Methodology for Consumer Price Index Seasonal Adjustment in the Bank of Russia

Contents

I. Introduction

This Methodology for Consumer Price Index Seasonal Adjustment (hereinafter, the Methodology) was developed by the Bank of Russia to stipulate the principles, stages and algorithms for assessing seasonally adjusted series of changes in monthly values of the consumer price index (hereinafter, CPI) and its main components.

The Methodology significantly enhances the quality of the identification of the current short- and medium-term meaningful trends in consumer prices the Bank of Russia factors in when making its monetary policy decisions.

The guidance provided in the Methodology and supplemented with software codes ensure the transparency of the CPI seasonal adjustment algorithms applied and enable statistics users to comprehend and, where necessary, replicate the process of eliminating the seasonal component in consumer price movements.

The Methodology is based on the principles and approaches described in the publication by the Bank of Russia (Sapova A., Porshakov A., Andreev A., Shatilo E. Review of Methodological Specifics of Consumer Price Index Seasonal Adjustment in the Bank of Russia // Bank of Russia Working Paper Series. 2018. June. No. 33).[1] This Methodology takes into account the international experience of the seasonal adjustment of economic indicators set out in guidelines by the UNECE, Eurostat, the ECB, the U.S. Census Bureau, Bundesbank, Narodowy Bank Polski, and the statistical agencies of Australia, Singapore and Malta.

The Bank of Russia's periodicals using seasonally adjusted assessments of consumer price movements comprise the Monetary Policy Report, the information and analytical commentary Consumer Price Dynamics, and the macroeconomic bulletin Talking Trends prepared by the Research and Forecasting Department. The seasonally adjusted growth rates of consumer prices calculated by the Bank of Russia are also the basis for a complex of additional analytical indicators characterising the balance of medium-term inflation risks. Specifically, these are

[1] https://www.cbr.ru/Content/Document/File/87586/wp33_e.pdf

underlying inflation estimates and modified core inflation estimates. These indicators are essential for the Bank of Russia when making monetary policy decisions in order to ensure steadily low inflation (around 4%) over the medium-term horizon as they enable the monitoring of fundamental inflationary pressure trends based on short-term statistics.

II. Seasonal adjustment principles

The key objective of seasonal adjustment is to remove from the original time series any regular (but not necessarily arising at the same time) intra-annual variations caused by the rhythms of business processes, weather conditions, holiday seasons, and other developments associated with calendar specifics.

The seasonal component is eliminated from CPI series where there are regular intra-annual variations with the following characteristics:

- *economic explanation* (the seasonality of changes in economic time series may have multiple reasons, including the specifics of business and educational processes, sales seasons, holidays, traditions, customs, etc.);
- *robustness* (the estimate of seasonality is sufficiently robust for seasonality to be predicted with a high degree of probability);
- *objectivity* (formal tests confirm the assumption of seasonality).

The basic principle of the algorithm for eliminating the effect of a seasonal factor is to identify the parameters, or in other words, the specifics of seasonal adjustment. The identification of specifics may be divided into three main stages. It should be noted in advance that most often seasonal adjustment procedures and their mandatory stages involve iterations. This helps achieve the best result in terms of both formal tests and criteria and the economic interpretation of the identified seasonality.

The first stage addresses the following fundamental questions: whether a time series has seasonality (tests, visual analysis, economic logic, automatic seasonal adjustment), which method to use for seasonal adjustment (X12-ARIMA, TRAMO-SEATS, X1-ARIMA-SEATS), whether to apply a direct or indirect approach, what should be the level of data disaggregation, etc.).

The second stage involves time series pre-processing. Specifically, this includes setting a sample period, determining the need for log transformation (based on the Akaike, Hannan–Quinn, Schwarz information criteria), elimination of the calendar factor where it exists, as well as the detection of outliers, and the automatic determination of ARIMA model parameters. A particular focus is put on the analysis of the reasons for outliers, that is, one-off shocks and shifts. The quality of the time series pre-processing procedure is controlled by analysing the periodogram for the absence of seasonal and calendar frequencies and the parameters of the seasonal part of the ARIMA model.

The removal of seasonality as such takes place at *the third stage*, which is followed by testing the quality of the seasonal component. *First*, the seasonal factor is analysed for stability and predictability. A seasonal factor is considered to be stable and predictable when it has a logical explanation, and seasonal peaks happen during the same periods every year with a relatively stable amplitude of seasonal fluctuations. *Second*, the seasonal factor is tested for importance, and the periodograms of the seasonally adjusted series and the series of residuals are analysed for the absence of residual seasonality.

The seasonally adjusted series of changes in the CPI and its main components are calculated on a monthly basis. To mitigate the wagging tail effect (a significant revision of a seasonally adjusted series when a new observation is added), the main parameters of seasonal adjustment are fixed for each particular series, including the start date of a sample, ARIMA model parameters, and the set of outliers. Moreover, for the current calendar year, software is allowed to identify outliers automatically. The above parameters are updated once a year.

To implement the seasonal adjustment algorithm, we are using the EViews 9 software package (see the section ‘Seasonal adjustment’).

III. Algorithm

Data and weights

The Bank of Russia applies an *indirect approach* to CPI seasonal adjustment. This method implies that seasonality is eliminated in the movements of prices for certain types of products and services included in the CPI calculation, after which the resulting seasonally adjusted indices are aggregated (see the section ‘Aggregation’).

Monthly data on consumer price indices for certain goods and services groups, as well as the basic structure of consumer spending for the CPI calculation are measured and published by Rosstat.[2] Seasonal adjustment is made for data samples since January 2002. The base index is built using the released statistics on month-on-month (MoM) price changes. The base is the month preceding the start of the publication of statistics on a particular CPI component. For instance, if data are released from January 2002, the base period is December 2001; and where data are published from January 2006, the base period is December 2005.

Seasonal adjustment

Seasonal adjustment is performed using the X13-ARIMA-SEATS algorithm developed and maintained by the U.S. Census Bureau[3] providing for free use a special-purpose software product for assessing the seasonal component in time series.

The EViews[4] software is applied as a user interface to this algorithm. It is also used to automatically export and import data for the purposes of this Methodology.

The process of seasonal adjustment using EViews involves the following steps:

1. The first step is to import data to EViews, e.g. using the menu option File-Import (the majority of popular data formats are supported).
2. The second step is to create a text object (e.g. through the menu option Object-New object) and save the specification for seasonal adjustment therein.
3. At the third step, the seasonal component may be isolated using the command

{*name*.x13(save="s10 s11", spec="*spec_name*")},

where *name* is the name of the series imported to EViews, and *spec_name* is the name of the text object with the specification of seasonal adjustment. When this command is completed, two new series will be created in the work file in EViews: *name_s11* with the values of seasonally adjusted data and *name_s10* with the seasonal factor.

Integration of samples

In a situation when seasonality significantly alters in index dynamics for whatever reason, analysis is performed based on individual parts of the sample where seasonality remains relatively stable. Thus, seasonal adjustment is made based on a range of subsamples. The obtained results are integrated into a single final seasonally adjusted series by calculating price growth rates compared to the previous period.

[2] https://www.gks.ru/price
[3] http://www.census.gov/
[4] http://www.eviews.com/

Special approaches to seasonal adjustment

Seasonal adjustment implies that, among other things, price movements are influenced by regular seasonal factors that repeat every year. However, these factors may be predefined in some cases. Specifically, the annual indexation of utility tariffs is carried out during the periods and in the amounts stipulated by the annual resolutions of the Government of the Russian Federation, and that of railway tariffs is carried out by the order of the Federal Antimonopoly Service.

As the annual size and time of indexation may vary in different years, the SEATS algorithm is not efficient for isolating seasonality in such data. To address this problem, the seasonal factor is built manually based on released information regarding planned indexation in each month, using the following formula:

$$SF_i = \frac{\frac{I_i}{100}}{\left(\prod_{i=1}^{12} \frac{I_i}{100}\right)^{\frac{1}{12}}}$$

where SF_i – a seasonal factor in the month i,

I_i – the tariff growth rate planned in the month i.

The indexation of tariffs for housing services is not determined strictly. Therefore, it is assumed that the size and time of their indexation will be the same as for utility services. As regards tariffs for housing and utility services and railway transportation, the seasonal factor is calculated for the calendar year as of which the indexation parameters are determined. Moreover, changes in railway tariffs are also characterised by intra-annual seasonality which is isolated from the price index adjusted for indexation using the X13-ARIMA-SEATS method.

Aggregation

The result of the aggregation of various consumer price subindices is not always the same as the aggregated index published. This difference is due to the rounding of values, especially where released statistics are rounded to one decimal place. To address this issue, indirect aggregation is used. This approach involves the following. First, a seasonal factor of the aggregated indicator is calculated as the ratio of seasonally unadjusted and adjusted aggregated indicators. Then, the seasonally adjusted indicator is calculated as the ratio of the published unadjusted indicator and its seasonal factor.

$$SF = \frac{\sum_j w_j \pi_j^{NSA}}{\sum_j w_j \pi_j^{SA}}$$

$$\pi^{SA} = \frac{\pi^{NSA}}{SF}$$

where SF – a seasonal factor of the aggregated indicator,

w_j – the share of expenses for certain goods and services groups in consumer spending,

π_j^{NSA} – the published MoM growth rate of prices for certain goods (services) groups,

π_j^{SA} – the seasonally adjusted MoM growth rate of prices for certain goods (services) groups,

π^{NSA} – the published MoM price growth rate according to the aggregated indicator,

π^{SA} – the seasonally adjusted MoM price growth rate according to the aggregated indicator.

IV. References

The website of the Russian Federal State Statistics Service (Rosstat) is the source of information on consumer price indices and the basic structure of consumer spending for the CPI calculation.

The Government of the Russian Federation and the Federal Antimonopoly Service publish data on the levels of indexation of utility and railway tariffs, respectively (see the section 'Special approaches to seasonal adjustment').

The authors of the Methodology relied on the following papers as a theoretical framework:

1. Sapova A., Porshakov A., Andreev A., Shatilo E. Review of Methodological Specifics of Consumer Price Index Seasonal Adjustment in the Bank of Russia // Bank of Russia Working Paper Series. 2018. June. No. 33.[5]
2. Handbook on Seasonal Adjustment. 2018 edition / Eurostat. 2018. [6]
3. Bessonov V. Problems of the Analysis of the Russian Macroeconomic Dynamics of the Transition Period. Moscow: Institute for the Economy in Transition, 2005.
4. Bessonov V. Development of the Methodology for Building a Framework of Agricultural Producer Price Indices in Seasonal Production and Usage (Processing) Conditions. Report / Bessonov V. Moscow: Interstate Statistical Committee of the CIS, 2015.
5. Bessonov V., Petronevich A. Seasonal Adjustment as a Source of Spurious Signals. HSE Economic Journal, 2013, No. 4.
6. Statistical Research Division. X13-ARIMA-SEATS Reference Manual / U.S. Census Bureau. 2017.[7]

[5] https://www.cbr.ru/Content/Document/File/87586/wp33_e.pdf
[6] https://ec.europa.eu/eurostat/documents/3859598/8939616/KS-GQ-18-001-EN-N.pdf
[7] https://www.census.gov/ts/x13as/docX13AS.pdf

Annex 1. CPI seasonal adjustment specifications

Food products

Series	Live and chilled fish	Dairy butter	Milk and dairy products	Cheese	Eggs	Sugar	Fruit and vegetables, including potato	Other food products
Sample	2008.12–to date	2001.12–to date	2008.12–to date	2001.12–to date	2001.12–to date	2001.12–to date	2005.12–to date	2011.12–to date
Transformation	log	log	log	log	log	log	log	log
Outliers	LS2012.Apr LS2013.Feb LS2013.Dec LS2014.Jan LS2015.Jan LS2016.Jan LS2016.Feb LS2016.May LS2016.Jul LS2017.Apr LS2017.Jul LS2017.Nov	LS2002.Nov LS2002.Dec LS2003.Jan LS2007.Aug LS2007.Sep LS2007.Oct LS2007.Nov LS2010.Aug LS2010.Sep LS2015.Jan LS2015.Feb LS2016.Oct LS2016.Nov LS2016.Dec	LS2010.Aug LS2010.Sep LS2013.Sep LS2015.Feb LS2016.Oct	LS2007.Sep LS2007.Oct LS2007.Nov LS2008.Apr LS2008.May LS2008.Jun LS2009.Dec LS2015.Jan	LS2007.Jul LS2007.Oct LS2010.Sep LS2014.Jul LS2018.Dec	LS2006.Feb LS2009.Sep LS2014.Nov LS2014.Dec LS2015.Jan	LS2010.Aug LS2010.Sep LS2015.Jan LS2017.Jun	LS2014.Dec LS2015.Jan LS2015.Feb LS2015.Mar LS2015.Apr
ARIMA model	(1 1 0)(1 0 0)	(3 1 1)(0 1 1)	(1 2 2)(0 1 1)	(2 1 0)(0 1 1)	(0 1 2)(0 1 1)	(1 1 0)(0 1 1)	(2 1 0)(0 1 1)	(1 1 0)(0 1 1)

Non-food goods

Series	Clothing and underwear	Furs (1)	Furs (2)	Knitwear	Leather, textile and combined footwear	Perfumes and cosmetics	Smallware	Furniture
Sample	2001.12–to date	2001.12–2015.12	2015.12–to date	2001.12–to date	2001.12–to date	2001.12–to date	2001.12–to date	2001.12–to date
Transformation	log	log	log	log	log	log	log	
Outliers	LS2009.Feb LS2009.Mar LS2009.Apr LS2014.Dec LS2015.Jan LS2015.Feb LS2015.Mar LS2019.Jan	LS2011.Nov LS2014.Dec LS2015.Jan LS2015.Feb	-	LS2009.Feb LS2009.Mar LS2009.Apr LS2014.Dec LS2015.Jan LS2015.Feb LS2015.Mar	LS2009.Mar LS2015.Jan LS2015.Feb LS2015.Mar LS2015.Apr	LS2009.Feb LS2009.Mar LS2009.Apr LS2009.May LS2009.Jun LS2014.Dec LS2015.Jan LS2015.Feb LS2015.Mar LS2015.Apr LS2015.May LS2018.Sep LS2019.Jan	LS2009.Feb LS2009.Mar LS2009.Apr LS2015.Jan LS2015.Feb LS2015.Mar LS2015.Apr LS2019.Jan	LS2014.Dec LS2015.Jan LS2015.Feb LS2015.Mar LS2019.Jan
ARIMA model	(1 1 2)(0 1 2)	(1 1 0)(0 1 1)	(0 1 0)(0 1 1)	(3 1 1)(0 1 1)	(2 2 1)(0 1 1)	(0 2 1)(0 1 1)	(0 2 2)(0 1 1)	(0 2 1)(0 1 1)

Series	Electrical goods and other household appliances	Printed goods (1)	Printed goods (2)	Other non-food goods
Sample	2001.12 –	2001.12–2009.12	2009.12–	2005.12–
Transformation	log	log	log	log
Outliers	LS2009.Feb LS2009.Mar LS2014.Dec LS2015.Jan LS2015.Feb LS2015.Mar LS2015.Sep LS2019.Jan	AO2002.Jan AO2002.Feb LS2002.Oct LS2009.Jan LS2009.Aug	LS2010.Mar LS2015.Jan LS2019.Jan LS2019.Feb	LS2009.Feb LS2009.Mar LS2009.Apr LS2009.May LS2014.Dec LS2015.Jan LS2015.Feb LS2015.Mar LS2015.Apr LS2019.Jan
ARIMA model	(1 1 0)(0 1 1)	(1 1 1)(1 1 1)	(1 1 0)(0 1 1)	(3 2 1)(0 1 1)

Services

Series	Personal services	Passenger transportation excluding railroad (1)	Passenger transportation excluding railroad (2)	Rail transportation (1)	Rail transportation (2)	Preschool (1)	Preschool (2)	Education (1)
Sample	2001.12–to date	2001.12–2013.01	2013.01–to date	2003.03–2013.01	2013.01–to date	2001.12–2013.12	2013.12–to date	2001.12–2009.02
Transformation	log	log	log	log	log	log	log	log
Outliers	AO2003.Feb LS2005.Feb LS2005.May LS2007.Oct LS2008.Aug LS2009.Jan LS2011.Jan LS2012.Jun LS2013.Nov LS2015.Jan	LS2004.Jan LS2004.Nov AO2004.Dec LS2009.Apr	LS2012.Jan AO2012.Jul LS2015.Feb LS2018.Jan	AO2007.Feb AO2007.Oct AO2008.Feb AO2008.Oct AO2012.Feb AO2012.Dec	AO2013.Mar AO2013.May AO2014.Apr AO2017.Feb	LS2002.Sep LS2004.Feb LS2004.Jul LS2005.Jan LS2006.Apr	LS2014.Jan LS2015.Jan LS2016.Jan LS2016.Sep	LS2002.Jan AO2002.Aug LS2004.Sep
ARIMA model	(1 2 1)(0 1 1)	(1 1 0)(0 1 1)	(0 1 1)(0 1 1)	(0 0 0)(0 1 1)	(0 0 0)(0 1 1)	(1 1 1)(0 1 1)	(0 1 0)(0 1 1)	(0 1 1)(0 1 1)

Series	Education (2)	Education (3)	Cultural services (1)	Cultural services (2)	Outbound tourism	Sanatorium and health services	Medical services (1)	Medical services (2)
Sample	2009.02–2014.08	2015.01–to date	2001.12–2015.01	2015.01–to date	2001.12–to date	2001.12–to date	2004.01–2015.12	2015.12–to date
Transformation	log	log	log	log	log	log	log	log
Outliers	LS2012.Aug LS2012.Sep	AO2015.Jan LS2015.Aug LS2017.Sep LS2018.Sep	LS2003.Oct LS2005.Mar LS2012.Dec	LS2016.Jan LS2016.May LS2017.Aug	LS2009.Jan LS2014.Dec LS2015.Jan LS2015.Apr LS2015.Aug LS2016.Jan	LS2003.Oct LS2011.Nov LS2017.Jun	LS2005.Mar LS2005.Sep LS2005.Oct AO2010.Feb AO2014.Mar LS2015.Jan	LS2016.Jan
ARIMA model	(1 1 0)(0 1 0)	(0 1 1)(0 1 1)	(1 1 1)(0 1 1)	(1 1 1)(1 0 0)	(3 1 1)(0 1 1)	(1 1 0)(0 1 1)	(1 1 1)(0 1 1)	(0 1 1)(0 1 1)

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