double_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #8
17	Volatility_one_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #9
18	Rmse_trend_one_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #10
19	Rmse_trend_double_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #11
20	Persistence_double_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #12
21	Persistence_volatility_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #13
22	Persistence_volatility_triple_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #14
23	Correlation_double_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights as for indicator #15

24	Persistence_one_mediana	Median of an ordered distribution of seasonally adjusted monthly price change with new weights determined by the product of component persistency (one lag was taken for the computation) in the landmark window
25	Wavelet_min_std_transform_direct	Wavelet method (direct method, transforms, without one component) with parameters providing a minimal variance
26	Wavelet_min_std_transform_inderect	Wavelet method (indirect method, transforms, without one component) with parameters providing a minimal variance
27	Wavelet_min_std_transform_S3_direct	Wavelet method (direct method, transforms, without two components) with parameters providing a minimal variance
28	Wavelet_transform_min_std_S3_indirect	Wavelet method (indirect method, transforms, without two components) with parameters providing a minimal variance
29	Wavelet_dev_thresh_direct	Wavelet method (direct thresholding method) with parameters providing a minimum deviation from the CPI
30	Wavelet_rmse12_thresh_direct	Wavelet method (direct thresholding method) with parameters providing a minimal mean square error between the indicator and the CPI trend (12-month moving average)
31	Wavelet_std_thresh_direct	Wavelet method (direct thresholding method) with parameters providing a minimal variance
32	Wavelet_dev_tresh_short_direct	Wavelet method (direct thresholding method, wavelet length is limited by 12) with parameters providing a minimum deviation from the CPI
33	Wavelet_rmse12_tresh_short_direct	Wavelet method (direct thresholding method, wavelet length is limited by 12) with parameters providing a minimal mean square error between the indicator and the CPI trend (12- month moving average)
34	Wavelet_std_tresh_short_direct	Wavelet method (direct thresholding method, wavelet length is limited by 12) with parameters providing a minimal variance
35	Wavelet_dev_thresh_inderect	Wavelet method (indirect thresholding method) with parameters providing a minimum deviation from the CPI
36	Wavelet_rmse12_thresh_inderect	Wavelet method (indirect thresholding method) with parameters providing a minimal mean square error between the indicator and the CPI trend (12- month moving average)
37	Wavelet_std_thresh_inderect	Wavelet method (indirect thresholding method) with parameters providing a minimal variance
38	Wavelet_std_thresh_short_inderect	Wavelet method (indirect thresholding method, wavelet length is limited by 12) with parameters providing a minimal variance
39	Wavelet_rmse_12_thresh_short_inderect	Wavelet method (direct thresholding method, wavelet length is limited by 12) with parameters providing a minimal mean square error between the indicator and the CPI trend (12- month moving average)
40	Wavelet_dev_thresh_short_inderect	Wavelet method (indirect thresholding method, wavelet length is limited by 12) with parameters providing a minimum deviation from the CPI
41	Exp_smoothing	Exponential smoothing (indirect method)
42	HP_smoothing	Hodrick-Prescott filter (indirect method)
43	Trim_skew	Seasonally adjusted CPI with truncation from 1% to 25% at both ends of an ordered monthly price change distribution based on the minimal skewness of the residual price distribution
44	ADJ_INF_TRIM_SA	Method of adjusting the estimate (5) for the skewness of an ordered seasonally adjusted monthly price change distribution
45	ADJ_INF_TRIM2525_SA	Method of adjusting the estimate (6) for the skewness of an ordered seasonally adjusted monthly price change distribution
46	ADJ_INF_MEDIAN_SA	Method of adjusting the estimate (7) for the skewness of an ordered seasonally adjusted monthly price change distribution
47	BP_3_6	Bandpass filter or BP filter with the range of (3,6)
48	BP_3_12	Bandpass filter or BP filter with the range of (3,12)
49	BP_3_18	Bandpass filter or BP filter with the range of (3,18)
50	BP_3_24	Bandpass filter or BP filter with the range of (3,24)
51	BP_6_12	Bandpass filter or BP filter with the range of (6,12)
52	BP_6_18	Bandpass filter or BP filter with the range of (6,18)
53	BP_6_24	Bandpass filter or BP filter with the range of (6,24)

54	BP_12_18	Bandpass filter or BP filter with the range of (12,18)
55	BP_12_24	Bandpass filter or BP filter with the range of (12,24)
56	BP_18_36	Bandpass filter or BP filter with the range of (18,36)
57	BP_18_48	Bandpass filter or BP filter with the range of (18,48)
58	BP_18_60	Bandpass filter or BP filter with the range of (18,60)
59	BP_18_96	Bandpass filter or BP filter with the range of (18,96)
60	DFM_2stage	Estimate obtained using a dynamic factor model
61	UC_noise	Estimate obtained using a state space model by an indirect method
62	Unobserv_components_noise_excl	Seasonally adjusted CPI excl. components showing the largest noise relative to a general component estimated using a state space model by an indirect method in (61)
63	Unobserved_components	Estimate obtained using a state space model by a direct method

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 14

Estimating Core Inflation Indicators based on the Optimality Criteria

	P-value of the ADF test for the difference between core inflation& CPI in 2016-2022.	P-value of the constant in regression of the difference between core inflation & CPI by a constant in 2016-2022.	P-value of the Wald test for the cointegration between core inflation & CPI in 2016-2022.	P-value of the Wald test for predictive capability of core inflation after 6 mths in 2016-2022.	P-value value of the Wald test for predictive capability of core inflation after 12 mths in 2016-2022.	P-value value of the Wald test for predictive capability of core inflation after 18 mths in 2016-2022.	P-value value of the Wald test for predictive capability of core inflation after 24 mths in 2016-2022.	Coefficient responsible for weak exogeneity of core inflation	P-value of the preceding coefficient	RMSE between core inflation and 24-mth moving average CPI in 2016-2022.	Standard deviation of core inflation estimates in 2016-2022.
BCPI_sa	0.00	0.04	0.01	0.87	0.21	0.11	0.43	-0.98	0.02	0.18	0.50
Excl_8_sa	0.00	0.96	0.24	0.70	0.16	0.42	0.44	-0.83	0.03	0.19	0.39
Excl_13_sa	0.00	0.74	0.52	0.77	0.16	0.12	0.45	-0.84	0.03	0.19	0.41
Excl_25%_sa	0.00	0.98	0.40	0.70	0.11	0.08	0.48	-0.89	0.03	0.20	0.40
Trim_10_sa	0.00	0.01	0.00	0.20	0.15	0.23	0.13	-0.57	0.19	0.19	0.41
Trim_2525_sa	0.00	0.00	0.00	0.04	0.02	0.05	0.03	-0.44	0.16	0.24	0.37
w_mediana_SA	0.00	0.00	0.01	0.30	0.08	0.18	0.18	-0.65	0.01	0.22	0.41
Overweight_sa	0.00	0.05	0.00	0.30	0.22	0.30	0.20	-0.62	0.13	0.19	0.35
Volatility_one	0.00	0.00	0.00	0.21	0.10	0.15	0.20	-0.62	0.03	0.20	0.31
Rmse_trend_one	0.00	0.01	0.00	0.28	0.12	0.18	0.24	-0.71	0.03	0.20	0.33
Rmse_trend_double	0.00	0.20	0.00	0.42	0.24	0.40	0.35	-0.78	0.09	0.19	0.36
Persistence_double	0.00	0.00	0.00	0.00	0.27	0.08	0.61	-1.36	0.08	0.21	0.59
Persistence_volatility	0.00	0.92	0.54	0.66	0.05	0.03	0.23	-1.28	0.01	0.18	0.39
Persistence_volatility_triple	0.00	0.01	0.02	0.68	0.12	0.07	0.59	-1.17	0.02	0.20	0.45
Correlation_double	0.00	0.30	0.00	0.00	0.00	0.00	0.00	-1.46	0.00	0.38	0.61

Volatility_double_mediana	0.00	0.00	0.00	0.10	0.06	0.12	0.15	-0.66	0.01	0.24	0.31
Volatility_one_mediana	0.00	0.00	0.00	0.06	0.03	0.05	0.10	-0.54	0.01	0.25	0.27
Rmse_trend_one_mediana	0.00	0.00	0.00	0.08	0.04	0.06	0.11	-0.58	0.01	0.25	0.29
Rmse_trend_double_median a	0.00	0.01	0.01	0.11	0.06	0.12	0.19	-0.71	0.01	0.24	0.32
Correlation_double_mediana	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.50	0.02	0.32	0.84
Persistence_one_mediana	0.00	0.41	0.68	0.45	0.05	0.03	0.22	-1.10	0.00	0.20	0.44
Persistence_double_mediana	0.00	0.09	0.03	0.02	0.11	0.05	0.49	-0.85	0.01	0.22	0.49
Persistence_volatility_media na	0.00	0.16	0.25	0.38	0.06	0.01	0.26	-0.98	0.00	0.21	0.35
Persistence_volatility_triple_ mediana	0.00	0.92	0.98	0.23	0.03	0.03	0.38	-0.89	0.00	0.24	0.41
Wavelet_min_std_transform _direct	0.00	0.76	0.44	0.58	0.37	0.28	0.25	-0.30	0.47	0.14	0.37
Wavelet_min_std_transform _inderect	0.00	0.08	0.08	0.74	0.26	0.61	0.43	-0.72	0.02	0.20	0.37
Wavelet_min_std_transform _S3_direct	0.00	0.73	0.43	0.74	0.32	0.23	0.14	-0.62	0.12	0.12	0.33
Wavelet_transform_min_std _S3_indirect	0.00	0.18	0.10	0.75	0.22	0.54	0.51	-0.75	0.02	0.18	0.33
Wavelet_dev_thresh_direct	0.00	0.98	0.29	0.14	0.16	0.25	0.32	0.08	0.81	0.14	0.45
Wavelet_rmse12_thresh_dir ect	0.00	0.61	0.00	0.70	0.54	0.26	0.46	0.00	1.00	0.14	0.21
Wavelet_std_thresh_direct	0.00	0.58	0.62	0.00	0.18	0.76	0.66	-0.12	0.18	0.20	0.09
Wavelet_dev_tresh_short_di rect	0.00	0.98	0.29	0.14	0.16	0.25	0.32	0.08	0.81	0.14	0.45
Wavelet_rmse12_tresh_short _direct	0.00	0.58	0.00	0.53	0.51	0.19	0.45	0.02	0.89	0.14	0.23
Wavelet_std_tresh_short_dir ect	0.00	0.55	0.44	0.00	0.16	0.75	0.65	-0.11	0.18	0.21	0.11
Wavelet_dev_thresh_inderec t	0.00	0.50	0.18	0.00	0.00	0.15	0.14	-0.54	0.00	0.25	0.23
Wavelet_rmse12_thresh_ind erect	0.00	0.67	0.00	0.99	0.64	0.31	0.24	-0.19	0.27	0.18	0.23
Wavelet_std_thresh_inderect	0.00	0.96	0.99	0.00	0.02	0.73	0.50	-0.23	0.08	0.25	0.14
Wavelet_std_thresh_short_in derect	0.00	0.96	0.99	0.00	0.01	0.76	0.45	-0.26	0.07	0.25	0.15
Wavelet_rmse_12_thresh_sh ort_inderect	0.00	0.63	0.00	0.99	0.51	0.35	0.09	-0.29	0.19	0.19	0.25
Wavelet_dev_thresh_short_i nderect	0.00	0.79	0.00	0.25	0.17	0.47	0.11	-0.38	0.07	0.22	0.24
Exp_smoothing	0.00	0.78	0.52	0.00	0.07	0.02	0.10	-1.05	0.00	0.15	0.33

HP_smoothing	0.00	0.90	0.60	0.09	0.11	0.33	0.31	0.32	0.16	0.15	0.40
Trim_skew	0.00	0.00	0.00	0.23	0.08	0.12	0.18	-0.72	0.03	0.22	0.39
ADJ_INF_MEDIAN_SA	0.00	0.13	0.02	0.89	0.50	0.45	0.50	-0.28	0.31	0.17	0.43
ADJ_INF_TRIM2525_SA	0.00	0.19	0.00	0.25	0.55	0.22	0.51	0.22	0.55	0.16	0.39
ADJ_INF_TRIM_SA	0.00	0.34	0.01	0.14	0.28	0.05	0.29	0.33	0.52	0.16	0.42
BP_3_6	0.00	0.66	0.71	0.47	0.00	0.00	0.00	-0.59	0.01	0.23	0.45
BP_3_12	0.00	0.79	0.53	0.15	0.00	0.03	0.00	-0.80	0.01	0.28	0.44
BP_3_18	0.00	0.81	0.49	0.06	0.00	0.00	0.01	-1.18	0.00	0.26	0.42
BP_3_24	0.00	0.84	0.80	0.11	0.01	0.00	0.00	-1.12	0.00	0.19	0.38
BP_6_12	0.00	0.66	0.61	0.11	0.00	0.02	0.00	-0.95	0.00	0.29	0.49
BP_6_18	0.00	0.71	0.61	0.17	0.00	0.00	0.00	-1.32	0.00	0.28	0.47
BP_6_24	0.00	0.73	0.86	0.41	0.00	0.00	0.00	-1.29	0.00	0.21	0.43
BP_12_18	0.00	0.94	0.61	0.19	0.04	0.05	0.11	-1.12	0.04	0.22	0.47
BP_12_24	0.00	0.99	0.77	0.42	0.09	0.02	0.06	-1.01	0.04	0.20	0.45
BP_18_36	0.00	0.63	0.55	0.01	0.01	0.11	0.04	-1.04	0.01	0.25	0.45
BP_18_48	0.00	0.50	0.30	0.00	0.01	0.04	0.05	-1.01	0.00	0.28	0.44
BP_18_60	0.00	0.46	0.29	0.00	0.00	0.04	0.06	-1.05	0.00	0.28	0.44
BP_18_96	0.07	0.42	0.54	0.00	0.00	0.03	0.09	-0.95	0.00	0.31	0.38
DFM_2stage	0.00	0.46	0.59	0.62	0.08	0.31	0.29	-1.01	0.01	0.23	0.45
UC_noise	0.00	0.22	0.46	0.50	0.01	0.03	0.02	-0.45	0.56	0.22	0.45
Unobserv_components_noise_excl	0.00	0.02	0.00	0.29	0.17	0.30	0.56	-0.75	0.04	0.21	0.52
Unobserved_components	0.00	0.70	0.24	0.09	0.23	0.37	0.33	0.30	0.52	0.14	0.39

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 15

Correlation of Core Inflation Indicators with Macroeconomic Variables

	M3(-1)	Retail_gap (-12)	ER (-1)	IR(-18)	Nominal Income(3)	Nominal Income(-3)	Nominal wage(-3)
BCPI_sa	0.38	0.17	0.52	-0.14	0.14	0.21	0.20
Excl_8_sa	0.40	0.16	0.57	-0.16	0.14	0.31	0.25
Excl_13_sa	0.37	0.16	0.50	-0.17	0.11	0.33	0.30
Excl_25%_sa	0.36	0.16	0.50	-0.15	0.11	0.32	0.31
Trim_10_sa	0.39	0.14	0.53	-0.13	0.13	0.19	0.19
Trim_2525_sa	0.36	0.11	0.49	-0.12	0.11	0.18	0.21
w_mediana_SA	0.33	0.10	0.50	-0.12	0.11	0.17	0.23
Overweight_sa	0.39	0.15	0.51	-0.15	0.12	0.31	0.27
Volatility_one	0.42	0.17	0.52	-0.12	0.14	0.27	0.20

Rmse_trend_one	0.38	0.15	0.51	-0.11	0.11	0.22	0.19
Rmse_trend_double	0.35	0.11	0.51	-0.13	0.06	0.25	0.25
Persistence_double	0.43	0.15	0.59	-0.12	0.16	0.22	0.15
Persistence_volatility	0.44	0.17	0.60	-0.12	0.16	0.23	0.17
Persistence_volatility_triple	0.38	0.14	0.58	-0.14	0.14	0.25	0.22
Correlation_double	0.44	0.10	0.56	-0.04	0.19	0.16	0.04
Volatility_double_mediana	0.26	0.09	0.40	-0.15	0.07	0.28	0.33
Volatility_one_mediana	0.36	0.13	0.48	-0.11	0.16	0.26	0.23
Rmse_trend_one_mediana	0.30	0.11	0.44	-0.10	0.11	0.19	0.22
Rmse_trend_double_mediana	0.19	0.04	0.38	-0.11	-0.02	0.21	0.31
Correlation_double_mediana	0.44	0.17	0.60	-0.06	0.20	0.17	0.10
Persistence_one_mediana	0.41	0.16	0.59	-0.09	0.18	0.19	0.14
Persistence_double_mediana	0.38	0.16	0.61	-0.12	0.20	0.17	0.11
Persistence_volatility_mediana	0.41	0.16	0.55	-0.10	0.15	0.23	0.18
Persistence_volatility_triple_mediana	0.29	0.11	0.49	-0.09	0.11	0.23	0.24
Wavelet_min_std_transform_direct	0.54	0.15	0.47	-0.14	0.05	0.21	0.17
Wavelet_min_std_transform_inderect	0.56	0.23	0.46	-0.18	0.04	0.19	0.19
Wavelet_min_std_transform_S3_direct	0.48	0.16	0.34	-0.16	0.10	0.16	0.13
Wavelet_transform_min_std_S3_indirec t	0.51	0.26	0.34	-0.21	0.08	0.14	0.15
Wavelet_dev_thresh_direct	0.42	0.14	0.53	-0.10	0.13	0.17	0.15
Wavelet_rmse12_thresh_direct	0.39	0.11	0.49	-0.15	0.19	0.15	0.10
Wavelet_std_thresh_direct	0.13	0.05	0.32	-0.15	0.18	0.06	0.05
Wavelet_dev_tresh_short_direct	0.42	0.14	0.53	-0.10	0.13	0.17	0.15
Wavelet_rmse12_tresh_short_direct	0.40	0.11	0.51	-0.14	0.17	0.16	0.12
Wavelet_std_tresh_short_direct	0.20	0.06	0.41	-0.10	0.19	0.09	0.06
Wavelet_dev_thresh_inderect	0.21	0.18	0.28	-0.28	0.15	0.09	0.08
Wavelet_rmse12_thresh_inderect	0.40	0.20	0.45	-0.19	0.14	0.13	0.15
Wavelet_std_thresh_inderect	0.16	0.22	0.24	-0.19	0.12	0.03	0.11
Wavelet_std_thresh_short_inderect	0.20	0.22	0.30	-0.17	0.13	0.06	0.12
Wavelet_rmse_12_thresh_short_inderect	0.41	0.21	0.47	-0.17	0.14	0.14	0.16
Wavelet_dev_thresh_short_inderect	0.37	0.21	0.46	-0.15	0.14	0.12	0.15
Exp_smoothing	0.28	0.18	0.22	-0.14	0.00	0.18	0.25
HP_smoothing	0.53	0.14	0.53	-0.12	0.06	0.21	0.18
Trim_skew	0.36	0.14	0.50	-0.12	0.13	0.14	0.17
ADJ_INF_MEDIAN_SA	0.36	0.09	0.49	-0.10	0.09	0.16	0.19
ADJ_INF_TRIM2525_SA	0.39	0.10	0.48	-0.10	0.08	0.16	0.18
ADJ_INF_TRIM_SA	0.41	0.13	0.53	-0.11	0.11	0.17	0.17
BP_3_6	0.48	0.14	0.45	-0.07	0.07	0.24	0.16
BP_3_12	0.48	0.11	0.33	-0.21	0.06	0.15	0.10
BP_3_18	0.39	0.21	0.29	-0.08	0.12	0.13	0.10
BP_3_24	0.30	0.19	0.18	-0.14	0.10	0.14	0.04
BP_6_12	0.42	0.10	0.43	-0.23	0.12	0.08	0.09
BP_6_18	0.33	0.18	0.40	-0.11	0.17	0.05	0.08
BP_6_24	0.25	0.15	0.32	-0.17	0.16	0.06	0.03
BP_12_18	0.36	0.20	0.50	0.02	0.16	0.16	0.14
BP_12_24	0.28	0.18	0.44	-0.02	0.16	0.17	0.10
BP_18_36	0.31	0.02	0.44	-0.11	0.09	0.18	0.10
BP_18_48	0.30	-0.02	0.42	-0.06	0.11	0.17	0.07
BP_18_60	0.29	-0.03	0.42	-0.05	0.10	0.16	0.07
BP_18_96	0.23	-0.03	0.41	-0.07	0.08	0.14	0.08
DFM_2stage	0.41	0.22	0.56	-0.14	0.14	0.17	0.18
UC_noise	0.48	0.09	0.52	-0.07	0.13	0.15	0.10
Unobserv_components_noise_excl	0.38	0.17	0.53	-0.16	0.15	0.20	0.19
Unobserved_components	0.52	0.15	0.52	-0.13	0.09	0.20	0.17

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 16

Assessment of the Effect of Core Inflation Estimates on Nominal Wage

	Coefficient	P-value of the coefficient	R^2
BCPI_sa	0.88	0.00	0.69
Excl_8_sa	0.73	0.01	0.59
Excl_13_sa	0.74	0.01	0.61
Excl_25%_sa	0.76	0.01	0.61
Trim_10_sa	0.89	0.00	0.69
Trim_2525_sa	0.90	0.00	0.69
w_mediana_SA	0.90	0.00	0.69
Overweight_sa	0.76	0.01	0.59
Volatility_one	0.77	0.01	0.58
Rmse_trend_one	1.07	0.01	0.45
Rmse_trend_double	1.09	0.01	0.47
Persistence_double	0.73	0.03	0.53
Persistence_volatility	0.75	0.02	0.54
Persistence_volatility_triple	0.76	0.02	0.54
Correlation_double	0.75	0.03	0.52
Volatility_double_mediana	0.84	0.00	0.61
Volatility_one_mediana	0.79	0.00	0.58
Rmse_trend_one_mediana	1.10	0.01	0.45
Rmse_trend_double_mediana	1.22	0.00	0.50
Correlation_double_mediana	0.75	0.03	0.52
Persistence_one_mediana	0.74	0.03	0.53
Persistence_double_mediana	0.75	0.03	0.52
Persistence_volatility_mediana	0.77	0.02	0.54
Persistence_volatility_triple_mediana	0.83	0.01	0.55
Wavelet_min_std_transform_direct	0.90	0.00	0.69
Wavelet_min_std_transform_inderect	0.89	0.00	0.69
Wavelet_min_std_transform_S3_direct	0.90	0.00	0.69
Wavelet_transform_min_std_S3_indirect	0.88	0.00	0.69
Wavelet_dev_thresh_direct	0.88	0.00	0.69
Wavelet_rmse12_thresh_direct	0.88	0.00	0.69
Wavelet_std_thresh_direct	0.81	0.07	0.69
Wavelet_dev_tresh_short_direct	0.88	0.00	0.69
Wavelet_rmse12_tresh_short_direct	0.89	0.00	0.69
Wavelet_std_tresh_short_direct	0.82	0.03	0.69
Wavelet_dev_thresh_inderect	0.87	0.00	0.69
Wavelet_rmse12_thresh_inderect	0.83	0.00	0.69
Wavelet_std_thresh_inderect	0.57	0.18	0.69
Wavelet_std_thresh_short_inderect	0.60	0.15	0.69
Wavelet_rmse_12_thresh_short_inderect	0.84	0.00	0.69
Wavelet_dev_thresh_short_inderect	0.82	0.00	0.69
Exp_smoothing	1.10	0.00	0.71
HP_smoothing	0.89	0.00	0.69
Trim_skew	0.89	0.00	0.69
ADJ_INF_MEDIAN_SA	0.92	0.00	0.69
ADJ_INF_TRIM2525_SA	0.92	0.00	0.69
ADJ_INF_TRIM_SA	0.90	0.00	0.69
BP_3_6	0.89	0.00	0.69
BP_3_12	0.91	0.00	0.69

BP_3_18	0.89	0.00	0.69
BP_3_24	0.88	0.00	0.69
BP_6_12	0.90	0.00	0.69
BP_6_18	0.88	0.00	0.69
BP_6_24	0.87	0.00	0.69
BP_12_18	0.87	0.00	0.69
BP_12_24	0.85	0.00	0.69
BP_18_36	0.89	0.00	0.69
BP_18_48	0.87	0.00	0.69
BP_18_60	0.87	0.00	0.69
BP_18_96	0.88	0.00	0.69
DFM_2stage	0.85	0.00	0.69
UC_noise	0.88	0.00	0.69
Unobserv_components_noise_excl	0.87	0.00	0.69
Unobserved_components	0.89	0.00	0.69

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 17

Mean Absolute Revision of Core Inflation Estimates (versus the Preceding Month) for 12 Months Ago with the Appearance of One New Observation, as pp

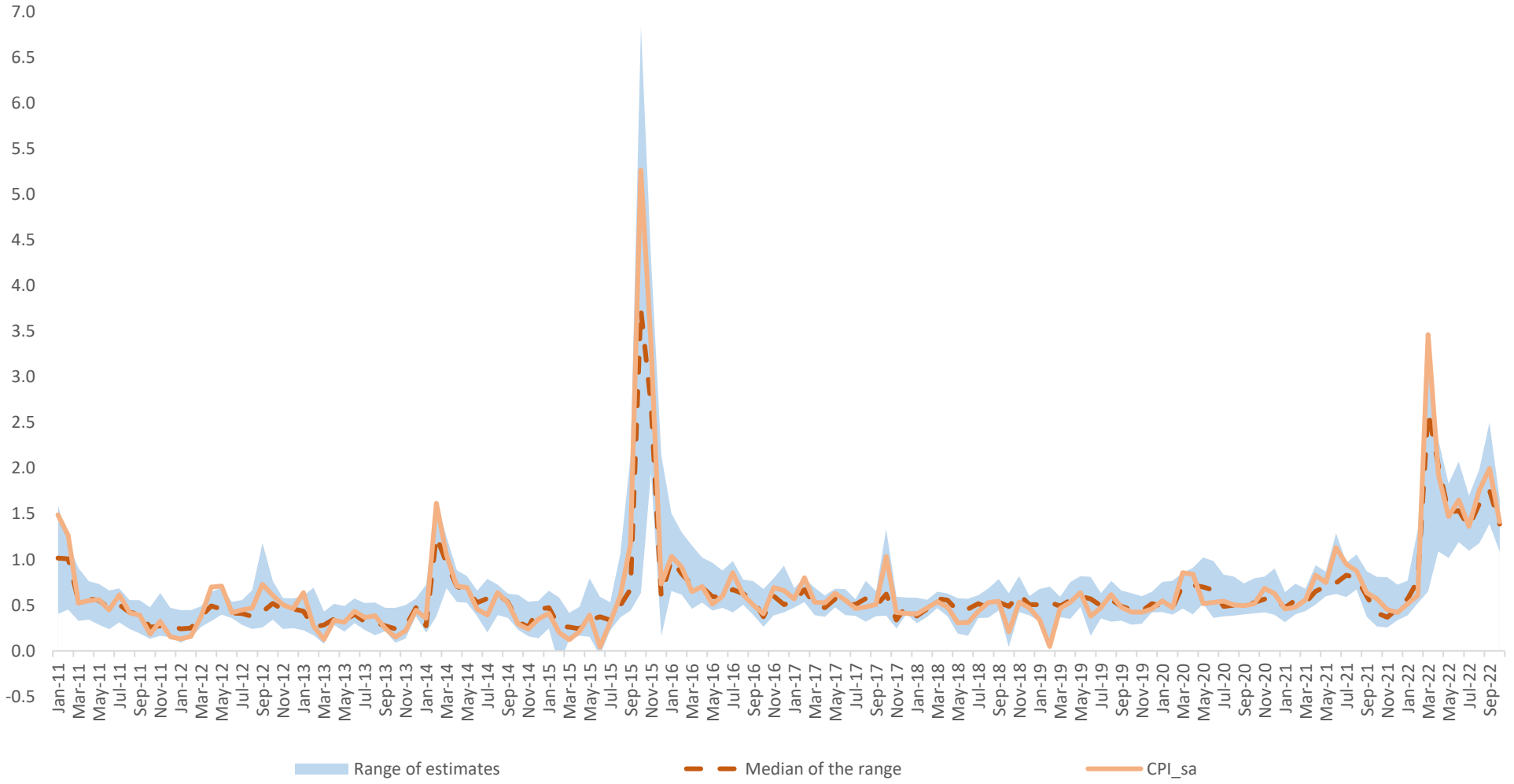
№	Trim_25 25_sa	Exp_smo othing	HP_smoo thing	ADJ_INF_ MEDIAN_ SA	ADJ_INF_ TRIM2525 _SA	ADJ_INF_ TRIM_SA	DFM_2st age	Unobserv ed_comp onents	UC_noise	BP_3_6	BP_3_12	BP_3_18	BP_3_24	BP_6_12	BP_6_18	BP_6_24	BP_12_18	BP_12_24	BP_18_36
1	0.01	0.03	0.11	0.002	0.002	0.001	0.01	0.07	0.01	0.00	0.04	0.05	0.06	0.04	0.05	0.06	0.02	0.03	0.02
2	0.00	0.01	0.02	0.002	0.002	0.001	0.00	0.03	0.01	0.09	0.09	0.08	0.07	0.00	0.01	0.02	0.01	0.02	0.02
3	0.00	0.01	0.01	0.002	0.002	0.001	0.00	0.02	0.00	0.00	0.04	0.03	0.03	0.04	0.03	0.03	0.00	0.01	0.01
4	0.00	0.01	0.01	0.002	0.002	0.001	0.00	0.01	0.00	0.05	0.00	0.00	0.00	0.05	0.05	0.05	0.00	0.00	0.01
5	0.00	0.01	0.01	0.002	0.002	0.001	0.00	0.01	0.00	0.00	0.03	0.04	0.04	0.03	0.04	0.04	0.01	0.01	0.00
6	0.00	0.01	0.00	0.002	0.002	0.001	0.00	0.01	0.00	0.00	0.00	0.02	0.02	0.00	0.02	0.02	0.02	0.02	0.00
7	0.00	0.01	0.00	0.002	0.001	0.001	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.02	0.01
8	0.00	0.01	0.00	0.002	0.002	0.001	0.00	0.00	0.00	0.02	0.00	0.02	0.02	0.02	0.01	0.00	0.02	0.02	0.01
9	0.00	0.01	0.00	0.002	0.002	0.001	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.02	0.01
10	0.00	0.01	0.00	0.002	0.002	0.001	0.00	0.00	0.00	0.02	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01
11	0.00	0.01	0.00	0.002	0.002	0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.02
12	0.00	0.01	0.00	0.002	0.002	0.001	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.02

№	BP_18_4	BP_18_60	BP_18_96	Wavelet_ min_std_ transfor m_direct	Wavelet_ min_std_ transfor m_inder ect	Wavelet_ min_std_ transfor m_S3_dir ect	Wavelet_ transfor m_min_s td_S3_in direct	Wavelet_ dev_thre sh_direct	Wavelet_ rmse12_t hresh_dir ect	Wavelet_ std_thres h_direct	Wavelet_ dev_tres h_short_ direct	Wavelet_ rmse12_t resh_sho rt_direct	Wavelet_ std_tresh _short_di rect	Wavelet_ dev_thre sh_inder ect	Wavelet_ rmse12_t hresh_in derect	Wavelet_ std_thres h_indere ct	Wavelet_ std_thres h_short_i nderect	Wavelet_ rmse_12_ thresh_s hort_ind erect	Wavelet_ dev_thre sh_short _inderect
1	0.02	0.02	0.03	0.11	0.12	0.04	0.04	0.04	0.05	0.01	0.04	0.07	0.01	0.17	0.04	0.04	0.08	0.04	0.05
2	0.02	0.02	0.03	0.10	0.11	0.04	0.04	0.02	0.03	0.01	0.02	0.03	0.01	0.29	0.03	0.01	0.03	0.03	0.01
3	0.02	0.02	0.02	0.06	0.06	0.03	0.04	0.03	0.02	0.01	0.03	0.02	0.01	0.08	0.02	0.01	0.02	0.01	0.01
4	0.01	0.01	0.02	0.00	0.00	0.03	0.03	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01
5	0.01	0.01	0.01	0.00	0.00	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
6	0.00	0.00	0.01	0.00	0.00	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.00
7	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00
8	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.00
9	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.01
10	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.00
11	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.10	0.01	0.00	0.01	0.00	0.00
12	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00

Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 18

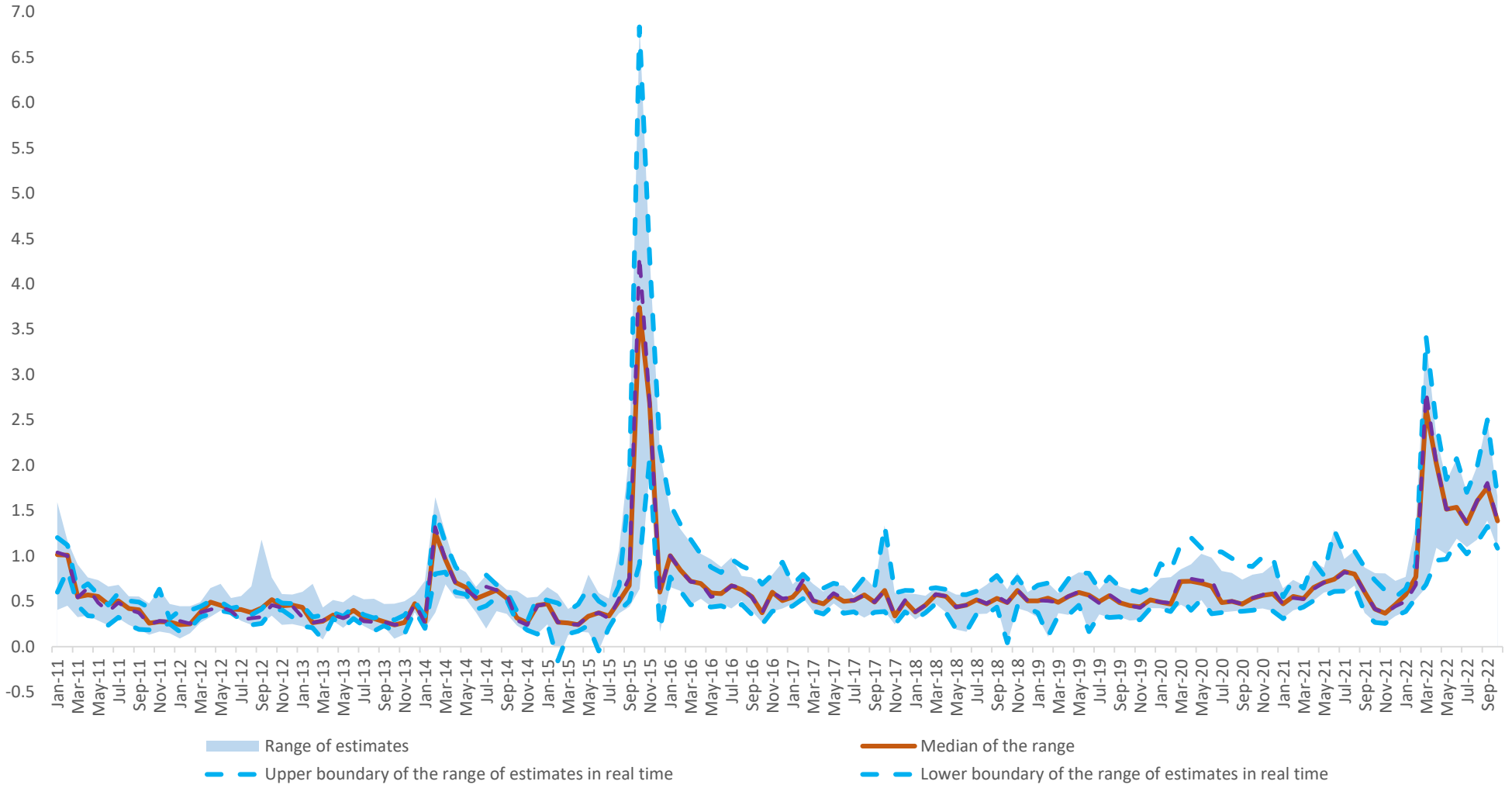
Dynamics of the Seasonally Adjusted CPIs and Core Inflation Estimates versus the Preceding Month, as pp



Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 19

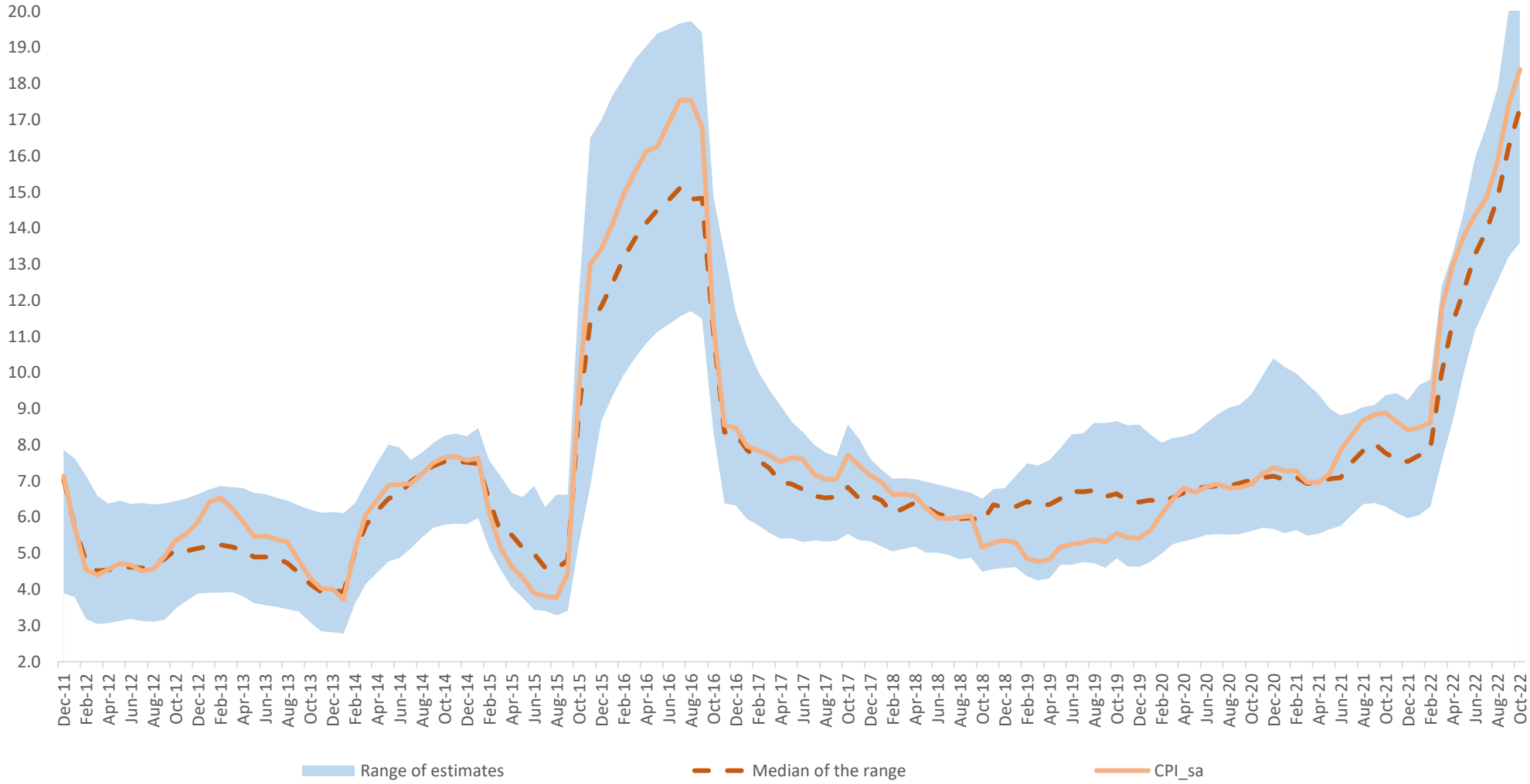
Dynamics of Seasonally Adjusted Core Inflation Estimates versus the Preceding Month, as pp



Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 20

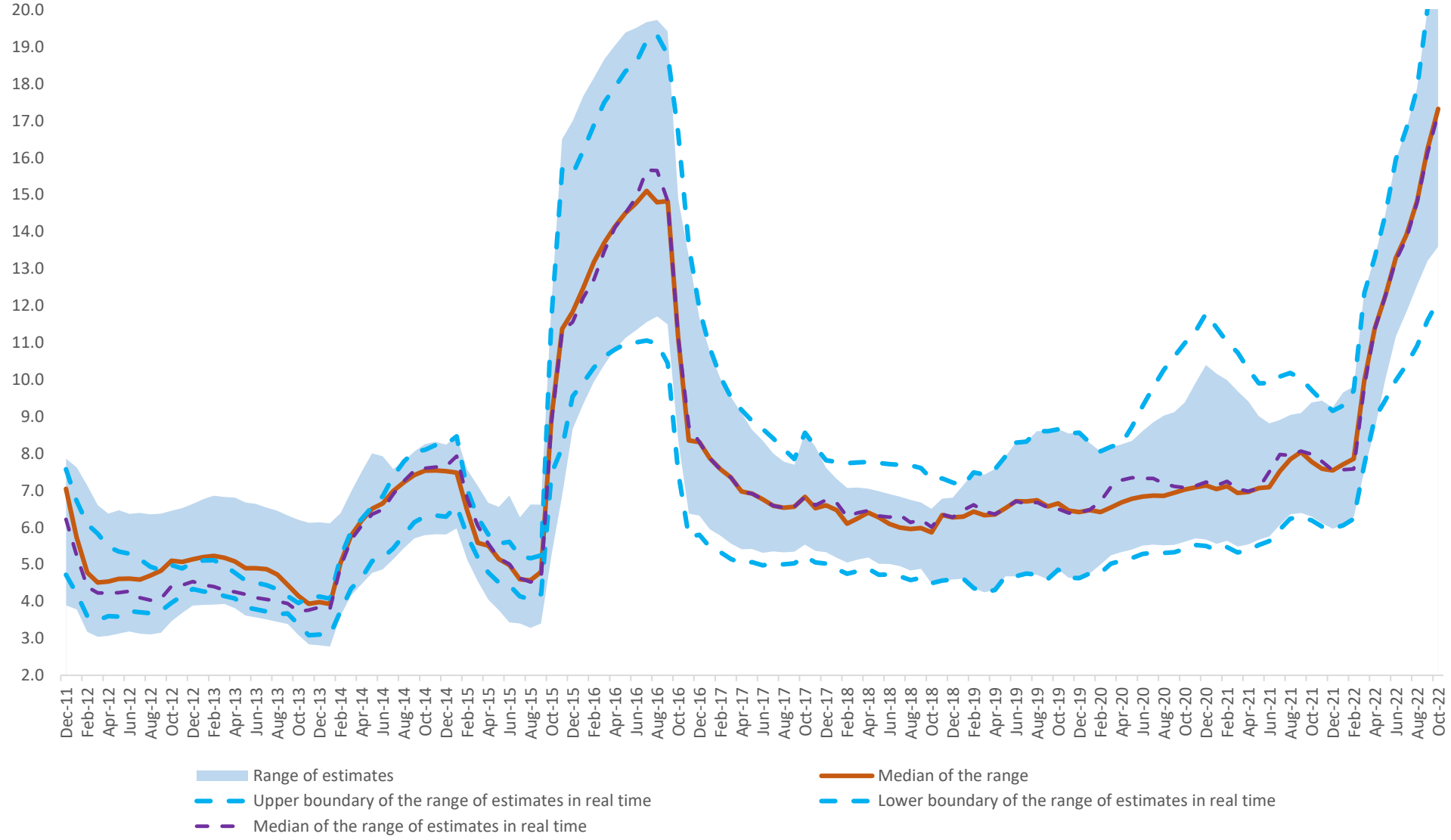
Dynamics of Seasonally Adjusted CPIs and Core Inflation Estimates versus the Corresponding Month of the Preceding Year, as pp



Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 21

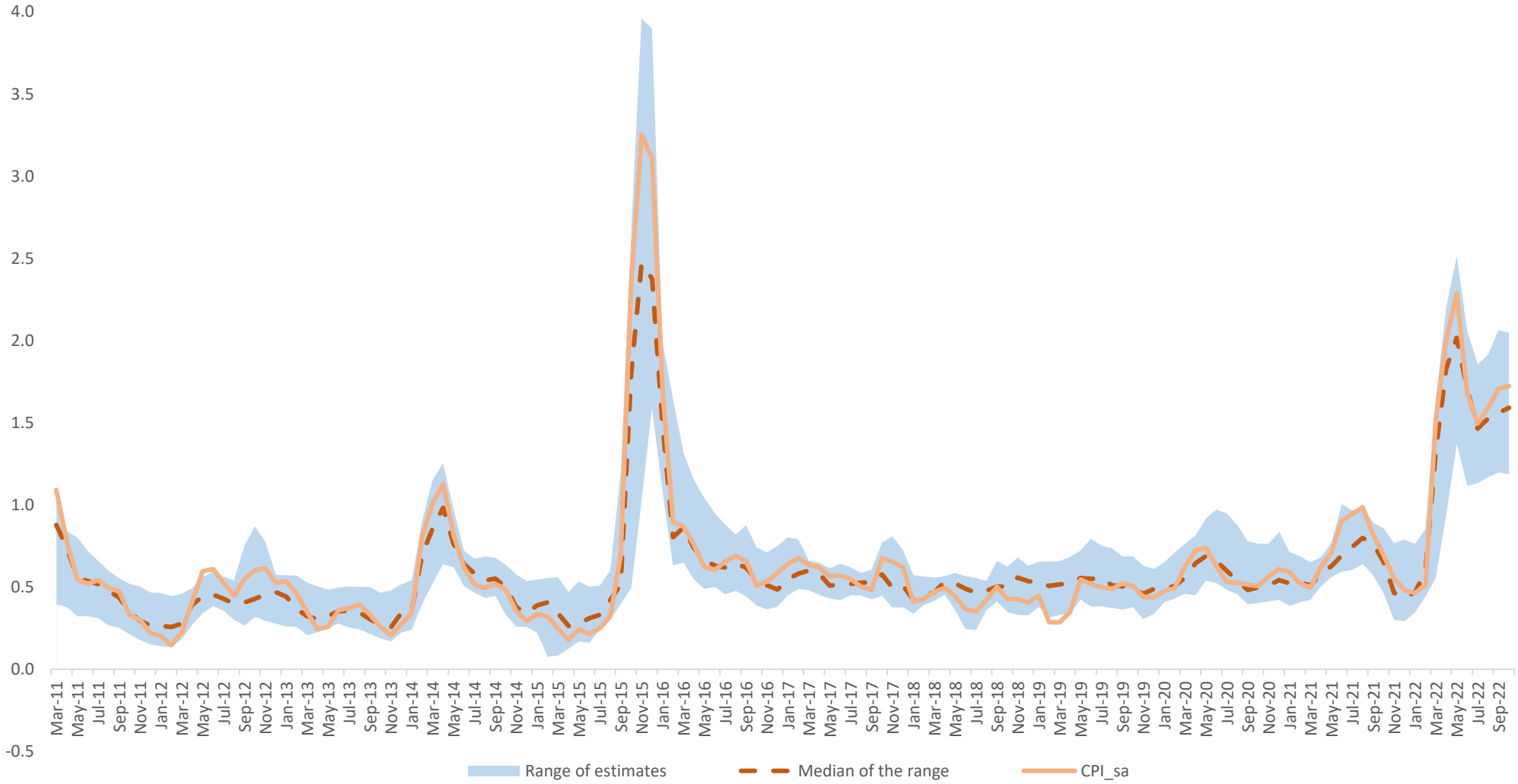
Dynamics of Seasonally Adjusted Core Inflation Estimates versus the Corresponding Month of the Preceding Year, as pp



Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 22

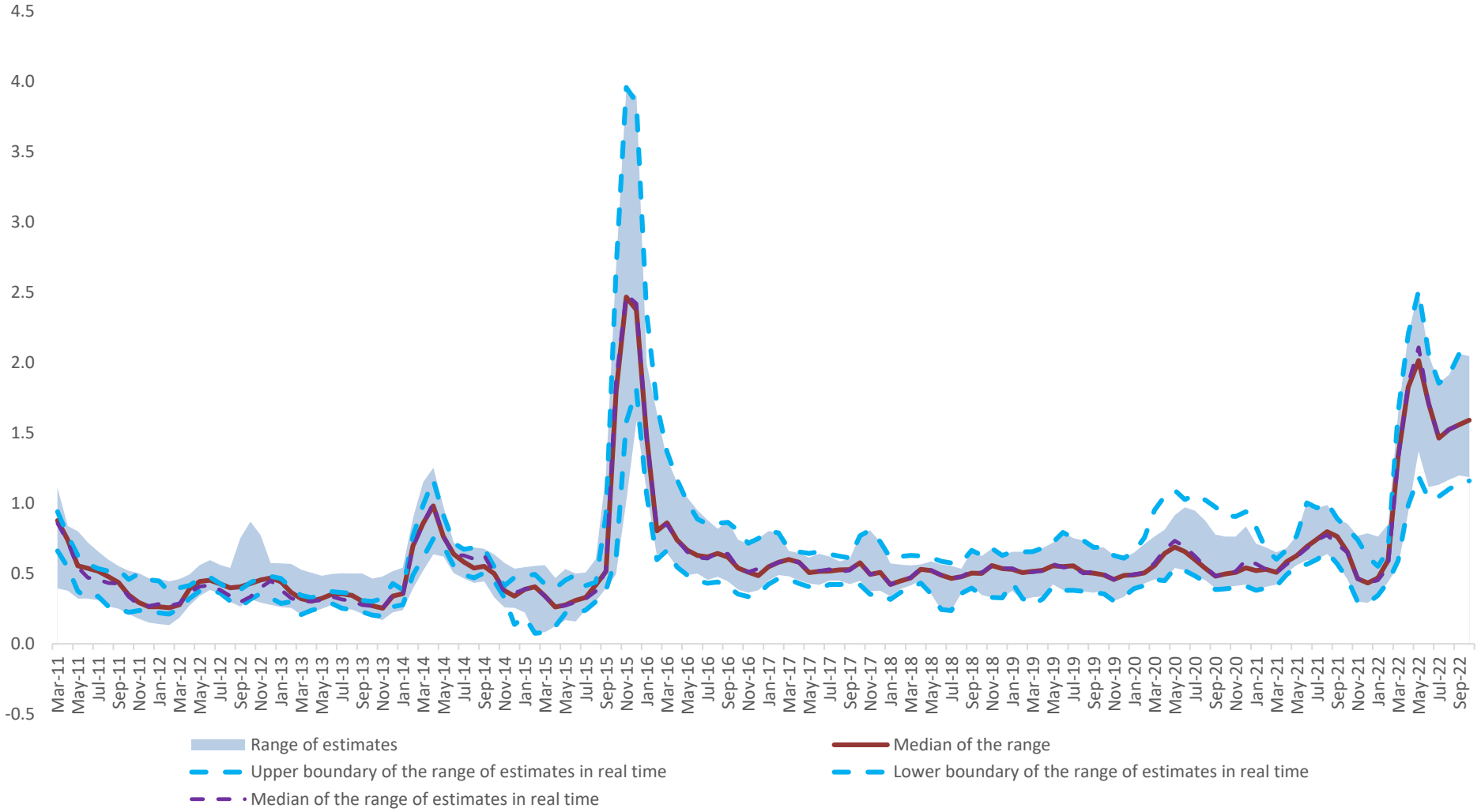
Dynamics of Seasonally Adjusted CPIs and of Core Inflation Estimates versus the Preceding Month, a Moving Average for 3 Months, as pp



Source: the authors' computations based on the data from the ASPR BNS RK

Appendix 23

Dynamics of Seasonally Adjusted Core Inflation Estimates versus the Preceding Month, a Moving Average for 3 Months, as pp,



Source: the authors' computations based on the data from the ASPR BNS RK