SEASONAL ADJUSTMENT OF TIME SERIES OF MONTHLY CONFIDENCE SURVEYS, MAY 2019

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ABSTRACT

In April 2019, confidence surveys monthly data covered a three-year time horizon[1], a minimum time span that is necessary to control for the presence of seasonality in the series. The purpose of this material is to determine whether the monthly series show patterns of seasonality, explaining the steps of the seasonal adjustment procedure that are followed in case the seasonal component is present. The procedure of removing the seasonal component helps the analysis of the series and allows the comparison of the results from one month to the other. Seasonal adjustment is the first step in the statistical processing of the balance series at a monthly frequency, which will be followed up in the future with the aggregation process at sector and economy level.

INTRODUCTION

Time series may exhibit seasonal patterns, which are defined as fluctuations that are repeated in the same period of the year, in the same direction and size.[2] Seasonal adjustment is the process during which the seasonal effects are removed from a time series, with the main purpose of facilitating the analysis of long-term trends and short-term fluctuations. Whereas, seasonal adjustment methods are techniques that decompose time series into its components, unobserved, with different dynamic features. However, seasonal adjustment should not be considered as a process that is automatically performed. Each time series is analysed for features in their pattern in order to determine (1) whether the series exhibits seasonal behaviour, (2) whether the seasonal behaviour is independent of the series level, (3) whether the seasonal adjustment will be performed at an aggregated or disaggregated level and (4) the method for seasonal adjustment.

[1] *Confidence surveys started to be conducted under the European Commission's harmonization program in May 2016. One of the changes that accompanied this shift was the increase in their frequency from quarterly to a monthly basis.*

[2] *The size is the same in the model known as the additive model. If the size of seasonality is not the same, but depends on the level of the series, then we have to deal with a seasonal multiplicative model.*

Despite the need to address the above mentioned issues related to the seasonal adjustment of time series, we point out some commonly agreed conclusions that the available literature in this area offers[3]:

a. Seasonal adjustment helps in the identification of important characteristics of a time series such as direction, turning points and consistency with other economic indicators.
b. The seasonally adjusted series should never replace the original series because: during seasonal adjustment, some of the information is lost; increased uncertainty because there is no single choice of the proper method of seasonal adjustment; the seasonally adjusted series undergoes revisions whenever new observations are added.
c. The seasonal adjustment does not intend to smooth a series and the irregular component is part of the seasonally adjusted series.
d. Regarding the choice between the direct and indirect method of seasonal adjustment[4], the indirect method is the most effective when the subcomponents do not have similar characteristics to each other.
e. In the case of short time series, less than 5 years of monthly data, it is difficult to identify a stable seasonal structure and grows the risk of major revisions of the seasonally adjusted series when new observations are added.[5]

In the case of the results obtained from our monthly frequency confidence surveys (CS), seasonal adjustment allows to compare month-to-month results and helps in the identification of the moving direction and turning points. In the questionnaires used in the confidence surveys, businesses are asked to give their opinion excluding seasonal fluctuations when making quarterly comparisons. Meanwhile, consumers are asked to make a comparison with the previous 12 months, eliminating theoretically the seasonal changes. However, the experience with quarterly surveys and the tests that will be discussed below regarding the monthly frequency series indicate the presence of the seasonal component. We point out that in the case of CS time series with monthly frequency, the decision-making on the above mentioned issues is also hampered, because their length is at the minimum allowed to adjust for seasonality, three years with monthly frequency.[6]

The second part explains in more details the process of identifying the monthly CS time series that show a seasonal pattern. The monthly balances of the CS that are selected to be seasonally adjusted are shown in the third part, to close out with some conclusions and recommendations for future work.

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[3] *ECB (2003): "Seasonal Adjustment", November 2003 and IMF (2014): "Update of Quaterly National Account Manual: Concepts, Data sources and Compilation", Chapter 7, Seasonal Adjustment.*

[4] *In the direct method, are seasonally adjusted the aggregated series of higher levels as for example confidence indicators at a sectorial level. In the indirect method are seasonally adjusted the constituent balances, which are then aggregated at higher levels.*

[5] *This risk is greater if seasonal adjustment techniques are selected based on models, such as SEATS than in the case when methods based on moving averages, such as X12, are used.*

[6] *McDonald-Johnson, K. et al. (2010): "Seasonal Adjustment Diagnostics Checklists", Census Bureau Guideline.*

2. THE IDENTIFICATION OF THE SEASONAL COMPONENT

Seasonal adjustment methods decompose the original series (X_t) into 4 components: the trend-cycle component (T_t), the seasonal component (S_t), the calendar component (C_t), and the irregular component (I_t). These are unobserved components and should be evaluated by considering the observed time series (original series). There are two main combinations of how these components are linked to each other: the additive combination and the multiplicative combination.

In the additive model, the original series is the sum of the components: $X_t = T_t + S_t + C_t + I_t$. The additive model assumes that the unobserved components are independent of each other. The seasonally adjusted series is obtained by subtracting the seasonal and calendar components from the original series: $X_t^a = X_t - (S_t + C_t) = T_t + I_t$. In the multiplicative model, the original series X_t is expressed as the production of unobserved components: $X_t = T_t * S_t * C_t * I_t$. In this model it is assumed that the size of the unobservable component is proportional to the series level, the seasonality increases with the increase of the series level: $X_t^a = X_t / (S_t * C_t) = T_t * I_t$.

For the implementation of seasonal adjustment in practice, among the most popular methods are *Census X12* and *X13* developed by the United States of America, as well as *TRAMO/SEATS* developed by the Bank of Spain. They not only allow the choice between several alternatives, but at the same time include tests that control for the presence of seasonality in a time series.[7] Among the features that characterize the X12 method is the fact that it contains a modelling component, which serves to identify extreme values, level shifts for a series, and whether calendar effects are applicable. The X12 also offers a wide range of statistical diagnostics that allow the monitoring of the seasonal component stability.[8]

The set of the X12 program statistics for assessing the quality of seasonal adjustment is explained in this material according to Velzen et al. (2011) and IMF (2014).9 The indicators referred to as M1 to M11 describe how successful was the seasonal decomposition. They get values from 0 to 3, where a value between 0 and 1 is considered an acceptable value. The lower the value of the indicator, the better evaluated is the aspect addressed by the indicators, while when their value is greater than 1, the indicator signals potential problems related to the tested seasonal adjustment process.

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[7] *We emphasize once again that seasonal adjustment should not be applied over a series that does not show seasonal movements or show seasonal movements that are not easily identifiable (IMF (2014)). As Mazzi and Savio (2005) point out, in the absence of a theoretical consensus, there is a set of criteria proposed in the literature to assess the quality of seasonal adjustment. The authors argue that there are some aspects of seasonal adjustment that can be evaluated and each of them has different criteria that can be used as a reference.*

[8] *European Commission (2006). European Economy. Special Report No.5. The Joint Harmonised EU Programme of Business and Consumer Surveys. Directorate-General for Economic and Financial Affairs.*

[9] *This set of statistics is defined and interpreted in detail by Dominique Ladiray and Benoit Quenneville (2001). Seasonal Adjustment with the X-11 Method, Lecture Notes in Statistics, Springer-Verlag, New York. Marcel van Velzen, Roberto Wekker and Pim Ouwehand. (2011). Method series. Seasonal adjustment, Method series (2011). Statistics Netherlands.*

These statistics are then synthesized in another indicator referred to as the Q indicator, which is a weighted average of 11 quality indicators, which also moves at an interval of 0 to 3. As argued in IMF (2014), the aggregate indicator from M statistics provides a general estimate of all the diagnostics performed on the quality of the seasonal adjustment process. This is because each M indicator evaluates different aspects of the seasonal adjustment process, making it impossible to use each of them as a single indicator in the overall assessment of the quality of seasonal adjustment. In principle, seasonal adjustment should not be performed if all these statistics receive unacceptable values, while this process can be executed even if some of the M indicators have values greater than 1. Below are briefly described the quality indicators, in terms of the aspect which they estimate in the seasonal adjustment process:

» M1 indicator – the contribution of the irregular component to the series fluctuations. The M1 indicator measures the relative contribution of the irregular component to the series changes. If the contribution is high, this means that the irregular component causes more fluctuations than the seasonal component in the series. Consequently, it is difficult to distinguish the seasonal component from the irregular one.
» M2 indicator – the contribution of the irregular component to the stationary series. Like the aforementioned indicator, the M2 indicator also estimates the contribution of the irregular component to the series variance or the stationary series. A high value of M2 indicates that even the irregular component is relatively high.
» M3 indicator – the ratio of the irregular component to the trend. In order for the seasonal pattern to be correctly identified, it is important that the fluctuations in the irregular component are not very large compared to the fluctuations in the trend. By definition, the M3 indicator measures the ratio between fluctuations in these two components and is of high value in the case of a flat trend.
» M4 indicator – the degree of connection in the irregular component. One of the most important assumptions about the irregular component is the lack of connection between two consecutive data points in the time series. In the contrary, if there is a strong connection between them, the irregular component may not have this nature, and to examine this feature we refer to indicator M4.
» M5 indicator – the number of months for which the cyclic component dominates in average terms the irregular component of a series. It is an indicator that, like M3, examines the changes in the irregular component to changes in the trend - cycle component. Even this indicator gets high values in the presence of a flat trend in the series.
» M6 indicator – the ratio of the irregular component to the seasonal component. This indicator controls whether the standard 3x5 filter is suitable for the tested series. A high value of M6 may suggest that the ratio of the irregular component to the seasonal component or is too small or too large for the applied filter. IMF (2014) argues that M6 indicator compares the stability of seasonality in annual terms with the changes in the irregular component and may suggest the use of filters with different

lengths to differentiate the performance of the seasonal behaviour from movements in the irregular component.

» **M7 indicator – the seasonal pattern identifier.** M7 estimates the relationship between the moving and stable seasonality. Among the quality indicators, it is also known as the most important indicator for the seasonal adjustment process. If M7 is higher than 1, the series may not be adjusted for seasonality. Basically, the indicator serves to determine the degree of seasonal effect identification in a series. If the seasonal pattern is identified with difficulty, the error in absolute terms in the seasonal component is large. The high values of the M7 may indicate a prevalence of the moving seasonal pattern compared to the stable one. As suggested in IMF material, this indicator can also be used as a test for the presence of seasonality in the original series.

» **M8 – M11 indicators – changes in seasonal behaviour over the years.** These indicators evaluate the extent to which the seasonal behaviour is subject to change in a series. If there are strong changes in this pattern, the seasonal filters of program X12 cannot accurately identify the seasonal behaviour, causing the error to be high. In particular, if the seasonal pattern, in recent years, changes significantly, the problem may be greater, as the error in the estimates, especially for the most current period, may be higher. Changes in the seasonal behaviour can occur in two ways. Firstly, the seasonal behaviour can be affected by arbitrary fluctuations and, secondly, it may be characterized by systematic increases or decreases. M8 and M10 indicators evaluate arbitrary fluctuations in the seasonal behaviour, while M9 and M11 estimate the rise or decline of the seasonal pattern systematically.

The method that we follow to examine the seasonality of the monthly survey series of confidence surveys is Census X12, in the Eviews program, using the additive model. We have only considered the additive model because: (i) the seasonal fluctuation magnitude does not depend on the series level and (ii) the time series obtained from the surveys contain negative values. Also, the calendar component is considered zero since the data received from CS are of a qualitative nature, and the opinion expressed from businesses and consumers in general is not affected by the working days of a particular month. In addition, this is also the approach followed by us in treating the seasonality of the quarterly series of confidence surveys.

Regarding the selection between aggregate or disaggregated seasonal adjustment, the latter is chosen. The main reason for this choice is that the monthly balances series we have got from the monthly CS seem to exhibit an uneven seasonal behaviour. In this case the literature suggests a seasonal adjustment at the disaggregated level, and then aggregating the adjusted series into higher level indicators (sector or economy). Also, the length of the series, which is still short, would increase the uncertainty over the decision whether the constituent components of monthly balances have similar characteristics.

The decision whether the original series received from the monthly survey will be adjusted for seasonality or not is based on two statistical diagnostics that control for the presence of seasonality[10]:

(i) The first group includes the quality statistics described above, focusing on M7 and Q (columns "b" and "c" in Table 1). The smaller the value of these indicators, the higher the certainty for the presence of seasonality in the given series. In general, the accepted limit value is 1.

(ii) It is also taken into consideration, the result of a second statistical diagnostics computed by the X-12 program, known as a combined test (column "d" of the table). This test controls for the presence of seasonality, and if it is present, it is further tested if the seasonal factors are stable enough over the years. The results of this combined test are summarized in the assertions:

1. *Identifiable seasonality is present;*
2. *Identifiable seasonality is probably not present;*
3. *Identifiable seasonality is not present.*

As it is pointed out in the IMF material (2014), if the program shows the result "Identifiable seasonality is not present", the series should not be subject to seasonal adjustment. So, if the combined test verifies assertion (1) or (2), the series is considered to have a seasonal component, and as such to be adjusted.

RESULTS

The following table summarizes the results of these tests. The seasonally adjusted series are those for which the value of M7 is less than 1 and in the combined test show the assertions (1) or (2). [11] There are cases that although M7 is slightly lower than 1, because the combined test verifies assertion (3) "Identifiable seasonality is not present", the series is considered without seasonal component and as such is not adjusted for seasonality. As a reflection of the above judgments, column "e" represents the final assessment whether the series should be adjusted for seasonality or not.

[10] *For longer time series, these tests also identify whether seasonality is stable in time or not.*

[11] *These series (monthly balances, not and seasonally adjusted where seasonality is present) are graphically presented in the annex of this material.*

Table 1. The results of the tests for the presence of seasonality

Questions	M7	Q	Combined test	Should the series be seasonally adjusted?
(a)	(b)	(c)	(d)	(e)
INDUSTRY				
Production trend observed over the past 3 months	0.888	0.69	Identifiable seasonality probably not present	Yes
Assessment of order – book levels	0.939	0.82	Identifiable seasonality is not present	No
Assessment of export order – book levels	1.821	1.34	Identifiable seasonality is not present	No
Assessment of stocks of finished products	1.076	0.83	Identifiable seasonality is not present	No
Production expectations over the next 3 months	0.797	0.88	Identifiable seasonality is not present	Yes
Employment expectations over the next 3 months	0.571	0.73	Identifiable seasonality probably not present	Yes
CONSTRUCTION				
Building activity development over the past 3 months	0.641	0.62	Identifiable seasonality probably not present	Yes
Main factors currently limiting your building activity: none	1.887	1.67	Identifiable seasonality is not present	No
Main factors currently limiting your building activity: insufficient demand	2.127	2.28	Identifiable seasonality is not present	No
Main factors currently limiting your building activity: weather conditions	0.682	1.04	Identifiable seasonality probably not present	Yes
Main factors currently limiting your building activity: shortage of labour force	0.853	1.13	Identifiable seasonality probably not present	Yes
Main factors currently limiting your building activity: shortage of material and/or equipment	2.491	2.45	Identifiable seasonality is not present	No
Main factors currently limiting your building activity: financial constraints	1.476	1.94	Identifiable seasonality is not present	No
Main factors currently limiting your building activity: other factors	3.000	2.76	Identifiable seasonality is not present	No
Evolution of your current overall order books	1.245	0.96	Identifiable seasonality is not present	No
Employment expectations over the next 3 months	0.660	0.78	Identifiable seasonality probably not present	Yes
SERVICES				
Business situation development over the past 3 months	0.550	0.61	Identifiable seasonality probably not present	Yes
Evolution of the demand over the past 3 months	0.917	0.86	Identifiable seasonality probably not present	Yes
Demand expectations over the next 3 months	0.831	1.07	Identifiable seasonality probably not present	Yes
Evolution of employment over the past 3 months	1.765	1.65	Identifiable seasonality is not present	No
Evolution of employment over the next 3 months	1.136	1.58	Identifiable seasonality is not present	No
TRADE				
Business activity (sales) development over the past 3 months	0.440	0.36	Identifiable seasonality is present	Yes
Volume of stock currently hold	1.441	1.89	Identifiable seasonality is not present	No
Orders expectations over the next 3 months	0.569	0.53	Identifiable seasonality probably not present	Yes
Business activity expectations over the next 3 months	0.628	0.65	Identifiable seasonality probably not present	Yes
Employment expectations over the next 3 months	1.690	1.95	Identifiable seasonality is not present	No
CONSUMERS				
Financial situation over the last 12 months	1.150	0.55	Identifiable seasonality is not present	No
Financial situation over the next 12 months	1.425	1.00	Identifiable seasonality is not present	No
General economic situation over the last 12 months	1.227	1.05	Identifiable seasonality is not present	No
General economic situation over the next 12 months	1.627	1.18	Identifiable seasonality is not present	No
Unemployment expectations over the next 12 months	0.830	0.84	Identifiable seasonality probably not present	Yes
Major purchases	0.735	0.42	Identifiable seasonality probably not present	Yes
Major purchases expectations	1.473	0.93	Identifiable seasonality is not present	No
Savings at present	1.510	1.05	Identifiable seasonality is not present	No
Savings over the next 12 months	2.099	1.21	Identifiable seasonality is not present	No
Statement on the financial situation of the household	1.774	1.48	Identifiable seasonality is not present	No

CONCLUSIONS

The material presents the procedure followed at the Bank of Albania regarding the seasonal adjustment of the monthly balances of business and consumer confidence surveys, publishing for the first time the original and the seasonally-adjusted monthly series. Despite the guidance provided to businesses and consumers that are part of confidence surveys, to take into account the seasonal fluctuations while providing answers to the questionnaires, the presence of seasonal factors is still present. This is also confirmed by our experience with the quarterly balances of confidence surveys, as well as the international practice that deals with monthly balances. The presence of seasonality in business and consumer monthly estimates and expectations has been tested through the Census X12 method. In this method, the seasonal adjustment model chosen to control for the presence of the seasonal component of the monthly confidence survey series is additive.

Regarding the selection of the monthly balances of confidence surveys that should be subject to the seasonal adjustment process, we have prioritised on meeting the condition that the seasonal adjustment results should be of an acceptable quality. Based on the quality tests, as well as the combined test, 15 series from 42 monthly confidence surveys balances have been seasonally adjusted. With the addition of new data, the monthly series will be periodically analysed for the presence of seasonality, the same procedure followed for the quarterly series of confidence surveys. This analysis is planned to be conducted once a year for all observation balances. We emphasize that the seasonal treatment requires special care, especially in the case of short-time series, to guarantee the quality of seasonal adjustment. The enrichment with data of the monthly series will consolidate the technical estimate of the seasonal component, enabling also the publication of aggregated confidence indicators and the economic sentiment indicator at monthly frequency in the future.

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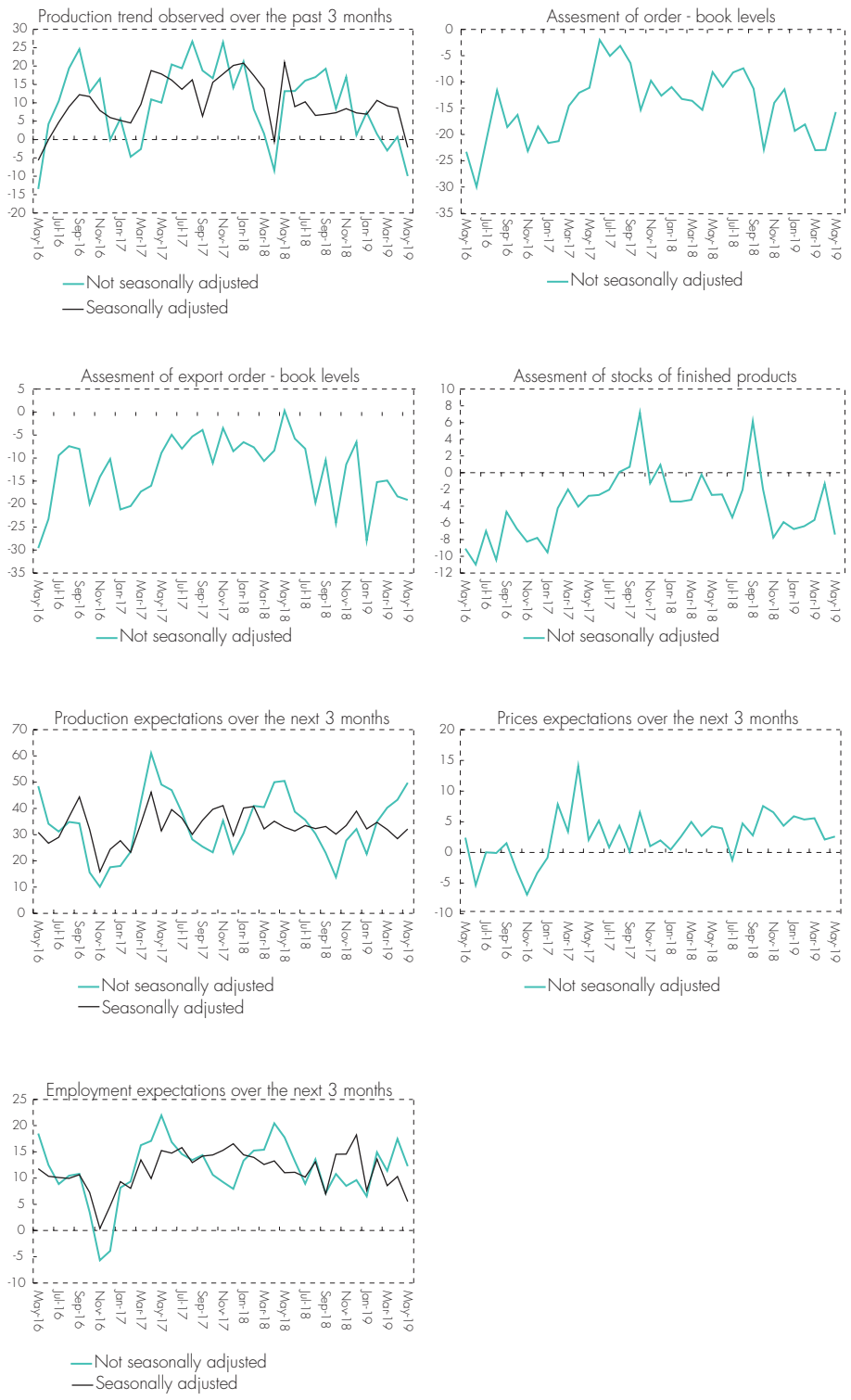
ANNEX

Chart 1. Industry monthly balances

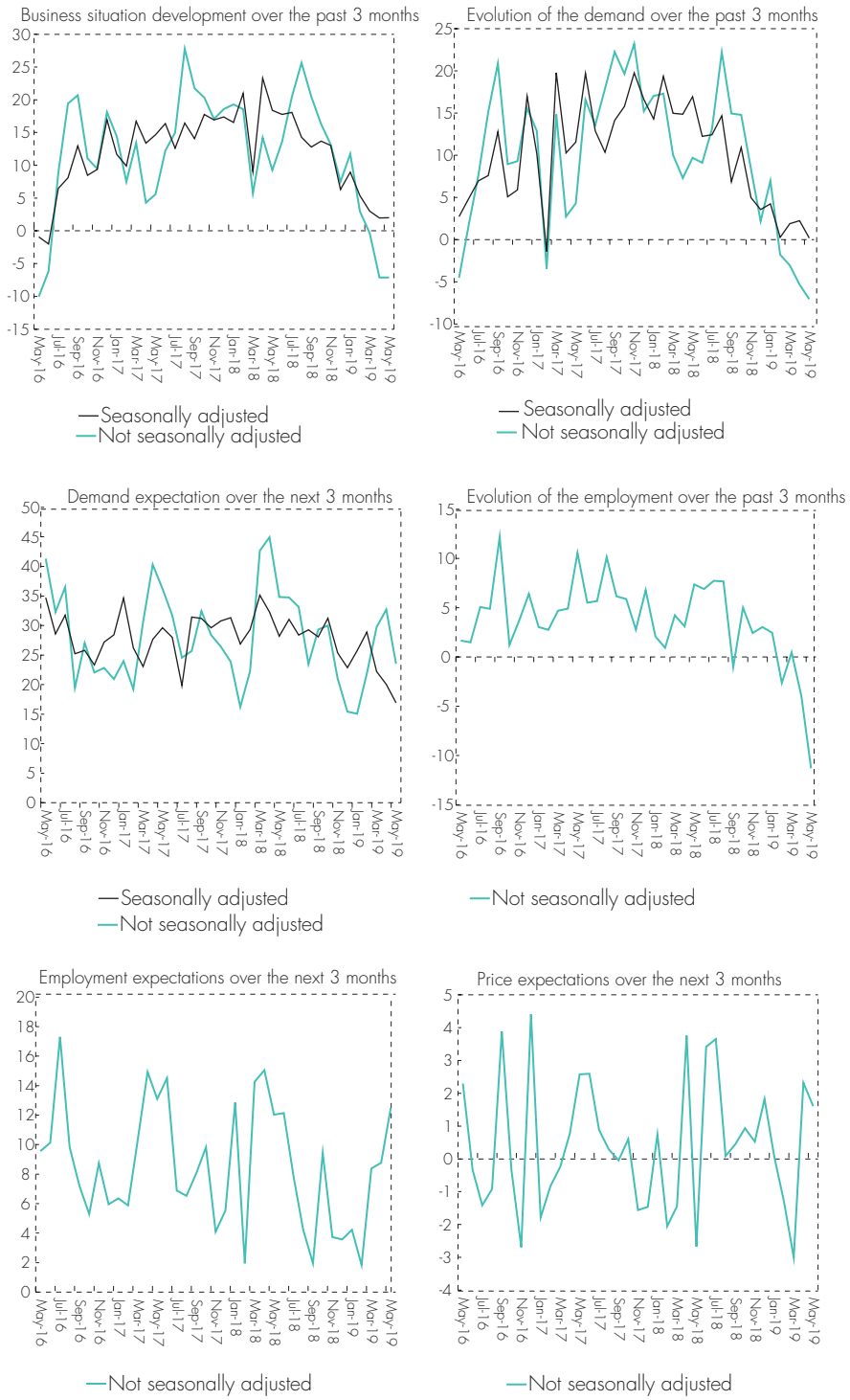


Source: Business Confidence Survey, Bank of Albania.

Chart 2 Construction monthly balances

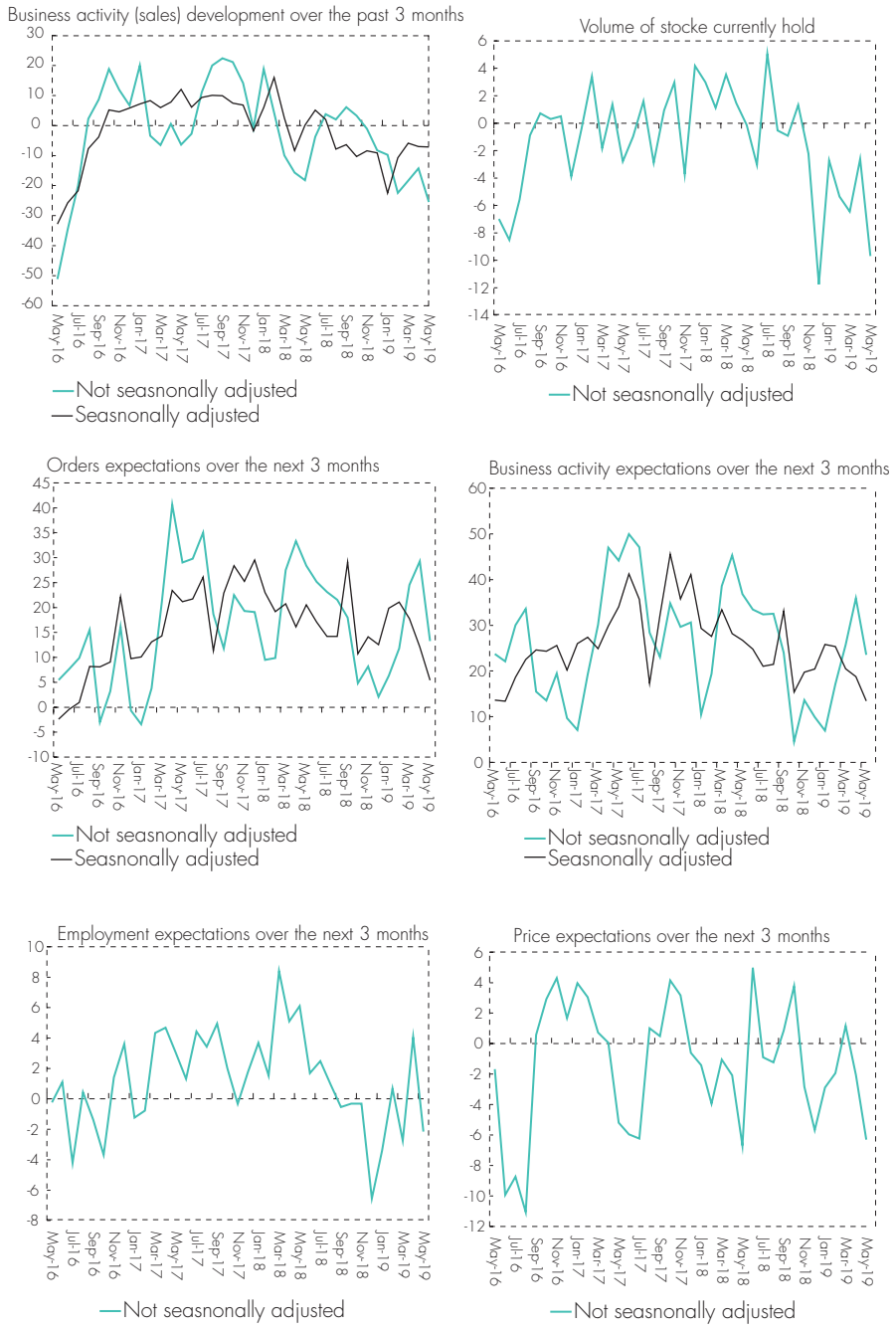
Source: Business Confidence Survey, Bank of Albania.

Chart 3 Services monthly balances



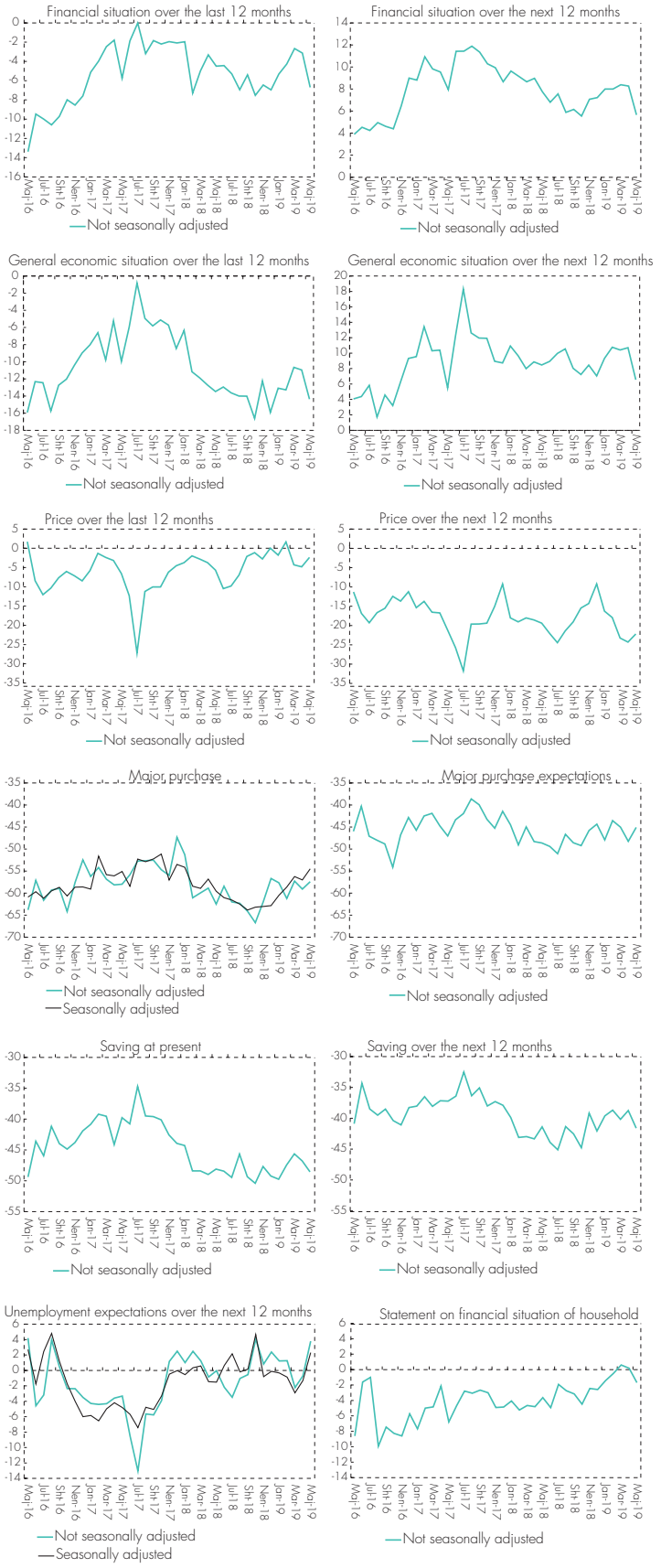
Source: Business Confidence Survey, Bank of Albania.

Chart 4 Trade monthly balances



Source: Business Confidence Survey, Bank of Albania.

Chart 5 Consumer monthly balances



Source: Consumer Confidence Survey, Bank of Albania.