The Role of Innovation and Human Factor in the Development of East Central Europe

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ABSTRACT

Schumpeter's one-hundred-year-old modernised theory of economic development is once again having a renaissance. The main factors of this are innovation and capital, which Porter expanded using further factors. In this report the following six countries were examined: Montenegro, Serbia, Russia, the Czech Republic, Poland and Hungary. Between 2007 and 2017, the roles that technological innovation, human factors and higher education played were examined. Indices used in the analysis were expanded using factors added to Schumpeter's theory by Porter, viz., economic growth, the development of the information technology sector, higher education, productivity and innovation, and they give an overview of the modern innovation theories. Due to the objectiveness of statistical indicators, it was these which were predominantly included in the report. The aim of the study was to examine will a given country be likely to have an economic development if the country makes the most of the opportunities that innovation and higher education present.

INTRODUCTION

Although historical traditions of economics connect the concept of competition with Porter (1990) and his book called the competitive Advantage of Nations, Porter's work was not without any antecedents. Schumpeter already examined the question of economic competitiveness in the first half of the twentieth century (Schumpeter, 1934). According to Schumpeter and his followers, economic development is an evolutionary phenomenon and its momentum changes along with development (Richmann, 2018). The initial incentive of development was capital investment, later, innovation became the primary motivation (Kogan et al., 2017). Recently, the role of the human factor has strengthened (Schultz, 1951). Human factor is a substantial element of modern organisational competitions., i.e. this creates innovation from resources (Czajkowski et al., 2013).

Innovation often appears to people without economical expertise as a process like the technical development ongoing in the highly developed countries. However, innovation is still the key driver of the economy in the developing countries (Dogan, 2016). Pressure of innovation and the effect of international standards and global value chains can be felt in numerous fields, e.g. R&D,

education, planning, marketing. The importance of innovation exceeds the importance of economic output in developing countries (GII, 2015), since it is indispensable in solving the problems arising from health-related matters, the condition of the environment, poverty and unemployment. According to Schumpeter's original model, Innovation links up with substantial growth, redistribution and creative transformation. Innovation causes significant medium-term fluctuations in the field of economic growth (Kogan et al., 2017).

Standard of education is of key importance in innovation. The Innovation Index developed by M. Porter and S. Stern (1999) measures its significance and is defined by the R&D, the level of tertiary education and the scale of government involvement. The literature dealing with human capital and education usually distinguishes four levels of education (Sweetland, 1996; Becker, 2018; Passaro et al., 2018; Psacharopoulos and Patrinos, 2018). The authors concentrated on the performance of tertiary education in this current analysis, and they interpreted the elementary and secondary education as processes supporting studies at a university or a collage and skills necessary in a workplace. Universities and colleges are in turn collaterals for human capital (Brymer et al., 2014). Though it is a single view in academic literature that education has a determining role in the development of human capital, today, a few authors already state (McCracken et al., 2015) that the standard and material of tertiary education doesn't fit the requirements of modern labour market. The fact that technological development becomes a major driver in the Industrial Revolution 4.0 is well characterised by the significant transformation of the index structure of the last competitiveness report of the World Economic Forum (WEF), added to the increase in the ratio of statistical data compared to survey data (Schwab, 2018). Innovation is an essential factor not only in competitiveness but also in sustainability and social welfare. Capacity of the educational system and labour market define the efficacy of competitiveness and innovation to a great extent, what makes these factors also important in creating a competitive advantage.

1. THEORY AND QUESTIONS

Eastern Europe, after having established its unity, could even step forward to become a centre. Poland, the Czech Republic and Hungary are currently members of the European Union, while Montenegro and Serbia are progressing recognised candidates since 2008 and 2009 respectively, and Russia is the leading state of the Commonwealth of Independent States. Poland, the Czech Republic and Hungary also participate in a sovereign lobbyist entity, the Visegrad Group. This current research focusses on six countries from East Central Europe between 2007 and 2017. The primary research question was whether it was possible to identify a significant correlation among competitiveness, measures of innovation and quality of tertiary education in these countries. In addition, authors examined what kind of causality existed between the relationships above if they could be totally or partially verified. They were also curious how the complex interaction of the factors affected competitiveness.

Concept of competitiveness, due to the acceleration of globalisation, differs now a lot from Porter's originally formulated definition. Indeed, Porter interpreted competitiveness solely on a microeconomic level. He argues that a primary object of a country is to elevate living standard and satisfaction level of the inhabitants in a country. Globalisation has already been exerting significant influence from the 1970s, and as a result, people have got used to the concept of world economy now. There is no such a country in the world which can achieve sustainable results without creating economic and physical well-being for its citizens. This is the aim of workplace creation and market enlargement, just as the aim of development of healthcare and education. While initially countries competed against one another, utilisation of co-operative benefits came to the front now. Competitiveness has now become one of the most important characteristics of capability to develop (Wisner et al., 2019). WEF summarises the principal factors of competitiveness in the following way: all those institutional, political and other factors that influence productivity of a country, since production is motivation for long-term well-being and upswing (Schwab, 2007-2017). According to the literature, competitiveness can be significantly enhanced in three areas in the examined countries:

on the fields of knowledge, effective and stable government and financial matters (Nikolic et al., 2016). This paper inspects one topic in further details, namely, the knowledge sector, that is, education and innovation. The authors search for the answer how competitiveness of the analysed countries, viz. Poland, the Czech Republic, Hungary, Montenegro, Serbia and Russia, changed between 2007 and 2017 and to what extent human factor, in particular, technological innovation, talent and tertiary education influenced development of the countries mentioned above. The authors were also motivated in their selection of topic by the great amount of literature available in this theme. These scientific reports analyse the question either globally (Atkinson, 2013) or with country specific adaptations (Rodinova, 2016; Averina et al., 2018). However, they only found few works reporting these countries together. Hence, collation and analysis imply an opportunity to open new perspectives for these countries.

Innovation has a strategic role in increasing competitiveness and, in turn, in the national economical dynamization (Dogan, 2016). The other important attribute of innovation is that the second result of the process above will be the positive influence exerted on society. Competitive advantage and enhanced productivity can be indicated as further consequences, primarily in those countries where innovation is the key drive of economy. Innovation is a multi-actor process, out of which authors emphasise the importance of politics, education, talent development, talent retain and infrastructure. Innovation means connection between sustainability of competitiveness and creation of a knowledge-based economy. Innovation at a governmental level was examined by several internationally recognised researchers (Simmons and Elkins 2004; Brooks 2005; Gilardi 2005). Analyses of other scientists put more emphasis on the analysis of local or regional governmental innovation. (Midlarsky, 1978; Lubell et al. 2002; Ito 2001) The two basic models in literature are the one based on internal determinants and the diffusion model (Berry and Berry 1990). One premise of the internal determinant model is that high-level of education is a basis for innovation. Even if innovation can imply significant expenses at times, higher income and greater wealth compensate these risks which are originally financial ones. Rogers's work is the fundament for the diffusion models of innovation (Rogers, 1976). WEF designates innovation among the twelve pillars of competitiveness as a separate one (Pillar 12: Innovation), which primarily defines the place of developed (according to WEF: innovation driven) countries in the competitiveness ranking. WEF assesses the following criteria (sub pillars) when defining innovative capacity and ranking (Schwab, 2016): Capacity for innovation, Quality of scientific research institutions, Company spending on R&D, University-industry collaboration in R&D, Availability of scientists and engineers and PCT patents (applications/million pop.). However, it is particularly important that, out of these indices, only 12.07 is founded on statistical data, all the others rest on solely questionnaire surveys and received values that depended on subjective opinion of respondents to WEF Executive Opinion Survey. Yet, it is interesting that methodology of WEF discussed talent development and retain between 2007 and 2017 not here but in Pillar 7 (Labour Market Efficiency).

Whilst WEF measured talent with values of capacity to attract and capacity to retain talent between 2007 and 2017, International Institute for Management Development (IMD) Business School, forming the other internationally used competitiveness index, also issues a Global Talent Report yearly. According to results, it has been observable for years that those middle-sized European economies perform the best in talent ranking which invest significantly into education and quality of life and attract to themselves foreign talented scientists and experts (IMD, 2019). According to the OECD, however, role of talent is not only important in developed countries but also in developing ones. (OECD, 2015) In developed countries, the presence of capital enhances innovation, while investments in education help innovation in emerging countries, and finally, innovation serves as a last resort in developing countries, like oil did for the Arab states. Support of innovation is the most successful if it covers all areas, supports every form of innovation, improves reconstructing carried out to develop innovation, and vitalises import of new technologies and procedures (Atkinson and Ezell, 2015). According to the viewpoint of OECD, R&D sector is the other major determinant of innovation (OECD, 2016).

The third examined factor is tertiary education in this paper. Literature often regards vis-à-vis knowledge how significant role it has in competitiveness of developing countries. (Dima et al, 2018) Indeed, this makes it possible for these countries to appear in markets outside their borders. It is also worth mentioning that we hardly meet a developing country on this developmental path. It is assuredly typical to these countries that their cheap labour force makes them more competitive due to low level of knowledge and innovation (Agenor, 2017). On the other hand, knowledge-based economies rather use capital involved in human factor, as natural resources, since ability to create, distribute and utilise information characterises these countries. Human factor is motivation to creativity, innovation and new ideas, which primarily rests on information technology (Cavusoglua, 2016). Having reviewed literature and available theories, the authors constructed their hypotheses vis-à-vis the countries under analyse. H1: Based on data from WEF, factors involved in the current research, that is, governmental system, tertiary education and innovation affect competitiveness directly. H2: The six countries analysed by the authors can be classified into clusters, and competitiveness in each factor is influenced predominantly by miscellaneous factors out of the ones being examined in this research.

2. METHODOLOGY

The authors used secondary resources in the research, viz., reports of WEF The Global Competitiveness Report between 2007 and 2017, the rankings of United Nations Human Development Index (UNHDI) between 2007 and 2017 and the Global Innovation Index reports issued by INSEAD Business School from 2007. They took into consideration the university raking of Center for World University Rankings (CWUR) in deciding the tertiary education ranking. Although this ranking only defines the university ranking of universities since 2012, the authors persisted in using this ranking because CWUR defines the ranking based on objective statistical data, e.g. number of publications, instead of subjective questionnaire surveys. Tertiary education was characterised with the tertiary education pillar of WEF by the authors in value-based inspections and model construction, in respect to the fact that it shared its methodology of construction with the other observed factors, and data from every analysed country can be found in the Global Competitiveness Report of each examined year. A few reviews can be studied on the connection of miscellaneous factors (Cetinguc et al., 2018; Nasierowski, 2016). The current research discusses the topic in the form of comparison. The USA, taking place as no. 1 in the WEF competitiveness ranking, and Germany, one of the leading European economic powers, serve as benchmarks. Indices being used in the research consider the different factors of Schumpeter's theory completed by Porter, namely, economic growth, tertiary education and innovation. This research covers the institutional system as well, which greatly affects competitiveness of a country (Ketels, C., 2017; MNB, 2017). Although the authors had initially planned to make a retrospective analysis back to 1990, they finally analysed the data back to 2007. Its fundamental reason is that such geopolitical changes happened in the region – disintegration of the former Soviet Union and Yugoslavia – that only terminated in 2006 at last. Hence, in favour of comparability of the data 2007 became the first year of examination. The ending year of the analysis, in turn, became 2017 because WEF had completely restructured the pillars. Consequently, fresh data and pre 2018 data are not comparable anymore. Despite world ranking's being a key aspect when classifying countries, non-ranking type of data with real values are much more useful for statistical estimations. In this way, the authors examined hard data values based on statistical indicators and the WEF Global Survey results in the next step of the research. They created clusters out of the data from all countries with IBM SPSS Statistics 26 programme with Ward method founded on the twelve competitiveness pillars (Majerova and Nevima, 2017). They inspected which clusters the analysed countries got into, and added to that, they compared this grouping with the GDP-based clusters created by WEF. They examined during the panel analysis whether there was a country the clustering of which had changed. Indeed, stepping forward to a higher ranked cluster can be interpreted as an obvious sign of progress. The authors measured, likewise with SPSS programme, direction, strength and significance of relationships

among competitiveness, innovation and tertiary education. The authors, using WEF data, worked on a simplified dataset. They used GDP per capita values as the measure of competitiveness, they characterised tertiary education with university and college matriculation rates and innovation with Pillar 12 of WEF system, nominated likewise. It is an important causality problem, with reference to detectable relationships, which element is cause and which one is effect. This question was answered with the use of Granger test. The principal of Granger test is that one variable, "x" is reason for the other one, "y" but inverted causal link cannot be evinced between the two. The authors do not touch upon introducing the mathematical apparatus of the test. The essence of the procedure is available in the literature (Foresti, 2006, Stokes and Purdon, 2017). The test, as being written on R programming language, was accomplished with RStudio programme, which makes the usage of the programme language very simple. In the next step the authors, using the results thereof, created a model with structural equation modelling with IBM-SPSS Amos 24.0.0 programme. This is a partial model focussing on the efficiency describing and explaining of GDP, which describes one aspect of the formation of GDP only from the currently examined directions, the innovation and the tertiary education. In order to conduct the most accurate research, the authors added those pillars and sub pillars, described by WEF, to the model, which characterise the role of innovation and tertiary education. Using the model being formed, the relationship network could be revealed and analysed through which education and innovation affect competitiveness and GDP.

2. FINDINGS AND DISCUSSION
2.1 Institutions

Literature has already shown direct correlation between innovation and competitiveness (Cvetanovic and Sredojevic, 2012). Nothing proves connection better than innovation's being one of the pillars of WEF competitiveness indicators. If we generally examine rankings in competitiveness and in Pillar 12 (Innovation) concerning every country from the report, this is indeed obvious. (Schwab, 2018). Authors examined the role of governmental institutions in scope of two questions: To what extent does the state create the basic conditions for the innovation processes of that country? To what extent does the state take part in innovation itself, and added to that, to what extent do companies have to shoulder costs of development? We examined innovation capacities (sub pillar 12.01) form 2007 to 2017 to answer the first question (Schwab, 2007-2017, 2018).

Having analysed 1-7 values calculated by WEF, trend of the currently investigated countries is slowly increasing but this does not appear in the ranking of each country. Indeed, performance of the Czech Republic and Poland is consistent while the potential of others diminishes. Solely Montenegro showed a great headway, that is, its position improved by 50 places. Unfortunately, it ranked lower again afterwards. It requires a further economical-political-social analysis to ascertain what caused the substantial advancement and how it would be possible to make the values of the previously positively affecting factors favourable again. What is certain is that, since 2008, a few EU programmes and projects launched for the development of the Western Balkans, also incorporating Montenegro. On behalf of the EU, Austria was the coordinator of the programs, adjacent data are located on the website wbc-inco.net, which has not been updated since its cut-off in 2014, but data at that time are available in 2019 as well (WBC-INCO, 2008-2014). Such a program was, for example, the 7th Framework Programme for Research and Technological Development (2007-2013). Some of the main objectives of the programme were the development of industrial environment, financial support, strengthening competitiveness and promotion of SMEs and supporting start-ups. Apart from WBC-INCO, further bilateral contracts also helped Montenegro's meteoric headway. The free trade agreement with CEFTA (Central European Free Trade Agreement) in December 2006 and the one with Turkey in 2008 are only a few examples. While other factors are also to be respected, innovation programmes and contracts mentioned above must have had a role in the significant progress of Montenegro. The developments – due to the endowments of Montenegro – aimed primarily at rising competitiveness of tourism (Cimbaljevic and Bucic. 2015;

Jaksic-Stojanovic and Seric, 2018). Positive feature of the country is its alignment to WTO regulation, which makes it possible for foreign investors to set up a company with conditions like home investors. Consequently, not only regional and European countries invested several millions of dollars in Montenegro, but also firms of such leading economic powers as the American Morgan Invest, the Japanese Daido or the Singaporean Aman Resorts. Privatisation of banking system also created competition on the credit market which favoured likewise borrowers. Privatisation not only passed off in the banking sector but also in the others (Milic, 2014). One opportunity to improve current unfavourable position could be to increase investments into R&D sector, because Montenegro, according to IMF data, lags behind other Western Balkans, and added to that, there is an even larger shortfall if we relate data to the Baltic states or Eastern European EU members. According to the data of the World Bank, the ratio of innovative firms is low, especially in respect of big companies employing more than a hundred employees, only 1% of which conduct an innovation programme, while 34% of firms do it on a global average (Hollanders, 2018). As the list of organisations partaking in the WBC-INCO programme also designates it, the role of state is proven to be closely linked to the organisation and satisfactory operation of secondary and tertiary education, which is a vital prerequisite for the education of knowledge-based innovative generations.

In order to answer the second question on public intervention, it is necessary to identify the source of capital, which can derive from either the government (GCI Pillar 12.05) or firms (GCI Pillar 12.03. Firms are, first and foremost, the motors of innovation in Germany, being at the top of the competitiveness rankings, and in the USA. Meanwhile, public and private sector contribute to development nearly to the same extent, but public sector slightly predominates. In this way, development depends on politics to a larger extent than in competitive countries, and the increase in the measure of public investments will be the key driver of innovation. According to the literature, efficiency of capital investment, applicable to productivity, is relatively low. (Ciocanel & Pavelescu, 2015) However, it is not recommended to primarily consider these indicators when distributing resources, since investments being mentioned do not, indeed, aim at increasing productivity, but, in the present case, the main goal is to facilitate innovation.

2.2. Talent

At present, talent is one of the key factors of innovation. For a country that would like to get into a better competitiveness position, not only is it important to develop talents, but also to retain them by offering attractive working conditions, enough salary and promotion prospects. The way of thinking is observable at WEF, too. Initially, from 2009, brain drain sub index was in use, then, they switched to the talent retain sub pillar (Schwab, 2007-2017). The field of Eastern European countries had torn into three parts. Poland and Montenegro succeed lagging behind the Czech Republic and Russia, while Hungary and Serbia bring up the rear. The six inspected countries went down different paths. during the examined ten years. The Czech Republic, Russia and Poland equally fell back in the first half of the decade, then, the tendency reversed, and they have now improved their ranking significantly. The importance of talent retain has been grasped by Russia and the Czech Republic having a similar statistical passage, where the sharp fall of previous years came to an end in 2013. Since then, it managed to realise a substantial amount of development with money and provisions., and Russia has stepped forward from no. 112 to no. 59 in ranking, Czechia, in turn, from no. 84 to no. 51. Similar, yet, much smaller incline can be experienced, likewise from 2013, in Serbia, while Hungary and Montenegro have not been able to come out of the regression lasting for almost six years.

2.3. Education

Knowledge has now become a product, practically. Hence, all the countries that concentrate appropriate resources for the development of their education system, and added to that, recognise the substantial role of apprenticeships, are able to raise a new generation of manpower capable of

coping with tomorrow's tasks with suitable knowledge and the necessary skills over one tertiary education cycle, i.e. in 5 to 10 years, which can lead to the grant of a selective advantage to them against the latecomers. Obviously, it is necessary for the Industry 4.0 compatibility of tertiary education to establish a stable foundation, which secondary education system may create. The authors examined the level and development of secondary school scientific education based on the ranking of the Math & Science Education index. Three significant changes happened during the investigation period. The initially tough competition had split into more distinct groups of countries by 2017, and while the USA became first from the last in this field, Hungary became the last, dropping 55 positions in the ranking. The probable reason of this latter fact is the prestige of pedagogy career being disappeared. As a second remark, the previously no. 1 Serbia is once again heading towards the top of the ranking. Finally, despite the presumptions of the authors, level of secondary school education in natural sciences does not directly affect positions in competitiveness ranking.

Literature has already verified relationship between tertiary education and competitiveness as well (Yildiz, 2016). The authors were investigating two aspects when analysing this connection. On the one hand, they examined the development of tertiary education based on such a university ranking (CWUR) which had not been created founded on a questionnaire survey being exposed to subjectivity and bias, but on objective statistics (number of publications, citation indices. Data from this index have been available since 2012. On the other hand, they were curious about the co-operation of universities and industry. Russia dominates the top in the competition of universities, the others, in turn, lag far behind it. The innovation-industry co-operation (Schwab, 2007-2017, 2018) works as a sort of innovation booster. The question arises with reference to the data series: what the background to the Hungarian low point reached in 2016 can be?

The assumed answer, on the one hand, can be the change in the economy of tertiary educational institutions, which is about the enhanced competent authority regulation, which made the economic freedom of institutions significantly restricted. On the other hand, multicentric management[1] did also not support the autonomy of science. The administrative admission quotas at certain majors, multiple restructuring of tertiary education institutions and the cut in the number of fully state-funded places all imply a decline in tertiary education, but it is slowly being rebuilt since 2017. (Beracs et al., 2017) Together with Hungary, which constituted the major setback in 2016, all the analysed countries show somewhat similar processes. There can be experienced a downturn like the Hungarian one in Montenegro, but there is no sign of progress there. There is a smaller but continuous decline in the Czech Republic. Russia has made the only substantial progress, it moved ahead 45 ranks vis-à-vis its bottom in 2012.

2.4. Analysis of the scores of the pillars

After having examined the rankings, as mentioned in the methodological part, the authors proceeded to the analysis of the values and statistical data with SPSS programme. Five clusters were created from statistical data with SPSS, the details of which are set out in Figure 1 (Schwab, 2007-2017). Numbering of clusters was made from 1 to 5 in ascending national income order, that is, cluster 1 contains the poorest while cluster 5 comprises the richest countries.

As an example, countries of the lowest income and competitiveness belong to the first cluster, e.g. Ethiopia or Haiti. The second one contains Montenegro out of the targeted countries, the third one includes Argentina or Egypt. Members of the fourth cluster are, e.g., the Czech Republic, Kazakhstan, while the fifth cluster consists of the most developed states, for example, the USA or Japan. The cluster classification of the countries under analysis is delineated in Table 1.

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Clusters from 12 pillars of GCI

Legend:
- 1st pillar: Institutions
- 2nd pillar: Infrastructure
- 3rd pillar: Macroeconomic environment
- 4th pillar: Health and primary education
- 5th pillar: Higher education and training
- 6th pillar: Goods market efficiency
- 7th pillar: Labor market efficiency
- 8th pillar: Financial market development
- 9th pillar: Technological readiness
- 10th pillar: Market size
- 11th pillar: Business sophistication
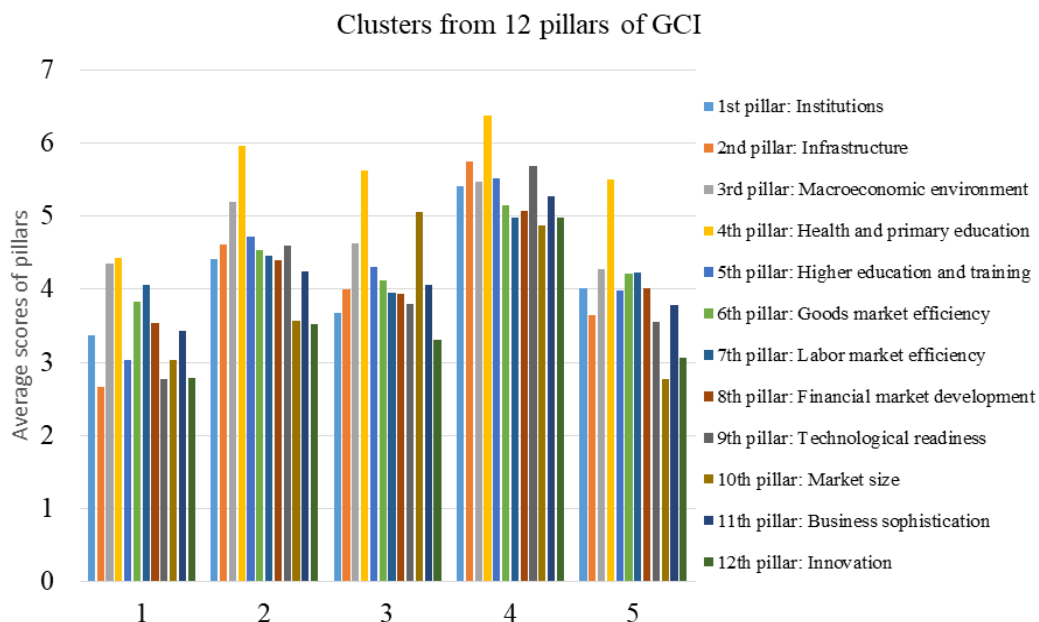- 12th pillar: Innovation

Figure 1. Clusters developed by the authors from data of Schwab (2017)

Source: own figure

Table 1. Examined and reference countries in clusters

	DEU	USA	HUN	MNE	SRB	CZE	POL	RUS
2007	5	5	2	2	2	4	3	3
2017	5	5	4	2	3	4	3	3

Source: authors' cluster data (2007 and 2017)

Two countries moved to a higher cluster during the ten years of analysis: Serbia was upgraded by one, Hungary was by two grades. From 2013 to 2017, classification of the countries studied did not change. Likewise, WEF created five clusters based on the GDP (Schwab, 2007-2017). The difference between the two cluster systems is clearly visible on Figure 2 (Schwab, 2007-2017) where the two types of cluster classification are compared to each other.

Figure 2. Authors clusters and WEF clusters

Source: authors cluster data compared to Schwab (2007-2017)

The values of the grouping applied by the WEF are much more favourable at half of the countries than the own classification. The authors do believe one of the main reasons is that while WEF categorises are only based on the GDP per capita values, the clusters of the authors had a more complex perspective on the competitiveness of the countries when creating the group characteristics. Their reflection is underpinned by the fact also known from the literature that GDP in no way contains every such factor that counts in considering competitiveness (Atkinson, 2013, Csath, 2018). For the purpose of comparison, the authors also examined how many countries' cluster numbers equal in the sample of the authors and the WEF. They found a total of 61 matches, which means a classification equal to the WEF sample in 39.8% of the countries presented in the Global Competitiveness Report. Among the countries analysed, there is no difference in the cluster number of the two reference countries, Germany and the USA, and there is even a difference of two clusters in the case of Montenegro and Poland. The results of the analysis carried out by SPSS programme were the following. Concerning the evaluation of the results from the sample, the authors already draw attention in advance that the statistical data provided by the countries of cluster 1 are extremely fragmented, yet, this cluster contains the most countries with 63. Figure 3 depicts relationships between GDP per capita, innovation and tertiary education in the clusters of the authors. Growth theory, being laid down in the literature multiple times, rests on the relationship of these three. According to the theory, education, innovation and the supporting institutional system are determinants of economic growth (Bouis et al., 2011; Aiginger and Vogel, 2015).
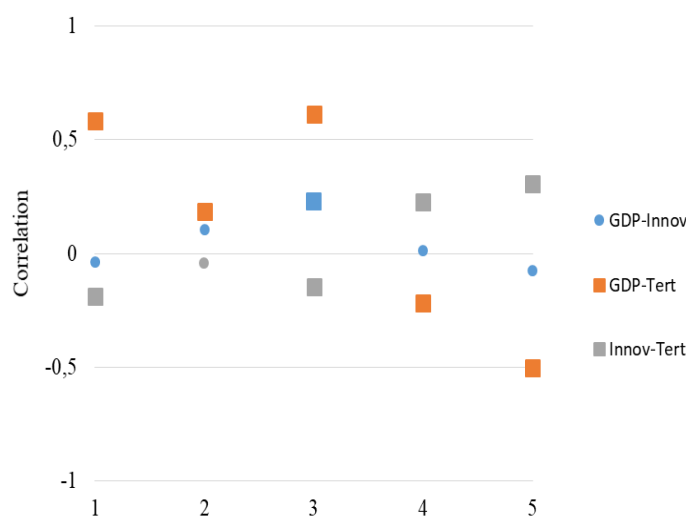

Figure 3. Correlations between GDP, innovation and tertiary education in authors' cluster 1-5

Source: authors' cluster data

'Square' means significant relationship and 'circle' indicates nonsignificant correlation, regardless of the colour

Significant correlations of a certain cluster in the figure are marked with squares placed in the data rows. In the first cluster there is a strong positive relationship between GDP per capita and tertiary education and a weak negative correlation between innovation and tertiary education. In the second cluster the authors only found a weak relationship between tertiary education and GDP per capita. All the three clusters have significant relationship with each other in cluster 3; GDP per capita has strong positive link to tertiary education and weak positive to innovation, while innovation and tertiary education have weak negative relationship. The fourth cluster is characterised by significant but weak connections; the GDP - tertiary education relationship is weak negative, and the one between innovation and tertiary education is weak positive. Correlations coming up in clus-

ter 5 are the same as in the fourth cluster but with medium strength. This underpins the observation of scientific reports that the economic growth of low-, middle- and high-income country groups is determined by miscellaneous factors (Bulman et al., 2016).

Correlation between GDP and tertiary education is the more pronounced in cluster 1, 3, and 5, while in the second and fourth clusters there is only a weak correlation between these two factors. This could also mean that poorer countries spend a significant amount of their GDP on tertiary education as a competitiveness enhancer, then, in the next stage, in the second cluster they start to dedicate the increase in national income on raising living standards. With the improving living standards, they get ever closer to the top border of the cluster, then, entering the third cluster, it will be important again, in addition to the better standard of living, to increase competitiveness with the progressive support of tertiary education. In the fourth cluster innovation appears rather dominant in boosting competitiveness, therefore, share of tertiary education in GDP and too its importance decrease. Finally, in the richest countries in the fifth cluster significantly high technological standards and automation may lead to the almost strongly negative correlation between the GDP and tertiary education for two reasons. One possible reason is that, due to the richness of the country, it entices the excellent professionals trained elsewhere into the country instead of raising the quality of higher education, that is, the phenomenon of brain drain. The alternative scenario is that, adjacent to the automated production lines, much less qualified workers are still enough for the production, thus, there is no need to enhance higher education. According to the authors, the real explanation is a combination of these two possibilities. The linear relation of education (School life expectancy) and GDP per capita (Income per capita in 1000 USD) has also been proved by the literature (Hongbin et al., 2017).

The cascading relationship between innovation and tertiary education is remarkable, too. The richer a country is, the more important role innovation plays in increasing competitiveness. It is crucial for innovation to provide quality training for professionals, and to establish co-operation between industry and higher education. This is described by the cascading course of the innovation - higher education correlation. The literature, too, mentions in connexion with the relationship between innovation and tertiary education that competitiveness of low-income countries extends primarily to the labour-intensive areas, while in the advanced economies knowledge-intensive activities are fundamental for competitiveness (Agenor, 2017).

Correlation between GDP and innovation, however, could only be resolved to show in the third cluster, which is in particular because countries of the first cluster rather spend on education than innovation, and countries from the fifth cluster enhance their competitiveness by indirectly augmenting innovation, spending not on education but on good specialists. Nevertheless, in the third cluster the significant competitiveness increasing effect of innovation appears. Considering the trend of GDP - innovation - higher education through the period under review, we can observe that while the GDP and tertiary education grows slowly but continuously, the effects on innovation of the economic crisis started to be felt: three years after the low point of 2010 it reached the pre-crisis level, thenceforth, it increases at a faster rate than both the GDP and higher education The authors also examined whether any of the factors of the different clusters unfold in time similarly (Figure 4- Figure 6). Considering the area of the GDP, similarities in course between the first two clusters and the third-fourth clusters have been clearly established. There are also many similarities between these two tiers as 2014 is the starting year in both for the acceleration of the schedule of increments, and only their pace differs. cluster 5 shows a constant slow growth deviating from the other four clusters. The first and third cluster follow similar paths in respect to innovation, these were struck by the economic crisis the most. Countries with the lowest incomes reached a valley in 2011, countries from the third cluster did that in 2012, then, they all started to slowly grow again, what indicates that more out of the rising post-crisis GDP goes on innovation as well. After a slight slowdown in 2009-2010 cluster 4-5 already injected substantial amounts into the innovative enhancement of competitiveness.
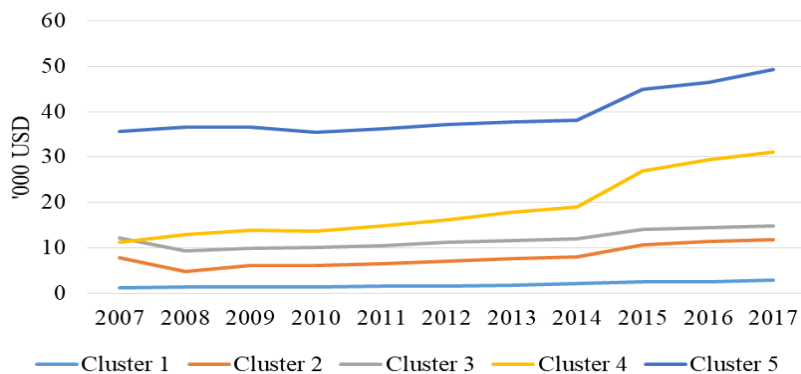
Figure 4. GDP time series in authors' clusters (2007-2017)
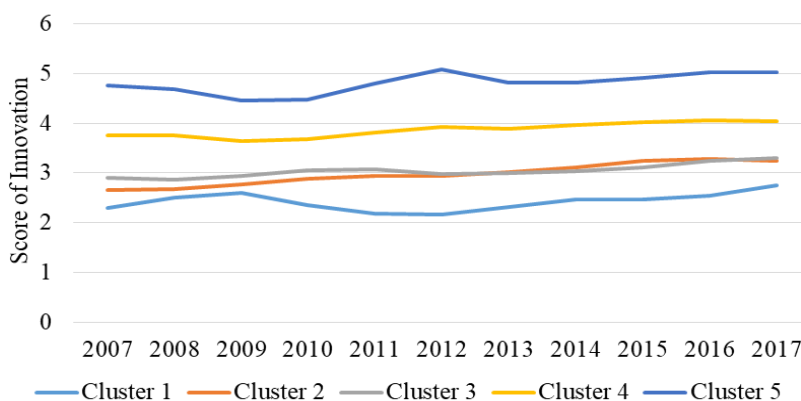Source: authors' cluster data

Figure 5. Innovation time series in authors' cluster (2007-2017)

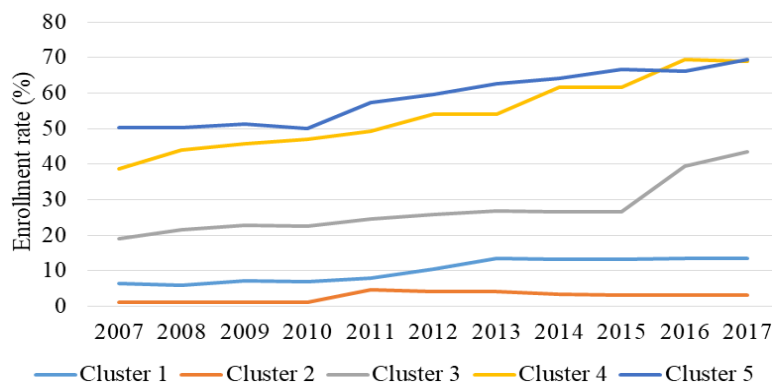Source: authors' cluster data

Figure 6. Tertiary education indicator time-series in authors' clusters (2007-2017)

Source: authors' cluster data

In tertiary education cluster 1 and 2 and cluster 4 and 5 have somewhat similar profiles, while cluster 3 is on a similar track to countries with low national income until 2015, then, its course resembles the ones of high-income countries. By way of refinement of the foregoing on tertiary education, the authors raise awareness that values of cluster 5 are specifically mean values, as decreasing, stagnating, and increasing tertiary education are detectable among the countries of the cluster (Figure 7).
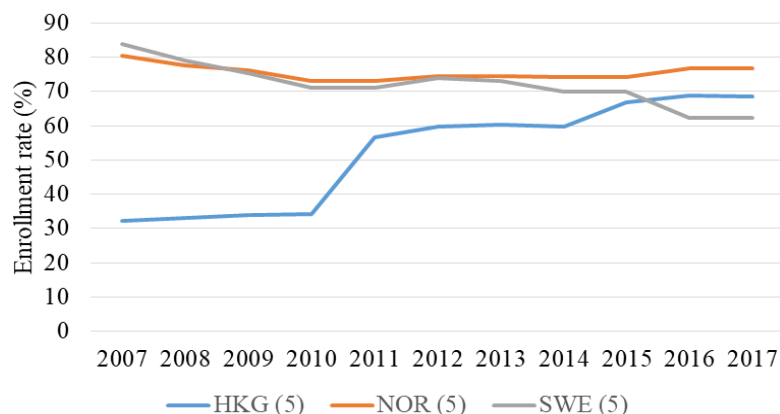
Figure 7. Tertiary education in authors' cluster 5

Source: authors' cluster data

The "big movers" of cluster 5 are Asian countries demonstrating intensive economic growth, such as Hong Kong and Singapore. China, too, tends to jump similarly from 2015. (Schwab 2007-2017) One possible cost-effective method to enhance higher education capacities is, e.g., to make use of open educational resources (OER - Damme, 2017).

2.5 Testing the causality links

After bearing out the correlations, their analysis follows. Its first arising question is the problem of causality. That is, e.g., whether correlation between the GDP and the level of education can be observed because the rising GDP increases the reception capacities and level of tertiary education, or not? Or, will the GDP become higher owing to the greater number of graduates? In addressing this question Granger causality test was applied. The test was carried on both Lag1 and Lag2 bases. Lag1 means that causality link can be detected based on the events of the past year; in the case of lag2, the result can be explained by the examination during the past two years.

Lag1 data are shown in Table 2, where bold values mark a significant result and the unformatted values indicate a tendency, which means that, looking back over a few years, the link would probably also be significant here. The same marking was used in the table of the lag2 results. (Table 3.)

Table 2. Granger test, Lag1-data

Country	Lag	Result	Cause	F	Sig
MNE	1	Tertiary	GDP_per_capita	3.7413	0.09433
HUN	**1**	**Innovation**	**GDP_per_capita**	**7.9875**	**0.02554**
HUN	1	Tertiary	GDP_per_capita	4.839	0.06375
DEU	**1**	**Innovation**	**GDP_per_capita**	**6.6207**	**0.03684**
POL	**1**	**Innovation**	**GDP_per_capita**	**6.6619**	**0.03642**
POL	**1**	**Tertiary**	**GDP_per_capita**	**7.0221**	**0.03295**
SRB	**1**	**Innovation**	**GDP_per_capita**	**7.3943**	**0.0298**
SRB	1	Innovation	Tertiary	5.2219	0.05621
RUS	**1**	**Tertiary**	**GDP_per_capita**	**12.849**	**0.008922**
RUS	**1**	**Tertiary**	**Innovation**	**7.0338**	**0.03284**
USA	**1**	**Tertiary**	**Innovation**	**9.6493**	**0.01717**

Table 3. Granger test, Lag2-data

Country	Lag	Result	Cause	F	Sig
MNE	2	Innovation	Tertiary	6.6358	0.05364
HUN	**2**	**Innovation**	**GDP_per_capita**	**9.9776**	**0.02788**
HUN	**2**	**Tertiary**	**GDP_per_capita**	**14.812**	**0.01415**
CZE	2	GDP_per_capita	Tertiary	6.7255	0.05254
CZE	**2**	**Tertiary**	**GDP_per_capita**	**15.899**	**0.01249**
RUS	2	Innovation	GDP_per_capita	4.3889	0.098
RUS	**2**	**Tertiary**	**GDP_per_capita**	**7.637**	**0.04307**
USA	**2**	**Innovation**	**Tertiary**	**28.119**	**0.00441**
USA	**2**	**Tertiary**	**Innovation**	**9.8823**	**0.02833**

Sources: authors' calculations

In order to reach greater transparency, the authors visualised their results hereinafter (Table 4)

Table 4. Visualised output of Granger-test

Country	Cluster (2017)	GDP vs Innovation	GDP vs Tertiary	Innovation vs Tertiary
MNE	2		→	←
HUN	4	→	→	
CZE	4		↔	
DEU	5	→		
POL	3	→	→	
SRB	3	→		←
RUS	3		→	↔
USA	5			→

Source: authors' calculated data

The arrows of the table indicate the causal links, they illuminate the path from cause to effect. With due regard also to these facts, it may be considered that, analysing the countries considered as a whole, the following phenomena can be described.

In cluster 1 an increase in the GDP per capita of the country results in a growth in the number of graduates. (Figure 8) Countries of the fifth cluster follow similar trends as well but the causal link is reverse, that is, if there are more graduate workers, the GDP per capita of the country will also be higher.

In the second cluster results from the Granger causality test show that the growth in both the number of people with third level qualifications and the GDP per capita of the country cause an increase, albeit slight, in innovation capacity (From 2.68 to 3.17 - Figure 10).
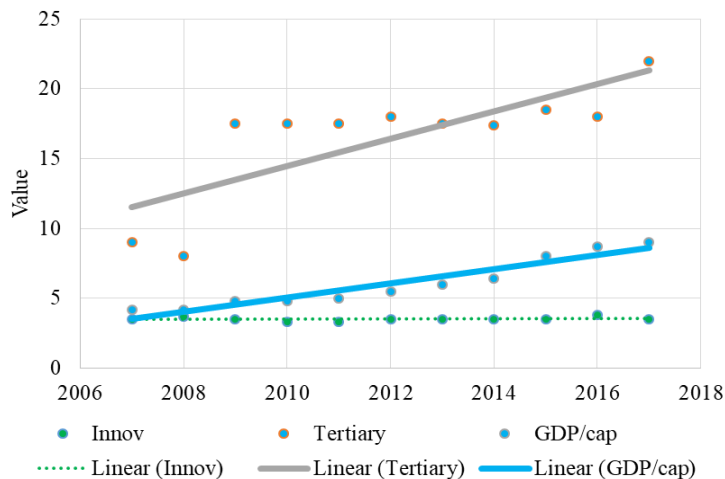
Figure 8. Trends of tertiary education and GDP in cluster 1 countries
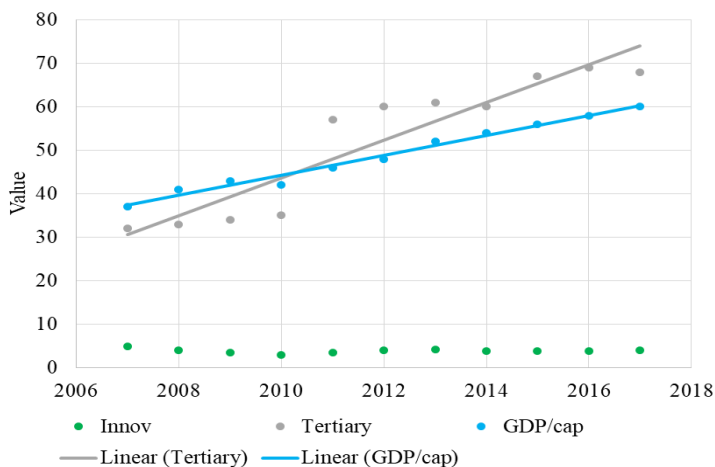
Source: authors' cluster data

Figure 9. Trends of tertiary education and GDP in countries from cluster 5
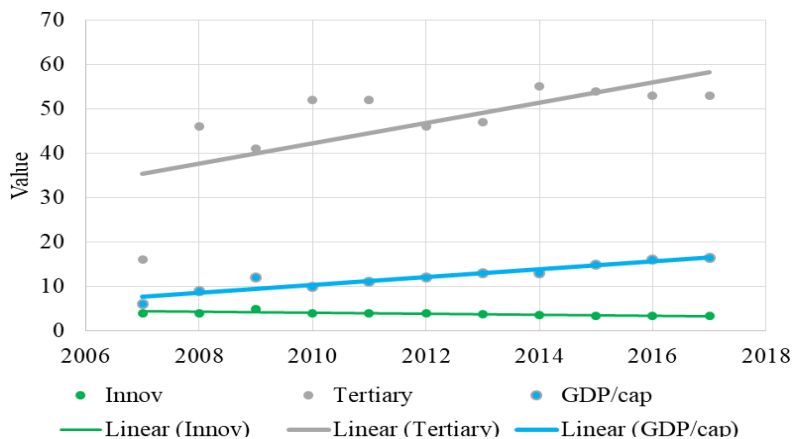
Source: authors' cluster data

Figure 10. Trends of tertiary education, GDP and innovation in countries from cluster 2

Source: authors' cluster data

Analysing the countries of the third and fourth clusters, we could not demonstrate a similar connection for all the countries of the cluster with Granger causality test. While the trend of tertiary education and the GDP per capita have a similar shape in the different clusters, the analysis of the relationship between innovation and tertiary education gave different results. In those countries where value of the GDP per capita is low (cluster 1), the country uses its GDP growth for tertiary education, what leads to the slow growth of innovation level. From the fifth cluster characterised by high GDP per capita, in the case of the two countries involved in the current analysis, Germany and the USA, the authors found that the two countries have conflicting trends, when observing the relationship between innovation and tertiary education. In Germany there is a linear relationship between innovation and the number of students studying in higher education. That is, Germany increases its innovation by investing GDP growth partially in tertiary education. In the United States The equivalent figure is reverse in the United States – it can be said that the USA is more likely to increase its innovation by paying fewer but excellently trained professionals, even exploiting opportunities offered by the brain drain (Figure 11 and Figure 12)
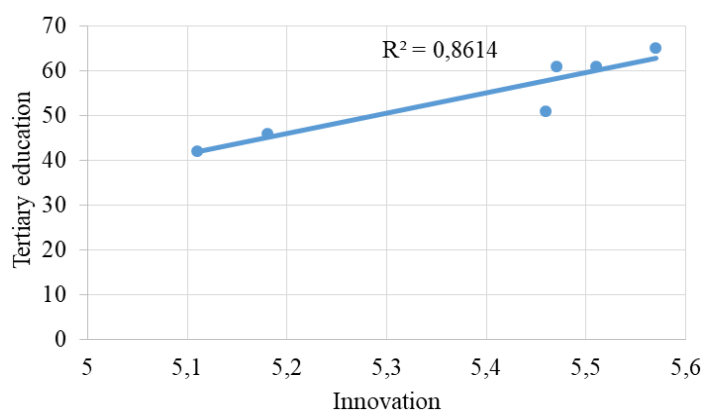

Figure 11. Correlation between innovation and tertiary education in Germany

Source: authors' cluster data
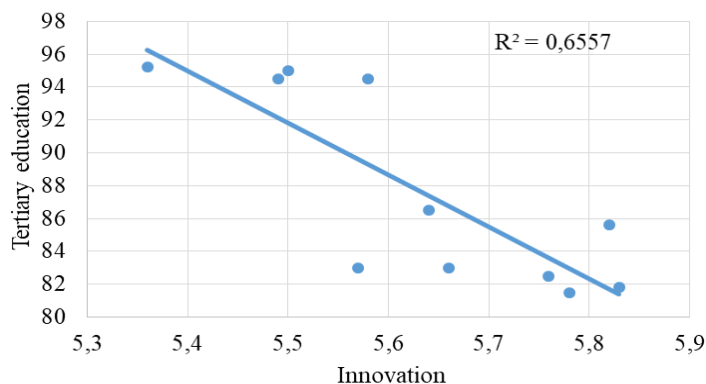

Figure 12. Correlation between innovation and tertiary education in the USA

Source: authors' cluster data

3.6. Role of institutions, innovation, and tertiary education in GDP developement (modelling)

The authors established the following model (Figure 13) based on the information acquired from the analysis of the causal links. This model was developed with the previously mentioned

IBM-SPSS Amos structural equation modelling procedure using data for the 165 countries included by WEF. Given its nature, the model is partial since it does not analyse the complex overall effect of the aggregated factors influencing competitiveness. According to the literature, in defining competitiveness, the main actors are not primarily the individuals but the complex overall effect of factor combinations (Schwab, 2007-2017). The aim of the authors was not the formulation of a complex model, but the investigation of how tertiary education affects competitiveness.
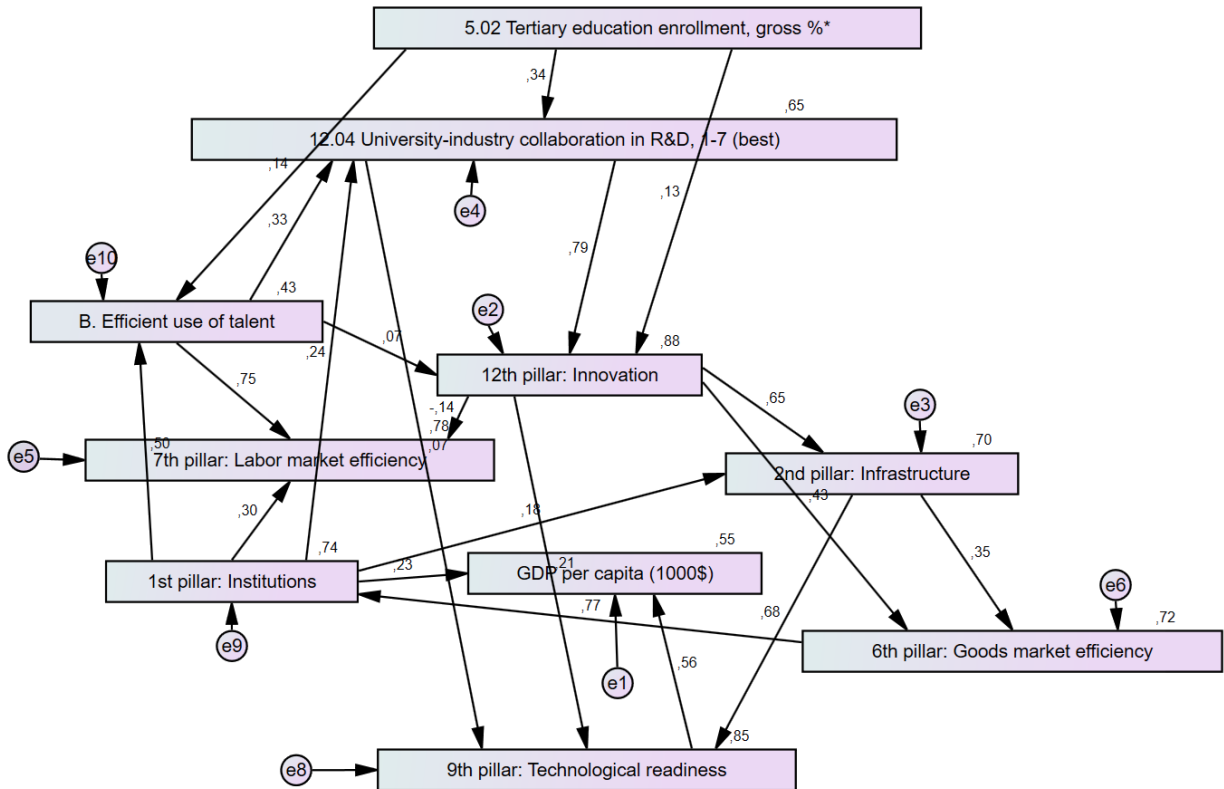

Figure 13. Institution-based model of GDP created with IBM-SPSS Amos 24.0.0

Source: self-made model

Table 5. Standardised Direct Effects

	v_065	v_031	v_096	v_108	v_043	v_151	v_155	v_130
v_031 Institutions	0.000	0.000	0.769	0.000	0.000	0.000	0.000	0.000
v_096 Goods m. eff.	0.000	0.000	0.000	0.000	0.352	0.000	0.430	0.000
v_108 Ef. use talent	0.139	0.502	0.000	0.000	0.000	0.000	0.000	0.000
v_043 Infrastruct	0.000	0.176	0.000	0.000	0.000	0.000	0.646	0.000
v_151 Un-ind collab	0.335	0.244	0.000	0.334	0.000	0.000	0.000	0.000
v_155 Innovation	0.126	0.000	0.000	0.068	0.000	0.787	0.000	0.000
v_130 T. readiness	0.000	0.000	0.000	0.000	0.684	0.065	0.212	0.000
v_109 Labour m. eff	0.000	0.304	0.000	0.755	0.000	0.000	-0.141	0.000
GDP_per_cap_PPP	0.000	0.233	0.000	0.000	0.000	0.000	0.000	0.556

Source: calculation of the authors, using the IBM-SPSS Amos programme

The variables used in drafting the model can be divided into four groups. One of them is GDP itself, the other one is structured around innovation. The third group consists of variables relating to tertiary education. Economic variables belong to the fourth group. The latter include the institutional system, commodity and labour market efficiency and the infrastructure. Part of the variables are in intermediate position. Efficient use of talent, by means of "talent", has a connection with tertiary education but the "efficient" use rather relates it labour market efficiency more closely. University-industry collaboration, too, is a transition between tertiary education and innovation. Values of standardised direct effects used to reference strength are reflected (Table 5). Moreover, the programme calculates indirect effects as well and the aggregate of the two types of effect, the full impact (Table 7).

Table 6. Standardised Indirect Effects

	v_065	v_031	v_096	v_108	v_043	v_151	v_155	v_130
v_031 Institutions	0.286	0.296	0.228	0.217	0.351	0.516	0.655	0.000
v_096 Goods m. eff.	0.372	0.385	0.296	0.282	0.104	0.670	0.422	0.000
v_108 Ef. use talent	0.143	0.149	0.500	0.109	0.176	0.259	0.329	0.000
v_043 Infrastruct	0.398	0.352	0.406	0.302	0.143	0.718	0.267	0.000
v_151 Un-ind collab	0.164	0.289	0.410	0.089	0.145	0.212	0.270	0.000
v_155 Innovation	0.412	0.464	0.357	0.340	0.126	0.184	0.234	0.000
v_130 T. readiness	0.419	0.494	0.380	0.320	0.134	0.710	0.691	0.000
v_109 Labour m. eff	0.224	0.515	0.630	0.090	0.222	0.215	0.414	0.000
GDP_per_cap_PPP	0.300	0.344	0.444	0.229	0.537	0.552	0.655	0.000

Source: calculation of the authors, using the IBM-SPSS Amos programme

Table 7. Standardised Total Effects

	v_065	v_031	v_096	v_108	v_043	v_151	v_155	v_130
v_031 Institutions	0.286	0.296	0.997	0.217	0.351	0.516	0.655	0.000
v_096 Goods m. eff.	0.372	0.385	0.296	0.282	0.457	0.670	0.852	0.000
v_108 Ef. use talent	0.282	0.650	0.500	0.109	0.176	0.259	0.329	0.000
v_043 Infrastruct	0.398	0.528	0.406	0.302	0.143	0.718	0.912	0.000
v_151 Un-ind collab	0.499	0.534	0.410	0.423	0.145	0.212	0.270	0.000
v_155 Innovation	0.538	0.464	0.357	0.408	0.126	0.971	0.234	0.000
v_130 T. readiness	0.419	0.494	0.380	0.320	0.818	0.776	0.903	0.000
v_109 Labour m. eff	0.224	0.819	0.630	0.845	0.222	0.215	0.273	0.000
GDP_per_cap_PPP	0.300	0.577	0.444	0.229	0.537	0.552	0.655	0.556

Source: calculation of the authors using the IBM-SPSS Amos programme

The model explains GDP in 55% as the income in relation to tertiary education and innovation. Explanation of other parts of GDP follows from the effect of further agents that the authors did not analyse, and they designated them in Figure 13 as 'e1'. One such agent in forming the GDP is the institutional system, which exerts its regulatory effect in several areas, as underpinned by miscellaneous studies, too (Lekovic, 2013, Felméry, 2014). Although it has a direct influence on GDP

(with a 0.23 value), its aggregated effect, where the indirect effects of the institutional system also count, is more than twice as strong (with a 0.58 value. This overall impact is stronger than all the effects of technological readiness, which directly influences GDP with a 0.56 value. This indicates that the effect of institutional system is crucial in forming the GDP. As the strength of the two direct GDP forming factors are close to each other, the authors recounted the definition of Ian Bremmer, according to whom those countries are so called emerging where politics has at least as much effect on economics as market (Bremmer, 2009). Stonkiene expressly stated the importance of institutional system, starting from a completely different direction, by describing competitiveness factors through adapting Porter's diamond model (Stonkiene et al., 2015). Although it defines GDP directly, too, its effect through the indirect processes is much stronger. This fact is further indicated by the direct effect of technological readiness, which plays a major part in forming the GDP, being twice as strong on this area as political determinants. Nevertheless, factors influencing readiness are all subject to institutional regulation. The value of standardised full effect is 0.643, which indicates, on the one hand, a 2.8 times stronger indirect effect of institutions on GDP than the direct one, on the other hand, it indicates that institutional system is one of the direct determinants of GDP. The second direct determinant of GDP, other than institutions, is the degree of technological readiness; all other factors make an indirect impact on GDP merely influencing technological readiness. That is, efficiency of neither labour market nor commodity market affects GDP directly. The first one does not even affect in an indirect way. Accordingly, the question arises how efficacy of market of goods can influence the institutional system with its particularly strong effect (0.77). The authors explain this with the fact that the effectively working commodity market does not require institutional correction, moreover, it makes fiscal arrangements possible to be revised, and this approach allows a simplification of procedures vis-à-vis FDI or business creation. In this way, a more efficient restructuring of institutional system becomes possible. The authors mention, by way of illustrating institutional restructuring, that the Ministry of Foreign Affairs and Trade has been managing external economic issues and the Ministry of Finance has been directing internal economic trends in Hungary since 2010, while both economic sectors used to belong to a single ministry. The "institutions - infrastructure - commodity market efficiency - institutions" circuit seems to be a self-reinforcing dynamic, but this circle, having regard to the necessity that the institutional system be stabilised, will not, in fact, have a role in driving the GDP sharply up.

Tertiary education is the other field of investigation in this paper. In the light of the model, it is considered that this does not directly affect the evolution of GDP, only indirectly, through university-industry collaboration, talent nurturing and innovation. Although it has the strongest impact through the university-industry collaboration, it has, according to this model, an important role in selecting new talents, too, by whom university-industry collaboration gradually improves and the value of innovation index is anticipated to slightly pick up as well, nevertheless, growing talents, by increasing human capital, enhances efficiency of labour force the most, in respect of its direct effects. GDP growth via human capital is mentioned by other authors as well (Ali et al, 2016; Hanushek, 2016). On this point there has therefore been concluded a different result from Stonkiene's et al., since tertiary education, in their model, does not feature as an input but as an intermediary on grounds of several determining factors.

Innovation, which was also analysed by the authors, is situated at the centre of the model. Significant correlation has only been demonstrated in cluster 3 out of the ones created by the authors, which is the cluster of emerging countries. Recalling Bremmer's above mentioned definition, it seems that the model characterises primarily emerging countries, even though it was created by using data from all the countries ranked by WEF. This is not surprising, since developed countries move ahead mainly with their capital intensity, while low GDP makes every development impossible for developing countries. Innovation as a factor is established by the effect of a few other factors, and it is also responsible for developing further factors. It is influenced by the tertiary education - industry collaboration to the greatest extent in a direct way, the direct effect of tertiary education and talent nurturing is only one sixth and one eleventh respectively. However, innovation di-

rectly affects primarily infrastructure, as well as efficiency of commodity markets and technological readiness, and added to that, indirectly affects GDP, too. Nevertheless, innovation influences labour force effectiveness negatively. This was explained by the fact that innovation increases need towards more educated workers, hence its direct impact on labour market will be negative. Its additional adverse effect will be the development of inequality between workers with and without the right skills, as other authors mention it as well (Dachs, 2018). Relationships between innovation, tertiary education and competitiveness can be summarised based on to the model as follows: development of tertiary education does not directly increase GDP, its effects play an important role primarily in selecting talented innovators, thus, it has an indirect GDP increasing effect by promoting innovation. Innovation does not directly increase GDP either, but it makes its contribution through technological readiness. Although, apart from the model set out above, several other factors can play a decisive role, alignment and explanation of the model may be considered as quite good (table 8).

Table 8. Values characterising the compliance of the authors' model

Baseline Comparisons					
Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	0.919	0.807	0.921	0.810	0.920
RMSEA					
Model	RMSEA	LO 90	HI 90	PCLOSE	
Default model	0.197	0.189	0.205	0.000	

Source: calculation of the authors, using the IBM-SPSS Amos programme

Prior to the summary, partly to underpin its observations, the authors summarised relations between competitiveness and human factor in the countries under examination in Table 9.

Table 9. GCI and HDI ranks and scores in the countries examined

Country	GCI Rank (WEF)	GCI score (WEF)	HDI Rank (UN)	HDI Score (UN)
United States	3	5.70	13	0.924
Germany	5	5.57	5	0.936
Czech Rep.	31	4.72	27	0.888
Poland	36	4.56	33	0.865
Russian Fed.	43	4.56	49	0.816
Hungary	69	4.20	45	0.838
Montenegro	82	4.05	50	0.814
Serbia	90	3.97	67	0.787

Source: Schwab, 2017, UNDP, 2017

In Table 9 the authors compare the position of the examined countries in the WEF competitiveness ranking and in the UNHDI (Life expectancies, Schooling, GNI). They took the data of the final year of the study, 2017 as the basis for comparison. The values show the position among the countries of the world, and added to that, the position relative to the USA and Germany used as reference points.

CONCLUSION

The authors succeeded to detect significant correlation among competitiveness characterised by GDP per capita, tertiary education and innovation, out of the aims defined in chapter Theory and Questions. Relationship of tertiary education and GDP is significant in the cases of Poland, the Czech Republic, Russia and Hungary, while correlation between innovation and the GDP is significant in Serbia, Poland and Hungary. We succeeded to demonstrate significant correlation between tertiary education and innovation solely in Russia. It is clearly visible that significant investment into tertiary education in fact increases competitiveness, as scientific literature describes it as well. (Block and Khvatova, 2017; Alnafrah and Mouselli, 2019) It was successfully proven with Granger test that the increase in GDP per capita of the analysed countries affects both innovation and tertiary education positively. Causality link between tertiary education and innovation could be observed in both ways. Heterogeneity of the countries can explain the fact that the authors could not verify significant relationship between all observed factors. This heterogeneity manifests for example in the efficiency level how the different countries can utilise governmental expenditures for increasing their competitiveness. According to the cause and effect analyses, Poland and Hungary managed to be the most efficient in this sense during the period concerned. These countries developed their tertiary education and innovation capacity in parallel with the increase in GDP. Based on the model created by the authors, correlations are much more complex than this is visible from the Granger test. The authors also found a direct effect of governmental institutional system on competitiveness, but the same sector has a much stronger indirect effect through its contribution to the development of tertiary education, innovation and infrastructure. It is a further reasonable result of the model that neither innovation nor tertiary education affect GDP increasing directly, they enhance economic potential of the country only indirectly, through increasing technological readiness.

Competitiveness has become an important factor for every country because, in turn, wellbeing and prosperity can be created that governments owe their residents. Currently, economy is becoming knowledge-based in an increasing manner. This change can only be managed at an organisational level that skilled labour-force is becoming more and more useful for the employers. In this way, several old employees already lack those skills and knowledge that would be necessary when defining and distributing the tasks to be resolved. Continuous development of knowledge and skills is indispensable in performing efficiently in a workplace. Considering the deficiencies of tertiary education, that are already obvious today, training the employees has become the interest of companies as well, viz., they tend to even take over the costs of the education, as authors have already been reporting on the topic for years (Cappelli, 2011; Farndale et al., 2010; Ogundipe et al., 2018). Innovation is a typical trait of successful economy. It is a device which makes it possible for countries having been examined by the authors to become competitive against such countries that reach high quality owing mainly to their capital intensity, e.g. Germany and the USA, which were being used as reference countries in the analysis. These countries can finally get the opportunity to catch up with the cutting edge of economic competition through a significant amount of capital investment being focussed on education, R&D and innovation, without standards of living deteriorating substantially. The key role of innovation in competitiveness is emphasised by a few authors from recent scientific literature.

Governmental institutional system predominantly affects economic development of the countries being analysed. Its direct effect could also be detected by a model created by the authors. Yet, tertiary education and innovation takes effect solely indirectly on the GDP used for characterising competitiveness. That is, hypothesis H1 has partially been verified. The main role of the government is to create the most optimal conditions of economic growth: the infrastructural background, the educational system adjusted to present-day standards, added to a health care system and culture which can be a basis for workers' health condition necessary for their optimal performance. The authors haven't covered the topic of health; however, it seems to be a promising field of research as well. Insufficient public funding is a common problem in the analysed countries,

having effect in both tertiary education and the R&D sector. This financing could be completed by the OER system mentioned previously, which is open to everybody who is interested, whether it is a professor or a student. The online available software packages and contents can be shared, combined and freely applicable in the spirit of Creative Commons license. Cost-based view is not the only way for OER to be approached, nevertheless, the sum of user supports and the augmenting of free supply to be provided accordingly are important measures of success as well. Amount of income available for people having graduated from a given education is the milestone for success at the income-based approach. OER can also be perceived on a Community basis, regarding which the work of devoted collaborators can increase the headcount of the Community and broaden the number of services and contents. OER is currently supported by twenty-five countries at a governmental level, realising the significance in developing the suitable level of education and skills. Not only can the OER improve the competitiveness of a country and the quality of its tertiary education but it also increases the innovativeness of pedagogy. It is a positive tendency that the university-industry co-operation has been presenting a slow but continuous development in all the six examined Eastern European countries since 2013. This collaboration has proved to be particularly favourable in the case of Serbia and Hungary, although the changes in the Hungarian tertiary education in 2016 caused a little fallback. Integrating private sector into innovation processes (Private and Public Partnership - PPP) while utilising the inherent capital, knowledge and business morale could, in turn, provide a large impetus to each country based on the analysed data. Numerous other authors deal with this topic (Patrizii and Resce, 2015; Faboyede et al., 2015). It can be concluded based on the scores of both GCI and HDI that the examined countries stand very close to each other. Similar developmental and competitiveness values can indicate promising possibility for these countries to co-operate with and concentrate resources among each other. With the aid of this latter one, such developments become viable that can lead to substantially higher prosperity than one could expect it from the separate activity of these countries. Consequently, alliance and common innovation means one of the greatest alternatives to increase competitiveness for these countries. Unfortunately, economic power of the countries does not favour talents to be made stay at home, thus, this could not be realised with money but through creating an atmosphere that guarantees meritocracy and comfort. In the frame of the international platform, every country could add to the common goal what it can realise the best. The realising resource and capital concentration, in turn, could become appropriate for achieving a major headway in innovation, and thus increasing the competitiveness of the collaborating countries.

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