Seasonal Adjustment of Consumer Price Index as Against December Previous Year on Fuels in Romania between 2020 ynd 2022 Using Jdemetra+ 2.2.3

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ABSTRACT

Modelling Consumer Price Index as strategy for inflation targeting is of significance in the existing global context. Moreover, in the current economic state, identifying seasonal patterns and modelling short term time series becomes essential in building a sustainable economy. The paper analyses a dataset on fuel prices, made available by National Institute of Statistics Romania with values from 2001 to 2022. Promising results on the seasonally adjusted series are obtained by employing the X13 package in JDemetra+ 2.2.3. The results show that the series has been log-transformed and no calendar effects are present. Moreover, seasonality tests show that the residuals are not affected by seasonality. The plot of the series components reveals a strong irregular component.

Keywords: Consumer Price Index, Romania, JDemetra+ 2.2.3, seasonal adjustment, fuel

JEL Classification: *C10*

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1. INTRODUCTION

Inflation targeting is a popular approach adopted by many countries as a mean for controlling price increases, New Zealand, Canada, the United Kingdom, Finland, Sweden, Australia or Spain among others (Debelle, Masson, Savastano, & Sharma, 1998). Modelling the Consumer Price Index (CPI) as strategy for inflation targeting using ARIMA models is widely spread in the scientific literature (Gautam & Kanoujiya, 2022). Such models have proven reasonable in terms of quality for CPIs in developed countries (see for example (Nyoni, 2019)) as well as developing ones (see for example (Mohamed, 2020); (Nyoni, 2018); (Saz, 2011)). Also, ARIMA models with seasonal component produced better predictions compared to other approaches such as Holt-Winters triple exponential smoothing (Lidiema, 2017).

In addition to inflation targeting, modelling the CPI as a seasonally adjusted series might be important for policy makers, as seasonally adjusted data help them understand seasonal patterns and respond to them accordingly (Mirica, Glavan, Toma, & Patrascu, 2019). Many statistical offices do not publish seasonally adjusted CPI as "the common practice is to omit seasonal adjustment even though many of the price series are seasonal" as stated by the United Nations Economic Commission for Europe (UNECE, 2020). Yet, the US Bureau of Statistics and the European Central Bank publish a seasonally adjusted CPI and HCPI respectively ((ECB, 2023); (US Bureau of Statistics, 2022)). Bundesbank also produces such series (Deutsche Bundesbank Eurosystem, 2022).

The paper aims to model the Consumer Price Index as against December previous year on fuels in Romania applying an easy-to-use automated procedure. The paper contributes to the field in two ways. Firstly, it offers some insights on how to model a very short time series with seasonal patterns. The topic is extremely important for practitioners in official statistics as time series in official statistics are relatively short, reflecting a delicate balance between coverage and the need for continuous uptakes (Buono, Infante, & Mazzi, 2018). Secondly, the National Institute of Statistics of Romania currently does not publish a seasonally adjusted version of the selected time series. Should the need of such a series arises, our research may be useful in determining the best approach to perform seasonal adjustment.

2. LITERATURE REVIEW

Bell and Hillmer (1984) pointed out in their seminal work on policy issues related to seasonal adjustment of time series that "the society is conditioned to expect and even demand seasonally adjusted data" as monetary and economic policies rely on them (Bell & Hillmer, 1984). The use of seasonally adjusted data instead of raw data has multiple advantages both in the context of a single series analysis as well as in econometric modelling. For example, (Granger, 1978) pointed out that using seasonally adjusted data in a regression analysis removes a crucial cause of spurious relationship and improves forecasts. In a single series analysis, seasonally adjusted data allow for large masked seasonality effects to reveal themselves; this is often the case of winter holidays during the recession years that cause an increase in raw monthly series from November to December but a decrease in seasonally adjusted series ((Jiann, 2005); (United States Census Bureau, 2023)).

An acceptable alternative to seasonal adjustment in the analysis of short-term time series is the comparison of data on a year-over-year basis (Majaski, 2023). However, this method, while it reduces the seasonal fluctuations, it does not permit the user to observe significant changes in the business cycle in a timely manner but rather late after they occur (The Federal Reserve Bank of Dallas, 2023). Also, such comparisons don't account for Easter effects, as Easter is a moving holiday that may fall on different months is consecutive years (International Monetary Fund, 2017). Therefore, the use of seasonally and calendar adjusted data for studying the underlying trends within a series, when the series present such pattens, is recommended (Fortier & Gellatly, 2023).

With regard to the Consumer Price Index, seasonally adjusted data should be used for analysing short term price trends in the economy, while unadjusted data should be used for escalation purposes ((U.S. Bureau of Labour Statistics, 2023); (U.S. Bureau of Labour Statistics, 2020)). Also, the seasonally adjusted Consumer Price Index may be used to find inflection points in the economic activity (Zhang, 2017).

One of the most delicate issues in the process of seasonal adjustment is choosing the length of the time series because the quality of the results reduces with the number of observations included in the process (European Commission, 2005). From a theoretical point of view, in order to perform time series modelling with a SARIMA model the number of observations must exceed the number of estimated parameters with just one, yet in practice a considerably higher number of observations is needed (Hyndman & Athanasopoulos, 2018). When long time series are not available or are

not suitable, choosing the appropriate method for seasonal adjustment is problematic. Scientific literature reports that the X12 methods are more suitable than model-based ones such as TRAMO-SEATS in such circumstances (European Commission, 2005).

3. METHODOLOGY

For the purpose of this paper, data on the Consumer Price Index as against December previous year on fuels is retrieved from the Tempo-Online database provided by the National Institute of Statistics Romania on March 20th 2023. Dataset containing values from 2001 to 2022 is downloaded and JDemetra+ 2.2.3 was employed in order to further perform the analysis on the time series. By comparison, Bundesbank (Deutsche Bundesbank Eurosystem, 2023) uses JDemetra 2.2.2. The software, freely available on Github, was developed according to the Eurostat Guidelines on Seasonal Adjustment, being officially recommended for this purpose (JDemetra, 2023). All products in the JDemetra+ family have key advantages: multi-platform availability (Windows, MacOS, Linux, Solaris); modularity (its capabilities can be extended by plugins); possibility to reconvert in other languages (JDemetra, 2023). The latest version of JDemetra+ is 2.2.4 but it was only released on January 2023. On the other hand, JDemetra 2.2.3 as released on July 2020, providing enough time for practical tests, including on time series severely affected by the COVID pandemic.

In order to establish the series length, a graphical inspection was performed. According to the Eurostat ESS Guidelines on Seasonal Adjustment, the graphical analysis should be performed on the unadjusted series (Eurostat, 2015). If the series pattern drastically changes at some point in time, analyzing a shorter series span is considered, respecting the minimum length of three years for monthly data recommended by UNECE (UNECE , 2021).

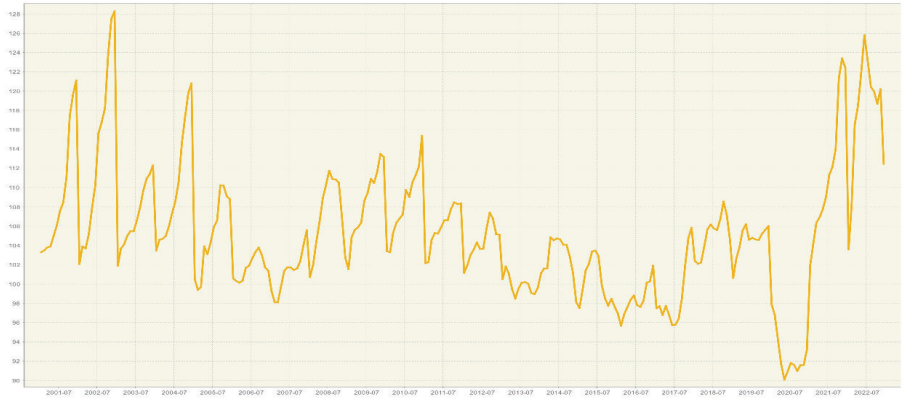
Next, the outlier detection tool was used in order to observe the outliers in the time series. Finally, the automatic procedure for seasonal adjustment was applied, as suggested in previous studies on monthly data (see for example (Toma, Mirica, & Paunica, 2018)). The procedure for seasonal adjustment comprises of several steps: pre-adjustment (calendar adjustment, outlier detection and correction, series transformation); series modelling (estimating the coefficients based on the SARIMA model) and series decomposition (JDemetra, 2023). For the calendar adjustment step, all the legal holidays in Romania were considered relevant for the series and thus incorporated within the analysis. Indicators from the main results in the output were reported and analyzed.

4. RESULTS

Figure 1 shows the evolution of the Consumer Price Index as against December previous year on fuels in Romania between January 2001 and December 2022. A clear seasonal pattern can be observed from the graph. However, the pattern drastically changes since the beginning of the Covid-19 pandemic, more specifically January 2020. As such, before continuing to the seasonal adjustment phase, the series is cut and the now time frame considered is January 2020 – December 2022.

Consumer Price Index as against December previous year on fuels in Romania between January 2001 and December 2022; source: designed by the authors using JDemetra+ 2.2.3

Figure 1



Outliers generated by the COVID-19 pandemic within the time series may create incorrect revisions (Enright, 2023). Moreover, they can affect one or more components of the time series (Tiller, Oh, & Liu, 2021). Thus, identifying and correcting them, preferably using an automated procedure is necessary (Mirica, Catrina, Ceban, Partas-Ciolas, & Calota, 2022).

In the case of the Consumer Price Index as against December previous year on fuels in Romania, four outliers are identified, as observed in Figure 2: one level shift in January 2021, one level shift in October 2021, one transitory change in January 2022 and an additive outlier at the end of the series. The outlier in January 2021 followed just as the number of cases in the November 2020 pandemic wave was diminishing in Romania; the one in October 2021, occurred as the October-November 2021 pandemic wave was at its peak; the one in January 2022 also occurred at the peak of a pandemic wave (more details may be consulted at (WHO, 2023)). The last outlier is located at the

end of the series, thus suggesting an economic change; however, more data need to be available in order to properly interpret it (Eurostat, 2020).

Consumer Price Index as against December previous year in Romania on fuels between 2020 and 2022 – Outliers; source: designed by the authors using JDemetra+ 2.2.3

Figure 2

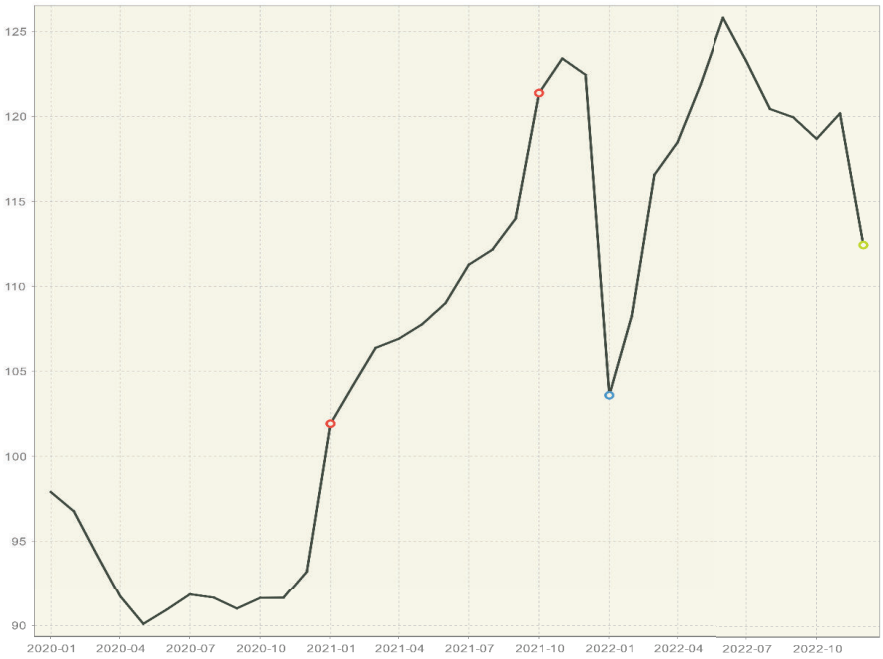


Table 1 displays the results of the seasonal adjustment process using two customized specifications: the RSA 5c form the X13 package and the RSA full from the Tramo-Seats package. Both specifications returned a log-transformed series, no trading day effects and no Easter effects. The basic checks show promising results. The residual seasonality tests show no seasonality present in the residuals. However, the entire process was diagnosed as good using X13 and severe using Tramo-Seats. The results are in concordance with those obtained by (Buono, Infante, & Mazzi, 2018) who explain the better performance of X13 though "its intrinsic non-parametric nature, so that the choice of the moving average filters is less influenced by the changes in the length of the series." (Buono, Infante, & Mazzi, 2018).

Seasonal adjustment on Consumer Price Index as against December previous year on fuels in Romania between 2020 and 2022- Main results; source: designed by the authours using JDemetra+ 2.2.3

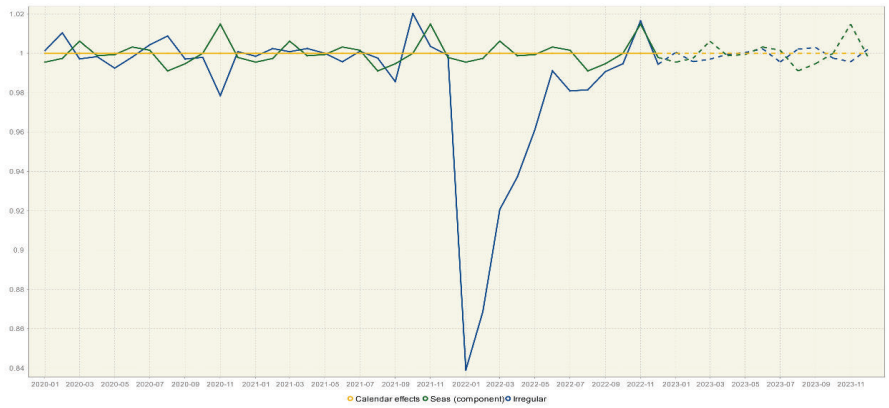
Table 1

	X13 – RSA 5c custom specifcation	Tramo-Seats – RSA full custom specifcation
Series transformation	log-transformed	log-transformed
Trading day effects	none	none
Easter effects	none	none
Basic checks	definition:Good(0.000) annual totals:Good (0.000)	definition:Good (0.000) annual totals:Good (0.000)
Regarima residuals	normality:Good (0.444) independence: Good (0.189) spectral td peaks: Good (0.450) spectral seas peaks: Good (0.138)	normality: Good (0.247) independence: Good (0.917) spectral td peaks: Uncertain (0.085) spectral seas peaks: Good (0.185)
Outliers	number of outliers: Bad (0.056)	number of outliers: Severe (0.111)
Residual seasonality tests	qs test on sa: Good (1.000) f-test on sa (seasonal dummies): Good (0.998) qs test on i: Good (1.000) f-test on i (seasonal dummies): Good (0.985)	qs test on sa: Good (1.000) f-test on sa (seasonal dummies):Good (0.934)
Summary	Good	Severe

Figure 3 displays the series components as generated using X13. The seasonal and the irregular component are very strong. However, there are no calendar effects.

Series components (calendar effects, seasonal and irregular) generated using X13 RSA 5c custom specification source: designed by the authors using JDemetra+ 2.2.3

Figure 3



5. CONCLUSIONS

The paper contributes to the field as it offers insights on how to model a very short time series with seasonal patterns. Our research concluded that the Consumer Price Index as against December previous year in Romania during the COVID pandemic presents outliers strongly linked to the pandemic waves. As such the automatic procedure available in JDemetra+ 2.2.3 offers promising results for modelling monthly time series of just 3 years length.
Further research, including manually entering the SARIMA model (Mirica, Andrei, Dascalu, Mincu Radulescu, & Glavan, 2016) is needed in order to improve the estimations. Such procedure would require executing several ARIMA models and seasonal filters and choosing the best model based on the magnitude of the revisions; more specifically, the model that leads to minimum revisions should be chosen (Mirica, Andrei, Dascalu, Mincu Radulescu, & Glavan, 2016). Thus, our paper presumed that the most relevant holidays for this particular time series are the legal holidays in Romania. Other important celebrations may be added to the calendar used in the seasonal adjustment process to assess whether or not they are relevant.

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