A COMPARATIVE STUDY OF INNOVATION CAPACITY FROM HUMAN CAPITAL PERSPECTIVE ON Regional LEVEL: STUDY OF SLOVAKIA[1]

M. Lučkaničová[2], Z. Maliková[3]

Abstract

The paper deals with innovation index related to existing US innovation index. The US Innovation Index provides comparison of innovation capacity of selected territorial entities.

This comparative study looks closer on one of the component sub - indices: Human capital. Both, theorists and policy - makers, too are aware of human capital which takes active role as catalyst for innovation. This is evident not only from researches but also from various indicators in which human capital represents one of the measured component. Such indicators tempt to measure innovation capacity or potential of given territory and allow making rankings among countries. The aim of this paper is to use Human Capital Index derived from US Innovation Index for Slovak regional comparison and to analyze ranking of countries of Visegrad Group from the same perspective.

The paper is organized as follows: first part deals with the role of innovations and knowledge within knowledge economy, supported by theoretical approaches about importance of human capital in the whole context. Second part dedicates to regional disparities of Slovak regions and innovation overview of selected countries based on diverse indices. Practical part provides methodology and descriptive analysis, supported by maps and calculations run in computing and graphics software R. The results exhibit regional diversity of innovation capacity among selected regions and Visegrad Group countries, too.

[1] This paper was supported by the project Economic efficiency of providing public services in municipalities of different population size in Slovakia supported by the Slovak Research and Grants Agency based on the contract VEGA 1/1046/11.

[2] Martina Lučkaničová, Faculty of Economics, Technical University of Košice, Slovakia, martina.luckanicova@tuke.sk

[3] Zuzana Maliková, Faculty of Economics, Technical University of Košice, Slovakia, zuzana.malikova@tuke.sk

Key words

Human Capital Index, US Innovation Index, innovation capacity, regional disparities

The role of innovation and human capital in knowledge economy

Benoit (2006) reflects that the early concept of knowledge and its relationship to statistics appeared in 1960s. This change was related to the advancement and support of new trends in economy.

American futurist Toffler (1991) has been describing changes in economies through concept of three waves, thus societies. The first wave was based on agricultural activities and was later replaced by second wave that reflected society developed during the Industrial Revolution. According to Toffler, such society can be described by “mass” element of many aspects of the life, e.g. mass production/ consumption/ distribution/ education/ media/ entertainment and mass destruction. Third wave, so called post-industrial society, started to take over in developed economies since the late 1950s and is described by terms as information age, space age, global village or electronic era. The intention of mentioned naming is to predict knowledge- based orientation, diversity and the acceleration of change.

Actually, knowledge has gained the attention as primary source, intangible asset or key factor of production from both, theorists and practitioners, too. (David and Foray: 2002, Truneček: 2004, Fernandez: 2004) Brinkley (2006) points out that knowledge economy depicts new emerging structure that originates from the position of intangible assets (e.g. knowledge, skills and innovative potential) in creation of wealth of nations.

It is evident that there is an increasing emphasis on more productive usage of intangible assets. This is provoked by the changing environment which Hawryskzkiewycz (2010) defines by following features; increasing globalization, ability of the companies to harness expertise from many parts of the world, the ability to market its product globally and the practice of more collaborative approach. David and Foray (2002) conclude that quality of human capital and the creation of new ideas (innovation) and knowledge are the drivers of progress that create disparities in the productivity and growth of different countries.

Authors conclude that innovations are recognized as driving tool for increasing competitiveness. (Chan and Mauborgne: 1999, Powell and Snellman: 2004)

Moreover, many researchers confirm the existence of tight connection between innovations and human capital. Nelson and Phelp (1996) integrated the idea that the adoption of new technology depends on capacity of human capital. They build on ideas that countries closer to the technology frontier have accumulated higher levels of human capital that was supported by innovation while countries far from the frontier focus on technology diffusion. It means that absorptive capacity of country is determined by level of education. Benhabib and Spiegel (1994) also build model of technology diffusion. They confirm statistically significant positive effect of human capital in connection with technology gap by using growth-accounting method. Another research by Xu (2000) affirms the importance of specific level of human capital in country to benefit from technology flows.

Politics realise that innovation and its many benefits are dependent on investments of time, effort and human resources and so they direct diverse strategies on international and national levels towards encouragement of innovative environment reflected in such visions as: ensuring sustainable economic growth, future prosperity or creating jobs and industries of the future (*Strategy for American Innovation*[4]), concentrating on productivity and social cohesion (*Europe 2020*[5]), supporting the creation of knowledge economy by establishing stronger links between R&D sector and companies and implementation of e-government tools (Polish government program “Directions to Improve Innovation in the Economy 2007-2013”), etc. Fulfilment of visions is monitored by diverse goals in which human capital takes almost constant role, e.g. human capital is considered to be important input to innovation in Europe 2020 where one of target is related to education; “*reducing school drop-out rates below 10% and at least 40% of 30-34 years-olds completing third level education*[6].”

There are several indices that attempt to measure innovation on national levels. This approach allows politicians and academics to understand the position of a country among selected cluster, create comparisons and diverse rankings. Example of such indices are; Summary Innovation Index (SII), US Innovation Index, National Innovative Capacity Index (NICI), Global Innovation Index (GII), Creative Class or Knowledge Economy Index, etc.

In this paper we use methodology of Human Capital Subindex of US Innovation Index to evaluate human capital from innovation capacity perspective of Slovak republic and others members of Visegrad group (Hungary, Poland, Czech Republic). We also apply given Subindex

[4] White House: Strategy for American Innovation: Executive Summary
5 European Commission (2012): Europe 2020
6 European Commission (2012): Europe 2020 targets

to Slovak regions[7] with aim to analyze territorial disparities from innovative perspective. According to NUTS 3 system, Slovakia has eight following regions: Bratislava region, Trnava region, Trenčín region, Nitra region, Žlina region, Banská Bystrica region, Prešov region and Košice region.

US Innovation Index assesses innovation capacity of US countries, regions and departments. It has already been monitored for 25 years and it is used for cross country comparison in order to offer insights into regional development of knowledge-based innovation economies. As it is promoted, the purpose of this tool is "*to help a region guide strategic discussions about where to invest scarce resources to build prosperity for the next generation*".

Innovation index is composed of following four sub- indices: Human capital, Economic Dynamics, Productivity and employment and Economic Well Being.

Innovation overview of selected countries and disparities of Slovak regions

Banerjee and Jarmuzek (2009) analyze various dimensions of Slovak regions disparities and confirm dimension and persistence of disparities during 1995 - 2006. Based on the per capita GDP, they divide country into two groups; richer western regions (Bratislava, Trnava, Trenčín and Nitra) and poorer eastern regions (Žilina, Banská Bystrica, Prešov and Košice), with illustration of the highest distinctness present between Bratislava (per capita GDP about 234%) and Prešov (per capita GDP about 55%) of the national average in 2006. For more details, see Regional GDP per capita, in percentage of Slovak average.

Table 1 Regional GDP per capita, in percentage of Slovak average

	1995	2000	2001	2002	2003	2004	2005	2006
Bratislava region	214	217	220	226	225	226	243	234
Trnava region	110	105	102	100	104	105	108	122
Trenčín region	94	94	94	91	92	93	88	93
Nitra region	86	87	85	85	87	88	89	86
Žilina region	81	82	83	82	80	81	82	81

[7]According to Nomenclature of territorial units for statistics used by Eurostat, European Commission (2012)

Banská Bystrica region	83	83	84	86	86	82	72	74
Prešov region	64	61	61	62	61	60	59	55
Košice region	87	90	93	90	89	88	84	84

Source: Statistical Office of the Slovak Republic

Moreover, by using the coefficient of variation over time, they identified that the dispersion remained stable during 1995 – 1999. However, after stated period it started to widen and the accession of Slovakia to European Union (EU) in 2004 even fostered it. This is supported by dimensions as: household disposable income, already mentioned per capita GDP, productivity level (except for Košice, with 96% of Slovak average in 2006 it stands apart from other eastern region and represent third highest productivity level in the country) and labour utilization manifested in unemployment (e.g. unemployment rate in Bratislava decreased from 6% in 1998 to 4.3% in 2006, which coincides with 66.6% of labour utilization in 2006; in Kosice unemployment rate increased from 18.7% in 1998 to 20.3% in 2006, which coincides with 34.5% of labour utilization in 2006).

They identify that "*total factor productivity improvements in the western regions could be related to the technology and knowledge spillover aspects of foreign direct investments (FDI), while the gains in the eastern regions likely resulted from the restructuring process and labor shedding."* (Banerjee, Jarmuzek, 2009, p.16).

Stimulating employment growth in eastern regions should be realized by improvements of quality and accumulation of both, human and physical capital, too. Baláž (2006) uses a regression model for identifying major factors that are behind regional disparities in relation to regional average wages. Those factors are: tertiary education levels, unemployment rates, investments and foreign investors.

Innovation policy of each country is oriented on weaknesses of innovation performance. Slovak republic is characterized by low volume and low quality of R&D activities, low cooperation between firms and universities in a Research and Development (R&D) field, low engagement of Slovak firms in R&D, poor innovation policy tools[8].

[8] Pro Inno Europe 2011. Innovation and Innovation policy in Slovak republic. Available at:http://www.proinno-europe.eu/page/innovation-and-innovation-policy-slovak-republic

In Czech Republic three main problems were discovered: low cooperation between firms and researchers, lack of researchers and science and engineering (S&E) graduates, insufficient intellectual property rights (IPR) protection[9].

According to OECD report, Hungary demonstrates also poor spending on R&D. Moreover, IPR indicators such as patenting are low, most technologies and knowledge are imported, only each fifth firm is innovative and there were identified huge regional disparities of R&D resources and performance[10].

Poland has one of the lowest R&D intensities in EU, private sector invest poorly in R&D and number of scientific publications and patent application is under EU average[11].

There are several different indices which measure countries innovation potential or capacity, e.g. Summary Innovation Index (SII, it rates 27 countries for years 2009/2010), National Innovative Capacity Index (NICI, it rates 71 countries in 2001), Innovation Capacity Index (ICI, it rates 131 countries for years 2009/2010) and Global Innovation Index (GII, it rates 125 countries in 2011). They slightly differ in the factors from which are composed and the methodology of how are calculated. However, human capital enters to some extent to all of them. Indices on national levels allow us to rank the countries and compare their capacity among other countries. In the following Table 2, the ranking of Visegrad Group countries is demonstrated within previously mentioned indices. In the table is also shown the position of countries from the perspective of human capital (HC) that enters as input factor to all used indices (e.g. HC_{SII} represents human capital (HC) factor calculated according to methodology of Summary Innovation Index and so on representatively). The worst positions among Visegrad Group countries are marked in bold.

Table 2 Ranking of countries from Visegrad Group within chosen indices and human capital as input factor

	SII	HC_{SII}	NICI	HC_{NICI}	ICI	HC_{ICI}	GII	HC_{GII}
Czech Republic	17	18	26	**36**	32	25	27	28
Slovak Republic	22	11	34	26	39	31	37	46
Poland	**23**	14	**36**	32	40	**39**	**43**	**48**

9 Pro Inno Europe 2011. Innovation and Innovation policy in Czech republic. Available at http://www.proinno-europe.eu/page/innovation-and-innovation-policy-czech-republic

10 OECD 2007. National system of innovation in Hungary. Available at: *www.nih.gov.hu*

11 European Commission 2011. Innovation Union Competitiveness report 2011. Available at: http://ec.europa.eu/research/innovation-union/pdf/competitiveness-report/2011/countries/poland.pdf

Hungary	19	**21**	28	34	**41**	30	25	36

Source: Authors' calculation based on data Inno Europe, OECD reports

Data and Methodology

As it was proved by theorists and quantitative researches in the previous part, human capital enters into economy as important factor that influences competitiveness of the countries. Taking into consideration this reason and possible available data on regional level in Slovak republic, we have decided to calculate Human Capital Index (HCI) that derives from US Innovation Index as its sub-index.

Human Capital Index calculates to which extent inhabitants of specific region are able to engage in innovation activities. Applying same methodological approach as US Innovation Index uses (with some minor changes explained below) we calculate four dimensions that enter to the HCI by equal weight. Data from various databases were used for whole quantitative analysis; from Slovak statistical database for calculation of HCI for diverse regions in Slovakia and from Eurostat database for calculation of HCI for Visegrad Group. The aim was to ensure the usage of same data collection´s methodology and so avoid possible mismatch created by diverse approaches to data collection. We have also used data from International Labour Organization (ILO[12]) for quantification of creative class dimension on national level (applied to Visegrad Group). Analytical part was based on calculations and supporting maps run in computing and graphics software R.

Human Capital Index consists of following dimensions:

- **Education –** it attempts to measure the skills and knowledge as necessary input to population's capacity to innovate. US Innovation Index considers number of absolvent with college degree or higher. For the purpose of our analyze we consider number of absolvent from the groups ISCED 5 and above. ISCED represents international standards classification of education[13] and is basically a framework for the standardized reporting of a wide range of policy relevant education statistics according to an internationally agreed set of common definitions. ISCED 5 and 6 represents first and second stage of tertiary education. ISCED 7 represents master degree or its equivalent.
  It is measured as the percentage of population aged 25 to 64 with tertiary education completed in given territorial unit. It is measured as:

[12] ILO International Labour Office 2012. LABORSTA internet database
[13] UNESCO (2011). Revision of the international Standard classification of education ISCED

$$\mathrm{PERaTER}_{\mathrm{i,t=lya}} = \frac{\mathrm{TER}_{\mathrm{lya}}}{\mathrm{POP}_{\mathrm{lya}}}$$

Where;

TER_{lya} = *Number in population with tertiary education completed*

POP_{lya} = *Population in given territorial unit aged 25 to 64*

- $PERaTER_{i,t=lya}$ on regional level of Slovakia, the TER_{lya} uses data from the 2001 Census as the latest year available (with tertiary education completed, which corresponds to ISCED 7 and ISCED 8).
- $\mathrm{PERaTER}_{\mathrm{i,t=lya}}$ on national level for all countries of Visegrad Group was based on data from Eurostat, with tertiary education completed corresponding to ISCED5 or ISCED 6, lya for data is 2010.

- **Population growth rate –** it is measuring the growth rate of persons aged 25 to 64 because younger group is most likely involved in the educational process and older group represents retirement age.

$$POPgrow_i = \frac{\ln(POP_{t=lya}) - \ln(POP_{t=2001})}{lya - 2001}$$

$POPgrow_i$ *data for regional level of Slovakia were used from Slovak statistical database*

$POPgrow_i$ *data for national level for all countries of Visegrad Group were used from Eurostat database*

- **Occupational mix –** it attempts to measure number of employees aged 25 to 64 who work in the so called “creative occupations.” Creative occupations are socioeconomic classification that was introduced by Boschma and Fritsch (2007). They select those occupations which are identified as key driving force for economic development of post-industrial economies (creative occupations are listed in the appendix).

  Occupational mix derives from “Technology – Based Knowledge Occupation Cluster (KOC) within US Innovation Index that measures share of technology – based cluster jobs for the latest year available. Clusters are defined as “groups of related industries operating in a given location with the impact on economic performance” that stimulate and revitalize cooperation in the business environment and emerge from two principal forces:

agglomeration and convergence (Porter et al., 2011, pp.1). However, as Bialic-Davendra (2011) investigates, the technology clusters in Visegrad Group are still young concept and there are many issues to be improved on the levels of both, the policy makers and clusters themselves, too in order to develop intense inter and cross- cluster cooperation and so become more competitive.

Therefore, under mentioned conditions, we have decided to apply occupational mix as the antecedent of KOC for the analysis, calculated as:

$$CREAT_{i,t} = \frac{CREATemp_{lya}}{TOTemp_{lya}}$$

Where;

$CREATemp_{lya} = Number\ of\ creative\ occupations\ employment\ for\ the\ last\ year\ available$

$TOTemp_{lya} = Total\ employment\ for\ the\ last\ year\ available$

- $\mathrm{CREAT}_{\mathrm{i,t}}$ on regional level of Slovakia was adopted from the calculations of Blahovec (2010), whose research was based on data from Slovak statistical database, lya 2008[14].
- $\mathrm{CREAT}_{\mathrm{i,t}}$ on national level for all countries of Visegrad Group was based on data from International Labour Organization, lya 2001.

- **High – Tech employment Share** – it attempts to measure number of highly skilled and specialized workforce (who works in the High Tech industry) that represents an important source for contribution to innovation.

$$AVERHTshare_i = \frac{\sum_{2008}^{lya} HTE_t}{\sum_{2008}^{lya} TOTemp_t}$$

Where;

$HTE_t = High\ tech\ employment\ in\ year\ t$

$TOTemp_t = Total\ employment\ in\ year\ t$

- $\mathrm{AVERHTshare}_{\mathrm{i}}$ data for regional level of Slovakia were used from Slovak statistical database, lya 2009. Data collection of employment in High tech sector in Slovak regions by Slovak national statistics was realized only once within period 2008 and

[14] Slovak statistical database provide such kind of data only for enterprises with more than 20 employees.

2009. The Slovak Statistic Office confirmed that it does not plan to repeat this kind of data collection.

- $\mathrm{AVERHT}share_{\mathrm{i}}$ data for national level for all countries of Visegrad Group were used from Eurostat database, lya 2010.

Final HCI on Slovak regional level is calculated as:

$$HCI_{Slovakia} = 100 \times \sum_{i=1}^{n} \alpha_1 \left(\frac{x_{ij}}{x_{i\ aver}}\right) \dots \alpha_n \left(\frac{x_{nj}}{x_{j\ aver}}\right)$$

Where;

$HCI_{Slovakia}$ = *Human Capital Index for Slovakia*

n = *number of dimensions that enters to the HCI, that are four*

X_{ij} = *i-th variable (or measure) region j relative to the Slovak average for variable* $X_{i\ aver}$

α = *the weight of the ration (each component influences HCI equally, 25%) for the i-th variable*

Final HCI of countries of Visegrad Group is calculated as:

$$HCI_{VG} = 100 \times \sum_{i=1}^{n} \alpha_1 \left(\frac{x_{ij}}{X_{i\ Slovakia}}\right) \dots \alpha_n \left(\frac{x_{nj}}{x_{j\ Slovakia}}\right)$$

Where;

HCI_{VG} = *Human Capital Index for countries of Visegrad Group (VG)*

n = *number of dimensions that enters to the HCI, that are four*

X_{ij} = *the i-th variable (or measure) country j relative to the Slovak average for variable* X_i

α = *weight of the ration (each component influences HCI equally, 25%) for the i-th variable*

Results

It is assumed that the Innovation Index and its sub-indices are based on theoretical assumptions of the factors that have statistically significant impact on economical performance.

Based on these assumptions, thus the usage of Innovation index, we concentrate on the analysis of components and not the theories themselves on innovation capacities.

Analytical part is divided into two parts; first one concentrates on the innovation capacity from human capital perspective in the regions of Slovakia and second part provides the comparison of Human Capital Index valuation within Visegrad Group countries.

In Table 3 there are values of Human Capital Index (see column "HCI") for all eight regions of Slovakia. Moreover, table contains the values of all dimensions of regions that enter to the calculation of HCI. The measures clearly demonstrate the degree of similarity/ disparity between the regions, e.g. Bratislava region has much higher educational attainment (30.32%) than the country's average (14.83%). All dimensions of HCI and their values/ regions are presented in following maps where colour diversity demonstrates the differences among the regions (Map 1 and Map 2).

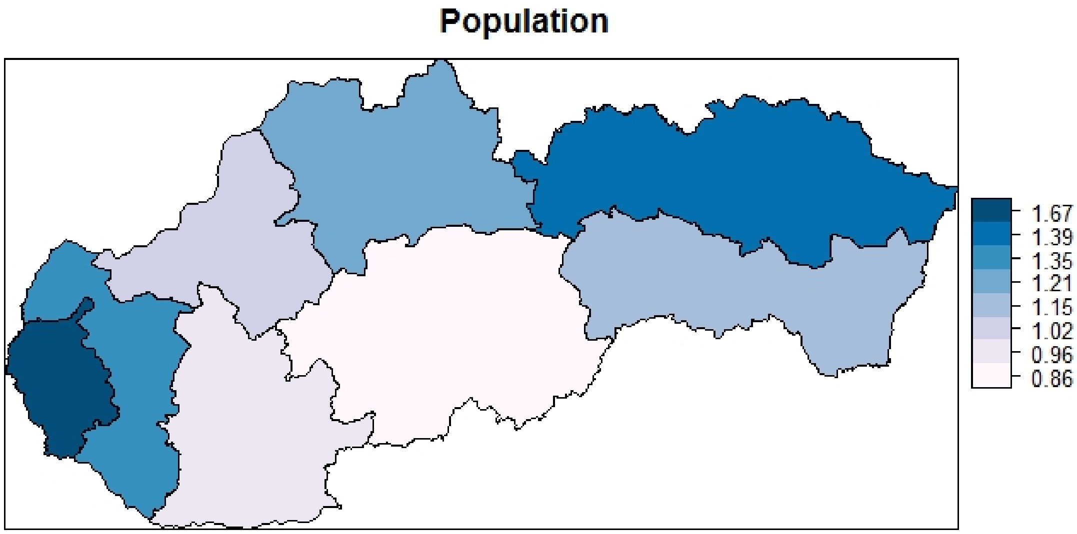
Table 3 Comparison of Human Capital Index values among Slovak regions

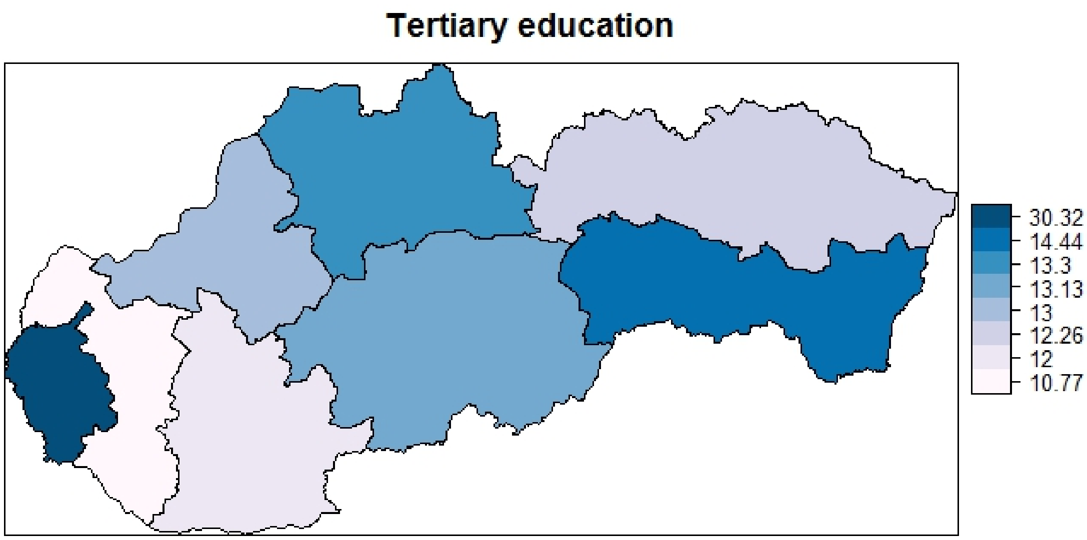
	Population growth rate	Educational attainment	Creativity	High-tech	HCI
Bratislavský kraj	1.67%	30.32%	11.37%	5.57%	180.11
Trnavský kraj	1.35%	10.77%	5.63%	3.25%	97.94
Trenčiansky kraj	1.02%	13.00%	4.11%	1.44%	71.38
Nitriansky kraj	0.96%	12.00%	5.93%	2.18%	81.97
Žilinský kraj	1.21%	13.30%	6.29%	1.74%	86.15
Banskobystrický kraj	0.86%	13.13%	5.02%	0.71%	63.91
Prešovský kraj	1.39%	12.26%	4.26%	0.78%	71.66
Košický kraj	1.15%	14.44%	9.23%	1.80%	97.25
Slovakia	**1.20%**	**14.83%**	**7.50%**	**2.48%**	**100**

Source: Authors' calculation based on data from Slovak statistical office

Population growth rate of working persons aged 25 to 64 achieves the highest value in Bratislava region (1.67%) and the lowest in Banská Bystrica region (0.86%). As it is shown in the table, all factors from HCI reaches the highest points in Bratislava region. This can be partially explained by the fact that the capital is situated in this region.

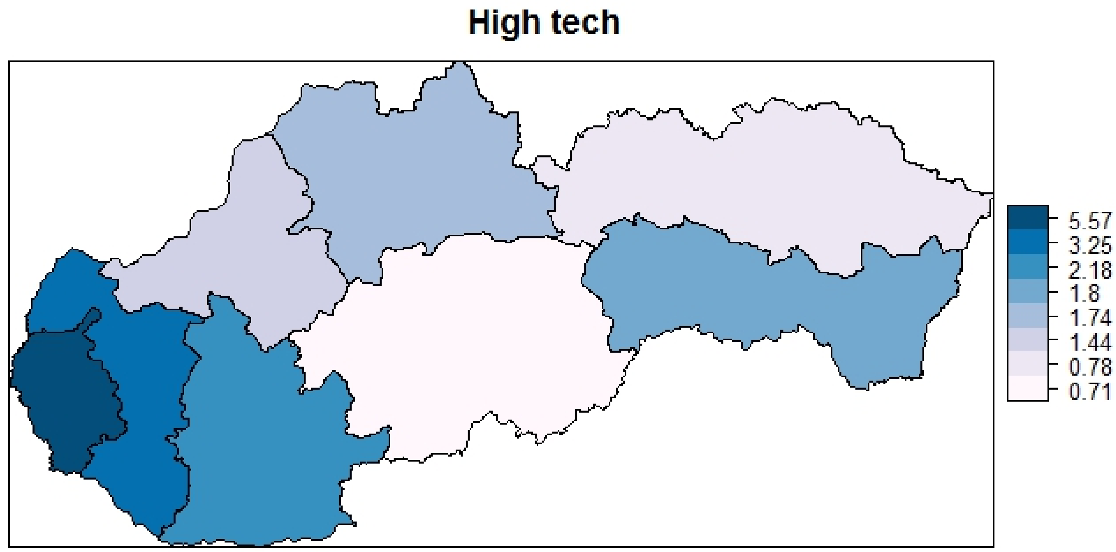
Map 1 Diversity of Slovak regions from the perspective of Population and Tertiary education

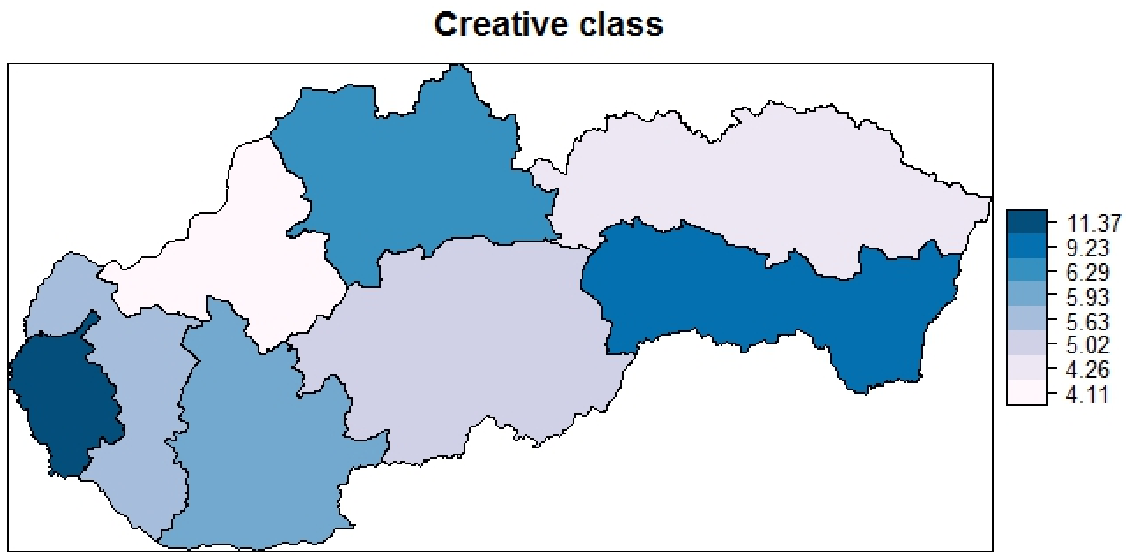




Educational Attainment is concentrated on evaluating the percentage of population aged 25 to 64 with higher degrees completion (ISCED 7 on regional level). Bratislava region peaks more than 30% and the rest of the regions lag behind it for almost 15%. The view on overall situation in Slovak regions just demonstrates the discussed need for actions, deriving and supported also from Europe 2020, towards increasing number of tertiary educated habitants.

Map 2: Diversity of Slovak regions from the perspective of High Tech and Creative occupations



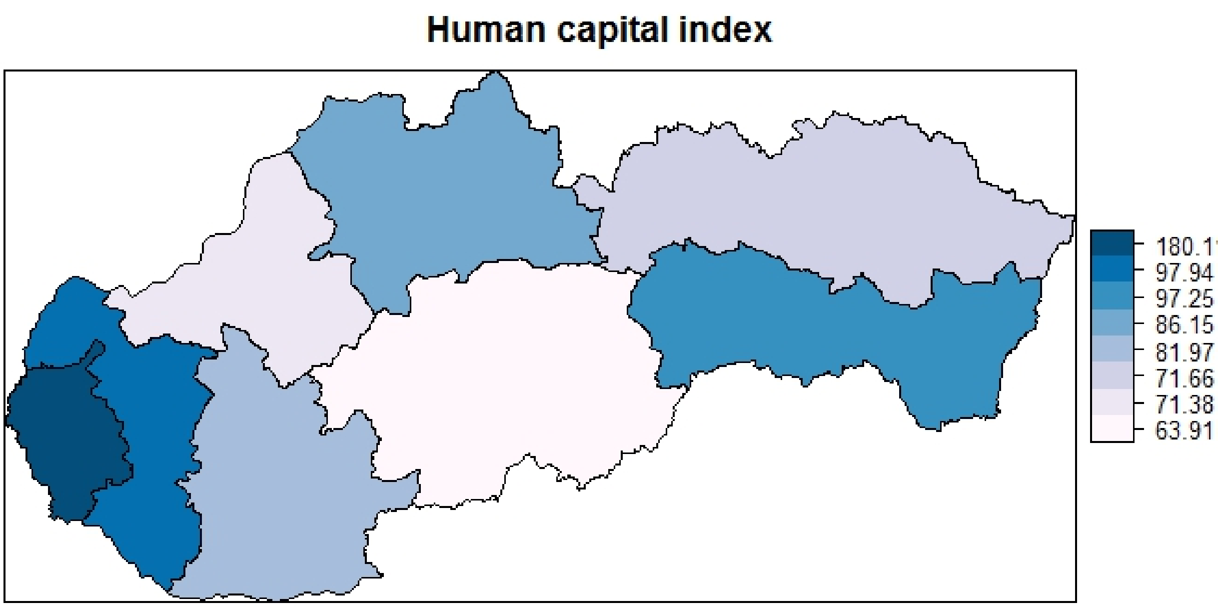


A view on **Creative occupations** ranking differences reveals both, areas of strengths and weaknesses, too. Prešov region with 4.26% lags behind all Slovakia´s regions, while the highest valuation receives Bratislava region again with 11.37%. Second position is occupied by Košice region with 9.23% (second largest city of Slovakia is situated in this region). The rest of regions reached around 5% of employees in creative occupations. The average rating of Slovak republic within creative occupations factor is 7.5%.

The last factor of Human Capital Index is percentage of population working in **High - tech sector**. The worst values obtained Prešov region with 0.78% and Banská Bystrica region with 0.71%. There is a huge gap between the worst values and the best ones. Bratislava region achieved 5.57% of employees working in High - Tech sector and Trnava region stayed behind it with 3.25%.

The last column of Table 3 demonstrates the overall Human Capital Index. According to valuation of HCI, only Bratislava region achieved a value over the 100% (which represents the national average). There are two regions which stayed closely behind, namely: Trnava an Košice regions. The rest of regions lagged behind, achieving from almost 87% to 71% of national average (see Map 3).

Map 3 Human capital index of Slovak regions



Relative ranking of Human Capital Indices of countries from Visegrad Group is shown in Table 4. Despite observed differences in all factors of HCI, the Human Capital Index also shows interesting differences. HCI of Czech Republic, Hungary and Poland were calculated as relative indices to HCI Slovak [15]value (that means that $HCI_{Slovakia}$ served as base for calculations,

[15] Please note that values of components of $HCI_{SLovakia}$ are different to those of $HCI_{SLovakia}$ measured within regional analysis. This derives from different data usage (for the comparison of Visegrad Group, it was desirable to use same databases, mainly Eurostat and ILO) and from different timeseries (last years available).

hence 100%). Interesting results derives from the fact, that all other countries form Visegrad Group achieved lower values than $HCI_{Slovakia}$. Although, Czech Republic and Hungary received very similar values, it was Poland that approached Slovak HCI closer (94.55%).

For the purpose of HCI_{USA} calculation we have used the online quantifier that is located on web page: www.statsamerica.com. As the results showed, USA reached almost 210% of Slovak HCI value.

Table 4 Human Capital Index of countries of Visegrad Group and USA

Visegrad group	Population growth rate aged 25-44	High tech	Creativity	Education	Human capital index to SR
Czech Republic	0.86%	4.03%	8.30%	16.78%	**92.21**
Hungary	0.27%	4.93%	8.63%	19.95%	**92.61**
Poland	1.06%	2.67%	8.21%	22.57%	**94.55**
Slovakia	1.30%	3.63%	8.58%	17.71%	**100**
United states	-0.2%	4.8%	8.4%	26.6%	**209.93**

Source: Authors' calculation based on data from Slovak statistical office, Eurostat and ILO

Conclusion

In this study we applied Human Capital Index derived from US Innovation Index to quantify both, the value of HC on regional level in Slovakia (according to NUTS 3 classification) and the value of HC on national level to compare the position of Slovakia among other countries from Visegrad group, too. Human capital (skilled, educated, motivated and conscious workforce) was identified as an important and integral part of innovations, which enters further into creation of knowledge economies and thus knowledge societies.

It is generally known that Slovak republic does not support research and educational activities to such extent as strategic project Europe 2020 recommends to EU member states. Moreover, country faces not only weak innovation performance but also suffers from relative large disparities on regional level. From this point of view, HC computed on regional level demonstrate huge gap between highest value of HCI for Bratislava region with 180.11% over the national average (only one region achieved value over 100%) and lowest value of HCI for Banska Bystrica region with 63.91% what is under national average (100%). Our findings partially support results of research Banerjee and Jarmuzek (2009) which divide Slovakia into two groups of regions.

The article provides comparison of V4 countries position within chosen indices measuring innovation potential. According to SII and NICI, Slovak republic has better position in a human capital than other countries of V4. It was confirmed also by our calculation of Human capital index from US innovation index methodology (see Table 4). There is, however, some disagreement in the case of ranking of ICI and GII, as Slovak republic and Poland are on much more lower positions than Hungary and Czech Republic (see Table 2). Proof of huge gap of human capital quality between USA and countries of Visegrad group is also the result of conducted research. USA reached almost 210% of Slovak HCI value, whereas countries of Visegrad group achieved lower values than Slovak HCI (see Table 4).

One of possible explanation of obtained result is that US states are states where democracy have been presented for longer time and so it helped to create a market supportive environment. Whereas Slovak republic and Visegrad group countries are representative countries of CEE part. E.g. Slovak economy passed through administrative transformation only in 1989.

The analytical potential of next research derives principally from availability of latest statistical data. It would be helpful and more explanatory to add higher levels of ISCED to the model, as they were not available at the time of this analysis.

Next research could focus on calculation of whole US indicator for European countries, to compare results and ranking by American methodology and European methodology. It would be helpful to analyze indices over time to see the dynamics and changes within European countries.

Furthermore, type of the comparative study that has been conducted in this paper has relevance for creation of both, national and regional innovation policies, too. The article points to international and regional disparities and similarities in innovation performance and so offers a scope for mutual learning from experience.

References

(1) Baláž, Vladimír (2006): Strategic Evaluation on Innovation and the knowledge based economy in relation to the Structural and Cohesion Funds, for the programming period 2007 – 2013. Report to the European Commission. Available at: http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/evalstrat_innov/slovakia.pdf (12.01.2012)

(2) Banerjee, Biswajt – Jarmuzek, Mariusz (2009): Anatomy of Regional Disparities in the Slovak Republic. International Monetary Fund Working Paper. WP/ 09/ 145. Available at: http://www.imf.org/external/pubs/ft/wp/2009/wp09145.pdf (27.12.2011)

(3) Benhabib, Jess – Spiegel, Mark (1994): The role of human capital in economic development: Evidence from aggregate cross- country data. In Journal of Monetary Economics. Vol.: XXXIV. No.: 2, pp.: 143 – 174.

(4) Benoit, Godin (2006): The Knowledge-Based Economy: Conceptual Framework or Buzzword? In The Journal of Technology Transfer. Vol.: XXXI, No.: 1, pp.: 17- 30. Available at: http://www.springerlink.com/content/f618u87350jp768q/ (19.02.2012)

(5) Bialic-Davendra, Magdalena (2011): Concept of World- Class Clusters in Europe – A Case Study of the Visegrad Group of Countries. In Journal of Competitiveness. Vol.: II. Available at: http://www.cjournal.cz/index.php?hid=archiv&SET_LANG=en&bid=&cid=&cp= (12.12.2011)

(6) Blahovec, Radoslav (2011): Ekonomická analýza kreatívnej triedy na slovenku podľa regiónov. In proceedings from Young Scientists Conference in Herlany, October 2011. Available at: http://www3.ekf.tuke.sk/mladivedci2011/herlany_zbornik2011/blahovec_radoslav.pdf (03.01.2012)

(7) Boscham, Ron and Fristch, Michael (2007): Creative Class and Regional Growth in Europe. In Jena Economic Research Paper No. 2007-066. Available at: http://www.wiwi.uni-jena.de/uiw/publications/pub_since_2004/2007/Boschma%20&%20Fritsch%20Creative%20Class%20and%20Regional%20Growth%202007.pdf (13.01.2012)

(8) Brinkley, Ian (2006): Defining the knowledge economy: Knowledge economy programme report. In The Work Foundation. London. Available at: http://www.theworkfoundation.com/assets/docs/publications/65_defining%20knowledge%20economy.pdf (15.02.2012)

(9) David, Paul, A. - Foray, Dominique (2002): Economic fundamentals of the knowledge society. Working Papers 02003, Stanford University, Department of Economics. Available at: http://129.3.20.41/eps/dev/papers/0502/0502008.pdf (11.02.2012)

(10) European Commission (2012): Europe 2020 targets. Available at: http://ec.europa.eu/europe2020/reaching-the-goals/targets/index_en.htm (03.01.2012)

(11) European Commission (2012): Europe 2020. Available at: http://ec.europa.eu/europe2020/index_en.htm (03.01.2012)

(12) European Commission (2012): Nomenclature of territorial units for statistics. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction (03.01.2012)

(13) European Commission 2011. Innovation Union Competitiveness report 2011. Available at: http://ec.europa.eu/research/innovation-union/pdf/competitiveness-report/2011/countries/poland.pdf

(14) Fernandez, Irma- Bacerra et al. (2004): Knowledge Management: Challenges, Solutions, and Technologies. Ney Jersey: Pearson Education.

(15) Hawryszkiewycz, Igor (2010): Knowledge Management: Organizing Knowledge Based Enterprises. New York: Palgrave Macmillan.

(16) ILO International Labour Office 2012. LABORSTA internet database. Available at: http://laborsta.ilo.org/default.html

(17) InnoMetrics 2012. Innovation union scoreboard 2011. Available at: http://www.proinno-europe.eu/inno-metrics/page/innovation-union-scoreboard-2011

(18) INSEAD Business schol of the World. The Global Innovation Index 2011. Available at: http://www.globalinnovationindex.org/gii/main/analysis/rankings.cfm#CGI.SCRIPT_NAME#

(19) Kim, W. Chan – Mauborgne, Renée (1999): Strategy, Value Innovation, and The Knowledge Economy. In Sloan Management Review. Spring 1999. pp. 41-54. Available at: http://jpkc.zju.edu.cn/k/439/download/ktsj/04.pdf (08.01.2012)

(20) Lopéz-Claros a Mata, 2002. The Innovation Capacity Index: Factors, Policies, and Institutions Driving Country Innovation. In The Innovation dor Development Report 2009-2010. Palgrave Macmillan. Dostupné na: http://www.innovationfordevelopmentreport.org/Report2009/papers/101_LopezClaros_Mata.pdf

(21) Nelson, Richard – Phelps, Edmund (1996): Investment in humans, technology diffusion and economic growth. In American Economic Review, Papers and Proceedings. Vol.: LI.

No.: 2, pp.: 69 – 75.

(22) OECD 2007. National system of innovation in Hungary. Available at: www.nih.gov.hu

(23) Porter a Stern, 1999. The new challenge to America’s prosperity: Findings from the Innovation index.Washington, D.C.: Council on competitiveness. Available at: http://www.isc.hbs.edu/Innov_9211.pdf

(24) Porter, Michael et al. (2011): Clusters, Convergence, and Economic Performance. In US Census Bureau Center for Economic Studies Paper No. CES-WP- 10-34. Available at: http://www.isc.hbs.edu/pdf/DPS_Clusters_Performance_2011-0311.pdf (02.01.2012)

(25) Powell, Walter W. – Snellman, Kaisa (2004): The knowledge economy. In Annual Review of Sociology. Vol. XXX. pp. 199-220. Available at: http://www.stanford.edu/group/song/papers/powell_snellman.pdf (15.12.2011)

(26) Pro Inno Europe 2011. Innovation and Innovation policy in Czech republic. Available at http://www.proinno-europe.eu/page/innovation-and-innovation-policy-czech-republic

(27) Pro Inno Europe 2011. Innovation and Innovation policy in Slovak republic. Available at:http://www.proinno-europe.eu/page/innovation-and-innovation-policy-slovak-republic

(28) Statistical Offices of the Slovak republic. Statistical database. Available at: www.statistics.sk

(29) Toffler, Alvin (1991): Powershift: Knowledge, Wealth and Violence at the Edge of the 21st Century. New York: Bantam.

(30) Truneček, Jan (2004). Management znalostí. Praha: C.H.Beck.

(31) UNESCO (2011). Revision of the international Standard classifiction of education ISCED. Available at: http://www.uis.unesco.org/Education/Documents/UNESCO_GC_36C-19_ISCED_EN.pdf

(32) White House: Strategy for American Innovation: Executive Summary. Available at: http://www.whitehouse.gov/innovation/strategy/executive-summary (05.01.2012)

(33) Xu, Bin (2000): Multinational enterprises, technology diffusion, and host country productivity growth. In Journal of Development Economics. Vol.: LII.pp.: 477 – 449. Available at: http://in3.dem.ist.utl.pt/master/03econ/lecture_5.pdf (11.01.2012)

Appendix1: Groups of creative people according to Bosch and Fritsch (2007) and their corresponding ICSO, *International Standard Classification of Occupations* (ISCO 88).

Creative core occupations	**ISCO**
physicists, chemists and related professionals	211
mathematicians, statisticians and related professionals	212
computing professionals	213
architects, engineers and related professionals	214
life science professionals	221
health professionals (except nursing)	222
college, university and higher education teaching professionals	231
secondary education teaching professionals	234
other teaching professionals	235
archivists, librarians and related information professionals	243
social sciences and related professionals	244
public service administrative professionals	247