Human Capital and Regional Growth Perspective

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Abstract

Accumulation of human capital is one of the major determinants of economic growth. In the last decades, theoretical and empirical literature has analysed this issue at regional level, providing interesting results. The analysis focuses on 35 regions of the Visegrad Group (NUTS 2 level) in 2002–2009 and is based on Eurostat Regional Statistics. The objective was to compare competitiveness and human capital intensity in the Visegrad Group regions, verify the existence of correlation and thus potential human capital growth effects. The analysis comprised two groups of indicators: measures of competitive position and human capital education indicators, as measures of competitive ability. The results showed that there have been and continue to be substantial differences among the regions as regards competitiveness and human capital. According to the correlation results, one can suppose — following the research assumptions — that human capital could have positive impact on regional competitiveness in the Visegrad countries in 2002–2009. However, one cannot forget that the relation between wealth and human capital can be reverse. Level of wealth and structure of the regional/local economy could affect the level and quality of human capital. Regardless of this, in the case of Visegrad Group regions, further econometrical research is still needed.

1 Regional competitiveness and human capital: theoretical considerations

The notion of competitiveness has become important in urban, regional, and national economic analysis and policy. There exists a large body of literature which states that "regions are an important resource of competitive advantage in a world of stronger interregional competition" (Boschma 2004, 1002). There is still no accepted consensus on the definition of regional (place/territorial) competitiveness (Gardiner, Martin, and Tyler 2004; Krugman 2003; Porter 2003; Golejewska 2012a). Regional competitiveness is neither a macroeconomic (national) nor a microeconomic (firm-based) issue, because regions are neither simple aggregations of firms nor scaled-down versions of nations (Cellini and Soci 2002). The export base of a region has long been viewed as key to regional prosperity (Gardiner, Martin, and Tyler 2004). Contrary to this approach, Krugman and Porter suggest that the best measure of competitiveness is productivity. Krugman states that regional competitiveness has more to do with absolute advantage than with comparative advantage. If a region is more productive, it attracts labour and capital from other regions, which tends to consolidate its "absolute productivity lead." According to Krugman, the starting point of comparative regional analysis should be relative aggregated productivity measured as: GDP per capita, GDP per worker, and employment rate. The relative changes of economic performance should in turn reveal dynamic competitive advantages of regions. However it is questionable as to whether a region is highly productive because it is competitive or it is competitive because it is productive. In reality, regional competitiveness should be regarded as "an evolving complex self-reinforcing process, in which outputs themselves become inputs, and thus influence future outputs" (Krugman 2003, 17–20). It does not suggest that export performance of regions is unimportant. Competition

between regions may exclude a region from an industry in which it could have established a comparative advantage, or drive a region from an industry in which comparative advantage could have been maintained. Regional competitive advantage is both absolute and comparative in nature. Productivity influences not only comparative advantage of a region's export sectors, but also other industries and services (Gardiner, Martin, and Tyler 2004, 1048). Implementing the assumptions of Krugman, in this article, regional competitiveness of the Visegrad Group was measured using GDP per capita and two of its components: labour productivity and employment rate.

The relativity of competitiveness requires comparative regional analysis and a search for the best practice (Golejewska 2012b). Consequently, the number of analyses and measures implemented for indicating "the winner" is still increasing. The main determinants of economic growth together with their main literature sources present Van Hemert and Nijkamp (2011, 65–66). Berger (2011) presents a detailed survey of almost 50 analyses of regional competitiveness, where the number of indicators ranges from 3 to 246. Nowadays, regional competitiveness depends more on the level of creativity and creation, circulation and absorption of knowledge. The theoretical foundation for a positive link between education and economic growth is human capital theory and growth theory (Yamarik 2011). According to the former, which is based upon the work of Schultz (1970), an educated population is a productive population. Provision of formal education is considered a productive investment in human capital (Olaniyan and Okemakinde 2008). Growth theory predicts that greater educational attainment will increase real income per person. In neoclassical growth theory, an increase in schooling raises the transitional growth rate, while in endogenous growth theory an increase in schooling raises the steady-state growth rate (Mankiw, Romer, and Weil 1992; Lucas 1988; Romer 1990). Lucas views human capital—in the sense of knowledge- as a central factor of production, which enables sustained growth due to its non-decreasing returns. Human capital is not only an input in the extended neoclassical production function but, in line with endogenous growth models, also a determinant of technological progress. It enables adoption of new technologies from abroad and in turn, technological catching-up (Benhabib and Spiegel 1994; Jurajda and Terrell 2009) and innovation (Romer 1990). Although endogenous growth theory explains differences in growth by emphasizing increasing returns and the endogeneity of human capital, it fails to take into account geography and place. This shortcoming has been corrected by the new economic geography. The links between human capital and economic development of a country may differ from those between human capital and regional economic development, because as with national economies, the human capital in a region has an impact on the aggregate productivity in the economy, but rather differently from national economies, it can also result in a spatial reallocation of factors at regional level (Faggian and McCann 2009; Golejewska 2012a).

The concept of human capital is ambiguous. The simplified Becker's definition of human capital, which included education and on-the-job training, was extended (as a result of the emergence of new growth theories) to include health and ability which improves acquisition of knowledge and skills (Becker 1964). The successive extension of human capital definition was influenced by sociology and political science. The broader concept of human capital took into consideration social capital, as social norms and institutions, fostering individual learning and skills. However, the most important twist on the human capital concept was connected with creative capital, popularized by Florida (Mellander and Florida 2012). Florida divided the workforce into three main occupational classes—the creative-, working- and service classes. According to the author, only the creative class is engaged in "knowledge" work. He distinguished two sub-groups of the creative class: the super-creative core (computer and math occupations; architecture and engineering; life, physical, and social science; education, training, and library positions; arts and design work; and entertainment, sports, and media occupations), and the creative professionals (management occupations, business and financial operations, legal positions, healthcare practitioners, technical occupations, and high-end sales and sales management) (Mellander and Florida 2012). This widening has led to much confusion in the literature. Nowadays, there is no general consensus on the definition of human capital, which has simply come to mean "any knowledge, skills and competencies embodied in individuals or their social relations that increase an individual's productivity" (Faggian and McCann 2009). The usual, and in some cases the only possible option of estimation of human capital

is educational data (Golejewska 2013). In this paper, as proxy estimates of human capital we apply educational data.

Cross-country analysis on the growth effects of human capital provide mixed results, which is due to the variety of often problematic measures of human capital. Many of the studies confirm positive impact of schooling on GDP per capita growth (Barro and Sala-i-Martin 1995; Sala-i-Martin 1997). As opposed to them, Benhabib and Spiegel (1994) found weak correlation between growth and increases in educational attainment across the countries. The results of regional analyses show that human capital might cause or, conversely, hinder regional convergence (Caroleo and Pastore 2010). Tondl shows that incomes and productivity of Southern EU regions are positively linked to school enrolment (Tondl 2001). Garofalo and Yamarik (2002) find that 4-year college education is positively correlated with growth in real income per worker. However, regional growth studies estimate an education share of income ranging from 15 per cent to 66 per cent (Mullen and Williams 2005). Benhabib and Spiegel (Benhabib and Spiegel 2005) claim that human capital is not only a productive factor, but also an engine of technological innovation. Recent studies also suggest that human capital concentration in urbanized regions is an important competitive factor to attract FDI in advanced sectors and reduce the cost of restructuring, as the case of Ireland and transition countries (Newell, Pastore, and Socha 2002; Walsh 2003). Izushi and Huggins (2004) find that those European regions with a higher level of investment in tertiary education also tend to have a larger concentration of ICT sectors and research functions. They also have low unemployment rates. The research done by the World Bank indicates a strong negative correlation between regional unemployment rates and the share of workers with a high level of education in Italy and in Poland (*Growth, Employment…* 2004). Complementarity between high technology industries and human capital generates persistence in unemployment differentials with respect to rural areas. This may be reinforced by migration and commuting flows (Fidrmuc 2004). According to Glaeser, it is harder to estimate the educational effects of human capital on economic growth for nations than for cities (Glaeser et al. 2004).

2 Empirical research

The empirical analysis focuses on 35 regions of the Visegrad Group (NUTS 2 level) in 2002–2009 and is based on Eurostat Regional Statistics. The choice of the analysed period results from availability of comparable regional data for the entire group of regions. The group of analysed regions consists of 16 Polish (voivodships[1]), 8 Czech, 7 Hungarian and 4 Slovak regions. The objective of the analysis is to compare competitiveness and human capital intensity in the Visegrad regions, verify the existence of correlation and thus potential human capital growth effects. The analysis comprises two groups of indicators:

- competitiveness indicators (measures of competitive position): GDP per capita (PPS), labour productivity (GVA/worker) and employment rate (age 15 years and over)
- human capital education indicators (measures of competitive ability): students in tertiary education (ISCED 5–6) as a percentage of the population aged 20–24 years; persons aged 25–64 with tertiary education attainment, share of labour force aged 25–64 with higher educational attainment; and participation of adults aged 25–64 in education and training (lifelong learning)

In terms of the economy, there have been both similarities and wide disparities between the Visegrad Countries. Similarities result from the socialist economy, which formed their economic and social systems for several decades. Differences are caused by cultural factors, different systems of law and dissimilar spatial structures among other things (Gorzelak and Smętkowski 2010). Between 2002 and 2009 the dispersion of regional GDP at NUTS level 2 rose in all the countries of the Visegrad Group. Despite its growth, the coefficient of dispersion in Poland still remains lower than the EU average. The highest regional diversity characterizes Hungary (almost 40 per cent in 2009). In interpreting regional diversity one should consider territorial division of a country (Domański, Guzik, and Micek 2003). Division into small and few regions causes higher concentration. This

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1. Voivodship — Polish administration region on the NUTS 2 level.

explains the smallest dispersion of regional GDP at NUTS 2 in Poland. A very important factor of regional diversity is a delimitation of the capital region, especially when the capital region dominates economically in a country where the number of regions is low. An extreme example is Slovakia, where the contrast between the capital region and the rest of the country is exceptionally large. The predominance of Praha is also visible, but because of a higher level of development throughout the country, it is not as large as in the case of Bratislava in Slovakia. The predominance of Mazowieckie in Poland is definitely the smallest. The analysis of dispersion of GDP per capita between the first and the second region and the second and the last region of each of the countries analyzed shows that regional diversity, in case of exclusion of the capital region, is not large. In the Visegrad Group, similarly to the rest of the EU countries, there is no relationship between the level of regional diversity and economic development of a country (Golejewska 2012b). The analysed variables and their descriptive statistics are presented in table 1.

The results of mean and median analysis show that in the entire group of regions there are some units which raise the average values of the variables. These units are particularly capital re-

Tab. 1. Descriptive statistics of the analysed variables

Variable	N	Mean	Median	Min.	Max.	Lower quartile	Upper quartile	Standard deviation	Coefficient of variation
2002									
GDP per capita (PPS) (EUR)......................	35	11 265,7	9 900,0	6 900,0	30 200,0	8 400,0	12 600,0	4 946,5	43,9
Labour productivity (1000 EUR)	35	13,5	12,8	8,1	28,6	10,9	14,3	4,1	30,5
Employment rate (%) ..	35	55,1	53,5	45,3	68,8	49,7	61,2	7,0	12,8
Students in tertiary education (%)	35	45,7	41,4	3,3	105,6	27,1	57,0	24,7	54,2
Persons with tertiary education attainment (%).............................	35	12,4	11,3	7,2	27,1	10,4	13,0	4,2	33,7
Share of labour force with higher educational attainment (%)	35	17,4	17,6	8,2	30,2	13,8	18,9	4,8	27,6
Lifelong learning (%) ...	35	4,7	3,9	2,2	14,6	3,1	4,7	2,7	58,2
2009									
GDP per capita (PPS) (EUR)......................	35	15 380,0	13 600,0	9 300,0	41 800,0	11 100,0	15 900,0	7 418,5	48,2
Labour productivity (1000 EUR)	35	19,8	18,0	10,7	48,9	14,9	21,8	8,4	42,2
Employment rate (%)	35	50,2	50,0	39,3	61,9	48,4	53,0	4,9	9,7
Students in tertiary education (%)	35	61,8	53,2	5,9	187,5	43,5	70,4	36,6	59,2
Persons with tertiary education attainment (%).............................	35	18,4	16,9	8,4	31,9	15,0	21,0	5,4	29,2
Share of labour force with higher educational attainment (%)	35	24,1	22,8	10,6	37,8	18,1	28,2	6,7	27,8
Lifelong learning (%) ...	35	4,5	4,2	2,0	10,8	2,6	5,7	2,0	44,3

[*Note:* In the journal (in both Polish and English texts) European practice of number notation is followed—for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style). Furthermore in the International System of Units (SI units), fixed spaces rather than commas are used to mark off groups of three digits, both to the left and to the right of the decimal point.—Ed.]

Source: Own calculations based on Eurostat Regional Statistics

gions. The highest coefficients of variation were recorded for GDP per capita and share of students in tertiary education. The lowest diversity characterizes employment rate and share of labour force with higher educational attainment. In the analysed period, only three indicators recorded decrease in the coefficient of variation. These indicators were: employment rate, share of persons with tertiary education attainment and share of adults in education and training. In 2002 in eleven regions GDP per capita was higher than its mean value for the whole group. To this group belong, apart from capital regions, six Czech regions (Strední Cechy, Jihozápad, Jihovýchod, Severovýchod, Strední Morava and Severozápad) and one Hungarian region (Nyugat-Dunántúl). In 2009, in comparison to 2002, most of the mean values of the analysed variables improved. The only exceptions were employment rate and lifelong learning. The group of regions where GDP per capita was the highest (higher than the mean value) consisted of thirteen regions. The group was joined by one Slovak (Západné Slovensko) and one Polish region (Dolnośląskie Voivodship). There were no Hungarian regions in the best performing group. The region with the highest GDP per capita in 2009 was surprisingly not Praha region but Bratislavský kraj, though the difference between them was slight. The group of the poorest regions consisted invariably of Eastern Polish and Hungarian regions. The highest growth rate of GDP per capita was observed in Slovak regions. According to the results of analysis of GDP per capita and its growth in 2002–2009, the group of the Visegrad regions can be divided into four subgroups (see fig. 1). The first one contains four regions with the highest values of both indicators: three capital regions and Severozápad. To the group with the highest GDP per capita and lower growth rate belong two Hungarian and five Czech regions. The group of "catching up" regions include fourteen regions: two Slovak, one Czech and the majority of Polish regions. The weakest group consists of the rest of the Hungarian regions and two Polish regions: Zachodniopomorskie and Kujawsko-Pomorskie voivodships.
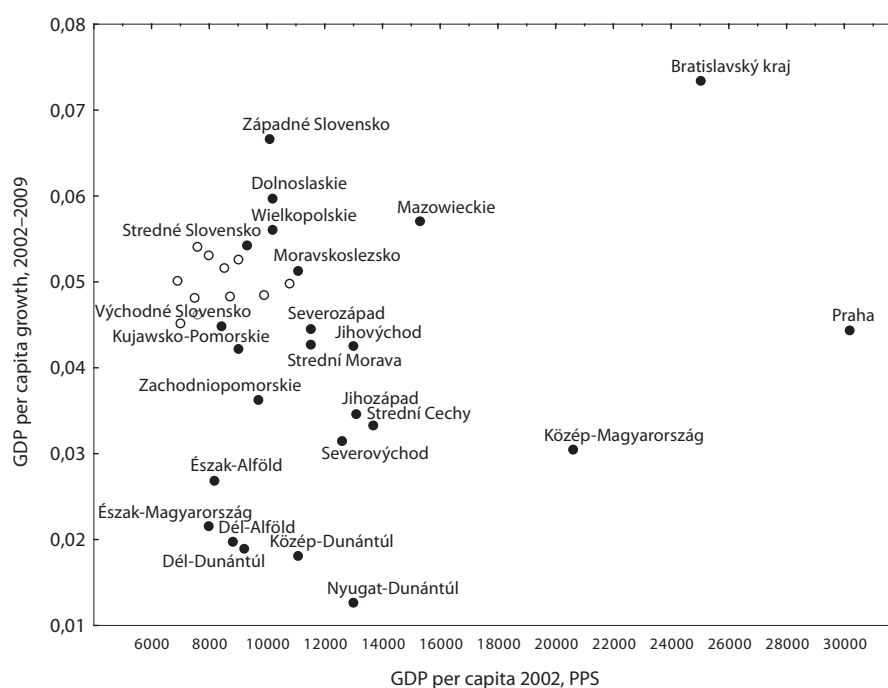

Fig. 1. GDP per capita and its growth rate in 2002–2009 (average growth rate calculated as $\ln(Y_n/Y_0)/n$)

To avoid misunderstanding, labeled points are marked by black-filled circles, unlabeled points are marked by empty circles
Source: Own calculations based on Eurostat Regional Statistics

In 2002, the highest labour productivity was recorded in capital regions, with Praha region as the leader and four Polish voivodships: Śląskie, Dolnośląskie, Pomorskie and Zachodniopomorskie. Voivodships with the lowest productivity were localised in Eastern part of Poland (Lubelskie, Podkarpackie, Świętokrzyskie and Podlaskie) and in Slovakia. In 2009 the group of the best performing regions consisted of capital and Czech regions. The lowest productivity characterized permanently

Eastern Polish and the most of Hungarian regions. At the end of the analysed period, the highest employment rate was registered in Bratislavský kraj, followed by Praha, Strední Cechy, Jihozápad, Mazowieckie, the rest of Czech regions and Západné Slovensko. The group with the lowest employment rate consisted mostly of Hungarian regions. According to the results presented in Figure 2, in three Polish voivodships belonging to the group with the highest growth rate of GDP per capita in 2002–2009, such as Dolnośląskie, Śląskie, and Pomorskie, high labour productivity was accompanied by a low employment rate. Another group of regions with high GDP per capita growth, except for Közép-Dunántúl, was characterized by inverse relations. The highest labour productivity growth rates were recorded in Slovak regions, characterized simultaneously by the highest GDP per capita growth.
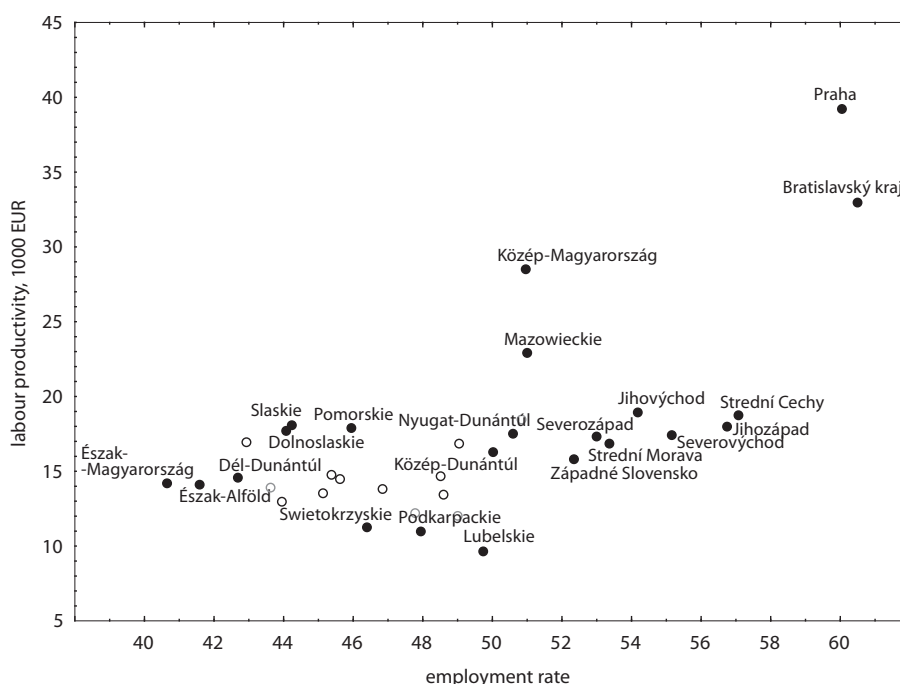

Fig. 2. Employment rate and labour productivity in 2002–2009 (mean values)

To avoid misunderstanding, labeled points are marked by black-filled circles, unlabeled points are marked by empty circles
Source: Own calculations based on Eurostat Regional Statistics

Tertiary education is central to the creation of the intellectual capacity of a region. Capital regions in the Visegrad Group belong to the group of regions with the highest differences in tertiary education in relation to the country average. Table 2 presents four analysed human capital education indicators in 2002 and 2009. The highest share of students in tertiary education (ISCED 5–6) measured as a percentage of the population aged 20–24 years was observed in capital regions, particularly in Praha, Mazowieckie, and in 2009 in Bratislavský kraj. It exceeded 100 per cent, which was connected with the inflow of students from other regions. In 2009 the highest share of persons with tertiary education attainment was in the capital region of Slovakia (almost 32%), the lowest-in Severozápad (8,4%). At the end of the analysed period, the lowest share of labour force with higher educational attainment characterized particularly Czech and Slovak regions. The lowest participation of adults in education and training was recorded in Slovak and Hungarian regions.

Considering average values for the entire analysed period 2002–2009, the highest share of students in tertiary education was, apart from capital regions, in Polish voivodships, such as Małopolskie (73,2%), Dolnośląskie (70,8 per cent), Łódzkie (67,6%), and Zachodniopomorskie (64,4%), and the lowest was recorded in Strední Cechy, Severozápad, Severovýchod and Východné Slovensko (less than 30%). The highest growth rate of this indicator characterizes Czech regions. A decline was registered in just four Polish voivodships: Świętokrzyskie, Zachodniopomorskie, Lubuskie and Podlaskie. The highest average share of persons with tertiary education attainment

was recorded in capital regions, where it exceeded 23%, followed by Małopolskie (17,8%), Podlaskie (17,6%), Lubelskie (17,3%), Pomorskie (17,1%) and Dolnośląskie (16,9%) voivodships. Similarly, the share of labour force with higher educational attainment was the highest (besides the capital regions) in Polish voivodships, such as Dolnośląskie, Pomorskie, Zachodniopomorskie and Śląskie (over 24%). The regions with the highest growth rate of both indicators were also mainly Polish regions. The lowest average values of both measures were recorded in six Czech (Severozápad, Severovýchod, Strední Cechy, Jihozápad, Strední Morava and Moravskoslezsko) and two Slovak

Tab. 2. Human capital education indicators in 2002 and 2009 (in %)

Region	Students in tertiary education		Persons with tertiary education attainment		Labour force with higher educational attainment		Lifelong learning	
	2002	2009	2002	2009	2002	2009	2002	2009
Praha	105,6	187,5	27,1	30,3	28,8	36,50	11,8	10,8
Strední Cechy	3,3	5,9	8,5	13,8	10,8	16,78	4,7	6,6
Jihozápad	27,9	46,4	10,7	14,1	12,0	15,69	3,9	6,1
Severozápad	10,4	21,5	7,2	8,4	8,2	10,63	6,4	7,1
Severovýchod	19,2	34,0	9,4	12,8	11,7	15,46	3,6	6,2
Jihovýchod	41,0	77,4	12,9	16,9	15,5	20,05	6,4	6,4
Strední Morava	20,5	39,6	9,5	12,8	12,2	15,16	3,9	5,4
Moravskoslezsko	27,1	55,4	9,7	14,1	12,8	18,01	4,3	5,7
Közép-Magyarország	79,8	102,8	21,3	29,3	28,5	33,71	4,2	3,9
Közép-Dunántúl	21,8	34,6	11,8	15,1	17,0	17,68	2,8	2,0
Nyugat-Dunántúl	31,5	43,5	12,3	16,9	16,0	18,24	2,4	2,0
Dél-Dunántúl	41,4	57,6	10,8	15,1	16,8	21,44	2,5	2,3
Észak-Magyarország	22,9	45,1	11,4	15,1	16,1	21,43	2,6	2,4
Észak-Alföld	32,1	46,5	11,5	15,0	18,9	22,12	2,2	2,6
Dél-Alföld	40,9	49,5	10,6	17,6	15,0	22,60	2,2	2,1
Lódzkie	55,6	83,3	13,0	20,2	18,4	26,62	3,6	3,9
Mazowieckie	102,9	114,1	16,6	29,3	23,1	37,82	5,9	7,2
Małopolskie	61,1	85,7	14,0	21,7	18,9	27,95	4,1	4,1
Śląskie	53,8	55,4	10,6	20,5	19,3	29,62	4,2	4,2
Lubelskie	56,4	61,9	13,8	20,8	18,7	27,67	5,1	5,3
Podkarpackie	40,3	43,8	11,1	21,0	17,6	25,46	3,1	3,1
Świętokrzyskie	64,9	57,0	12,6	21,0	19,0	29,08	3,4	4,2
Podlaskie	57,0	56,4	13,6	21,5	18,8	27,30	3,4	4,0
Wielkopolskie	55,0	70,4	10,6	17,5	17,6	28,20	3,5	3,7
Zachodniopomorskie	68,2	60,7	11,3	20,1	17,8	28,06	3,5	5,3
Lubuskie	37,2	34,5	10,5	16,3	17,8	26,68	2,8	3,3
Dolnośląskie	60,9	83,2	12,6	19,8	20,1	28,87	4,7	5,1
Opolskie	46,0	50,1	11,7	16,2	16,7	22,75	3,1	4,9
Kujawsko-Pomorskie	47,1	53,2	10,4	16,2	17,0	22,41	4,5	3,8
Warmińsko-Mazurskie	46,3	46,5	10,9	19,7	17,8	27,52	3,6	4,4
Pomorskie	48,3	63,1	13,1	21,1	19,7	30,77	4,1	5,4
Bratislavský kraj	99,3	173,7	24,3	31,9	30,2	36,23	10,9	7,4
Západné Slovensko	22,2	43,8	8,5	13,0	12,5	16,60	4,5	2,0
Stredné Slovensko	28,9	41,6	9,7	15,1	13,8	20,07	14,6	2,3
Východné Slovensko	22,0	37,3	9,2	12,7	13,1	18,11	7,1	2,0

Source: Own calculations based on Eurostat Regional Statistics

regions (Západné Slovensko and Východné Slovensko). In 2002–2009, participation of adults in lifelong learning increased in most of the Visegrad regions, except for Slovak and Hungarian regions (except for Közép-Magyarország), Kujawsko-Pomorskie Voivodship, and the region of Praha. The regions with the highest average value of lifelong learning indicators were the capital regions of Slovakia (11,7%), the Czech Republic (10,5%) and Poland (6,5%), followed by two Czech regions: Jihovýchod (6,4%) and Strední Morava (5,5%). The lowest shares—less than 3%—were recorded in Hungarian (Nyugat-Dunántúl, Dél-Alföld, Észak-Magyarország, Észak-Alföld) and Slovak regions (Východné Slovensko and Západné Slovensko).

The estimation of a potential link between human capital and regional growth requires the analysis of correlation. The correlation matrix of the variables used in the analysis for the years 2002 and 2009 is presented in Tables 3 and 4. In 2002 the strongest positive correlation shows GDP per capita with the share of people with tertiary education attainment (0,81) and the share of labour force with higher educational attainment (0,59) and labour productivity with the same indicators, respectively 0,78 and 0,67. This could mean that in the beginning of the analysed period, completed tertiary education had stronger impact on regional competitiveness in the Visegrad Group than number of students and lifelong learning. However, in 2009 the results changed fundamentally. In 2009 the strongest and positive correlation was found between analysed competitiveness indicators and the two latter human capital indicators. The correlation between labour productivity and labour force with higher educational attainment decreased to merely 0,34 and in case of GDP per capita to 0,46. This can result from the overeducation phenomenon observed in the Visegrad countries, particularly in Poland, where overeducation does not transform into appropriate productivity growth (McGuinness 2006).

However, interpretation of correlation results can't be unambiguous. Diversity of workforce qualifications should be evaluated in the light of high disproportion in opportunities for education and lifelong learning. It concerns not only financial possibilities of individuals but also intensity of lifelong learning education, diversified in the case of Polish regions. Few possibilities for lifelong learning and business education in Świętokrzyskie, Podkarpackie, Lubuskie and Warmińsko-Mazurskie show that accumulation of human capital in these regions of Poland still remains at a low level and constitutes a development barrier for these regions (Bąk et al. 2009). Rich regions attract and create jobs for highly educated people. Big cities tend to attract the best individuals from surrounding areas/regions, additionally increasing human capital intensity this way.

Tab. 3. Correlation matrix for the analyzed variables, 2002

Variable	GDP per capita	Labour productivity	Employ-ment rate	Students	Tertiary education attainment	Labour force with higher educational attainment	Lifelong learning
GDP per capita	1,00	0,90	0,64	0,53	0,81	0,59	0,55
Labour productivity	0,90	1,00	0,39	0,63	0,78	0,67	0,36
Employment rate	0,64	0,39	1,00	−0,11	0,25	−0,10	0,37
Students	0,53	0,63	−0,11	1,00	0,84	0,90	0,31
Tertiary education attainment	**0,81**	**0,78**	0,25	0,84	1,00	0,91	0,44
Labour force with higher educational attainment	**0,59**	**0,67**	−0,10	0,90	0,91	1,00	0,26
Lifelong learning	0,55	0,36	0,37	0,31	0,44	0,26	1,00

Source: Own calculations based on Eurostat Regional Statistics

Tab. 4. Correlation matrix for the analyzed variables, 2009

Variable	GDP per capita	Labour productivity	Employ-ment rate	Students	Tertiary education attainment	Labour force with higher educational attainment	Lifelong learning
GDP per capita	1,00	0,98	0,74	0,83	0,64	0,46	0,69
Labour productivity	0,98	1,00	0,70	0,76	0,52	0,34	0,67
Employment rate	0,74	0,70	1,00	0,48	0,36	0,19	0,75
Students	**0,83**	**0,76**	0,48	1,00	0,86	0,76	0,55
Tertiary education attainment	0,64	0,52	0,36	0,86	1,00	0,93	0,39
Labour force with higher educational attainment	0,46	0,34	0,19	0,76	0,93	1,00	0,30
Lifelong learning	**0,69**	**0,67**	**0,75**	0,55	0,39	0,30	1,00

Source: Own calculations based on Eurostat Regional Statistics

According to the results, one can suppose—following the research assumptions—that human capital could have had positive impact on regional competitiveness in the Visegrad countries in 2002–2009. However, one cannot forget that the relation between wealth and human capital can be reverse. Level of wealth and structure of the regional/local economy affect the level of human capital. In the case of Visegrad Group regions, further econometrical research is still needed.

Summary

Available capital available is one of the basic sources of development. The commonly used option of human capital estimation is educational data. Since the objective of education is to provide knowledge, it is reasonable to suppose that a higher level of education will provide more knowledge and therefore, more human capital. In the Visegrad Group, there have been and continue to be substantial differences among regions as regards competitiveness and human capital. The highest diversity is seen GDP per capita and share of students in tertiary education, the lowest—employment rate and share of labour force with higher educational attainment. Capital regions belong to the group of regions with the highest differences in education in relation to the country average. Beside capital regions, the highest average shares of both persons and labour force with tertiary education attainment were recorded in Polish regions. Polish regions are also characterized by high shares of students, in comparison to the rest of the group. Interpretation of correlation results can't be unambiguous. On the one hand, the results suggest positive, however varied in intensity, impact of particular human capital indicators on competitiveness of the Visegrad regions in 2002–2009. On the other hand, level of wealth and structure of the regional/local economy could affect the level of human capital.

The differences between regions in accumulation of human capital and its degree of use contribute to the differences in per capita income between the regions of the Visegrad Group. The future development of the Visegrad regions will depend on their ability to accumulate more human capital, to use it efficiently, and to reduce the notable differences existing between the regions. The key issue is the adaptation of the competences of graduates to labour market requirements (Golejewska 2012a).

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