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HUMAN CAPITAL AS THE GROWTH FACTOR IN REGIONAL COMPETITIVENESS

In the recent years, the world economy has undergone an enormous transformation. It can be noted that it is not only based on industry, but also on knowledge. Achieving a competitive advantage by regions is further focused on investing in fixed assets, but, what is also important, in human capital. At present, a factor that is increasingly important in achieving competitiveness is the ability to use intangible resources.

Expenditures on education and research, investing in people, their knowledge and skills are an essential precondition of raising competitiveness. In the case of a highly qualified staff, it allows the efficient introduction of new technologies and the creation of new directions for its development. The competitiveness of the regions is influenced, inter alia, by human talents, knowledge, entrepreneurship, initiative and own resources to improve living conditions. Human capital is thus a key determinant of the competitiveness of regions in Poland.

Therefore, the priority of this article is to analyze the impact of selected components of human capital on the competitiveness of regions in Poland in the years 2007-2014. The article is both theoretical and empirical. The first part reviews the literature closely related to the topic of the work. The second part includes a statistical analysis and a construction of a panel model estimated by the method of least squares. GRETL program was used for calculations.

JEL Classification Codes: C40, O15, R15.

Keywords: human capital, regional competitiveness, regional development, method of least squares.

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Introduction

Regions are currently one of the most interesting subjects of research. They are also an object of analysis of many disciplines, ranging from geography, economics, sociology and legal science. The regional theme is strictly interdisciplinary and can be analyzed from different perspectives (Golejewska, 2012).

Regional development is a continuous improvement of the competitiveness of economic entities, the standard of living of the inhabitants and the economic potential of the regions, which is related to the development of the whole country. Many scholars claim that there is a link between material resources and the economic development of the region in the resource category. However, such development is made to a certain extent when material assets are already insufficient. Then the regional development is focused solely on intellectual property. It has a great impact on the competitiveness of regions (Marakova, Dyr, Wolak-Tuzimek, 2016).

The core challenge for regions was to build a knowledge-based economy where human capital plays a key role. In this system, it is not work, raw materials or material capital that is the basic resource, but a knowledge that will enable achieving competitiveness and a high level of development. Human capital is recognized as the medium of this knowledge (Bartnik, 2016).

Human capital constitutes a key factor shaping the competitiveness of regions, which is also related to the development of a knowledge-based economy. Its value and quality must remain high, so that the process of knowledge creation and transfer is seamless. Human capital is an important factor for regional development in the European Union countries. This is reflected in the objectives of the European regional policy. On the microeconomic level, the human capital influences the level of wages and incomes, however at the macroeconomic level it stimulates production, affects the location of business activity, determines the implementation of innovative processes and adaptability of technologies created and used abroad (Golejewska, 2012).

The main aim of the article is to analyze the impact of human capital on the competitiveness of regions in Poland in the years 2007-2014. The paper examines the relationship between GDP of Polish voivodeships and the selected components of human capital. GRETL program was used for calculations.

Theoretical analysis of human capital

In the literature on the subject it is often noted that human resources, intangible assets or human capital are used interchangeably. However, in the Polish or foreign literature there is no clear definition of these concepts and the differences between them. Some authors claim that the changes in the aforementioned terms are much deeper than in the linguistic sphere. Others do not see the difference in these terms and use them as synonyms (Samul, 2013).

The concept of human capital, shaped for good in the 60s of the 20th century, has then begun to be linked to investments that people make in themselves through education, skills acquisition or other activities that will result in higher labor productivity and higher incomes in the future. It is also worth mentioning that at the turn of the 50s and 60s of the 20th century in the Western European countries emerged a theory of human capital, according to which people were recognized as the most valuable resource of enterprises (Butkiewicz-Schodowska, 2015).

The definitions of human capital "change along with the cultural context, fashion, paradigms, metaphors, customs and linguistic practices of a given author and his time. The existing differences allow a more comprehensive discovery of the complex structure of the phenomenon, but at the same time considerably complicate the practical application of the concept" (Król, Ludwiczyński, 2006). The most important cognitive problems of the concept of human capital are:

- various levels of consideration of human capital;
- fuzzy and highly diversified definitions;
- the lack of researchers' consent for the structural elements of human capital;
- development in the management of human capital concepts such as knowledgemanagement, talent management, competence management;
- different approaches taken from different disciplines of social, economic, sociological, humanist and technical disciplines (Samul, 2013).

Human capital is also one of the components of intellectual capital. Sometimes these two concepts are used interchangeably (Dyr, Ziółkowska, 2017). This is due to the fact that the human capital is regarded as the most important component of intellectual capital. Nevertheless, it is important to remember not to confuse these two concepts and not to use them interchangeably (Adamowicz, Apelska, 2013).

Intellectual capital is a kind of a pillar on which the regions, businesses or society operate. It is also treated as the ability of these three levels to qualitatively combine new competencies in order to create new values (Edvinsson, Malone, 2001).

One of the stated definitions is that the human capital is a source of knowledge and skills, the acquired learning and professional practice as well as a resource of health and vital energy. The other one treats human capital as the whole of the specific qualities that are embodied in employees who have a certain value and are a source of future income for the employee who owns human capital and for the organization that benefits from that capital under certain conditions (Samul, 2012).

While making a theoretical analysis of the human capital, it is also worth mentioning its constituent elements that appear in the given definitions. Table 1 presents the selected elements of human capital structure according to I. Miciuła.

Table 1. Elements of human capital structure of selected authors

Human capital			
Qualifications		Social competences	Attitudes and practices
Knowledge	Abilities	Interpersonal skills, cooperative abilities, communication, abilities	Motivation, commitment, goal orientation, attitudes and behavior towards the organization, identification with an organization
Education, theoretical knowledge	Experience, practical skills		

Source: Miciuła, Miciuła, 2015.

In conclusion, human capital is a driving force for the development that encompasses enormous motivational opportunities which are only revealed when a company, a region or society is effectively managed (Juchnowicz, 2004). Human capital is permanently linked to the area in which it occurs, with its mission, vision and purpose. It is characterized by the ability of cooperation, creativity and qualifications. It is a force without which it is impossible to develop further and a factor that determines the differences between organizations and constitutes a real basis of competitive advantage.

Human capital and competitiveness of the regions

Today, human capital is treated as a new factor of production that increases the productivity of other resources. Its importance is determined, among other things, by the fact that knowledge-based economy is not only the access to knowledge, but above all the ability to use it, i.e. a skill that a man possesses. The higher the level of human capital is, the faster the dissemination of innovation and its implementation take place. The resources of this capital in a region allow the import and application of innovations from the far more developed regions (Tomaszewska, 2010).

Therefore, the human capital constitutes the primary source of competitive advantage, because the remaining assets of an enterprise or a region are measurable and thus, easier to standardize and become fully comparable. Human resources are the key strategic resources of an organization and they determine its dominance over the competition (Adamowicz, Apelska, 2013).

Model

When analyzing the impact of human capital components on the competitiveness of regions (voivodeships) in Poland, the econometric analysis was used based on the classic method of least squares. The study was conducted on a panel data, i.e. those, that are observed in at least two dimensions (Kufel, 2013). The proposed article also examines the Gross Domestic Product for 16 Polish voivodeships in the years 2007-2014. Assuming that the index i = 1, 2, ..., N denotes consecutive areas (voivodeships) and the index t = 1, 2, ..., T units of time, the constructed model has the form:

$$GDP_{it} = \alpha_{it} + PhD_{it} + U_{it} + RD_{it} + MSc_{it} + v_{it} \quad (1)$$

where:
GDP_{it} – dependent variable: Gross Domestic Product in million PLN (in current prices),
explanatory variables:
PhD_{it} – the total of PhD students (persons),
U_{it} – theregistered unemployed for more than 1 year in total (persons),
RD_{it} – the total of the R & D employment (persons),
MSc_{it} – the graduates of master's degree studies (persons),
α_{it} – structural parameter of a model,
v_{it} – total random error (consisting of a purely random part ε_{it} and the individual effect u_i, so $v_{it} = \varepsilon_{it} + u_i$) (Kufel, 2013).

In the empirical research, the statistics from the Local Data Bank (www.bdl.stat.gov.pl) was used. The absence of some data (at the level of 1.56%) caused the model to be an unbalanced panel (Brożek, Kogut, 2016). The results of the model described above are shown in the following tables and chart, and the results of the most important and also the necessary tests are provided beneath.

The results of model estimation

The results of the model described above are presented in the tables below and in the graph. The results of the tests can be found below.

It should be mentioned here that the estimation using the classical method of least squares (KMNK) is considered acceptable if the individual effect is absent and the panel is treated as a cross sectional dataset (Kufel, 2013). The situation is described in the examined model.

Using the GRETL econometric program, the estimation is obtained and presented in Table 2. It contains the numbers characterizing and describing the results of the least squares panel estimation (see Brożek, Kogut, 2017).

Table 2. Model 1: Panel OLS estimation using 126 observations 16 cross-sectional data units are included. Time series length: minimum 7, maximum 8. The dependent variable (Y): PKB_{it}

	Factor	Standard error	Student's t-	p-value	
const	5450.71	6313.95	0.8633	0.3897	
PhD_i_t	−7.09344	3.61328	−1.9632	0.0519	*
U_i_t	0.201487	0.157528	1.2791	0.2033	
RD_i_t	8.68749	1.20872	7.1873	<0.0001	***
MSc_i_t	3.73408	0.710899	5.2526	<0.0001	***
The arithmetic mean of the dependent variable		93461.86	The standard deviation of the dependent variable		75581.29
The sum of squared residuals		6.29e+10	The standard error of the residues		22800.06
Coefficient of determination R-square		0.911912	Adjusted R-squared		0.909000
F(3, 156)		313.1551	P-value of F test		8.26e-63
Log-likelihood		−1440.585	Akaike information criterion		2891.169
Schwarz Bayesian Criterion		2905.351	Hannan-Quinn Criterion		2896.931
Autocorrelation of residues – rho1		0.921014	Durbin-Watson status		0.135704

Source: based on the program GRETL.

Based on the conducted studieswe can assume that two out of the four variables such as the R&D staff (RD_{it}) andthe graduates of master's degree studies (MSc_{it}) are very good stimulants of the Gross Domestic Product in the voivodships. This is demonstrated by their significance level of 0.01. As for a variable, such as the PhD students (PhD_{it}), it is also a good contributor to GDP (significance level is 0.1). As far as the registered unemployed (U_{it}) are concerned, this is the only explanatory variable that is not a driving force for a given variable.

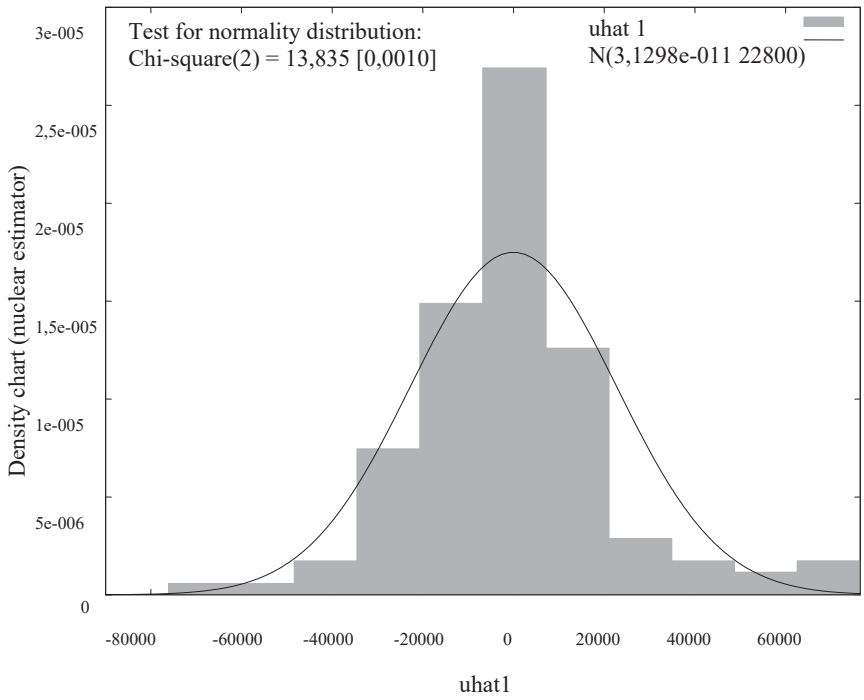

Figure 1. Test for normality distribution

Source: based on the program GRETL.

The frequency distribution for uhat1, observations 1-128. The number of intervals = 11, mean = 3.12982e-011, standard deviation = 22800.1.

Table 3. The frequency distribution

Intervals	Mean	Number	Frequency	Cumulative	
< -62198	-69 132	1	0.79%	0.79%	
-62198 - -48328	-55 263	1	0.79%	1.59%	
-48328 - -34459	-41 394	3	2.38%	3.97%	
-34459 - -20590	-2 752	13	10.32%	14.29%	***
-20590 - -6720.4	-13 655	26	20.63%	34.92%	*******
-6720.4 - 7148.9	214.26	47	37.30%	72.22%	**********
7148.9 - 21018	14 084	22	17.46%	89.68%	******
21018 - 34887	27 953	5	3.97%	93.65%	*
34887 - 48757	41 822	3	2.38%	96.03%	
48757 - 62626.	55 691	2	1.59%	97.62%	
>= 62626	69 561	3	2.38%	100.00%	

Source: The author's own research.

Missing observations = 2 (1.56%)
Null hypothesis: the empirical distribution function has a normal distribution. The Doornik-Hansen test (1994) – transformed skewness and kurtosis. Chi-square(2) = 13.835 with a p-value of 0.00099

Collinearity rating VIF (j) – variance inflation factor:
VIF (Variance Inflation Factors) - the minimum possible value = 1.0.
Values > 10.0 may indicate a problem of collinearity - inflation of the variance.
PhD_{it} 20.557
U_{it} 2.686
RD_{it} 14.141
MSc_{it} 9.594

VIF(j) = 1/(1 - R(j)^2), where R(j) is a coefficient of multiple correlation between the variable 'j' and the other independent variables of the model.
The results indicate that in the studied model there is a problem of collinearity in the variables PhD_{it} and RD_{it}. With the other two variables the values are less than 10, so there is no variance.

The properties of the matrix X'X:
1-norm = 4.2979366 e + 011.
Determine = 9.3744697e + 038.
The matrix index of the CN = 3.0331474e-011.

Table 4. Estimated fixed effects allow for a unit-specific component to the error term

const:	54207	(9766.2)	[0.00000]
PhD_{it}:	26.22	(2.3678)	[0.00000]
U_{it}:	-0.13614	(0.090792)	[0.13673]
RD_{it}:	2.5171	(1.0316)	[0.01635]
MSc_{it}:	-2.3267	(0.61152)	[0.00024]

Source: based on the program GRETL.

16 medium groups including data:
Residual variance: 5.76696e + 009 / (126 - 20) = 5.44053e + 007

The total significance of inequality of the group medium:
F (15, 106) = 70.0103 with p-value of 7.28345e-048
(Low p-value means the rejection of H0 hypothesis that OLS panel model is correct, to the H1 hypothesis that the fixed effects model is more appropriate.)

Breusch-Pagan test statistics:
LM = 155.626 with p = prob (chi-squared (1)> 155.626) = 1.02198e-035
(Low p-value means the rejection of H0 hypothesis that OLS panel model is correct, to the H1 hypothesis that the random effects model is more appropriate.)

Variance estimators:
between = 2.28676e+008
within = 5.44053e+007
Panel is unbalanced: theta varies across units.

Table 5. Estimated random effects allows for a unit-specific component to the error term

const:	37 085	(7841.9)	[0.00001]
PhD_{it}:	22.762	(2.5989)	[0.00000]
U_{it}:	-0.049837	(0.10159)	[0.62462]
RD_{it}:	3.8074	(1.0603)	[0.00048]
MSc_{it}:	-1.2213	(0.49621)	[0.01526]

Source: based on the program GRETL.

Hausmann's test statistics:
H = 51.5796 with p = prob (chi-square (4)> 51.5796) = 1.68885e-010
(The low value of p denotes the null hypothesis of the model with random effects versus the alternative hypothesis of the model with fixed effects.)

Joint test on named regressors:
Test statistic: F (4, 106) = 108.952 with p = P (F (4, 106)> 108.952) = 1.22221e-036.

Test for the variation of absolute term in groups:
Hypothesis: Groups share a common absolute term.
Test statistic: F (15, 106) = 70.0103 with p = P (F (15, 106)> 70.0103) = 7.28345e-048.

Table 6. Model 2: Fixed Effects estimation, using 126 observations, 16 units of cross-sectional were included. Time series length: minimum 7, maximum 8. Dependent variable (Y): PKB_{it}

	Factor	Standard error	Student's t-	p-value	
const	54 206.7	9766.16	5.5505	<0.0001	***
PhD_{it}	26.2205	2.36776	11.0740	<0.0001	***
U_{it}	0.136136	0.0907916	1.4994	0.1367	
RD_{it}	2.51706	1.03157	2.4400	0.0163	**
MSc_{it}	2.32671	0.611524	3.8048	0.0002	***
The arithmetic mean of the dependent variable		93 461.86	The standard deviation of the dependent variable		75 581.29
The sum of squared residuals		5.77e+09	The standard error of the residues		7 375.995
Coefficient of determination R-square		0.991924	Adjusted R-squared		0.804359
F(3. 156)		685.2075	P-value of F test		8.8e-102
Log-likelihood		1 290.051	Akaike information criterion		2 620.103
Schwarz Bayesian Criterion		2 676.828	Hannan-Quinn Criterion		2 643.149
Autocorrelation of residues - rho1		0.692616	Durbin-Watson status		0.423360

Source: based on the program GRETL.

Table 7. Random Effects estimation (GLS), using 126 observations. Nerlove's transformation was used 16 units of cross-sectional were included. Time series length: minimum 7, maximum 8. Dependent variable (Y): PKB_{it}

	Factor	Standard error	Student's t-	p-value	
const	46 956.5	11887.6	3.9500	0.0001	***
PhD_{it}	25.6055	2.30721	11.0980	<0.0001	***
U_{it}	0.117296	0.088798	1.3209	0.1890	
RD_{it}	2.92877	0.979518	2.9900	0.0034	***
MSc_{it}	1.90875	0.525907	3.6295	0.0004	***
Arithm. mean of depend. variable		93461.86	Stand. deviation of depend. variable		75581.29
The sum of squared residuals		1.21e+11	The standard error of the residues		31452.87
Log-likelihood		1481.641	Akaike information criterion		2973.282
Schwarz Bayesian Criterion		2987.463	Hannan-Quinn Criterion		2979.043

Source: based on the program GRETL.

Variance 'Within' = 4.57695e+007
Variance 'Between' = 2.28676e+008.
Breusch-Pagan test on:
The null hypothesis: The variance of the error in the unit = 0.
Asymptotic test statistic:
Chi-square(1) = 155.626with a value of p = 1.02198e-035.
Hausmann's test shows that the estimator (GLS) is compatible for the null hypothesis UMNK. Asymptotic test statistic: Chi-square(4) = 11,3412with a p-value = 0.0229856.

Conclusions and recommendations

The aim of the study was to analyze the relationship between the doctoral students, the registered unemployed and the persons unemployed for longer than 1 year, the employed in R&D and the graduates of master's degree studies on Gross Domestic Product in the years 2007–2014.

The model was given on the estimation using the classical method of least squares with GRETL program. The results of the estimation and analysis presented in the paper allow formulating the following conclusions:

– The least squares estimation is a useful solution for analyzing problems related to the study of the impact of the human capital components on Gross Domestic Product of the Polish Provinces;

- Variables such as: the PhD students, the R&D graduates and the master's degree graduates are important components of the human capital influencing the competitiveness of the Polish voivodeships (Gross Domestic Product). As a consequence, the increase of the level of these variables positively influences the increase of the competitive advantage;
- The volatility of GDP data of regions influences three out of four examined variables in a statistically significant way. These are: the PhD students (0.1), the R&D staff (0.01) and the graduate students (0.01).

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