

# Drivers of Global Competitiveness in the European Union Countries in 2014 and 2017

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**Background and Purpose:** The main purpose of this study is to find the key drivers of Global Competitiveness Index (GCI) in the European Union (EU-28) countries from the aspect of country's global competitiveness: institutions, macroeconomic environment, infrastructure, higher education, market effectiveness, market size, technological readiness, innovation and business sophistication.

**Methodology:** This paper investigates global competitiveness of the EU-28 countries with the use of GCI in the periods 2014-2015 and 2017-2018. The correlation analysis and regression analysis are applied for testing the set two hypotheses.

**Results:** The empirical results confirmed our hypotheses that GCI is particularly significantly positively correlated with innovation and business sophistication, and universities-industry collaboration in researches, and clusters development.

**Conclusion:** The paper contributes to the literature of global competitiveness, by examining the relationship of sub-indexes of competitiveness of the EU-28 countries, pointing out the influence of universities-industries collaboration in researches and cluster development with geographic concentration of companies. The results and findings can be relevant for science, economic and research policy, and managerial practices that enhance innovation and business sophistication for research in collaboration of companies, universities, higher education institutions, and decision makers. The implications of this study can be important for better understanding of drivers of the EU-28 countries global competitiveness.

**Keywords:** *competitiveness, economic activities, global competitiveness index, innovation*

## 1 Introduction

Global competitiveness of countries is a set of institution, policies and factors, which determine level of country productivity (World Economic Forum – WEF, 2009). This means that for global competitive economic system is important quality of institution, which has to be ensured by national instruments, and namely legal infrastructure, laws, regulations, legal titles and stable monetary policy.

Strategic target of the Lisbon strategy for the European Union (EU) was that Europe would become the most competitive, dynamic and on knowledge based economy

in the world, with more and better work places, bigger social cohesion and considering environment (European Commission, 2010, 2).

Europe has to be capable to compete with numerous emerging economies in the global market such as BRIC (Brasil, Russia, India, and China) countries. The importance of competitiveness is significantly increasing, not only for the companies, but for countries and nations. Globalisation usually means absorbing and expansion all over the world. The international trade was expanded by 73% from the year 1999 to the year 2009 (European Commission, 2010). This can be a reason why there is countries

interest to attract inflow of capital that they can accelerate economic development, to raise living standards or to gain and retain growth of gross domestic product (GDP). Different institutions have developed different methods to measure competitiveness.

The purpose of this paper is to analyse Global Competitiveness Index (GCI), to find out its main drivers and to analyse the EU-28 countries from the global competitiveness aspect. Focus is on factors of GCI according to WEF (2014, 2017) for the EU-28 countries: institutions and institutional environment, macroeconomic environment, development of infrastructure, higher education, market effectiveness, market size, technological readiness, innovation and business sophistication. Due to heterogeneity of the EU-28 countries, there are different phases in their developments and factors that influence on global competitiveness achievement. For this reason, we include GDP per capita to find out the key drivers of global competitiveness. The main idea is to check correlation between GCI and level of economic development measured by GDP per capita, and other selected elements, which construct GCI. These evidences can be important for government competitiveness policy.

Therefore, this paper aims to analyse relationship between indicators of sub-index and GCI, e.g. business sophistication and innovation, and influence of collaboration between companies and universities-industries in researches, and clusters development with geographical concentration of companies in the EU-28 countries. We aim to answer on the following three research questions:

- Is there a significant correlation between three pillar groups of sub-index variables and GCI?
- What is the relationship between three pillar groups of sub-index variables of GCI and competitiveness?
- What is the influence of collaboration between universities-industries in researches and clusters development on competitiveness in the EU-28 countries?

The rest of the paper is organized as follows: in the next section are presented theoretical basis and review of the literature. The following sections present description of variables included in the empirical analysis and the empirical results of the statistical analysis of indicators with the discussion of the results. Final section concludes and derives main findings with policy and practical implications.

## 2 Literature review and hypotheses development

Smith (1776) studied competitiveness and developed theory of absolute comparative advantages based at low cost production. Ricardo (1962) developed concept of relative comparative advantages in international trade or com-

parative advantages that come from differences in labour productivity. New competitiveness theories, neoclassical theories and new factor endowments theories were developed. Modern theory Heckscher-Ohlin-Samuelson and competitive advantage of country is definite with endowments of production factors, instead of production costs (Sheppard, 2011). Among new theories is new economic geography (Krugman, 1998).

Krugman (1994) on one side contradicts national competitiveness as “dangerous obsession” out of a reason, that causes unsuitable arrangement of sources and leads to protectionism or trade war. On the other side, connecting economy on world scale potentially strengthens agglomeration of economy and specialization (Krugman, 1998).

Satsysk (2015) shows that modern university can be globally competitive in the case when it is provided with opportunities for engaging its talented researchers, teachers and students with sufficient quantity and quality of material/financial resources, infrastructural base and with effective governing/management model. In terms of limited resources, institutional and financial government support are aiming at modernization of university.

In the literature we can encounter different definitions of territorial, national and regional competitiveness. Based on OECD (Garelli, 2002), competitiveness of nations is a stage, in which country can in circumstances of free and open market produce goods and services, which fulfil international standards on market, preserve and at the same time expand income of their own population for a long term. Reaching competitiveness is important at country level.

Porter (1998) argued that competitive advantages, geographical integration of industry or industrial clusters are vitally important. Porter (1990) emphasized indirect effects that can play geographical agglomeration of clusters in particular field for strengthening of competitive advantages. Clusters and geographical concentration among interactive companies, specialized suppliers, service providers and with them related industries and institutions can play important role on an individual area, which can compete, but can also cooperate (Porter, 2000).

Innovation can be one of the most important determinants of competitiveness (Kovačič, 2007; Shamout, 2019). Smaller countries can through clusters and updated strategies achieve that their relatively smaller country size becomes advantage (Pitelis, 2008). In this regards dynamic industrial policy of cluster developments is important in the EU-28 countries.

Reduction of unemployment can be linked to fostering small and medium enterprises development, changes on labour market, the educational system and the entrepreneurship activities (Gričar et al., 2019; Južnik Rotar et al., 2019). These factors became more important for competitiveness in recent years. Nekrep, Boršič and Strašek (2018) indicated the link between expenditures for research and development (R&D expressed in % GDP) and labour pro-

ductivity based on observed data for the EU member states in the period 1995-2013.

Liberalization of the economy can be important factor for international competitiveness (Fagerberg, 1988), new technologies, and innovations (Fagerberg et al., 2007). The process of trade liberalization can rise possibilities for expanding import and export for similar products, and thus encourage growth inside branch trade (Bojnec & Novak, 2005).

Cross-sectional innovation platform can create a symbiosis between the university, the economy, and local communities that manage innovation activities and technologies to increase competitiveness (Gjelsvik, 2018).

A special attention is to consider quality of institutional environment and particularly the role of rules and legal infrastructure that can effect on a business location, such as elimination of limitations on setting-up firms and shops, factors mobility, and attraction of foreign direct investment (FDI) (Bojnec & Fertó, 2017; 2018). In addition, the percentage of population of a certain age with finished tertiary education can be important for global competitiveness. The number of bachelors from the tertiary education in the EU countries has increased. Tertiary education expansion has had positive effects for incomes and wellbeing of individuals and for growth of economies (Čepar & Bojnec, 2008, 2010; Čepar, 2009, 27). Knowledge-based economies in rapidly changing markets require organisation and strategies to effectively use knowledge and skills (Kareem & Mijbas, 2019). Many countries have increased their national competitiveness such as Israel, the Netherlands, Finland, and Germany, driven by education and skilled labour contributing to high level of productivity and investments in R&D, which further promotes innovative world-class clusters development (Paraušić et al., 2014).

Camagni (2008) argues that institutions, rules and norms create conditions for reduction of market transaction costs. They can provide warranty for contracts and obligations enforcements, and can help to resolve company's problems related to conflicts of interests and monopoly power. They can create favourable business climate that is beneficial for local companies and can improve attractiveness for external companies and investors. Petryle (2016) examined the relationship between the GCI and GDP growth of countries during the period 2006-2015. It was found that there is a weak or no relationship in the EU-27 countries plus Norway, Switzerland, Iceland, the United States, and the Russian Federation.

The WEF methodology is the most known system of a country's competitiveness assessment. The datasets are gathered from survey information comparing development and competitiveness between countries in the following

areas: institutions, infrastructure, macro environment, health care and education, higher education, effectiveness of market, size of market, technological condition, innovation and business sophistication. Since 2005 the WEF analysis of competitiveness are based on the GCI as a tool, which measures microeconomic and macroeconomic foundations of competitiveness of the country (WEF, 2014, 4–5). The GCI is calculated as a cogent average of different components (factors), which measure specific aspects of competitiveness.

The GCI has passed a whole picture of territorial competitiveness by countries. Therefore, the GCI is aggregated umbrella index, which is composed from three sub-indices of competitiveness development phases: (I) basic competitiveness requirements (factor driven), (II) efficiency enhancers (efficiency-driven), and (III) innovations and business sophistication (innovation-driven).

If it is an efficiency-driven country, then GDP, inflation rate, trade, labour productivity, and costs are important determinants of competitiveness, while for innovation-driven country the determinants of competitiveness are GDP, inflation, tax rate, FDI, trade, and cost (Rusu & Roman, 2018).

WEF defines different countries groups that are arranged based on the level of economic development measured by GDP per capita: low, middle, and high income countries. In addition, as an important criterion referred to amount of mineral resources exported in entire export considering development phases in a way of competition and country categories in the phase of transition.

## 2.1 Hypotheses

Following previous literature and in accordance with aims of our study, we set the following two hypotheses (H):

H1: Relationship exists between the level of the EU-28 countries competitiveness and indicators of innovation and business sophistication, but weak correlation exists between the EU-28 countries competitiveness and sub-indices of other two pillar groups (basic conditions and efficiency enhancers).

H2: University-industry collaboration in researches and clusters development with geographical concentration of companies have statistical distinctive influence on national competitiveness in the EU-28 countries.

Empirical studies (Dima et al., 2018) have indicated that the highest correlation is between the GCI and R&D expenditure as a % of GDP (0.8257), a result that indicates a very strong positive relationship between innovation and competitiveness.

1 Some companies have an 'employee first' policy, with a basic premise that contented or happy employees perform better. South West Airlines is a well-known example. In such companies, serious demands are made on employees and strict selection procedures are in place, and teams are responsible for performance. It is far from a free-floating culture.

Parašić et al. (2014) argues that the coefficient of a simple linear correlation indicates that there is a strong positive correlation in the sample between state cluster development in a country and its national competitiveness.

While studies indicated some similarities and differences in results, in general there is expected positive impacts of the analysed variables on global competitiveness, including for the EU-28 countries.

### 3 Data and Methodology

The collected publicly available secondary data are used in the empirical analyses. The source of data is WEF (2014, 2017) and data from Eurostat (2014 and 2017) for GDP per capita for the EU-28 countries. Due to the differences in the level of economic development between the EU-28 countries GDP per capita is included to check correlation between GCI and the level of economic development measured by GDP per capita, and other selected elements, as an additional control indicator in the analysis. For global country's competitiveness evaluation, the GCI is used. The GCI is constructed from indicators, which are evaluated based on scale from 1 to 7. We used 40 variables. The applied methodology was empirical the analysis of indica-

tors: institutions, macroeconomic environment, development of infrastructure, higher education, market effectiveness, market size, technological readiness, innovation, and business sophistication. We used correlation and regression analyses to test the hypotheses. The Pearson's correlation coefficient is applied to investigate the relationship between GCI and indicators of country's global competitiveness. Furthermore, the regression analysis is applied for validation of tested models and their assessed fittings. The IBM SPSS software was used for the data analyses.

## 4 Drivers of global competitiveness

### 4.1 Basic requirements and global competitiveness

Indicators of basic requirements are referred to quality of institutions or institutional management, macroeconomic environment, infrastructure, health care, and basic education (WEF, 2014). In addition to basic competitiveness requirements, there are included the following drivers of global competitiveness (Table 1):

Table 1 presents the analysed basic requirement variables and their expected a positive or a negative sign of correlation coefficient with GCI.

Table 1: Expected sign of correlation between GCI and basic requirements

Variables of basic requirements	Sign of correlation
Property rights and intellectual property – owners are not willing to invest their company shares in improvement and maintenance of their assets, if their ownerships on intellectual property rights are not protected, <i>propert, intel. prop.</i>	+
Corruption – means dishonesty at treatment of public orders, lack of visibility and reliability, inability to assure suitable services for business sector and political dependence of judiciary, what causes substantial economic costs to companies and slowdown process of economic development, <i>corruption</i>	+
Government regulation – government attitude to market and freedom is very important, as exaggerated bureaucracy can negatively effect on operation effectiveness, <i>gov. reg.</i>	+
Legal framework in setting disputes, legal and judicial system for company in which individual, companies and governments communicate, because they are important for creating wealth, <i>leg. dis.</i>	+
Quality of roads, ports, airports, <i>qual road, qual port, qualia airport</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

Table 1: Expected sign of correlation between GCI and basic requirements (continued)

Fixed telephone lines and per 100 inhabitants – the number of working landline telephone, <i>telfix</i>	+
Mobile telephone per 100 inhabitants – the number of subscription to a public mobile telephone service, <i>tel. mob.</i>	+
Government debt – is consisted from all obligations, which demand payment or interest payments and is connected to main debtor to creditor relations, <i>gov. debt</i>	+
Budget – government balance, public finance balance as a percentage of net lending (+) / net borrowing (–) and is calculated as public finance salary minus expenses, <i>budget</i>	+
Savings-gross national savings as a percentage of GDP, joint national savings are defined as public and private savings and as a percentage of nominal GDP, <i>savings</i>	+
Inflation – influences changes in living standard through changes in prices, <i>inflation</i>	–
Primary school enrolment – is a stage, which suits child relationship (as it is described in national educational system), who are enrolled to school in population of official schooling age, <i>primarysch</i>	+
Rating creditable of country –as assessing the probability of sovereign debt default, <i>rating</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

## 4.2 Efficiency enhancers and global competitiveness

To test the relationship between global competitiveness and **efficiency enhancers**, Table 2 presents the sub-index efficiency enhancers variables that are based on WEF (2014). It is expected that these variables can be important in correlation with GDP per capita with an influence on GCI. Therefore, we check our assumption with expected theoretically positive signs of correlations.

## 4.3 Innovation and business sophistication and global competitiveness

Innovation and business sophistication give signs of specialization and contribute to a bigger effectiveness in production of goods and services and increases quality of business performance, especially in mutual relationships, for example clusters development with geographical concentration of companies. Innovation means competence for innovations, knowledge and labour force experiences, technological innovations, namely availability of technological products, scientists, and patents.

Important indicators are value chains (companies of trade and production), clusters development and innovations. Clusters development with geographical concentration of companies can be linked with transactions and collaboration between companies, development of com-

munication technologies, social and cultural relationships between research institutions and universities.

Table 3 presents expected signs on correlation between innovation and business sophistication variables and GCI. Focus is on researches, universities-industries collaboration in researches and clusters development, in correlation with GCI. Clusters development stage can positively influence on GCI as well as can geographical concentration of companies increase productivity of domestic competitors and increase rivalry.

## 5 Empirical Analysis and Results

With correlation analysis is investigated the relationships between GCI and their explanatory variables for the EU-28 countries. The GCI and explanatory indicators – basic requirements, efficiency enhancers, and innovation and business sophistication indicators – are taken from the WEF reports (2014-2015 and 2017-2018). The validation of the set two hypotheses is assessed by the applied regression and correlation analyses. The variables are grouped into three sub-index pillars. To evaluate the validation of the model it is used the regression analysis and correlation analysis, which are based on 56 observations, and assessed is the validation of the model for the EU-28 countries.

Table 2: Expected sign of correlation between GCI and variables of efficiency enhancers

Variables of efficiency enhancers	Sign of correlation
Import in % of GDP, <i>import/GDP</i>	+
GDP per capita at standard of purchasing power parity (in PPP), <i>gdpp</i>	+
Secondary education, share of enrolment in higher education ISCED 2, ISCED 3, <i>second.educ</i>	+
Tertiary education, enrolment in %, share of enrolment in tertiary education level ISCED 5, 6, <i>tert.educ (in %)</i>	+
Quality of educational system, <i>qual. educ</i>	+
Intensity of local competition, <i>loc. compet.</i>	+
Availability of technology – in what scope they are technologies available in country, <i>tech.avail</i>	+
Absorption of technologies, in what range company accepts new technologies, <i>absorb. tech</i>	+
Direct investments and technological transfers, in what extent FDI brings new technologies, <i>nti-transf</i>	+
Internet users, (in %), <i>internet</i>	+
Gross domestic product GDP (in PPP), valued in standards of PPP in billions of dollars, <i>GDP</i>	+
Domestic market, index of size of local market, aggregate value of GDP in value of import of goods and services minus value of export of goods and services, <i>dom. market</i>	+
Foreign market, index of size of foreign market is valued as aggregate value of export of goods, <i>foreign. market</i>	+
Export in % of GDP, <i>export/GDP</i>	+
Import in % of GDP, <i>import/GDP</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

Table 3: Expected sign of correlation between GCI and variables of innovation and business sophistication

Variables of innovation and business sophistication	Sign of correlation
GDP per capita at standard of PPP, <i>gdpp</i>	+
State of clusters development – geographical concentration of companies, suppliers, producers, <i>cluster develop</i>	+
Value chains breadth – companies trade and production, <i>chain</i>	+
Innovation capacity, to what extent do companies have the capacity to innovate - <i>capac. of inov.</i>	+
Quality of research institutions assesses the prevalence and standing of private and public research institutions, <i>qual. of research</i>	+
Expenses for research in companies, to what extent do companies invest in research and development, expenditure on research and development (R&D) as a percentage of GDP, <i>expenses for research</i>	+
Universities-industry collaboration in researches, to what extent do business and universities collaborate on research and development (R&D), <i>univind</i>	+
Government procurement of technological products, to what extent do government purchasing decisions foster innovation, <i>gov.proc.</i>	+
Availability of scientists, <i>scientists</i>	+
Number of registered patents, <i>patent</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

### 5.1 Correlation analysis between GCI and basic requirement variables

Table 4 presents correlation coefficients between two pair of variables. Our focus is on the correlation coefficients with the GCI. Correlation coefficient points on the relationship between pair of individual variables. Higher correlation coefficient means stronger relationship, which can be positive or negative.

Among higher positive correlation between chosen variables, these are: intellectual property, clean of corruption, governmental regulation, legal framework in disputes, resolving disagreements, and infrastructure quality.

Table 4 presents the Pearson correlation coefficients for 17 considered basic requirements variables and their pairs of correlation with GCI. The highest correlation coefficients are with the following variables with the GCI: intellectual property (0.88), property rights (0.90), corruption (0.86), legal framework in disputes (0.83), quality of roads (0.73), rating (0.84), and primary education (0.76). GDP per capita also shows high correlation with GCI (0.67) as well as government regulation (0.63).

It is interesting to note that 9 variables are most appropriate drivers of GCI, because correlation coefficient is over 0.4. Finally, the correlations between the GCI and some variables are very low: quality of ports and quality of air, mobile and fixed telephone lines, budget, savings, inflation, and government debt.

### 5.2 Correlation analysis between GCI and efficiency enhancers variables

Table 5 presents correlation coefficients between selected efficiency enhancers variables and GCI. The highest correlation coefficients for GCI are with the following variables: technological absorption (0.94), availability or accessibility of technology (0.93), quality of educational system (0.84), local competitiveness (0.80), and secondary

education (0.76). It is interesting to note that GDP per capita also shows high correlation with GCI (0.67) as well as domestic markets (0.62), and foreign markets (0.77).

In all other cases the correlation coefficients between GCI and investigated variables are less than 0.5 or very low. For example, indicators of tertiary education do not affect significantly on GCI (0.43). It is surprisingly that variable enrolment into tertiary education has correlation coefficient with GDP per capita only 0.07, and internet users they also show on very low correlation with GCI (0.12). There is a negative correlation coefficient between tertiary education and variables of import/GDP. There exists also very low correlation between GCI and variables of export/GDP and internet users (0.12).

A correlation coefficient is lower between GCI and the share of import/GDP (0.19), and between GDP per capita and the share of export/GDP (0.21).

### 5.3 Correlation analysis between GCI and innovation and business sophistication variables

Table 6 presents correlation coefficients between GCI and selected innovation and business sophistication variables. There is a strong correlation of GCI with all included variables, namely with GDP per capita (0.64), with clusters development (0.82), with chains (0.85), with capacity of innovations (0.91), with research expenses (0.94), with collaboration of companies and universities-industries collaboration in researches (0.89), and with patent of suppliers (0.86). However, the correlation coefficient is lower with availability of scientists (0.48). In addition, there is a strong correlation between variables of chains and development of clusters (0.89). If the cluster development is evolving and local suppliers are collaborating, then proportionately the role chains is increasing.

To sum up, innovation and business sophistication variables are strongly correlated with GCI than with variables of the other two sub-indexes.

Table 4: Correlation matrix between Global Competitiveness Index (GCI) and basic requirement variables for the EU-28 countries, data for 2014 and 2017

Pearson Correlation Coefficients																		
	Global index competitiveness, GCI	GDP per capita, <i>gdpp</i>	property rights, <i>prop-ertyr</i>	intellectual property, <i>intell. prop</i>	corruption	government regulation, <i>gov.reg</i>	legal framework	quality of road, <i>qualr</i>	quality of port, <i>qualp</i>	quality of airport, <i>qualair</i>	mobile telephone, <i>elmob</i>	fixed telephone, <i>telfix</i>	budget	saving	inflation	government debt, <i>gov.debt</i>	rating creditable, rating	primary school, <i>primarsch</i>
Global index competitiveness, <i>GCI</i>	1.000	.609*	.907*	.888*	.893*	.632*	.830*	.732*	.252	.300	.220	.307	.134	.436	.230	.083	.841*	.831*
GDP per capita, <i>gdpp</i>	.609*	1.000	.726*	.736*	.704*	.403	.674*	.562*	.064	.101	.162	.441	.169	.212	.053	-.006	.622*	.323
property rights, <i>prop-ertyr</i>	.907*	.726*	1.000	.969*	.944*	.719	.922	.720*	.326	.371	.304	.159	.466	.306	.285	.054	.829*	.627*
intellectual property, <i>intell. prop</i>	.888*	.736*	.969*	1.000	.927*	.674*	.614*	.927*	.307	.352	.064	.197	.450	.323	.285	.124	.806*	.617
corruption	.893*	.704*	.944*	.927*	1.000	.614	.871	.740*	.169	.213	.233	.295	.093	.148	.093	.619	.765*	.646*
government regulation, <i>gov.reg</i>	.632*	.403	.719*	.674*	.614*	1.000	.752	.415	.796*	.817	-.386	-.126	.197	.785	-.068	.619	.813	.388
legal framework	.830*	.674*	.922	.883*	.871*	.752	1.000	.643*	.339	.378	.203	.293	.254	.464	.134	.813	.548*	.458
quality of road, <i>qualr</i>	.732*	.562*	.720*	.730	.740*	.415	1.000	1.000	.174	.215	.480	.480	.154	.239	.370	.813	.622*	.622*
quality of port, <i>qualp</i>	.252	.064	.326	.307	.169	.796*	.339	1.000	1.000	.998*	.480	.480	.154	.239	.360	.813	.622*	.622*
quality of airport, <i>qualair</i>	.300	.101	.371	.352	.213	.817	.378	.215	1.000	1.000	.998*	.998*	.998	.994	.394	.813	.622*	.622*
mobile telephone, <i>elmob</i>	.220	.162	.304	.088	.304	-.386	.104	.088	.213	.215	-.386	-.337	-.747	.064	.093	.813	.622*	.622*
fixed telephone, <i>telfix</i>	.307	.441	.304	.339	.203	-.126	.284	.441	-.337	-.306	1.000	1.000	-.183	-.260	.110	.813	.622*	.622*
budget	.134	.169	.159	.054	.134	.197	.254	.169	.293	.294	1.000	1.000	1.000	.284	.254	.813	.622*	.622*
saving	.436	.212	.466	.306	.323	.450	.464	.436	.944	.949*	-.625	-.260	.341	1.000	.940	.813	.622*	.622*
inflation	.230	.053	.306	.285	.148	.785	.325	.230	.998	.994*	-.750	-.351	.284	1.000	.058	.813	.622*	.622*
government debt, <i>gov.debt</i>	.083	-.006	.054	.124	.013	-.068	-.129	.054	.075	.093	-.120	.410	-.306	-.052	1.000	.813	.622*	.622*
rating creditable, rating	.841*	.622*	.829*	.806*	.765*	.619	.548*	.360	.360	.394	.067	.110	.254	.547	.352	.813	.622*	.622*
primary school, <i>primarsch</i>	.831*	.323	.627*	.617	.646*	.388	.458	.622*	.115	.158	.362	.324	-.096	.248	.090	.813	.622*	.622*

\*\*Statistically significant at 5% significance level. Source: Authors' calculations



Table 5: Correlation matrix between Global Competitiveness Index (GCI) and efficiency enhancers variables for the EU-28 countries, data for 2014 and 2017

	Global index competitiveness GCI	GDP per capita <i>gdpp</i>	Secondary education <i>second. edu</i>	Tertiary education <i>tert. educ</i>	quality of education <i>qual. educ</i>	import/GDP	Local compet, <i>loc comp.</i>	Availability of technology, <i>tech. avail.</i>	Absorption of technologies, <i>absorb. tech.</i>	Direct investments-technology <i>nti-transf</i>	Internet users <i>internet</i>	domestic market	foreign market	export/GDP
Global index competitiveness, <i>GCI</i>	1.000	.673*	.764	.431	.842*	.199	.803*	.931*	.940*	.799*	.121	.627*	.777*	.214
GDP per capita, <i>gdpp</i>	.673*	1.000	.460	.075	.662*	.340	.430	.635*	.650*	.558*	.600*	.321	.456	.406
secondary education, <i>second. edu</i>	.764*	.460	1.000	.582	.646*	.140	.583*	.749*	.708*	.659*	-.022	.495	.617*	.154
tertiary education, <i>tert. educ</i>	.431	.075*	.582*	1.000	.315	-.169	.377	.411	.402	.219	-.392	.390	.406	-.170
quality of education, <i>qual. educ.</i>	.842*	.662*	.646*	.315	1.000	.229	.630*	.828*	.851*	.678*	.098*	.464	.464	.229
import/GDP	.199	.340	.140	-.169	1.000	1.000	.349	.270	.269	.481	.501	-.341	.014	.984*
Local competition, <i>loc comp.</i>	.803*	.430	.583*	.377	.630	.349	1.000	.808	.819*	.776*	.066	.464	.663*	.322
availability of technology, <i>tech. avail.</i>	.931*	.635*	.749*	.411	.828*	.270	.808*	1.000	.967	.802*	.157	.491	.658*	.277
absorption of technologies, <i>absorb. tech.</i>	.940*	.650*	.708*	.402	.851	.269	.819*	.967	1.000	.821*	.151	.466	.638*	.275
direct investments- technology, <i>nti-transf</i>	.799*	.558*	.659*	.219	.678*	.481	.776*	.802*	.821*	1.000	.214	.407	.645*	.489
Internet users, <i>internet</i>	.121	.600*	-.022	-.392	.098*	.501	.066	.157	.151	.214	1.000	-.192	-.053	.538
Domestic market, <i>dom. market</i>	.627*	.321	.495	.390	.330	-.341	.464	.491	.466	.407	-.192	1.000	.924*	-.295
Foreign market, <i>foreign. market</i>	.777*	.456	.617*	.406	.464	.014	.663*	.658*	.638*	.645*	-.053	.924	1.000	.063
export/GDP	.214	.406	.154	-.170	.229	.984*	.322	.277	.275	.489	.538*	-.295	.063	1.000

\*\*Statistically significant at 5% significance level. Source: Authors' calculations

Table 6: Correlation matrix between GCI and innovation and business sophistication variables for the EU-28 countries, data for 2014 and 2017

	Pearson correlation coefficients										
	Global index competitiveness GCI	GDP per capita <i>gdpp</i>	state of clusters development, <i>cluster develop.</i>	value chains breadth <i>chain</i>	Innovation capacity innovation <i>capac. inov.</i>	quality of research institutions <i>qual. research</i>	expenses for research in companies, <i>expens. research</i>	universities-industry collaboration in researches <i>univind</i>	govern. procurement technology, <i>gov proc.</i>	availability of scientists <i>scients</i>	number registered patents, <i>patent</i>
Global index competitiveness, GCI	1.000	.641*	.828*	.857*	.918*	.872*	.943*	.890*	.742*	.489	.867*
GDP per capita, <i>gdpp</i>	.641*	1.000	.659*	.640*	.665*	.517*	.674*	.602*	.620*	.306	.561*
state of clusters development <i>cluster develop</i>	.828*	.659*	1.000	.896*	.828*	.770*	.828*	.801*	.667*	.540*	.717*
value chains breadth, <i>chain</i>	.857*	.640*	.896*	1.000	.855*	.765*	1.000	.764*	.566*	.584*	.788*
innovation capacity, <i>capac. inov</i>	.918*	.665*	.828*	.855*	1.000	.825*	1.000	.813*	.445	.593*	.791*
quality of research institutions <i>qual. research</i>	.872*	.517*	.770*	.765*	.825*	1.000	.854*	.901*	.518*	.593*	.724*
expenses for research in companies, <i>expens. research</i>	.943*	.674*	.828*	.874*	.950*	.854*	1.000	.855*	.496	.676*	.867*
universities-industry collaboration in researches <i>univind</i>	.890*	.602*	.801*	.764*	.813*	.901*	.855*	1.000	.559*	.746*	.777*
government procurement technology, <i>gov proc.</i>	.742*	.620*	.667*	.584*	.663*	.593*	.676*	.746*	1.000	.362	.614*
availability of scientists, <i>scients</i>	.489	.306	.540*	.566*	.445	.518*	.496	.559*	.362	1.000	.557*
number of registered patents, <i>patent</i>	.867*	.561*	.717*	.788*	.791*	.724*	.867*	.777*	.614*	.557*	1.000

\*\*Statistically significant at 5% significance level. Source: Authors' calculations

### 5.4 Regression Analysis

The aim of the linear regression analysis is to determine the association between the GCI and two explanatory variables for cluster development with geographical concentration of companies, and universities-industries collaboration. Regression analysis is limited to only two variables and we want to test the hypotheses. We used partial regression analysis when we selected only one explanatory variable. Thus future studies could be focused on multiple explanatory variables of GCI in regression analysis. Data for the analysed variables are obtained from WEF (2014) and WEF (2017).

The variables are grouped into two pillars (11th and 12th) innovation and business sophistication. Explanatory variables were selected individually because universities define the competitiveness of technological innovation, while the clusters development with geographical concentration defines the competitiveness of non-technological innovation.

The regression analysis is based on 56 observations, which correspond to EU-28 country observations for the

two analysed years 2014 and 2017.

Table 7 presents the GCI association with companies and universities-industries collaboration in researches. Determination coefficient  $R^2 = 0.793$  shows that 79% of GCI variability is explained with companies and universities-industry collaboration in researches variable.

Coefficient of correlation ( $R = 0.891$ ) suggests on a strong linear relationship between companies and universities-industry collaboration in researches and GCI.

Table 8 presents the analysis of variance (ANOVA). At a significance level less than 1% ( $p = 0.000$ ), the explanatory variable universities-industry collaboration in researches is statistically significant.

F-test shows that there is a linear dependence between variables ( $F = 203.222$ ), and variable is statistically highly significant. If the p-value is less than the critical significance level ( $p < 0.005$ ), then sample data provides sufficient evidence to conclude that the regression model fits the data.

Furthermore, Table 9 presents regression coefficients with t-test and p-value, and statistic characteristics of the regression model.

Table 7: Model Summary

Model Summary <sup>b</sup>									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.891 <sup>a</sup>	0.793	0.789	0.22681	0.793	203.222	1	53	0.000
a. Predictors: (Constant). Universeind									
b. Dependent Variable: GCI									

Table 8: ANOVA

ANOVA <sup>a</sup>						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	10.455	1	10.455	203.222	0.000 <sup>b</sup>
	Residual	2.727	53	0.051		
	Total	13.181	54			
a. Dependent Variable: GCI						
b. Predictors: (Constant). Universeind						

Table 9: Regression Coefficients

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.679	0.151		17.735	0.000
	Universeind	0.495	0.035	0.891	14.256	0.000

a. Dependent Variable: GCI

The regression line value is  $GCI=2.679+0.495 \text{ universeind}$ . If companies and universities-industry collaboration in researches increases for 1 scale, then GCI increases by 0.495 scale, ceteris paribus. Table 10 shows to what extent GCI is associated with clusters development with geographical concentration of companies. Coefficient of correlation ( $R=0.831$ ) shows a linear relationship between clusters development and GCI. Coefficient of determination ( $R^2=0.69$ ) shows that regression model fits the data: 69% of variability in GCI is explained with clusters development with geographical concentration of companies. Higher cluster development values are associated with higher GCI.

ANOVA with F-test shows that clusters development with geographical concentration of companies is statistically significant at 1% level ( $p<0.001$ ) (Table 11).

The research hypothesis about the existence of strong positive correlation between GCI and clusters development with geographical concentration of companies can be accepted. This is further confirmed by statistically significant regression coefficient (Table 12).

Regression line value is:  $GCI= 2.534+0.533\text{cluster}$ . The regression equation shows that the regression coefficient that is pertained to cluster development variable is 0.533. If clusters development with geographical concentration of companies increases by 1 scale, then GCI increases by 0.533 scale of GCI, ceteris paribus.

Table 10: Model Summary

Model Summary <sup>b</sup>									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.831 <sup>a</sup>	0.690	0.684	0.27766	0.690	117.971	1	53	0.000

a. Predictors: (Constant). Cluster  
b. Dependent Variable: GCI

Table 11: ANOVA

ANOVA <sup>a</sup>						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	9.095	1	9.095	117.971	0.000 <sup>b</sup>
	Residual	4.086	53	0.077		
	Total	13.181	54			

a. Dependent Variable: GCI  
b. Predictors: (Constant). Cluster

Table 12: Regression Coefficients

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.534	0.211		12.018	0.000
	Cluster	0.533	0.049	0.831	10.861	0.000

a. Dependent Variable: GCI

## 6 Discussion

The correlation coefficients between three sub-indexes variables – basic requirements, efficiency enhancers, and innovation and business sophistication – and GCI for the EU-28 countries indicated a positive correlation. The stronger positive correlation of GCI is with innovation and business sophistication sub-index than other two sub-indexes. Some variables of the sub-index basic requirements have a weak correlation such as quality of port and quality of air, mobile and fixed telephone lines, budget, savings, inflation, and government debt. In addition, a lower correlation between GCI and sub-index of efficiency enhancers is for export/GDP, import/GDP, and internet users. While there are differences in the results, all three groups of sub-indexes variables are in a significantly positive correlation with GCI. This implies that improvements in basic requirements, efficiency enhancers, and innovation and business sophistication are crucial to increase GCI.

The validity of the H1 cannot be rejected on the importance of the innovation and business sophistication sub-index for GCI. In addition, the regression analysis confirmed the H2 on the importance of universities-industries collaboration in researches and cluster development for GCI (p-value is less than the critical significance level,  $p < 0.005$ ).

To increase global competitiveness, a greater focus should be given to the importance of innovation and business sophistication at different levels. In addition, global competitiveness can be improved through universities-industries collaboration in researches, which supported the networking approaches in ongoing funding of research in some of the EU-28 countries to contribute to rise of global competitiveness.

The relevance of our study is that rises awareness for policy and decision makers on the importance of drivers of global competitiveness and possible ways for improving the EU-28 country's global competitiveness. It can be relevant for science, policy formation and managerial practices, that enhance innovation and business sophistication in relation to research and collaboration of companies and

universities-industry, research institution management, and policy of higher education that create knowledge and training.

The scientific contribution of the study is that developed relationships between three pillar groups of sub-indexes variables of GCI and competitiveness. The paper contributes to the literature of global competitiveness, by examining the role sub-indexes of competitiveness for global competitiveness of the EU-28 countries, pointing out the influence of universities-industry collaboration in research and cluster development with geographic concentration of companies. Our results are consistent with Rusu and Roman (2018) on the relationships between the sub-indexes of competitiveness and GCI. Paraušić et al. (2014) found that cluster development and innovation and business sophistication can have a significant influence on national competitiveness in emerging markets and developing countries.

Therefore, cluster developments and universities-industries collaboration in researches can have important role in the improving global competitiveness for the EU-28 countries, but it can also require well targeted investments in uncertain global environment.

## 7 Conclusion

The paper contributes to analyses of drivers of global competitiveness. Different drivers can explain global competitiveness in the EU-28 countries. To investigate this research question, we have applied the correlation and regression analyses in the years 2014 and 2017. There exists strong correlation especially between the GCI and expenses for research, innovation capacity, universities-industries collaboration in researches, and patents. All these is related to investments, organization and management of R&D, and innovation and business sophistication activities. The relationships between GCI and variables in the sub-index of innovation and business sophistication are stronger than in other two groups of sub-indexes for basic requirements and efficiency enhancers. In the third group of indicators for innovation and business sophistication, there is a strong

correlation of the GCI with cluster development, capacity of innovations, chain value, with quality of research institution, with research expenses, with universities-industries collaboration in researches, government procurement, and with patent of suppliers. It is interesting, that very low correlation is found only with availability of scientists and engineers.

The regression analysis confirmed H1: Relationship exists between the level of the EU-28 countries competitiveness and indicators of innovation and business sophistication, but weak relationship exists between the EU-28 countries competitiveness and sub-indexes of other two pillars groups (basic requirements and efficiency enhancers). Therefore, H1 cannot be rejected, because the existence of strong relationship between the level of GCI in the EU-28 countries and the third group of indicators of sub-index, i.e., innovation and business sophistication. Improvements in innovation and business sophistication can lead to increases in GCI.

The statistical analysis showed that clusters development with geographic concentration of companies and universities-industry collaboration in researches have strong positive influence on the GCI. The regression analysis confirmed H2: University-industry collaboration in researches and clusters development with geographical concentration of companies are statistically significant drivers of the GCI in the EU-28 countries.

Therefore, global competitiveness of the EU-28 countries can be improved by widespread clusters development with geographical concentration of companies and other drivers of innovation and business sophistication on the international market, as well as with improved universities-industry collaboration in researches. This can have policy implications for science and universities, innovation and business sophistication, and managerial practices for doing business in companies.

Our study has more limitations. The analysis is limited to two WEF data calculations/reports in 2014 (2014-2015) and in 2017 (2017-2018) with comparable indicators. Among study limitations, the study investigated only two variables in the regression analysis. Therefore, an issue for further research is to expand analysis with investigation of dynamics in longer time-frame in the multivariate analysis. The correlation and regression analyses are limited to the sub-indexes of GCI. In addition, the regression analysis is limited to partial analysis of two explanatory variables, the companies and universities-industry collaboration in researches, and clusters development with geographic concentration of companies for the two analysed years. In the future research, first, the panel data analysis for more years can be applied. Second, the model specification can be extended on variables of higher education. Finally, it could be applied cluster analysis for three groups of the EU-28 countries according to the stage of WEF development. As the EU-28 countries are at different stages of WEF development, individual factors can have different

meanings for the competitiveness of individual countries. Therefore, an issue for research in future is to introduce the heterogeneity of the EU-28 countries.

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### Dejavniki globalne konkurenčnosti v državah Evropske unije v letih 2014 in 2017

**Ozadje in namen:** Glavni namen raziskave je ugotoviti ključne dejavnike globalnega indeksa konkurenčnosti (GCI) v državah Evropske unije (EU-28) z vidika globalne konkurenčnosti države: institucije, makroekonomsko okolje, infrastruktura, visoko šolstvo, učinkovitost trga, velikost trga, tehnološka pripravljenost, inovacije in poslovna prefinjenost.

**Metodologija:** Članek raziskuje globalno konkurenčnost držav EU-28 z uporabo GCI v obdobjih 2014–2015 in 2017–2018. Korelacijska analiza in regresijska analiza se uporabljata za testiranje postavljenih dveh hipotez.

**Rezultati:** Empirični rezultati so potrdili postavljeni hipotezi, da je GCI zelo pomembno pozitivno povezan z inovacijami in poslovno sofisticiranostjo, sodelovanjem med univerzami in industrijo v raziskavah in z razvojem grozdov.

**Zaključek:** Raziskava prispeva k literaturi o svetovni konkurenčnosti s preučevanjem razmerja podindeksov konkurenčnosti držav EU-28. Poudarja na vpliv sodelovanja univerz in industrije pri raziskavah in razvoju grozdov z geografsko koncentracijo podjetij. Rezultati in ugotovitve so lahko pomembni za znanost, ekonomsko in raziskovalno politiko ter vodstvene prakse, ki povečujejo inovativnost in poslovno prefinjenost raziskav v sodelovanju podjetij, univerz, visokošolskih zavodov in odločevalcev. Implikacije raziskave so lahko pomembne za boljše razumevanje dejavnikov globalne konkurenčnosti držav EU-28.

**Ključne besede:** konkurenčnost, gospodarske dejavnosti, indeks globalne konkurenčnosti, inovacije