Analysing structure of employed and unemployed population of Czech Republic as part of human capital on labour market

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Abstract

The article analyses the historical course of quarterly time series of employed and unemployed population of the Czech Republic at the age of 15 years and more for the period 1993-2018. The objective of the contribution is to describe the statistical distribution of the number of employed and unemployed persons, characterise time course of relevant time series and subsequently propose at least two optimal forecasting models and compare their statistical properties and their accuracy. The contribution deals with forecasting macroeconomic variables of the number of employed and unemployed persons. For forecasting, Brown's linear exponential smoothing, and Winters smoothing model are used. The accuracy of final forecasts is characterised by Mean Squared Error (MSE) and Mean Absolute Error (MAE). The results are interpreted only in the Czech context, not on the European level. The analysis is based on decomposition, seasonal adjustment, determination of empirical seasonal index and determination of optimal point and interval forecasts for the period 2019-2021. Since the null hypothesis of the series independence on the quarter was rejected, both time series had to be seen as seasonal.

Key words: employment, unemployment, Brown's linear exponential smoothing, Winters model of smoothing.

Introduction

The contribution submitted deals with two macroeconomic indicators – employment and unemployment of the population in the Czech Republic. The main macroeconomic indicators of a state include unemployment. With gross value added, inflation, monetary stability, and other indicators, it expresses the economic and social level of a given

country. Statistical surveys, measuring and analysing employment and unemployment is based on the division of population into economically active and economically inactive and their further classification by various criteria (Macek et al., 2008).

Unemployment together with other indicators measures the economic and social level of a given country. The Czech Republic invests resources in taking preventive measures in the labour market, in combating unemployment (Hančlová and Šimek, 2014). The position of the state to labour market includes all policies, institutes, and legal standards aimed at the economically active population. In terms of political economy, labour market can be analyses also as a market of investments in human capital. (Bonoli, 2010). Vokoun et al. (2017) define unemployment as a situation on the labour market when a certain group of the population refuses to find a paid job.

By economic activity, the population is divided into the following categories: economically active population (employed and unemployed) and economically inactive population (Helísek, 2002). In the Czech Republic, the category of economically active population includes people at the age of 15 and more, that could be included in the subcategories of employed and unemployed population in the country. Employed people are those who have an employment relationship or any other formal link to employment and are paid by an employer or are employed in their own business (this includes also members of production cooperatives). One of the authors dealing with unemployment is Mareš (2002) who introduced the definition of unemployment accepted in the European Union. According to this definition, the unemployed population includes the persons who do not have an employment relationship, who are registered as unemployed at the Employment service, who are actively seeking a job and who are able to start work immediately. On the other hand, the economically inactive population includes other inhabitants, whose economical inactivity can have both objective and subjective causes.

Unemployment is a problem for all market economies; therefore a wide range of analysts pay attention to its analysing. The results related to unemployment (e.g. the current values of the unemployment rate) are expected with great interest of state authorities, economic subjects, as well as the general public (Čabla and Malá, 2017). Similarly, a problem as important as the number of unemployed people, or the unemployment rate, is also a period of time for which the unemployed have been looking for a new job. Unemployment longer than one year is referred to as long-term unemployment. Long-term unemployment rate is an important indicator of the situation on the labour market and also the economy as a whole (Krueger, Cramer and Cho, 2014).

The number of the unemployed and their structure, the number of vacancies and the length of unemployment are affected by many various factors (Hunt, 1995). To identify these factors, to describe and quantify their influence or subsequently formulate and implement measures to diminish negative influence and enhance positive influence is a permanent task of all bodies responsible for economic development (Røed, Jensen and Thursie 2008). The system, amount and time of payment of unemployment benefits (Jurajda and Tannery 2003), the tax system and the existence and amount of minimum

wage (Bover, Arellano and Bentolila, 2002) also play a significant role. The chance to get a job in the labour market is positively influenced by good health and the absence of other health limitation; unemployment (especially long-term unemployment) negatively affects the health of the unemployed (Korpi, 2001; Krueger et al., 2011), thus reducing their chances in the labour market.

Mass unemployment is an urgent issue in almost all developer countries. Unemployment is a situation in which a person actively seeking work cannot find a job. This phenomenon is sometimes used as an indicator of economic health. Currently, a serious problem is not only natural unemployment but also weak demand for workers, and structural or regional unemployment. Prolonged unemployment represents a risk that many unemployed people lose their skills and will become discouraged from finding a job, which increases permanent unemployment. Unemployment affects the entire population of a country, not only the unemployed and their families (Krueger et al., 2011).

Unemployment can be defined as a situation of imbalance between the supply and demand of work, i.e. the supply is higher than the demand. This phenomenon can be measured by macroeconomic indicator of the unemployment rate. Using this indicator it is possible to evaluate the current situation on the labour market. However, it shall be noted that this indicator shall be perceived in a wider context. In other words, to evaluate the labour market performance it is necessary to examine not only the level of unemployment rate but also to divide unemployment into several groups by its duration, qualifications of the unemployed and also the regional dimension shall be taken into account (Tvrdoň, 2014).

The view of employment service workers in regional labour markets: The results indicate that the active employment policy tools and passive political instruments are seen as ineffective and inappropriate. The unemployed usually do not have any previous work experience, they mostly only completed primary education and are not willing to travel for work. An urgent problem appears to be the quality of secondary education, the problem of access to „poverty trap“ of the unemployed and generous social benefits without a „treat“, which makes the employment policy ineffective (Novák et al., 2016a).

The dependence of the minimum wage on the wage decile index was confirmed in the case of the unemployed, who usually receive these wages in the least qualified professions. This dependence is based on the assumption that such least qualified professions are disappearing and are partly or fully replaced by robotization in many forms (AI, RPA, ML ...). Due to the increase in the minimum wage, for companies, it is cheaper to deploy e.g. 10 robotic system controlled by one or two workers. This was already happening in the period 1998-2013 when robotization only took forms of automation and control of systems. This relation will probably be confirmed in the last five years thanks to supporting robotization and digitalization of companies (Vokoun and Straková, 2016).

Palíšková (2014) considered structural unemployment as a serious problem in the Czech labour market. She sees its causes in inappropriately established state employment policy. Due to high social benefits compared to minimum wage, great part of the unemployed was not interested in finding a job.

By analysing the labour market, Vokoun (2013) concluded that the active employment policy instruments are only effective for a short time, i fat all. Their impact on the state markets (Vokoun et al., 2017) is zero in many cases, and sometimes even negative (Novák et al., 2016b).

Židek (2006) refers to the young, unskilled workers, graduates, women after maternity leave and the disabled as problem groups on the labour market. In his work, he states that as for the above-mentioned groups, university graduates had the highest chances to get a job.

A special and also problematic group on the labour market are the Roma, who are generally associated with a worse attitude towards employment. The Roma minority is also associated with a high unemployment rate and discrimination on the legal labour market (Kajanová and Kmecová, 2018a). The authors in their study focus on the perspective of companies employing the Roma and the specifics of working with this group. The authors addressed the companies in the South Bohemian Region and the Vysočina Region, who employ educated and qualified Roma. Within the analysis of the obtained data, the following categories were identified: Employment positives, Employment negatives, and Specific approaches to employing Roma employees. The authors assumed that there would be a difference in employing Roma with different qualification and education level. However, the assumption was not confirmed by the results.

Hajská and Poduška (2006) state that the Roma are in a very low position in the labour market. The Roma often participate in the illegal labour market. One of the reasons is the discrimination and prejudice from the side of the employers. The prejudice and stereotypes related to the Roma are different, but most employers believe that the Roma do not want to work and that they abuse state social benefits (Gabal, Čada and Snopek, 2008). The Roma participating in the labour market often have only short-term jobs of seasonal character (Davidová et al., 2010). Černušáková (2017) mentions the „invisibility"of Roma work. The reason is that a large proportion of the Roma minority work without having an employment contract, and in the informal labour market they usually do highly unstable, socially insecure, and often physically dangerous work.

In their study, Kajanová and Kmecová (2018b) point out that a number of authors address the causes of the Roma unemployment. According to them, it is a combination of factors such as discrimination on the labour market and in public discourse in general (Gabal, Čada and Snopek, 2008), and a small number of jobs for low-skilled workers (Mareš, Sirovátka and Vyhlídal, 2003), and the related low education or qualifications in the Roma population (O'Higgins and Ivanov 2006). Šajgalíková and Copuš (2017); Swietek (2013) et al. see the main problem in intergenerational employment. If there

are no work patterns within a family, it results in the situation that a child sees this as normal, a standard. However, the main cause of low employment is in high indebtedness and the related salary deductions, which is demotivating. The Roma thus switch to the illegal labour market that provides fast and secure earnings. Fuzesi et al. (2008) see poor health as the main cause.

Kajanová and Kmecová (2018b) analyse the unemployment rate of the Roma minority in selected European countries. The results showed that in most European countries there the data on the target place are not accessible, except for the post-communist countries. The unemployment of the Roma minority has no relation to general unemployment; i tis always many times higher and is primarily related to the exclusion of the Roma minority. It appears that the main causes of their unemployment consist mainly in their social exclusion, not in the ethnicity per se.

Methods and Data

The objective of the contribution is to describe a statistical distribution of the number of employed and unemployed population of the Czech Republic at the age of 15 and more, to characterize the time course of relevant time series, to propose at least two optimal prediction models and to compare their statistical properties and accuracy.

The contribution deals with the description and the analysis of the historical course, point and interval predictions of quarterly time series on the number of employed and unemployed inhabitants of the Czech Republic at the age of 15 and more for the period 1993-2018. Firstly, the basic numerical characteristics of both time series are determined and analysed, and the values are shown by means of a boxplot. Subsequently, the analyses of first the time series of the employed and then the unemployed are carried out. The course of the time series is shown in a graph. By analysis of variance (ANOVA) the seasonality of the time series is verified (a significant dependence of the values on the seasonality is proven). Therefore, their decomposition into trend, seasonal, and random component is carried out by means of the multiplicative method, then their seasonal adjustment is performed and empirical seasonal indices are determined. Then there are determined the optimal point and interval predictions for the years 2019-2021 of seasonally adjusted time series using Brown´s linear method.) are determined, and after the multiplication of these trend predictions by a seasonal factor, also predictions of the original time series. Forecasts are obtained also in a simpler way using the Winters method. The results of both methods are then compared and evaluated. The adequacy of these methods for the data used (i.e. for statistical properties of estimations) is evaluated and their accuracy is verified by the calculation of the Mean Square Error (MSE) and Mean Absolute Error (MAE) indicators. The data was obtained from the Czech Statistical Office online survey.

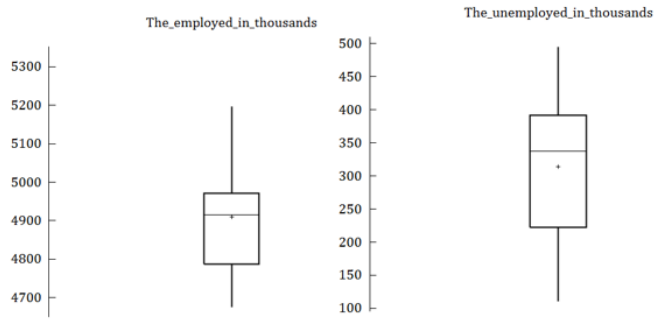
Cipra (1986 and 2013), Stuchlý (1999 and 2004) describe all forecasting methods used. Winters forecasting method for seasonal time series was introduced by Winters (1960).

The results were obtained by means of the programmes Excel, R (descriptive characteristics and classification of variables) and Statgraphics Plus for Windows, version 1 (analysis of time series and their point and interval predictions). The application of Statgraphics is described in the manual for Stratgraphics Plus, Time-series Analysis (1997). Statgraphics enables to choose various forecasting methods, to determine optimal values of their smoothing coefficients, and to determine and show point and interval predictions by means of graph, to evaluate their statistical quality using residual analysis, and to calculate the accuracy indicators of such forecasts (MAE, MSE, etc.). It also enables to compare the quality of up to 5 forecasting models. The statistical quality is evaluated by the graphs of residuals and autocorrelation function. For the purposes of the residual analysis, the results of 5 tests are given (randomness, level, variability, and autocorrelation of the residuals values – Box-Pierse Test). This detailed analysis, performed for the purposes of various forecasting methods, is not described in the text in order to keep an adequate extent of the text. It was only used for choosing the optimal forecasting methods appropriate for the data used.

Results and Discussion

Firstly, some methods of descriptive statistics are applied on the variables of the number of employed and unemployed methods. Graph 1 shows box plots and the basic numerical characteristics are calculated.

Graph 1: Box plot of the number of employed and unemployed persons in CR



Source: Czech Statistical Office, own processing.

From the calculation based on the Excel or R data, it results that the median of the number of employed persons at the age of 15 and more is 4916,100, while for the unemployed population the median is 337,300. The average numbers for the whole period are 4910,400 in the case of employed persons and 313,500 in the case of unemployed persons. The maximum number of the employed was achieved at the end of the period (5 326,330), while it is 494,380 in the case of the unemployed, which was achieved in the first quarter of 2000. On the other hand, the minimum numbers were 4 675,900 in the case of the employed (achieved in the first quarter of 2004) and

111,040 in the case of the unemployed (at the end of the period). Moreover, the 25% quantile of the employed is 4 786,800, while for the unemployed it is 221,950. 75% quantile of the employed at the age of 15 and more is 4 970,800, while in the case of the unemployed it is 391,020. The quartile deviation of the employed is 89,160 and in the case of the unemployed, it is 83,470. Relative variability is significantly higher in the group of the unemployed which will reflect in the forecast error in forecasting models.

The average absolute increase in the time series of the employed persons aged 15 and more per quarter from the whole period is 4 863,300 and the average growth coefficient of this time series is 0.096%., while this average absolute increase in the time series of the unemployed persons aged 15 and more is -1 146,000 thousand and the average growth coefficient of the examined time series is -0.701%. By extrapolation the average increases for the individual quarters of 2019 it is possible to get approximate forecasts of the number of employed persons in thousands (5263.1, 5294.1, 5306.2, 5331.2) and the number of unemployed persons in thousands (128.6, 117.1, 126.3, 109.9). In this case, the seasonality of the time series used is not considered.

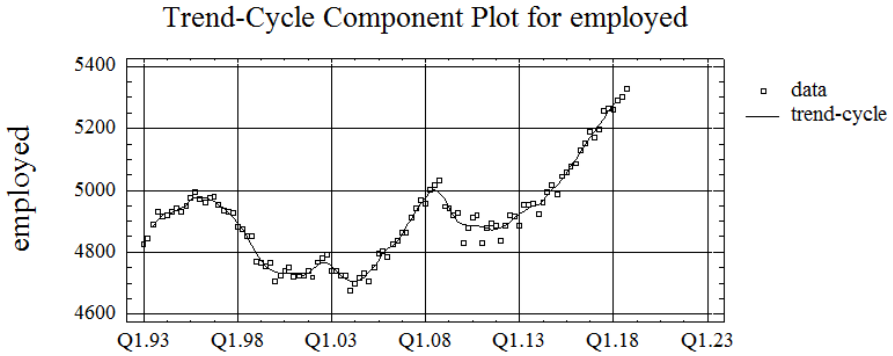
Graph 2 shows that the number of the employed grew between 1993 and 1995 (from 4 825,400 to 4 994,900 thousand), then it decreased between 1996 and 2001 (from 4 961,300 to 4 721,000) and mostly increased between 2001 and 2018 (from 4 721,000 to 5 326,300).

Furthermore, it was found that the number of the unemployed between 1993 and 1996 decreased (from 229,100 thousand to 192,700), then it grew between 1996 and 2001 (from 192,700 thousand to 436,700) and mostly decreased between 2001 and 2018 (from 436,700 to 111,000). It follows that the development in terms of employment rate in the Czech Republic from 2001 to the present can be considered favourable.

It was found that both time series have a seasonal character. By means of analysis of variance, it can be tested whether the number of persons in both time series depends significantly on the individual annual quarters. For the employed time series, the analysis of variance result is $F = 93.93$, p-value = 0 and for the unemployed time series, the result is $F = 5.27$, p-value = 0.0024. In the case of both time series, the null hypothesis of the series independence on the quarter factor was rejected. Therefore, both series shall be considered seasonal.

First of all, the time series of employed persons will be analysed. From advanced forecasting models, the model based on the decomposition of time series will be used. The multiplicative method of empirical seasonal indices will be applied. This method is the most widely used and numerically relatively simple.

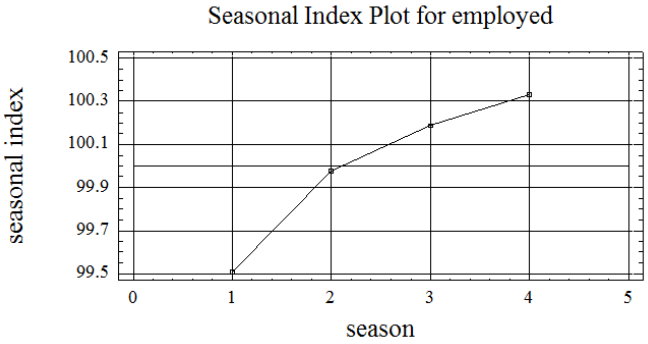
Graph 2: Time series of the employed – smoothing by primary trend



Source: Czech Statistical Office, own processing.

Empirical seasonal indices for the individual seasons in % achieve the following values: 99.5073; 99.9742; 100.187; 100.331 (see Graph 3). It means that on average, the highest number of the employed persons was in the 4th quarter, while the lowest number was in the 1st quarter.

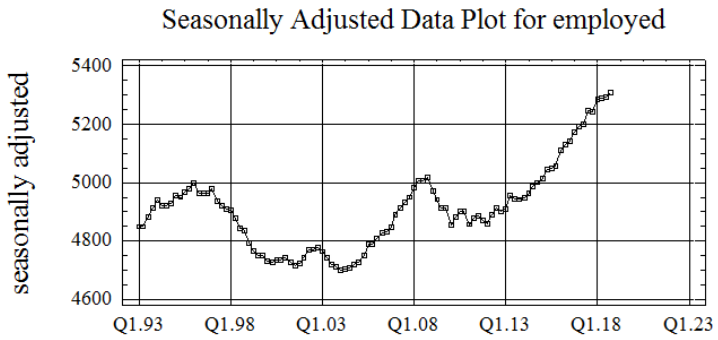
Graph 3: Empirical seasonal indices for time series of employed persons



Source: Czech Statistical Office, own processing.

Seasonally adjusted time series is shown in Graph 4.

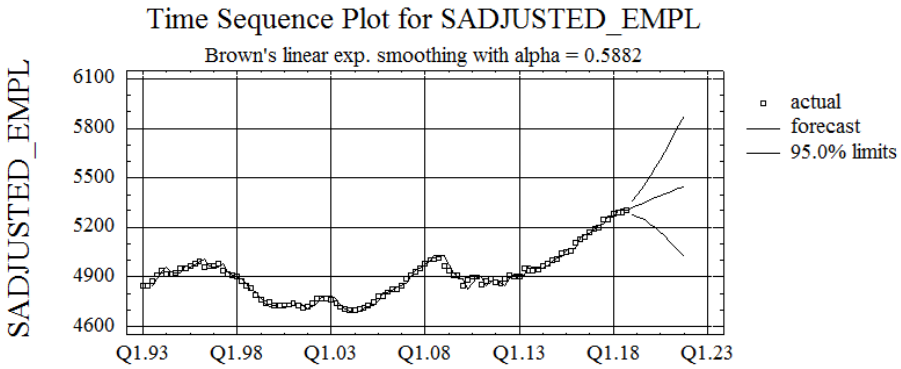
Graph 4: Seasonally adjusted time series – time series for employed persons



Source: Czech Statistical Office, own processing.

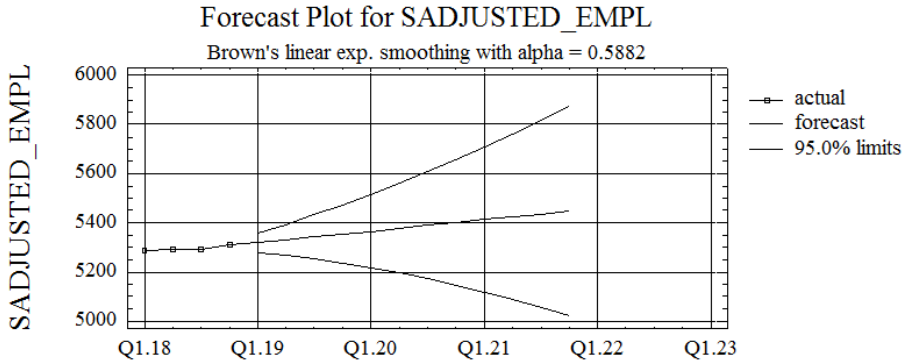
Seasonally adjusted data are subsequently used for a more adequate forecast of trend function in the period 2019 – 2021. For forecasting model, Brown's linear exponential smoothing with alpha = 0.5882 is used. The accuracy of these forecasts is characterised by MSE = 445.376, MAE = 16.672.

Graph 5: Smoothed values and forecasts of seasonally adjusted time series of employed persons.



Source: Czech Statistical Office, own processing.

Graph 6: Forecasts of seasonally adjusted time series of employed persons



Source: Czech Statistical Office, own processing.

Tab. 1: Point and 95% interval forecasts of adjusted time series trend and resulting values of the time series of the employed persons in thousands.

Period	**Trend Forecast**	**Low. Limit**	**Up. Limit**	**Seasonal .Index**	**Time Ser. Forecast**	**Low. Limit**	**Up. Limit**
Q1.19	5318.63	5277.47	5359.79	0.9951	5292.43	5251.47	5333.38
Q2.19	5330.45	5266.9	5394,01	0.9997	5329.07	5265.54	5392,62
Q3.19	5342,28	5253.03	5431.52	1.1870	6341.29	6235.35	6447.21
Q4.19	5354.1	5236.29	5471.91	1.3310	7126.31	6969.50	7283.11
Q1.20	5365.92	5216.98	5514.87	0.9951	5339.48	5191.28	5487.70
Q2.20	5377.75	5195.29	5560.21	0.9997	5376.36	5193.95	5558.78
Q3.20	5389.57	5171.39	5607.75	1.1870	6397.42	6138.44	6656.40
Q4.20	5401.39	5145.42	5657.36	1.3310	7189.25	6848.55	7529.95
Q1.21	5413.22	5117.49	5708.94	0.9951	5386.55	5092,28	5680.81
Q2.21	5425.04	5087.68	5762.40	0.9997	5423.64	5086.37	5760.91
Q3.21	5436.86	5056.08	5817.64	1.1870	6453.55	6001.57	6905.54
Q4.21	5448.69	5022.77	5874.60	1.3310	7252.21	6685.31	7819.09

Source: Czech Statistical Office, own processing.

To compare the accuracy of the individual seasonal time series forecasts, Winters smoothing model is used. In this contribution the authors refer to the following computer outputs only.

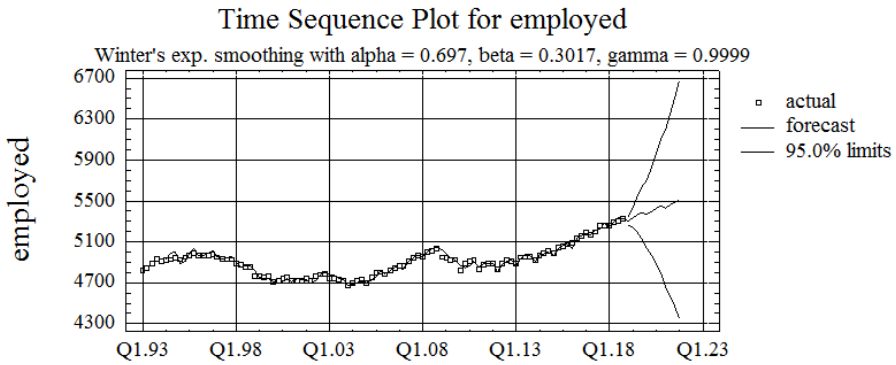
The accuracy of the resulting forecasts is characterised by MSE = 550.369 and MAE = 17.682. The smoothed values, as well as point and interval forecasts are shown in Table 2 and Graphs 7 and 8.

Tab. 2: Forecasts of employed persons in thousands obtained by means of Winters exponential smoothing with alpha = 0.697, beta = 0.3017, gamma = 0.9999

Season	**Employed**	**Forecast**	**Upper limit**	**Lower limit**
Q1.18	5258.2	5248.40		
Q2.18	5289.2	5295.27		
Q3.18	5301.4	5334.11		
Q4.18	5326.3	5320.48		
Q1.19		5308.01	5353.14	5262.88
Q2.19		5336.46	5437.61	5235.3
Q3.19		5365.90	5535.6	5196.19
Q4.19		5388.04	5636.77	5139.31
Q1.20		5369.36	5704.01	5034.7
Q2.20		5397.96	5829.48	4966.44
Q3.20		5427.56	5964.2	4890.92
Q4.20		5449.78	6098.38	4801.18
Q1.21		5430.71	6192.49	4668.93
Q2.21		5459.46	6347.04	4571.89
Q3.21		5489.22	6509.43	4469.02
Q4.21		5511.52	6669.26	4353.78

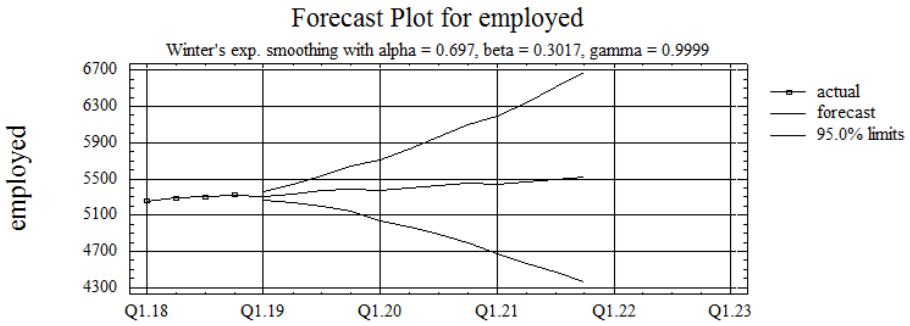
Source: Czech Statistical Office, own processing.

Graph 7: Smoothed values and forecasts of seasonal time series of employed persons obtained by means of Winters method.



Source: Czech Statistical Office, own processing.

Graph 8: Forecasts of seasonal time series of employed persons obtained by means of Winters method

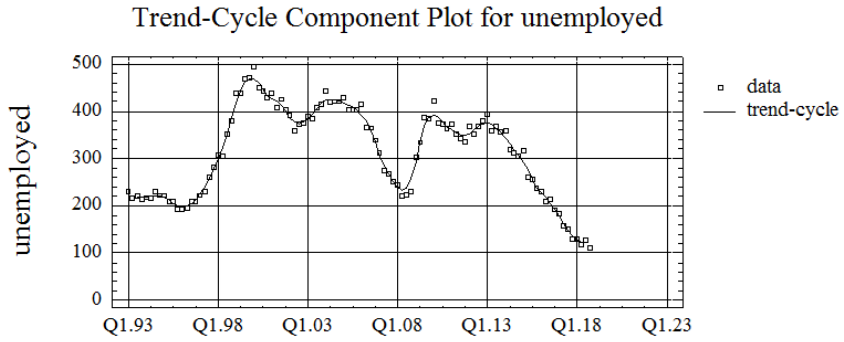


Source: Czech Statistical Office, own processing.

Both methods used provide quality forecasts. Relevant statistical tests show that they also have good statistical properties. The accuracy measures show that the method based on the decomposition of the time series and Brown's linear exponential smoothing with alpha = 0.5882 provide more precise results.

The following part will deal with proposing advanced models of the time series of unemployed persons. This time series must also be considered seasonal. First, the multiplicative model of empirical seasonal indices is used. The results obtained are shown below.

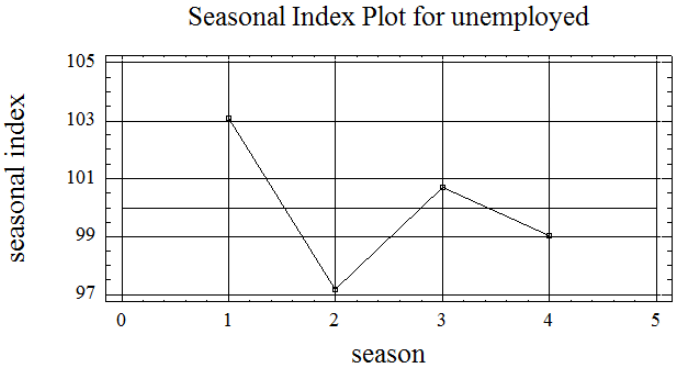
Graph 9: Time series of unemployed persons – smoothing by primary trend



Source: Czech Statistical Office, own processing.

Empirical seasonal indices for the individual seasons in % achieve the following values: 103.097; 97.155; 100.707; 99.040 (see Graph 10). This indicates that on average, the highest number of unemployed persons is in the 1st quarter, while the lowest number of unemployed persons is in the 2nd quarter.

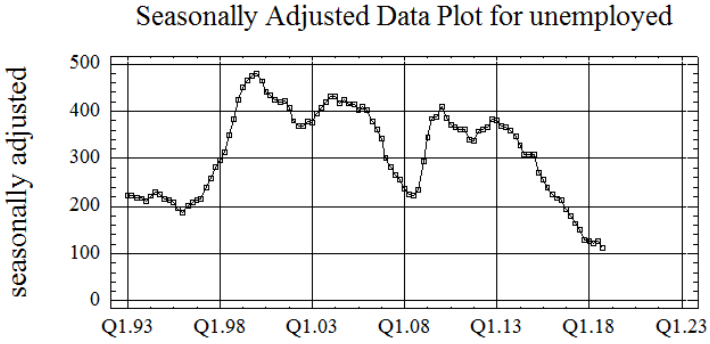
Graph 10: Empirical seasonal indices for time series of unemployed persons.



Source: Czech Statistical Office, own processing.

Graph 11 shows seasonally adjusted time series of unemployed persons.

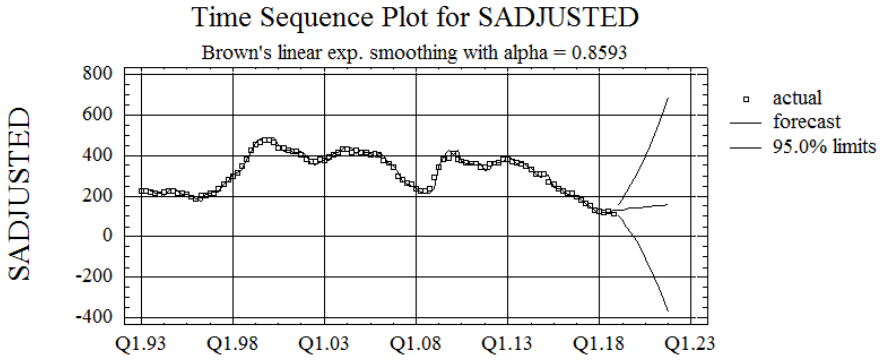
Graph 11: Seasonally adjusted time series for unemployed persons



Source: Czech Statistical Office, own processing.

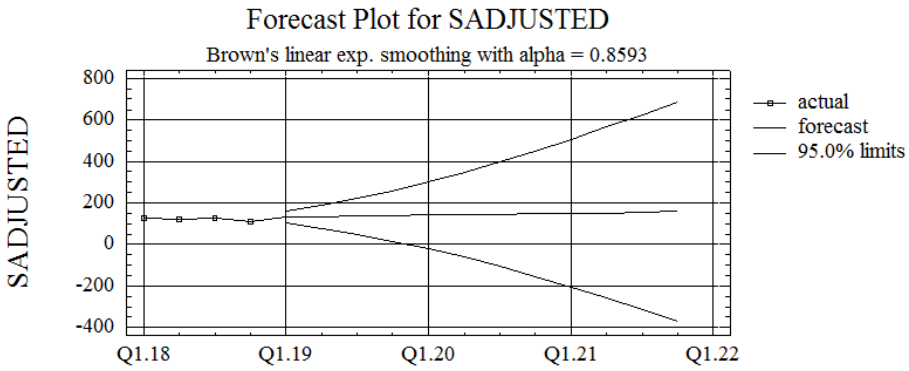
The optimal trend forecasts for seasonally adjusted time series of unemployed persons are obtained using the method of Brown´s linear exponential smoothing, with a smoothing constant α = 0.8593 (see Graph 12 and Graph 13). The minimum accuracy measures of this smoothing are MSE = 192.60 and MAE = 10.312.

Graph 12: Smoothed values and forecasts of seasonally adjusted time series of unemployed persons.



Source: Czech Statistical Office, own processing.

Graph 13: Point and interval forecasts of adjusted time series of unemployed persons



Source: Czech Statistical Office, own processing.

Tab. 3: Point and interval forecasts of trend of adjusting time series and resulting values of the unemployed persons time series in thousands

Period	Trend Forecast	Upper Limit	Lower Limit	Seasonal Index	Time Series Forecast	Upper Limit	Lower Limit
Q1.19	131.227	158.294	104.161	1.031	135.291	163.196	107.387
Q2.19	133.637	187.456	79.819	0.972	129.835	182.123	77.548
Q3.19	136.047	221.599	50.496	1.007	137.009	223.166	50.853
Q4.19	138.457	260.11	16.804	0.990	137.128	257.613	16.643
Q1.20	140.867	302.534	-20.800	1.031	145.230	311.903	-21.444
Q2.20	143.277	348.529	-61.976	0.972	139.201	338.614	-60.213
Q3.20	145.687	397.828	-106.455	1.007	146.717	400.641	-107.208
Q4.20	148.096	450.214	-154.021	0.990	146.675	445.893	-152.543
Q1.21	150.506	505.509	-204.496	1.031	155.167	521.165	-210.829
Q2.21	152.916	563.562	-257.729	0.972	148.566	547.530	-250.397
Q3.21	155.326	624.242	-313.590	1.007	156.424	628.655	-315.807
Q4.21	157.736	687.438	-371.966	0.990	156.222	680.840	-368.396

Source: Czech Statistical Office, own processing.

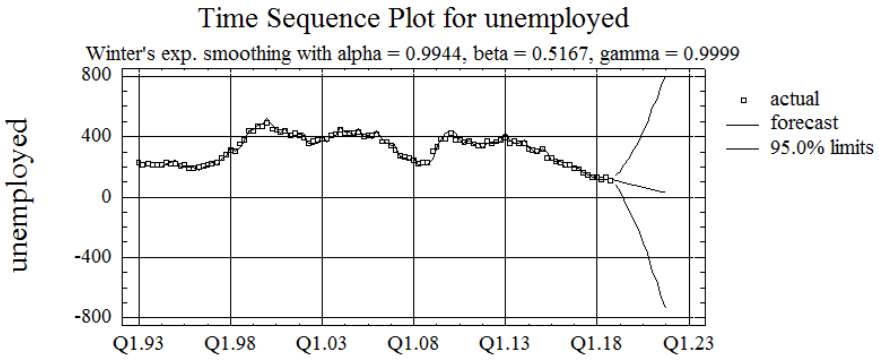
Another forecasting model used for obtaining forecasts is Winters exponential smoothing with alpha = 0.9944, beta = 0.5167, gamma = 0.9999. The accuracy of the obtained forecasts is characterized by MSE = 255.339 and MAE = 12.656. The smoothed values, as well as point and interval forecasts are shown in Table 4 and Graphs 14 and 15.

Tab. 4: Forecasting the number of unemployed persons in thousands obtained by Winters exponential smoothing with alpha = 0.9944, beta = 0.5167, gamma = 0.9999

Season	**Unemployed**	**Forecast**	**Up. limit**	**Low. limit**
Q1.18	129.767	120.230		
Q2.18	118.215	112.085		
Q3.18	127.470	112.926		
Q4.18	111.038	123.404		
Q1.19		110.750	142.734	78.766
Q2.19		98.1172	165.888	30.347
Q3.19		93.3834	209.394	-22.627
Q4.19		83.8453	248.664	-80.973
Q1.20		81.892	319.057	-155.274
Q2.20		70.769	359.865	-218.328
Q3.20		65.405	432.245	-301.435
Q4.20		56.691	486.472	-373.090
Q1.21		53.033	592.894	-486.828
Q2.21		43.421	638.048	-551.207
Q3.21		37.426	734.827	-659.974
Q4.21		29.536	796.692	-737.621

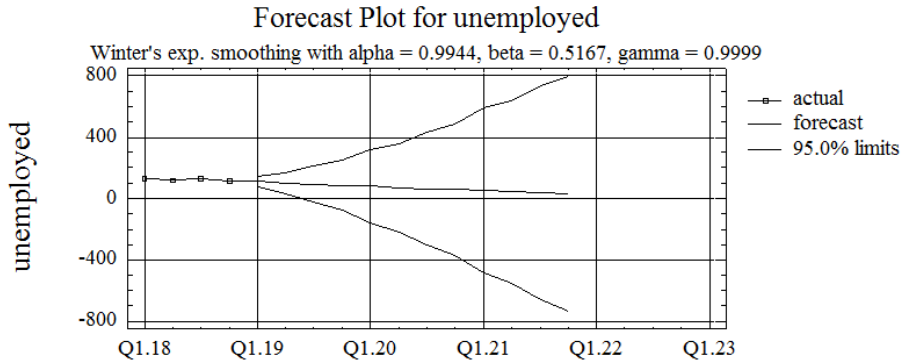
Source: Czech Statistical Office, own processing.

Graph 14: Smoothed values and predictions of seasonal time series of unemployed persons obtained by Winters method



Source: Czech Statistical Office, own processing.

Graph 15: Forecasts of seasonal time series of unemployed persons obtained by Winters method



Source: Czech Statistical Office, own processing.

For the seasonal time series of unemployed persons, the first model gives more accurate and adequate results. The second model shows underestimation. We work with a relatively low number of the unemployed and relatively high variability of the data, which results in the situation that from the second year, the forecast errors even exceed the point forecasts of the number of unemployed persons (the lower limit values are negative). However, point forecasts are close to expected values so, despite the possibility of large errors, these models can be used (results from more adequate models can be averaged).

Conclusion

Graph and basic numerical statistics describe the statistical distribution of the variables of employed and unemployed persons in the Czech Republic at the age of 15 and more. Their course over time is characterized by interesting graphs as seasonal time series,

where the seasons represent the individual quarters of the years 1993–2018. It shows that their course was favourable especially in the last period. The average number of employed persons for the whole period (1993–2018) was 4 910,400. On average, the highest employment rate was in the 4th quarter (4 926,700 persons, i.e. 100.331%) and the lowest employment rate was in the 1st quarter (4 886,200 persons, i.e. 99.507%). The average number of unemployed persons was 313,500 persons. On average, the highest unemployment rate was in the 1st quarter (323,200, i.e. 103.097%) and the lowest unemployment rate was in the 2nd quarter (304,600, i.e. 97.155%). Relative variability of the data on the unemployed persons is high (expressed by the coefficient of variation 30.7%); therefore the forecast errors in forecasting models are large. For both time series, adequate and optimal forecasting models were derived. Point and interval forecasts of the number of employed and unemployed persons for the years 2019 – 2021 were summarized in tables and graphs. Their accuracy was evaluated by the most frequently used accuracy measures - MSE and MAE. The most precise models for forecasting appear to be the models based on the decomposition of time series and its smoothing using Brown´s linear exponential smoothing.

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