GDP AS A RISK FACTOR OF CZECH ENTERPRISES

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ABSTRACT

The basic macroeconomic indicator used to measure the performance of the economy is gross domestic product. The achieving of sustainable economic growth, GDP growth, is one of primary goals of every country. In general, GDP growth is seen as a sign of the successful economy, it is able to consider the economy as prosperous economy. GDP can mean great possibility for the enterprises or some type of risk. It is necessary to analyse GDP for them in details, know the key to it. The aim of this paper is to make description of the development of GDP in Czechia in the years 2007 to 2018. The article analyses GDP of Czechia from the comprehensive statistical point of view. Distribution of the sample was specified by normality tests and P-P plot and Q-Q plot visualization. Autocorrelogram and partial autocorrelogram was made after that in time series. Inhomogeneous data of GDP period of the years indicated existence of a date at which there is a change in the data. Homogeneity tests showed not only one year of the change-point, but two different years were marked. It was computed using 10000 Monte Carlo simulations. Based on this was detected and declared positive statistical trend in economic growth of Czech Republic as well as significant synergic effect for Czech enterprises.

KEYWORDS: e*conomic growth, GDP, risk, time series.*

1. INTRODUCTION

Antonyova et al. (2017) note that macroeconomics evaluates the functioning of the economy as a whole, define macroeconomics as a social science, dealing with aggregate economic behaviour and concentrating on forecasts, trends and interrelationships of aggregate variables such as Gross Domestic Product. The characterization of the country's GDP or economic performance must be based on an organized, systematic observation that results in a specific set of data (Husar, 1998). The development of GDP depends on the mutual cooperation of all economic entities, which form one coherent and interacting system (Vrbka et al., 2019). It follows that not only GDP is influenced but GDP affects a priory. Solutions are being sought to understand the risks affecting markets and economic subjects (Hardingham et al., 2018). Economic entities are understood to be households, the state (government) and abroad, and especially enterprises (Bobakova, 2017). The development of GDP may present a challenge and an advantage on the one hand, but on the other, it may be a great source of risk for the enterprises. The fundamental trends in recent years, such as deregulation; increased competition due to the globalization process; the global financial crisis of the years 2007-2008 and its long-term consequences, have resulted in higher pressure in the sector to increase the efficiency of operational activities (Balcerzak et al., 2017). The aim of this paper is to make description of the development of GDP in Czechia in the years 2007 to 2018 to provide Czech enterprises a statistical proof of significant impact of GDP on them.

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2. MATERIALS AND METHODOLOGY

An analysis of the literature allows us to formulate the following hypothesis:
Hypothesis: There is a positive trend in the series of GDP of Czechia.
Sources of article are national and international scientific literature and articles linked to presented issue, data of Gross Domestic Product of Czech Republic from Eurostat capturing the period from the year 2007 to the year 2018, and the observations of average EBIT of 859 Czech enterprises gained from Amadeus database mapping years 2010 - 2018.
In the paper are used analysis, synthesis, deduction, induction, comparison and these statistical methods:

1. Grubbs test, boxplot to identify outliers.
2. Shapiro-Wilk test, Anderson-Darling test, Lilliefors test, Jarque-Bera test, Kolmogorov-Smirnov test, P-P plot, Q-Q plot to detect distribution.
3. Autocorrelogram and partial autocorrelogram to mark autocorrelation.
4. Pettitt's test, SNHT test, Buishand's test and von Neumann's test using 10 000 Monte Carlo simulations to test homogeneity.
5. Mann-Kendall trend test and Sen's slope to determine trend.

3. RESULTS

Table 1 demonstrates absolute values of GDP of Czech Republic and on the Figure 1 is shown development of GDP graphically.

Table 1. GDP of Czech Republic

Year	GDP [mill. €]	Year	GDP [mill. €]	Year	GDP [mill. €]
2007	138 302.9	**2011**	164 040.5	**2015**	168 473.3
2008	161 313.1	**2012**	161 434.3	**2016**	176 370.1
2009	148 682.0	**2013**	157 741.6	**2017**	191 721.8
2010	156 718.2	**2014**	156 660.0	**2018**	207 393.0

Source: authors based on https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tec00001&language=en

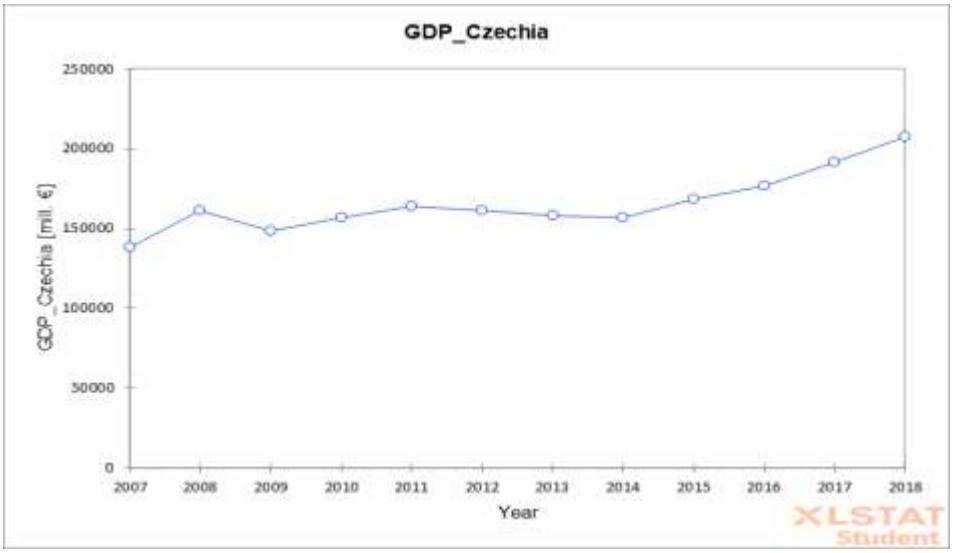

Figure 1. GDP of Czechia
Source: authors based on XL STAT

3.1 Identification of outliers

Firstly, it is necessary to detect existence of outliers before testing any assumptions and any hypotheses. The analysis of these observations of GDP of Czechia is realized by Grubbs test and boxplot because of identifying of inconsistent measurements' existence.

H0: There is no outlier in the data.

H1: There is at least one outlier in the data.

Table 2. Grubbs test for outliers

G (Observed value)	2.229
G (Critical value)	2.412
p-value (Two-tailed)	0.131
alpha	0.05

Source: authors based on XL STAT

As the computed p-value is greater than the significance level alpha, one cannot reject the null hypothesis *H0*, based on table 2. There is no outlier in the observations of GDP of Czech Republic. Boxplot (Figure 2) created by SPSS software has different markers for outlier values (small circle) and far outliers (extreme values) marked with a star based on interquartile range. In our case are not far outliers detected. It is marked only one value marked with the circle, but Nagy (2016) recommends to do exclude only extreme values, but not the values marked with circles. Analysis of outliers confirms that variance of series of GDP of Czechia does not contain great fluctuations and can be derived some systematic phenomena based on the series.

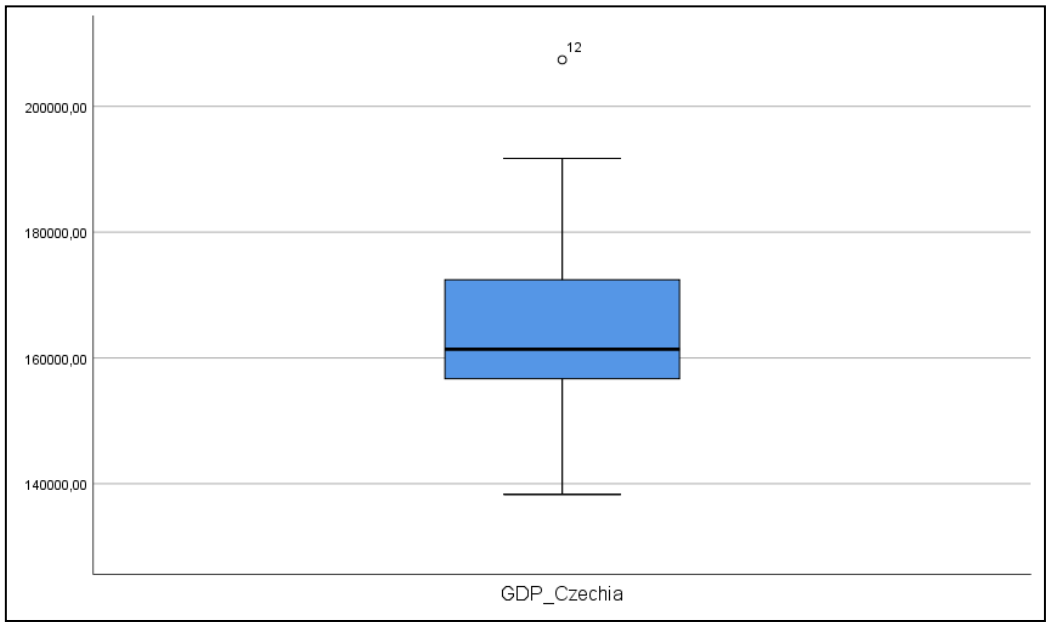

Figure 2. Boxplot of GDP of Czechia

Source: authors based on SPSS output

3.2 Hypotheses of normality tests

Secondly, we must know the distribution of data of GDP of Czechia. We expect a Normal distribution of the sample.

H0: The variable from which the sample was extracted follows a Normal distribution.

H1: The variable from which the sample was extracted does not follow a Normal distribution.

Table 3. Shapiro-Wilk test

W	0.912
p-value (Two-tailed)	0.228
alpha	0.05

Source: authors based on XL STAT

Table 4. Anderson-Darling test

A^2	0.545
p-value (Two-tailed)	0.126
alpha	0.05

Source: authors based on XL STAT

Table 5. Lilliefors test

D	0.203
D (standardized)	0.703
p-value (Two-tailed)	0.188
alpha	0.05

Source: authors based on XL STAT

Table 6. Jarque-Bera test

JB (Observed value)	1.761
JB (Critical value)	5.991
DF	2
p-value (Two-tailed)	0.414
alpha	0.05

Source: authors based on XL STAT

Table 7. Kolmogorov-Smirnov test

KS	0.203
p-value (Two-tailed)	0.186
alpha	0.05

Source: authors based on SPSS output

As the computed p-value is greater than the significance level alpha, one cannot reject the null hypothesis *H0*, based on Tables 3 - 7. We do not reject the hypothesis that GDP of Czechia are normal distributed for all computed tests. The results of all test mark the same and this fact of normality also duplicate layout (oscillation) of points around central line shown on P-P plot (Figure 3) and Q-Q plot (Figure 4).

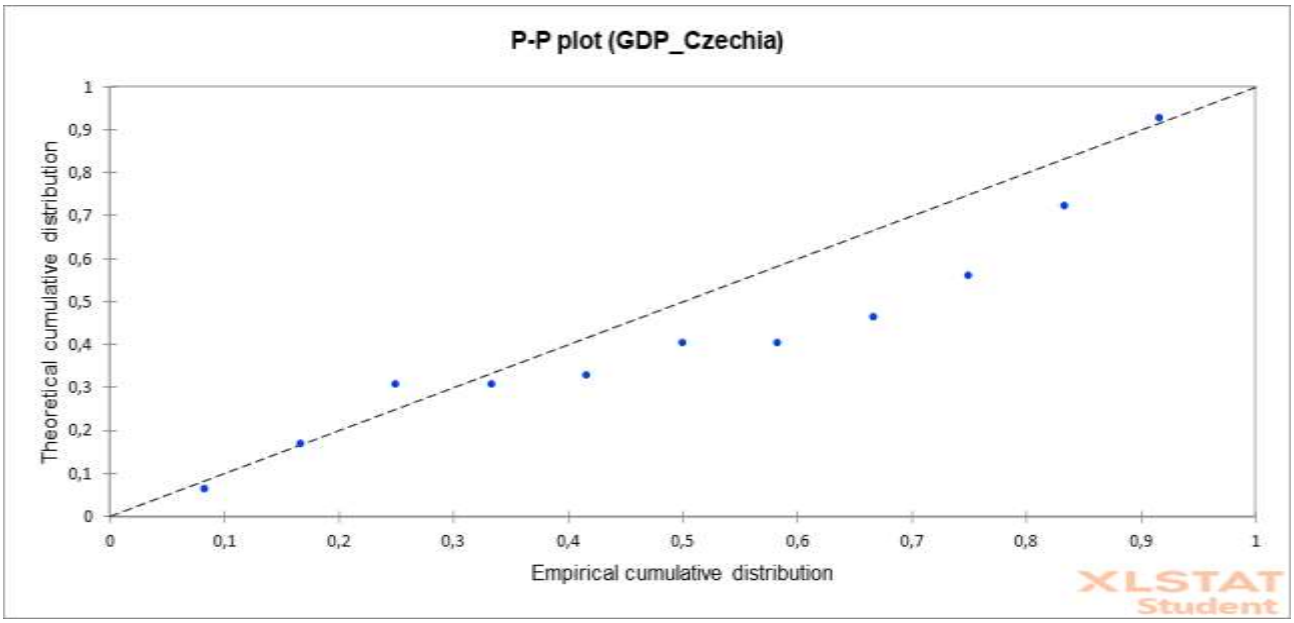

Figure 3. P-P plot of GDP of Czechia
Source: authors based on XL STAT

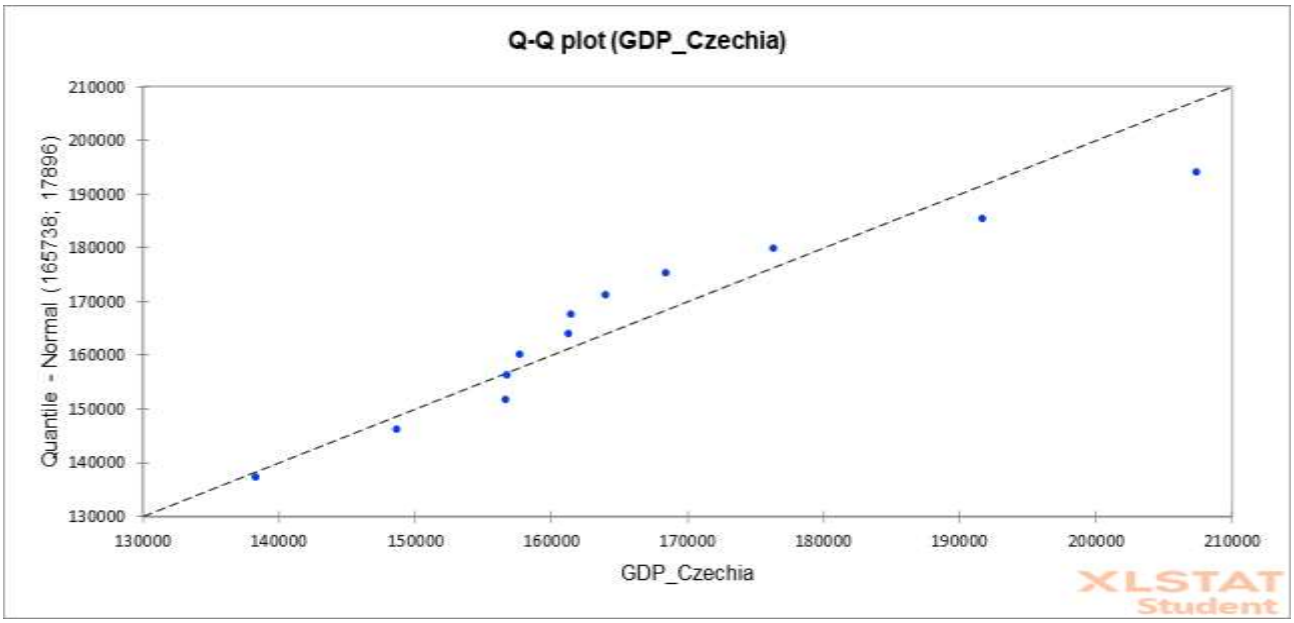

Figure 4. Q-Q plot of GDP of Czechia
Source: authors based on XL STAT

Thirdly, the autocorrelation and partial autocorrelation is realized.
Autocorrelation refers to the degree of correlation between the values of GDP od Czech Republic across different observations in time series. It is possible to see by autocorrelation how much the previous values of GDP impact to its future values. When running autocorrelation, the range of outputs is from 1 to negative 1, in line with the traditional correlation statistic. The values of autocorrelations and bounds are shown in Table 8 and illustrated on Figure 5, that confirms all values in borderlines. Lag 0 is always 1 and then followed first three lags mean weak positive correlation, only at the first lag is medium dependence. All of the rest lags mark weak negative dependence.

By partial autocorrelation is lag 0 always 1 as well as by the autocorrelation. The next lags are at the borderline of statistical significance (Figure 6). The values of partial autocorrelations and bounds are shown in Table 9. The correlations of lags are not constant, but changing. All of the lags mark medium (at first lag) or weak not statistically significant dependence. GDP of Chechia does not signal a significant autocorrelation or partial autocorrelation, that is great starting point for next modelling.

Table 8. Autocorrelation

Lag	Autocorrelation	Standard error	Lower bound (95%)	Upper bound (95%)
0	1.000	0.000		
1	0.480	0.289	-0.566	0.566
2	0.266	0.349	-0.684	0.684
3	0.051	0.365	-0.716	0.716
4	-0.092	0.366	-0.717	0.717
5	-0.047	0.368	-0.721	0.721
6	-0.028	0.368	-0.722	0.722
7	-0.065	0.369	-0.722	0.722
8	-0.245	0.370	-0.724	0.724
9	-0.291	0.383	-0.750	0.750
10	-0.233	0.401	-0.785	0.785
11	-0.297	0.412	-0.807	0.807

Source: authors based on XL STAT

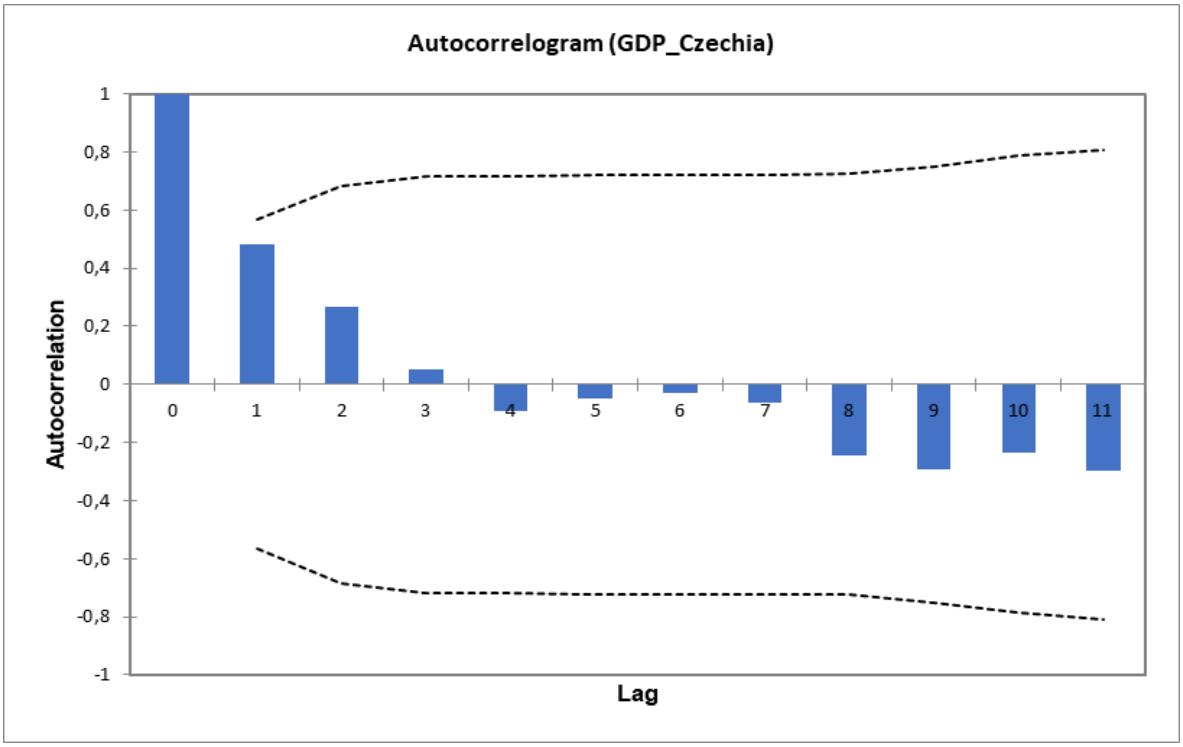

Figure 5. Autocorrelogram of GDP of Czechia
Source: authors based on XL STAT

Table 9. Partial autocorrelation

Lag	Partial autocorrelation	Standard error	Lower bound (95%)	Upper bound (95%)
0	1.000	0.000		
1	0.480	0.289	-0.566	0.566
2	0.047	0.289	-0.566	0.566
3	-0.121	0.289	-0.566	0.566
4	-0.112	0.289	-0.566	0.566
5	0.081	0.289	-0.566	0.566
6	0.012	0.289	-0.566	0.566
7	-0.097	0.289	-0.566	0.566
8	-0.276	0.289	-0.566	0.566
9	-0.090	0.289	-0.566	0.566
10	0.038	0.289	-0.566	0.566
11	-0.226	0.289	-0.566	0.566

Source: authors based on XL STAT

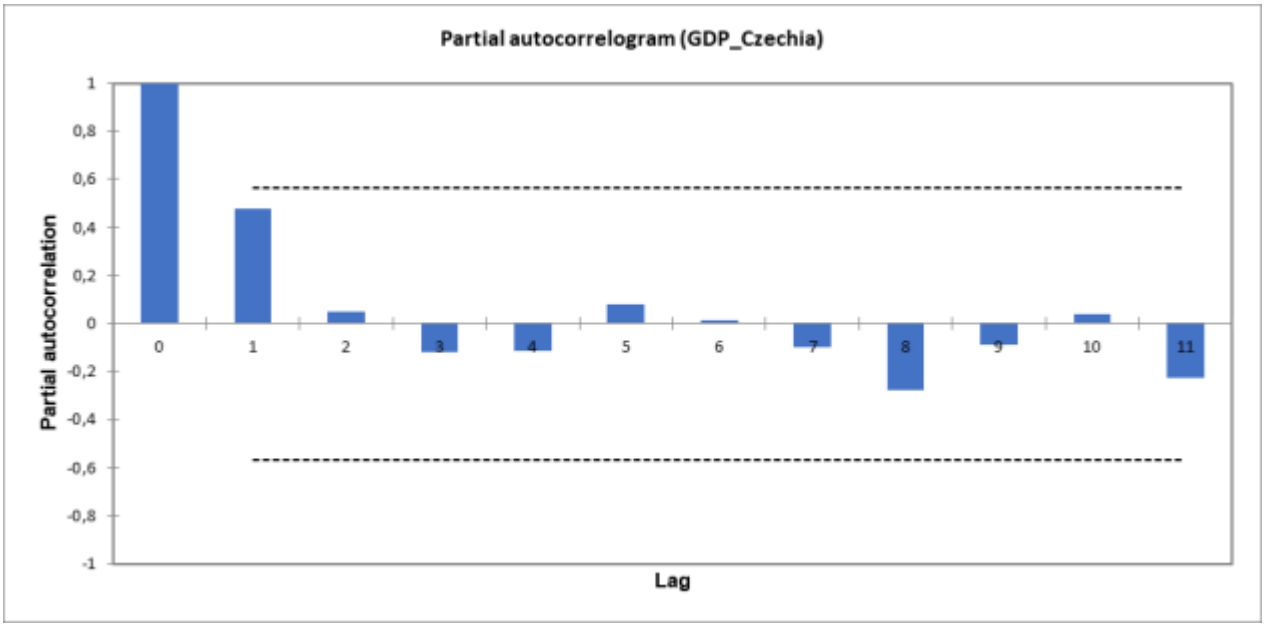

Figure 6. Partial autocorrelogram of GDP of Czechia
Source: authors based on XL STAT

Fourthly, homogeneity of time series means there is no change in data. We assume that GDP of Czechia contains not only one but at least two change-point. Four tests detect change-points using 10 000 Monte Carlo simulations.

3.3 Hypotheses of homogeneity tests

H0: Data are homogeneous.
H1: There is a date at which there is a change in the data.

Table 10. Pettitt's test of GDP of Czechia

K	32.000
t	2014
p-value (Two-tailed)	0.024
alpha	0.05

Source: authors based on XL STAT

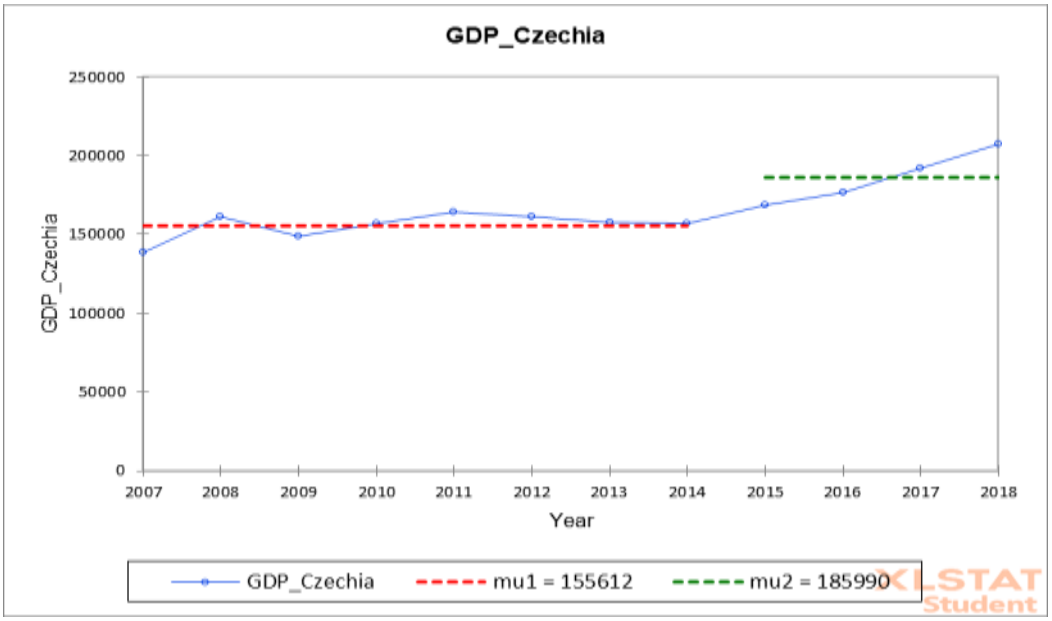

Figure 7. Pettitt's test of GDP of Czechia

Source: authors based on XL STAT

As the computed p-value is lower than the significance level alpha, one should reject the null hypothesis *H0*, and accept the alternative hypothesis *H1*, based on Table 10. The year 2014 is change-point according to Pettitt's test (Figure 8).

Table 11. SNHT test of GDP of Czechia

T0	7.857
t	2016
p-value (Two-tailed)	0.014
alpha	0.05

Source: authors based on XL STAT

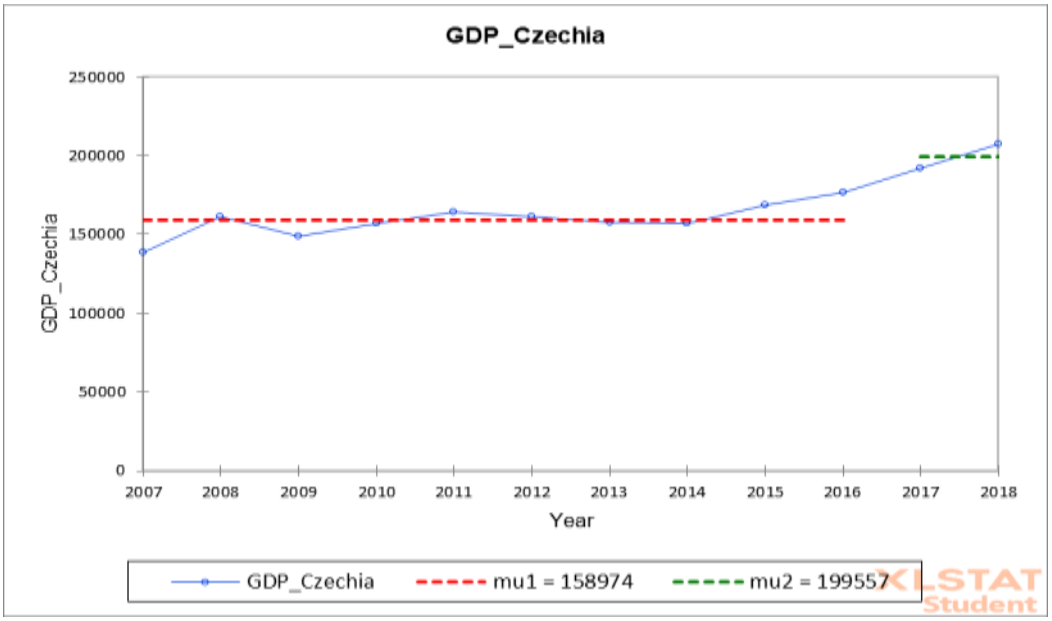

Figure 8. SNHT test of GDP of Czechia
Source: authors based on XL STAT

As the computed p-value is lower than the significance level alpha, one should reject the null hypothesis *H0*, and accept the alternative hypothesis *H1*, based on Table 11. The year 2016 is change-point according to SNHT test (Figure 8).

Table 12. Buishand's test of GDP of Czechia

Q	4.527
t	2014
p-value (Two-tailed)	0.002
alpha	0.05

Source: authors based on XL STAT

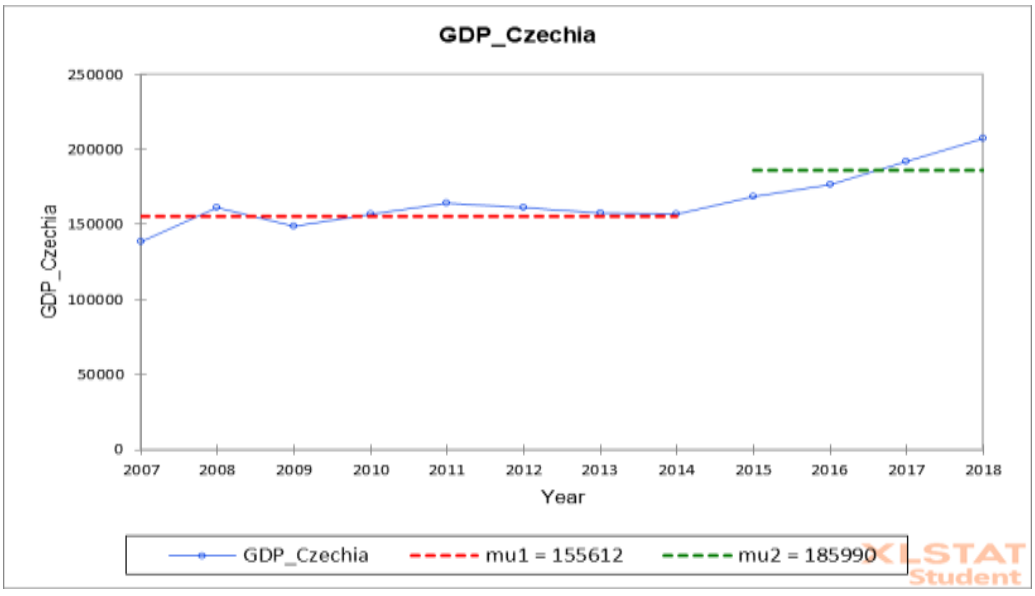

Figure 9. Buishand's test of GDP of Czechia
Source: authors based on XL STAT

As the computed p-value is lower than the significance level alpha, one should reject the null hypothesis *H0*, and accept the alternative hypothesis *H1*, based on Table 12. The year 2014 is change-point according to Buishand's test (Figure 9).

Table 13. von Neumann's test of GDP of Czechia

N	0.393
p-value (Two-tailed)	< 0.0001
alpha	0.05

Source: authors based on XL STAT

As the computed p-value is lower than the significance level alpha, one should reject the null hypothesis *H0*, and accept the alternative hypothesis *H1*, based on Table 13. Von Neumann's test detects the existence of change-point but not determined the year of change in GDP of Czechia.
Results of all homogeneity test accept the existence a date at which there is a change in development of GDP of Czechia. The tests mark as the year if the change the year 2014 and the year 2016. These years are identified change-points and there is also perceived connectivity to Czech enterprises and this relation can mean great possibility for the enterprises or some type of risk.

3.4 Hypotheses of trend test

Lastly, task missing in the description of the development of GDP in Czechia in the years 2007 to 2018 is confirmation statistically significant trend in the series.
H0: There is no trend in the series.
H1: There is a positive trend in the series.

Table 14. Mann-Kendall trend test of GDP of Czechia

Kendall's tau	0.667
S	44.000
Var(S)	212.667
p-value (one-tailed)	0.002
alpha	0.05

Source: authors based on XL STAT

As the computed p-value is lower than the significance level alpha, one should reject the null hypothesis *H0*, and accept the alternative hypothesis *H1*, based on Table 14. The continuity correction has been applied. Sen's slope (Table 15) captures the magnitude of declared trend. Sen's slope shows average how GDP of Czechia has changed each year between the period of years 2007 and 2018 and the intercept means the value of hypothetic value of GDP of Czechia in the year 0. There is a positive trend in the series of GDP of Czechia and based of connection (proofed in the part Discussion) with Czech enterprises, it means significant synergic effect of increasing for Czech enterprises.

Table 15. Sen's slope of GDP of Czechia

	Value	Lower bound (95%)	Upper bound (95%)
Slope	4429.378	2264.900	6334.350
Intercept	-8750206.989	-10666608.486	-6572741.786

Source: authors based on XL STAT

4. DISCUSSION

Based on presented results that the change-points of GDP of Czechia are the years 2014 and 2016, we support very narrow connection of this macroeconomic indicator to Czech enterprises in this part. Table 16 represents observations of average EBIT of 859 Czech enterprises gained from Amadeus database mapping years 2010 - 2018. The limitation is not the same the period of the years in comparing to analyzed period of GDP of Czechia. On the Figure 10 is shown development of average EBIT of Czech enterprises graphically.

Table 16. EBIT of Czech enterprises

Year	EBIT [thous. €]	Year	EBIT [thous. €]	Year	EBIT [thous. €]
2010	2713.514	**2013**	2917.464	**2016**	3312.093
2011	2833.784	**2014**	3031.773	**2017**	3947.410
2012	3028.290	**2015**	3301.751	**2018**	3805.430

Source: authors based on Amadeus database

Figure 10. EBIT of Czech enterprises
Source: authors based on XL STAT

4.1 Hypotheses of homogeneity tests

H0: Data are homogeneous.
H1: There is a date at which there is a change in the data.

Table 17. SNHT test of EBIT of Czech enterprises

T0	6.274
t	2016
p-value (Two-tailed)	< 0.0001
alpha	0.05

Source: authors based on XL STAT

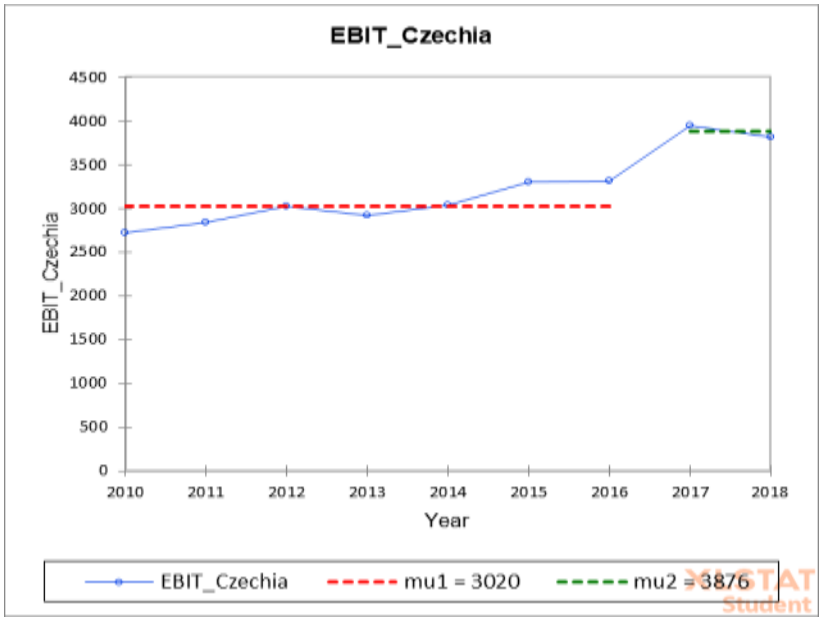

Figure 11. SNHT test of EBIT of Czech enterprises
Source: authors based on XL STAT

As the computed p-value is lower than the significance level alpha, one should reject the null hypothesis *H0*, and accept the alternative hypothesis *H1*, based on Table 17. The year 2014 is change-point according to SNHT test (Figure 11).

Table 18. Buishand's test of EBIT of Czech enterprises

Q	3.795
t	2014
p-value (Two-tailed)	0.001
alpha	0.05

Source: authors based on XL STAT

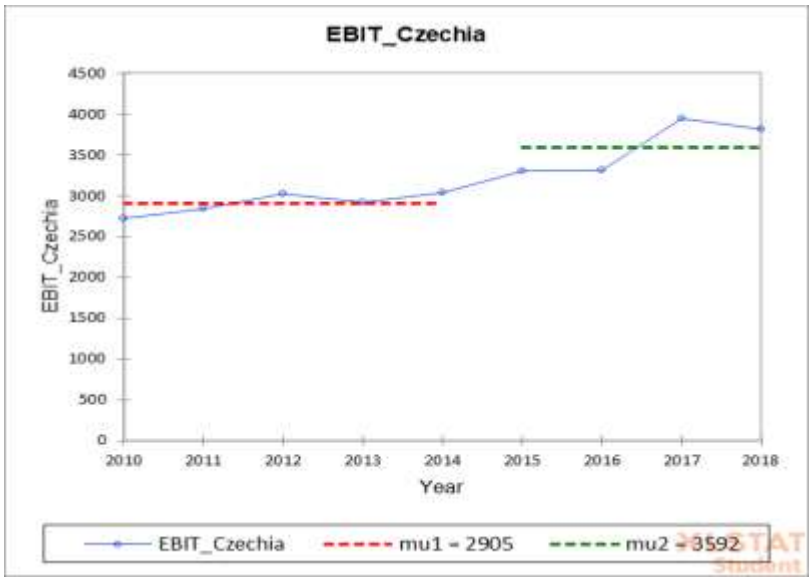

Figure 12. Buishand's test of EBIT of Czech enterprises
Source: authors based on XL STAT

As the computed p-value is lower than the significance level alpha, one should reject the null hypothesis *H0,* and accept the alternative hypothesis *H1*, based on Table 18. The year 2014 is change-point according to Buishand's test (Figure 12).
The homogeneity tests show two change-points in the development of average EBIT of Czech enterprises. They are the years 2014 and 2016. When we compare these results to results of GDP of Czechia, there are the same years 2014 and 2016. Comparative analysis proves that between GDP of Czechia and Czech enterprises business is narrow connection. The future research should focus on detailed analysis GDP of all countries of Visegrad Four and assess if the presented conclusion is valid only for Czechia respectively for all countries from the group.
Many studies concerned the impact of GDP are published. Mielcova (2017) solves the impact of GDP on the level of employment on different size enterprises. Michlek & Vybostok (2018) assess GDP to the relations and contexts of growth, inequalities and poverty on regional level in Slovakia. Hudakova (2017) discusses the connection between the value of GDP and research and development support of the enterprises. Not only the development of GDP is considered by authors for risk factor of business. Study of Kliestik et al. (2015) focus on techniques used for risk prediction such as logit and probit. Durana (2015) suggests leasing as a special form of financing needs of businesses and the instrument to the diversification risk. Olczyk & Kordalska (2018) deal with the determinants of trade balance in Polish and Czech manufacturing sectors. Kliestik et al. (2018) extend the knowledge on financial prediction and adapt existing models to local conditions, particularly local legislation in Slovak conditions. Valaskova et al. (2018) using multiple regression calculate nine financial indicators significant enough to manage financial risks and to affect the profitability and prosperity. Emerling & Wojcik-Jurkiewicz (2018) discuss the risk associated with the replacement of traditional budget with performance budgeting in the public finance sector management.

5. CONCLUSION

The aim of this paper is to make description of the development of GDP in Czechia in the years 2007 to 2018. No outliers are identified, normal distribution is detected distribution, no statically autocorrelations are marked, two change-points (2014 and 2016) are shown, and is accepted positive trend in the series of GDP of Czechia. Comparative analysis GDP of Czech Republic and average EBIT of Czech enterprises confirms narrow dependence between set variables. It is necessary for successful enterprises to make detailed analyses of the development of GDP and based on them appropriately react to opportunity of synergic effect of growth in this case or manage potential threat of business risk.

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