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Sustainable Competitiveness: How Does Global Competitiveness Index Relate to Economic Performance Accompanied by the Sustainable Development?

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Abstract

The research under discussion remains whether higher competitiveness of a country brings higher economic performance and sustainable growth, e.g., in the V4 region. The objective of the paper is to provide the results of extensive research based on verified Eurostat data to explore this research challenge in the V4 countries during the period of 2007-2019. Simultaneously, the objective is to link the country's economic performance (GDP) to urgent challenges of the contemporary world in the form of sustainability and life quality. In the paper, linear regression, multiple linear regression, and ANOVA were used. A significant impact of the Global Competitiveness Index (GCI) on the level of GDP, and the subsequent positive effect of GDP level on sustainability and life quality indicators has been demonstrated. Our research findings propose an unconventional sustainable competitiveness mechanism. The conclusion outlines the direction from improved competitiveness through higher economic performance reinforcing R&D expenditure and high-tech employment to better sustainability and well-being. Moreover, the research results bring initial empirical evidence of the functionality of the proposed mechanism in the V4 countries. Based on this, we can offer policymakers the key research findings pointing at the sustained economic growth accompanied by higher ecology, including life quality. At the same time, the drivers of this development are presented in more detail in our paper.

Keywords: competitiveness, sustainable competitiveness, global competitiveness index, economic performance, sustainable economic development, V4 countries
JEL Classification: O11, O44, Q01, Q56

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1. INTRODUCTION

Nowadays, it is necessary to realize why sustainable competitiveness is important and for whom. Sustainable competitiveness is not just about growth or economic performance but should consider the "soft factors" of competitiveness (Balkytė & Tvaronavičienė, 2010). It is not

negligible to assess competitiveness from the view of the environment, ecology, and life quality (United Nations, 2015). According to Mamipour et al. (2019), to be able to formulate a suitable model or trend of "sustainable competitiveness development", it is important to understand all its key components - economic, environmental, and social - and their interrelationships. However, several research studies have addressed only some parts of this integrated model, e.g., the link between sustainable development goals (SDGs) and well-being (De Neve & Sachs, 2020; Costanza et al., 2016; Uslu et al., 2020).

The competitiveness index as a strategic indicator reflects the quality of the business environment, influences investors' decisions about entering the country, and many other fields (Schwab, 2019). The most well-known indices are, among others, the Global Competitiveness Index (GCI), the World Competitiveness Index (WCI) and the Doing Business Index (DBI). Despite the interconnectedness and complexity of these indices, in general, the most comprehensive and used index is the GCI.

The present research is focused on exploring whether the country's competitiveness, expressed by the score of GCI, has an impact on the level of the economic performance (growth) measured by GDP in the V4 countries. The attention was also paid to the link of GDP level to selected indicators of sustainable development and life quality (QL). This way, we tried to bring a more integrated and complex view of the competitiveness issue compared to the previous studies. We believe that this issue and its processing by a new mechanism is the research gap needed to fill. We are trying to close this strategic mechanism from improved competitiveness and higher economic performance (e.g., GDP) to better sustainability and well-being of countries and their people.

The conclusion of this paper introduces the final research finding statement, which is an interesting highlight to the current state of knowledge emerging from the case of V4. The issue should represent an urgent challenge for both the future research chain and the policymakers. This is an important task mainly in countries such as China and other highly developed countries, which declare that they do not want to reduce their economic growth and well-being for the sake in the interest of meeting the goals of sustainable development.

2. THEORETICAL BACKGROUND

The country's productivity is closely linked to economic growth (performance). The country's economic performance has been usually measured and evaluated by GDP per capita, employment rates and public deficits, debt, and current account positions. However, it is needed to understand that competitiveness goes beyond these indicators or goals (Aiginger et al., 2013).

The World Economic Forum (WEF) defines GCI as an annual indicator consisting of 12 pillars that are mainly important for policymakers. It involves the set of factors that determine countries' productivity. This index is considered a strategic tool that is designed to assess and benchmark the competitiveness of all countries (Schwab, 2019). The results of several recent studies (Dima et al., 2018; García-Sánchez et al., 2018; Farinha et al., 2018; Gavurová, 2020) highlighted that innovation and research and development (R&D) are the significant factors which can increase the competitiveness of an economy. Furthermore, the proactivity of environmental performance

"generates the complementarities with technological proactivity" (Garcés-Ayerbe & Cañón-de-Francia, 2017). According to Kordalska & Olczyk (2016), "it is still an open question in the literature whether economic growth can be used to predict future global competitiveness or the other way round". One of the key findings of the European Competitiveness Report (Schwab & Brende, 2012) is that "high levels of economic prosperity cannot be sustained without high levels of competitiveness". According to Aleksejeva (2016), competitiveness is considered the crucial issue in a globalized world in the sense of the statement: "Raising productivity and competitiveness is crucial to sustaining economic growth and enhancing prosperity in a country". On other hand, according to Petrylè (2016), the examination of the interrelationships between competitiveness and GDP growth of countries is confirmed to be weak or with no relationship. Thus, future GDP growth cannot be forecasted.

2.1 Influence of Global Competitiveness Index on economic performance

Some recent studies and research are related to the issue of competitiveness: the assessment of the influence of factors as innovation-oriented and infrastructure-oriented models on competitiveness (Rostami et al., 2019, Tudose & Rusu; 2015); the interactions between smart economic development and competitiveness in Central and Eastern Europe (Dagilienè et al., 2020); the relationship between competitiveness and resilience to economic crisis (Petrylé, 2016), etc. Moreover, there are many other factors, e.g., the R&D expenditures, which can significantly affect competitiveness (Kiseľáková et al., 2018). In this way, the government of each country should invest in education, especially in higher education and in R&D (Ekici et al., 2019; Caballero-Morales et al., 2020).

Considering the above-mentioned, increasing competitiveness and improving the country's position in the GCI rankings should support its economic growth in the medium-term (Schwab, 2019; Schwab & Brende, 2012). The issue of the relationship between mentioned variables (competitiveness and GDP) was addressed in other recent research studies (Rusu & Roman, 2018; Kordalska & Olczyk, 2016; Korez-Vide & Tominc, 2016; Petrylè, 2016). However, there is some criticism of the GDP indicator, namely counting mainly market production, absence of some fields in the sense of education and health care or environmental impacts and social problems (Stiglitz et al., 2009).

Based on previous research studies and despite the above criticism of the GDP, we consider this indicator applicable to our research framework. The first research hypothesis (H1) was formulated: better positioning of the country in the GCI ranking brings the country higher economic performance (measured in GDP per capita in PPS - Purchasing Power Standard).

2.2 Influence of GDP on sustainable competitiveness and economic development

Economic outputs (e.g., GDP) are necessary for the country. At present, it is urgent to change the view of the overall performance in terms of other factors such as environmental and social aspects of business (Wang & Feng, 2021; Muo & Azeez, 2019; Maletic et al., 2015; Fauzi et al., 2010). Wang & Feng (2021) demonstrate that the transition to the green development of China is possible and could be achieved by a win-win strategy - environmental protection and economic development. On the other hand, they state that this development is still at a slow pace.

The transformation force of Agenda 2030 represents 17 sustainable development goals. In general, the mission of these goals is to stimulate actions in the next 15 years to achieve a set of important social and environmental priorities worldwide (United Nations, 2015; Hametner & Kostetckaia, 2020). In this regard, the term "sustainable competitiveness" is defined by WEF as "the set of institutions, policies, and factors that make a nation productive over the longer term while ensuring social and environmental sustainability". On one hand, the term is primarily based on the key premise that "competitiveness" can be equated with productivity. On the other hand, "sustainable competitiveness" is a concept with a wide range focused not only on economic outcomes (Corrigan et al., 2014). Moreover, the authors of Thore & Tarverdyan (2016) also addressed this issue in their research, namely - whether it is possible to link competitiveness and social cohesion and welfare and environmental protection. The combination of the economic performance of countries and sustainable development is at the centre of controversy by many authors. As research by Kalimeris et al. (2020) shows, "At the global level an increase in the use of resources by 96% between 1980 and 2009 induced a 153% growth in welfare as estimated by GDP. In effect, sustainability appears to be feasible, given the efficient use of resources induced by suitable policies not much different from those currently prevailing". The research of Radovanović & Lior (2017) offers an important finding that "It is recommended that developing countries that have globally relatively low GHG emissions and energy use, as well as GDP well above the poverty level, consider basing their sustainable development on raising the relative weights for natural wealth and income equality, and somewhat lower on the relative weight of GDP". In contrast, recent research studies provided by Nasir et al. (2019) in China or by Shahbaz et al. (2020) in the UK showed that economic growth leads to an increase in environmental degradation. Moreover, the high economic growth of a country is not accompanied by the tendencies to sustainable development, and thus the better environment (Bolcárová & Kološta, 2015).

Based on these various studies, we decided to examine the relationship between economic performance and sustainability issues in the conditions of the V4 countries. We formulated the second research hypothesis (H2). We assume that higher economic performance of a country influences its higher involvement and a positive focus on sustainability (while we look at the given issue from the view of several selected indicators of SDGs).

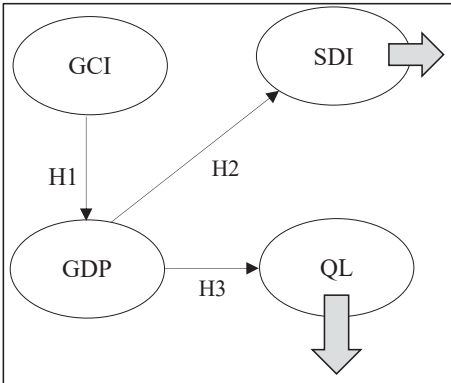
Moreover, according to Despotovic et al. (2019), the post-transition European countries have a lower level of sustainable competitiveness, even in social areas. This also applies to the rest of Europe. The social component of national competitiveness needs to be improved. Due to this reason, we focus on the importance of increasing the competitiveness and score of a country in the GCI rankings, following the increase in the level of well-being of its inhabitants. In the sense of finding of Cann (2017): productivity leads to growth, which can cause an increase in income and the improvement of well-being. Life quality is a multidimensional phenomenon related to the overall well-being of a society or an individual (Maricic, 2019). Also, De Carvalho et al. (2020) examined the inclusion of the aspect of life quality in the competitiveness of nations. The findings of O´Neill (2015) indicate that a steady-state economy can show the signs of socially sustainability. Moreover, Costanza et al. (2016) state in this sense a challenging claim "In today´s interconnected world, the SDGs cannot be achieved unless there is sustainable well-being globally".

In examining life quality as a well-being indicator, we formulated the following research hypothesis (H3) in which we assume that higher overall economic performance of the country has a positive effect on the standard of living of the country and its inhabitants measured by life quality indicators.

3. RESEARCH OBJECTIVE, METHODOLOGY AND DATA

The research objective is to explore whether the country's competitiveness, expressed by its score of GCI, has an impact on the level of the country's economic performance measured in GDP per capita in the V4 countries (H1). At the same time, the subject of interest is the link of the GDP level to the selected indicators of sustainable development (H2) and life quality indicators (H3). The research represents the starting point of the complex and holistic research into sustainable competitiveness in the condition of the V4 countries.

Data about the GCI and the total score of competitiveness were obtained from WEF reports. According to previous studies mentioned above, we can consider the rankings compiled by the WEF one of the most reliable, in which both academics and economists from practice cooperate (Schwab, 2019). There are many sustainable development indicators (SDI) and also indicators of life quality (QL). Sustainable development indicators cover the field of SDGs (The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015). Primary data of individual indicators (GDP, SDI, QL) were obtained from the database of Eurostat.



[1] Employment in high-technology sectors *(% of total employment)*
[2] Gross domestic expenditure on R&D *(% of GDP)*
[3] R&D by personnel *(% of active population)*
[4] People at risk of income poverty *(%)*
[5] Tertiary educational attainment *(% of population aged 30-34)*
[6] Gender employment gap *(% of total population)*
[7] Human resources in science and technology (*% of active population aged 25-64)*
[8] Average CO^2 emissions per km from new passenger cars *(g CO^2 per km)*
[9] Share of renewable energy consumption *(%)*
[10] Greenhouse gas emissions *(in CO^2 equivalent)*
[11] Greenhouse gas emissions *(tonnes per capita)*

[1] Median equalized net income *(in PPS)*
[2] Living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor *(%)*
[3] Unemployment rates *(%)*
[4] Average number of usual weekly hours of work in main job by employed persons *(number)*
[5] Inactive population *(% of total population)*
[6] Life expectancy *(years)*
[7] Arrears (mortgage or rent, utility bills or hire purchase) from 2003 (%)
[8] Gender pay gap *(%)*
[9] Income situation in relation to the risk of poverty threshold *(%)*
[10] Noise from neighbors or from the street *(%)*
[11] Gender employment gap aged 20-64 *(percentage points)*

Fig. 1 – Research framework and analysed indicators of SDI and QL. Source: own research

Within the selection of the analysed indicators (we researched the mediate role of SDI and QL), we had to consider the focusing of the indicator on the economic, environmental, and social area and availability of data for each analysed year. For the reason of data availability (data source: Eurostat, a, b), the analysis contained the data in the period of the years from 2007 to 2019. Figure 1 (see above) presents the selected analysed indicators, which are the object of our research framework.

We verify the assumptions of the interconnection of the analysed factors in the conditions of the V4 countries by setting 3 main research hypotheses (see section 2).

The V4 presents a dynamic regional group of EU member states. In general, it represents a homogeneous group of countries with similar historical, economic, social, and political development in the past. Given the main research objective as well as the proposed research framework, which goes beyond today's knowledge in the theory of competitiveness and economic growth, the V4 group seems to be very suitable due to its sufficient homogeneity to avoid the impact of other factors at minimum. Each country shows the typical features of supporting competitiveness and economic growth. The cooperation between these countries played an important role in the past concerning transition from a totalitarian regime to a democratic society (since 1989). At the same time, these countries represent, besides the countries of Western Europe, the potential for raising the living standards as well as gradually meeting the goals of sustainable development. Whereas, according to Androniceanu et al. (2018), economic growth and life quality are two essential topics to make a time-based analysis of the evolution of a state or a comparison with other states.

The analysed sample consisted of 4 countries, 24 indicators over 13 years. From the point of view of the statistical methods, a multiple regression analysis was used to verify the hypothesis H1. This analysis is used in the case of finding the linear combination of a set of predictors that provides the best point estimates of the dependent variable across a set of observations. Predictive accuracy is calibrated by the magnitude of the R2 and the statistical significance of the overall model. The second purpose conditional to statistically significant overall prediction is to draw conclusions about individual predictor variables. In such applications, the focus is on the size of the (standardized) regression coefficients, their estimated standard errors, and the associated t-test probabilities. These statistics are mainly used to test hypotheses about the effect of individual predictors on the dependent variable. Another applied analysis was the analysis of variance (ANOVA). It is a parametric statistical method for comparing more than two groups. The hypotheses H2 and H3 were verified through linear regression analysis, which expresses the relationship between two variables and estimates the value of the dependent variable (y) based on a selected value of the independent variable (x) through regression equation:

$$y = \beta_0 + \beta_1 x \quad (1)$$

Based on Pearson's correlation coefficient, we described the strength of the relationship between analysed variables. All statistical tests were carried out using the software STATISTICA 12. We used a .05 p-level of significance.

4. RESULTS

4.1 The relationship between GCI and GDP in the V4 countries

The initial interest of the research framework was to identify whether a better position of a country in the GCI (with a higher Global Competitiveness Index score) brings the country a higher economic performance measured in GDP per capita (H1). In the V4 countries, we tested the dependence of GDP on the position in the GCI ranking through ANOVA. The competitiveness index score of these countries during the analysed years 2007-2019 ranged from 58.61 to 71.18. The given interval had to be transformed into a factor with k-levels. For this reason, we used the calculation of quartiles (lower and upper quartiles). To carry out the analysis, we set the GCI as a factor with three levels: score less than 62, scores in the range of 62 to 66 and scores higher than 66. We chose the lower and upper quantiles of the GCI distribution as the frontiers. Based on the results presented in Table 1, we state that the level of GCI significantly (p-level =.000) affects GDP. Table 2 presents the basic descriptive characteristics of the level of GDP at individual levels of the GCI variable.

Tab. 1 – Analysis of Variance (GDP and GCI). Source: own research

Statistics	SS effect	df effect	MSeffect	SS error	df error	MS error	F-test	p-level
GDP	2.03E+08	2	1.01E+08	3.41E+08	49	6.97E+06	14.56	0.000

Note: SS - Sum of Squares; df - Degree of Freedom; MS - Mean Square

Tab. 2 – Description of dependent (GDP) and independent (GCI) variables. Source: own research

Level of GCI	GDP observations (N)	GDP mean	GDP standard deviation	GDP Minimum	GDP Maximum
< 62	19	18436.84	2286.49	14200.00	21500.00
62-66	23	19195.65	2820.03	13300.00	24200.00
> 66	10	23790.00	2832.92	20600.00	28500.00
Total	52	19801.92	3266.68	13300.00	28500.00

Data in Table 1 and Table 2 indicate that the level of GDP increases at individual GCI levels. At the same time, this effect is statistically more significant at a higher level of GCI score (> 66) (see Table 3). This fact is also evident looking at the minimum and maximum values of GDP at different levels of GCI. We can state that a higher level of GCI score is typical for the higher level of GDP. The results in Table 3 show a subsequent pair comparison of the average GDP. The level of GDP achieved with a GCI score in the range of 66 and above differs statistically significantly from the level of GDP at other GCI levels. The average level of GDP at GCI levels < 62 and 62-66 can be considered the same, the differences are not significant.

Tab. 3 – Post-hoc Tukey's HSD-test. Source: own research

GCI	Tukey's HSD		
	< 62	62 – 66	> 66
< 62		0.652	0.000

62-66	0.652		0.001
> 66	0.000	0.001	

At the same time, we also tested the effect of the time-shifting on the GDP of individual countries. Having focused on the time shift of three years (i.e., the GCI and GDP data pairs are time-shifted), only 3 GDP values are on the score scale of 66 and more. Based on this, the sample was not subjected to the ANOVA analysis. The following Figures (2-5) provide an interesting insight into the trend of GCI and GDP over time in the individual V4 countries.

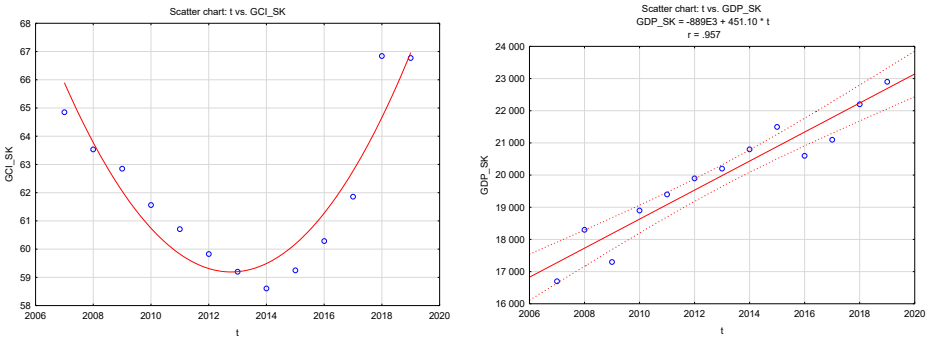


Fig. 2 – Trend of GCI and GDP in the Slovak Republic. Source: own research

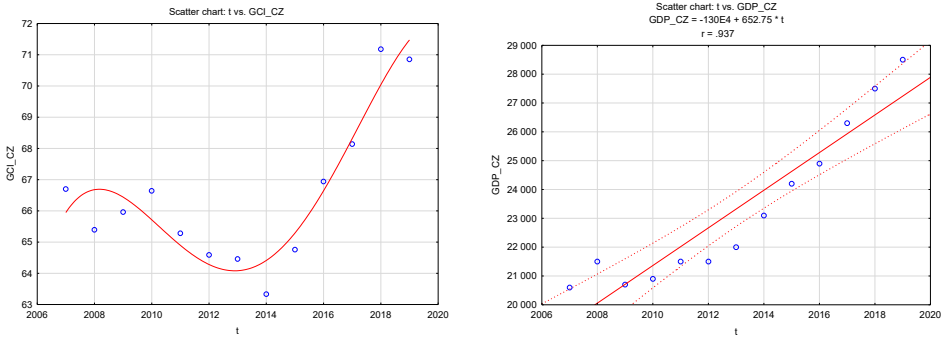


Fig. 3 – Trend of GCI and GDP in the Czech Republic. Source: own research

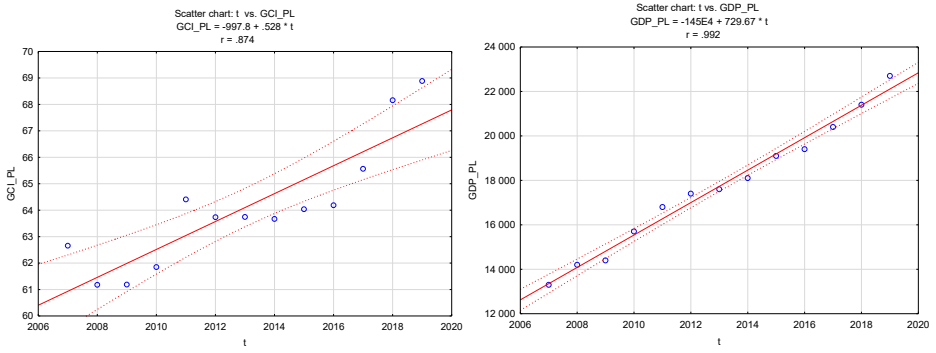


Fig. 4 – Trend of GCI and GDP in Poland. Source: own research

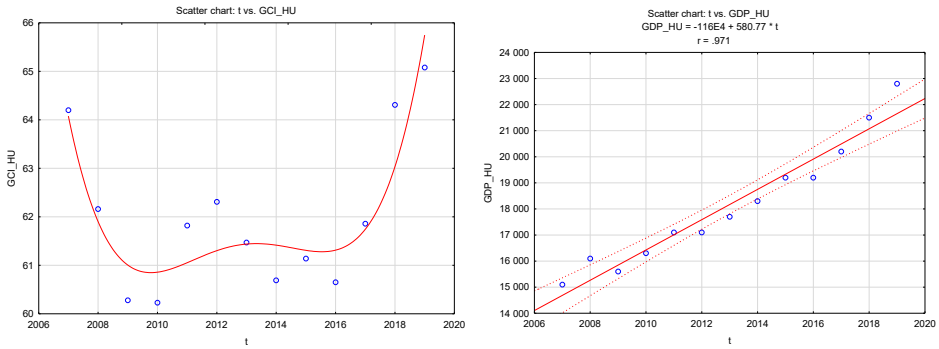


Fig. 5 – Trend of GCI and GDP in Hungary. Source: own research

Analysis by multiple regression model brings the results in Tables 4-6. In all V4 countries (except for Slovakia), a statistically significant dependence of the amount of GDP on the effect of two monitored variables, namely GCI and time in years (t), was confirmed. Based on the p-value, both explanatory variables have a significant position in the regression model concerning the explained GDP variable (y).

Tab. 4 – Multiple regression: y = β0 + β1 * t + β2 * GCI (PL). Source: own research

R^2= 99%; F(2.10)=619.41; p-level= 0.000			
N=13	Point estimate	t-test	p-level
β0	-162.93	-0.04	0.970
β1	618.01	14.41976	0.000
β2	211.66	2.97995	0.014

Tab. 5 – Multiple regression: y = β0 + β1 * t + β2 * GCI (CZ). Source: own research

R^2= 95%; F(2.10)=105.77; p-level= 0.000			
N=13	Point estimate	t-test	p-level
β0	-5558.95	-0.940473	0.369
β1	525.32	9.365628	0.000
β2	379.14	4.121424	0.002

Tab. 6 – Multiple regression: y = β0 + β1 * t + β2 * GCI (HU). Source: own research

R^2= 97%; F(2.10)=219.70; p-level= 0.000			
N=13	Point estimate	t-test	p-level
β0	-3289.01	-0.74781	0.472
β1	548.57	18.68232	0.000
β2	284.10	3.95970	0.003

The results of t-tests indicate that the individual explanatory variables (t, GCI) are statistically significant. The F-test (in the header of the table) indicates that the holistic model is also statistically significant. The results can be interpreted using the example of Poland (Table 4), where GDP will increase by an average of 618.01 PPS per year and in the case of increasing the GCI score by one unit, GDP will increase by an average of 211.66 PPS. In the specific case of Slovakia, the model is significant (F-test = 58.722; p-level = 0.000). Separate testing of the individual explanatory variables confirmed statistical significance only for the variable of time (t). However, surprising is that the correlation between the examined variables within the multiple regression model, considering a time shift for the 2, 3 and even 4 year shifting alternatives, has not been confirmed in either of the V4 countries.

Based on the above-mentioned, we can state that hypothesis H1 was confirmed in up to 3 V4 countries (PL, CZ, HU). In Slovakia, GDP also grew over time. Still, the development of the GCI score and Slovakia's position in the competitiveness rankings in the period 2007-2019 did not have a statistically significant effect on this economic growth.

4.2 The relationship between GDP and sustainable development indicators

To fulfil the research objective and ensure a more dynamic and integrated view of the researched topic, the analysis of the relationship between GDP and selected sustainable development indicators was performed. The significant linear statistical dependence between GDP and SDI was confirmed in almost all cases, as shown in summary in Table 7 (with a few exceptions).

Tab. 7 – The results of the linear regression between GDP and SDI. Source: own research

	SDI variables (numbering according to Figure 1)										
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**	**[8]**	**[9]**	**[10]**	**[11]**
SK p=	0.012	0.001	0.014	0.066	0.000	0.005	0.012	0.000	0.001	0.013	0.009
r=	0.72	0.87	0.71	0.57	0.92	-0.78	0.72	-0.88	0.85	-0.72	-0.74
β_0=	0.90	-1.67	0.21	6.41	-58.12	27.65	18.81	255.89	-7.29	94.89	13.42
β_1=	0.00015	0.00012	0.00002	0.00029	0.00421	-0.00064	0.00074	-0.00595	0.00089	-0.00174	-0.00026
CZ p=	0.007	0.044	0.000	0.235	0.000	0.000	0.001	0.001	0.006	0.022	0.014
r=	0.75	0.61	0.92	0.39	0.87	-0.92	0.84	-0.85	0.77	-0.68	-0.71
β_0=	1.85	-0.0112	-0.18	7.52	-29.92	30.03	27.78	242.97	-5.73	89.09	17.72
β_1=	0.00011	0.00007	0.00006	0.00008	0.00243	-0.00055	0.00044	-0.00459	0.00081	-0.00093	-0.00021
HU p=	0.942	0.004	0.002	0.409	0.002	0.007	0.000	0.000	0.396	0.375	0.724
r=	0.02	0.79	0.81	0.28	0.82	0.76	0.90	-0.90	0.28	-0.30	-0.12
β_0=	4.94	0.08	0.10	10.74	-3.54	1.80	21.86	228.60	7.63	79.1	6.81
β_1=	0.000003	0.00007	0.00004	0.00017	0.00186	0.00063	0.00075	-0.00505	0.00032	-0.00068	-0.00002
PL p=	0.000	0.000	0.000	0.048	0.000	0.073	0.000	0.000	0.001	0.774	0.502
r=	0.92	0.98	0.93	-0.61	0.97	-0.56	0.98	-0.96	0.84	0.10	0.23
β_0=	1.61	-0.467	-0.58	21.46	-0.84	16.71	10.10	210.58	1.98	83.70	10.15
β_1=	0.00007	0.00008	0.00007	-0.00026	0.00228	-0.00013	0.00165	-0.00410	0.00048	0.00009	0.00003

Note: Highlighted cells indicate statistical dependence between variables; significance p-level < 0.05.

For a clearer understanding of the data from the table, we present an interpretation of the results of the first analysed indicator in the case of Slovakia. In this case, it is possible to define the relationship between GDP and Employment indicator in high-technology sectors [1] (it means the high-technology manufacturing and knowledge-intensive high-technology services) through the regression function y = 0.90+0.00015x. From the above-mentioned, it is evident that with the improvement of the country's GDP of a thousand units in PPS, employment in the high-

tech sectors will increase on average by 0.15%. The correlation coefficient (r = 0.72) indicates a positive, moderately significant statistical dependence. Among the V4 countries, only in the case of Hungary, there is no statistical dependence between the analysed variables.

A positive linear statistical dependence was also demonstrated in the case of other analysed indicators (Table 7): the Gross domestic expenditure on R&D [2]; the Share of R&D personnel [3]; the indicator Tertiary educational attainment [5]; the indicator Human resources in science and technology [7]; the Share of renewable energy consumption in gross final energy consumption [9]. The development is similar in all V4 countries. In the case of the indicator Gender employment gap [6], which measures the difference between the employment rates of men and women aged 20 to 64, we can state that with the increase of Slovakia's GDP by a thousand units in PPS, the gender employment gap indicator will decrease on average by 0.64%. Only in the case of the Czech Republic, the development is similar.

Negative statistical linear dependence (however, it is a positive environmental oriented feature) is demonstrated for indicator of the Average carbon dioxide (CO2) emissions per km by new passenger cars in a year [8]. The trend is similar in all V4 countries. We can state that although GDP is growing and thus the overall economic performance of the V4 countries, it does not have a negative impact on emissions and the environment. In the case of CO2 Greenhouse gas emission indicators, a medium-strong negative statistical dependence was based on the correlation coefficient. When the country's GDP increases by a thousand units, emissions (in CO2 equivalent [10]) decrease by an average of 0.93 to 1.74 and in the case of tonnes per capita [11] by 0.21 to 0.26 (CZ, SK). From Poland and Hungary's point of view, the statistical dependence has not been confirmed. Within the indicator People at risk of poverty [4], no significant statistical dependence was proved in SK, CZ, HU. Only in the case of Poland, a moderately strong (r = -0.61) statistical dependence (p-level = 0.048) was demonstrated. It means that with GDP growth by one thousand units, the percentage of people at risk of poverty decreases on average of 0.29%.

As is evident from Table 7, only in a few cases there is no statistical dependence between the examined variables. Based on the above-mentioned, we can conclude that the research hypothesis H2 was confirmed in most cases. There is a significant statistical dependence between GDP and SDI, which has a positive effect on sustainable competitiveness in most of the analysed indicators.

4.3 The relationship between GDP and life quality indicators

Table 8 provides an overview of whether the higher overall economic performance of a country has a positive effect on the living standards (QL) of the country and its inhabitants (H3).

As in the previous analysis (SDI), in most cases, the statistical dependence between the analysed variables was also confirmed. The positive character of the statistical dependence between the variables can be observed in the case of the Net income indicator [1], where the increase of the country's GDP by one thousand PPS units increases the Median equalized net income increases on average by 35 PPS units (HU) or by 78 PPS units (SK). There is also a positive statistical dependence in the Life expectancy indicator [6], where with the improvement of a country's GDP of a thousand units of PPS, life expectancy in countries will increase on average by a quarter (CZ) to half a year (SK).

Tab.8 – The results of the linear regression between GDP and QL. Source: own research

		QL variables (numbering according to Figure 1)										
		[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**	**[8]**	**[9]**	**[10]**	**[11]**
SK	**p=**	0.000	0.18	0.197	0.004	0.000	0.000	0.262	0.012	0.000	0.000	0.005
	r=	0.90	-0.44	-0.42	-0.79	-0.87	0.91	-0.37	-0.72	-0.95	-0.97	-0.78
	β_0=	-6.18	14.36	27.24	44.61	47.80	65.70	20.38	29.05	77.63	60.16	27.65
	β_1=	0.00078	-0.00037	-0.00079	-0.00020	-0.00090	0.00054	-0.00058	-0.00045	-0.00314	0.00223	-0.00064
CZ	**p=**	0.000	0.001	0.000	0.001	0.000	0.000	0.001	0.024	0.000	0.042	0.000
	r=	0.96	-0.84	-0.89	-0.83	-0.95	0.87	-0.86	-0.67	-0.91	-0.62	-0.92
	β_0=	-1.40	30.22	21.38	45.31	50.82	72.37	14.98	35.08	40.44	25.57	30.03
	β_1=	0.00054	-0.00086	-0.00069	-0.00020	-0.00102	0.00026	-0.00043	-0.00054	-0.00109	-0.00045	-0.00055
HU	**p=**	0.000	0.640	0.001	0.77	0.000	0.000	0.057	0.001	0.779	0.319	0.007
	r=	0.95	0.16	-0.85	-0.10	-0.97	0.88	-0.59	-0.84	0.10	-0.33	0.76
	β_0=	1.15	18.14	31.57	39.89	73.29	69.21	48.06	37.45	10.76	17.23	1.80
	β_1=	0.00035	0.00035	-0.00130	-0.00001	-0.00217	0.00035	-0.00149	-0.00118	0.00009	-0.00031	0.00063
PL	**p=**	0.000	0.015	0.051	0.035	0.000	0.000	0.052	0.792	0.034	0.000	0.073
	r=	0.98	-0.70	-0.60	-0.64	-0.99	0.92	-0.60	-0.09	0.64	-0.88	-0.56
	β_0=	-2.87	34.68	17.76	41.42	48.32	71.35	24.70	8.60	5.07	28.54	16.71
	β_1=	0.00068	-0.00122	-0.00056	-0.00004	-0.00087	0.00032	-0.00067	-0.00007	0.00036	-0.00079	-0.00013

Note: Highlighted cells indicate statistical dependence between variables; significance p-level < 0.05.

Negative statistical dependence was demonstrated in the following cases (however, it means positive human well-being oriented feature): the Inactive population [5]; Average number of usual weekly hours of work in the main job by employed persons [4] (except Hungary); Gender pay gap [8]; Gender employment gap [11] (except for Poland); the indicator of Income situation concerning the risk of poverty [9]; the indicator of noise from neighbours or the street [10] (except for Hungary); the Unemployment rates indicator [3], where the value of the given indicator decreases on average by 0.69% (CZ) or 1.30% (HU) when the country's GDP improves by one thousand PPS units. With the improvement of GDP, the indicator of Total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor [2] will decrease on average by 0.86% (CZ) and 1.22% (PL). Statistical dependence for the Arrears indicator [7] was confirmed only in CZ.

Summarizing the results in Table 8, we can state that again, only the Czech Republic (followed by Slovakia) shows a significant statistical dependence of all analysed QL indicators and the level of GDP. Although, we have to say that in some cases, Poland and Hungary achieve the threshold level.

5. DISCUSSION

The research brings a more comprehensive view of the competitiveness issue. In the literature, this issue is mostly oriented to the relation between competitiveness and economic growth (Schwab, 2019; Schwab & Brende, 2012; Rusu & Roman, 2018; Kordalska & Olczyk, 2016; Korez-Vide & Tominc, 2016; Petrylè, 2016). Our research findings indicate a new sustainable competitiveness mechanism from improved competitiveness through the higher economic performance (measured by the GDP indicator) reinforcing R&D expenditure and high-tech employment to better sustainability and well-being. Based on provided research, we can point at the sustained economic growth accompanied by higher ecology (the environmental aspects of sustainable development: Is the importance of climate change deniable?) including life quality

of people (the social aspects of sustainable development: Are better competitiveness and higher economic growth only for companies and their owners, and capital? Or should it also bring social benefits to people in general?). These are broader relationships that cover a new sustainable competitiveness mechanism that was explored by our proposed research framework and even initial empirical evidence.

The assumption (H1) that a better position of a country in the GCI brings the given country a higher economic performance measured in GDP per capita in PPS was verified through several analyses. ANOVA analysis of examined data in the V4 countries confirmed the assumption that the GCI score, from a certain level, has a positive effect on the GDP of these countries. This statement is consistent with the results of several previous studies (Schwab, 2019; Alekseyeva, 2016; Schwab & Brende, 2012). In addition, the analysis of the V4 countries data separately by Multi Regression analysis brought the knowledge that both the time factor and the GCI score are statistically significant for the GDP growth in all V4 countries except Slovakia. The GDP of a given country also grows over time but independently from the GCI score.

There can be several reasons for declining competitiveness. Nevertheless, Slovakia has a sustained increasing trend of GDP. This trend is comparable to other V4 countries. One of the key reasons (mostly political) could be the fact that Slovakia, after the transformation (since 1989), has significantly increased the level of FDI (Foreign Direct Investment). However, FDI was carried out mainly after 2000, and thus Slovakia had a multi-year time-shifting compared to other V4 countries. We can say that the positive effect of these previous FDIs is still running. Furthermore, Slovakia is an export and open- economy-oriented country with the highest share of industrial production in total economic output in the EU. This strategic position of the automotive industry in Slovakia, combined with the time-shifting of a significant inflow of FDI into the sector, may be crucial why Slovakia has benefited from this despite the declining GCI score and has maintained GDP growth compared to other V4 countries.

Based on the results of our research and the above-mentioned facts, it follows that the trend of GDP in the analysed period shows a growing trend which is similar in all V4 countries. The situation is different in the case of the development of the GCI score. In addition, only one country of V4 (PL) shows the most stable development in the GCI rankings (see Figure 4). The Czech Republic (Figure 3) and Hungary (Figure 5) also show moderate fluctuations of GCI as the Slovak Republic in analysed years. We can look for reasons for this relatively strong volatility of the GCI score, which is quite difficult to establish. Furthermore, it is important to determine the extent to which the GCI is affected by the GDP of the V4 countries in the period 2007-2019. Due to this reason, we do not agree with the second part of Petrylè's statement because our results provide sufficient evidence that a better position in the GCI brings a higher GDP.

In terms of the relationship between GDP and SDI, we can state that the dependence between these variables was confirmed. The results show that the higher economic performance of countries (measured by GDP per capita in PPS) has an impact on improving the level of most selected sustainable development indicators (up to 87% of the analysed indicators). We consider this situation desirable, and we can partially confirm the research hypothesis H2, especially in the case of the Czech Republic and Slovakia. Our results are surprising and fully contradictory to the recent studies of Nasir et al. (2019) and Shahbaz et al. (2020). These research studies show

that economic growth, financial development and FDI lead to an increase in environmental degradation in the case of ASEAN-5 countries and the UK. Moreover, our results are in conflict with the study of Bolcárová & Kološta (2015), who state that economic growth is not accompanied by tendencies to sustainable development. Those discrepancies could be explained by our other research findings, which are presented below.

Regarding the importance of this field for the V4 countries, we can give some examples: the increasing % of Employment in high-technology sectors (Table 7), Gross domestic expenditure on R&D, R&D by personnel, or even Human resources in science and technology. Each of the above-mentioned indicators has a great potential for the future in the context of environmental performance and also for the whole SDI perspective analysed in the present study. Moreover, (see Table 7) those indicators also seem to serve as fundamental driving forces for the improvement of other mostly environmental indicators such as Average CO2 emissions per km, Share of renewable energy, Greenhouse gas emissions (in CO2 or tonnes), which is already following the recent research results achieved in the UK by Shahbaz et al. (2020) pointing at the R&D expenditures as the key moderating tools to meet the emissions target. In addition, our results are full of future expectations and multiplied with the results of several recent studies (Dima et al., 2018; García-Sánchez et al., 2018; Farinha et al., 2018). These studies highlighted innovation and R&D as significant factors which can increase the competitiveness of the economy on the one hand and simultaneously promote environmental performance.

Similarly, in the case of life quality indicators, economic performance had a positive effect on living standards in most of the analysed indicators. In 73% of cases, hypothesis H3 was confirmed. However, in the case of the V4 countries, we can partially agree with the authors Despotovic et al. (2019), who state that post-transition European countries with lower sustainable competitiveness have the potential to improve in all areas. The question remains how the above-mentioned values, in which the research hypothesis H3 was confirmed, develop if we include additional indicators in the SDI and QL perspectives in future research.

Furthermore, the achieved results have to be perceived in the context of the Kuznets curve (original Kuznets curve, environmental Kuznets curve). In this context, it is possible that the study period (2007 - 2019) of the V4 countries passed the turning point and is already affected positively by the Kuznets curves. Additionally, the present results seem to be following Schwab (2017), who in 2018 moved the Czech Republic to the highest category of countries, so-called Stage 3 Innovation-driven economies, while the remaining 3 countries still stayed in Stage 2 Transition economies from Stage 2 to Stage 3 (representing a lower development category).

6. CONCLUSION

Our research results showed that a better GCI score has an impact on higher GDP (hypothesis H1). It was further shown that this higher GDP is also positively reflected in the environmental field (hypothesis H2), including improved wellbeing (hypothesis H3), which is quite surprising compared to other recent research in the world. The following factors seem to be the driving forces of this highly valuable sustainable competitiveness development in the V4 countries: higher Employment in high-technology sectors (high-technology manufacturing and knowledge-

intensive high-technology services), Gross domestic expenditure on R&D (as a percentage of the GDP); the Share of R&D personnel, Tertiary educational attainment (as the share of participation in tertiary education); Human resources in science and technology as a share of the active population.

The limitations of our research are mainly the used data. They are based only on the data from reports of the WEF (GCI data) and Eurostat (GDP, SDI, QL data). In future research, we consider overcoming this limitation by focusing on other sources. For example, we will be able to use the GCI database for empirical data in the field of SDI. It will be possible after several years because these have only been systematically monitored within GCI since 2017. However, the data in the QL perspective remain questionable, as the WEF and its GCI have so far pursued and included this perspective insufficiently and unsystematically. One of the solutions seems to be the possibility of creating a new global index of sustainable competitiveness, which would systematically include the SD and QL perspectives in their methodology. Subsequently, our new unconventional mechanism of sustainable competitiveness can be further tested, for example, using a relatively homogeneous sample of the Baltic countries, or the Balkan countries (including Romania and Bulgaria), or even old EU members, to identify possible differences or confirm the correctness of this proposed model. If our mechanism is confirmed to be correct in future research in the above-mentioned homogeneous groups of countries, then other methodological approaches such as SEM (Structural Equation Modelling) or Hierarchical Cluster Analysis can also be used. Moreover, in the paper, we provide only implicit and indirect evidence in the functioning of our new mechanism concerning R&D. In future research, it is necessary to examine R&D and its moderating role within SEM.

It is also necessary to understand that the corporate sector should participate in this issue. However, the state policymakers play a key role in creating the conditions for future sustainable economic development. A more sophisticated creation of conditions for long-term sustainable economic performance is an essential prerequisite for business development and increasing the sustainable competitiveness of the country. In this context R&D, higher education, and high-tech employment play a crucial role.

Finally, despite a separate examination of these significant variables (components), we can conclude that our research study outlines that a sufficiently realistic new mechanism of sustainable competitiveness seems to exist in the V4 countries. In a figurative sense: "The strategic circle or snail, goes slowly but in the right sustainable competitiveness development direction based on integrated development of economic, environmental and social dimensions including better life quality for people". Based on this, we can conclude this paper with the final suggestion in the form of the main strategic future research chain: "from better competitiveness– through higher economic growth, more R&D expenditures and high-tech employment– to more sustainability even life quality", whereas more future evidence is needed.

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