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Human capital as the basis for creating a competitive advantage

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ABSTRACT

Looking at the directions of changes, which have occurred in the world economy in recent years, it is possible to notice that it more relies on knowledge than on the industry. Investing only in fixed assets is no longer the only way to provide increased competitive of regions. Currently, the factor that determines development in a large scope is among others human capital. An aim of this work is to study the human capital impact on the competitiveness of regions in Poland in 2005-2014. The article has both theoretical and empirical character. The first part is a review of literature referring to the subject of work. The second part presents analysis of statistical data and panel model, which was estimated with ordinary least squares method. GRETL program was used for calculations.

***Keywords*:** Human capital, competitiveness, regions in Poland, GDP

1. INTRODUCTION

The state and prospect of human capital development is an important research problem in the economic theory and business practice. Despite the fact that among economists, there is a difference of views on the role of growth factors, the importance of human capital to achieve competitive advantage of regions is recognized as significant (Skrodzka, 2015, 7).

The basic challenge for countries, regions and enterprises functioning in them is to build the economy based on knowledge, in which the key role has human capital. In this system not the work, raw materials or financial capital is a primary resource, but the knowledge that will enable to achieve competitiveness and high level of development (Dyr, Ziółkowska, 2014, 6). Human capital is exactly regarded as the carrier of this knowledge (Bartnik, 2016, 8).

Different qualifications, abilities or competence of people comprise the human capital. They are also associated with psychological and social factors, i.e. standards, models and systems of values, shaped in the given community, attitudes to work and education, creativity and entrepreneurship (Jabłoński, 2011, 81).

The main aim of this article is analysis of human capital impact on the competitiveness of regions in Poland in 2005-2014. The work presents study on relations between GDP and selected components of human capital. GRETL program was used for calculations.

2. THEORETICAL ANALYSIS OF HUMAN CAPITAL

The study of subject literature in equal measure shows that the concept and notion of human capital have not yet been clearly formulated. Researchers differently understand and define the concept of human capital. It should be noted that some authors point to the fact that human capital is treated as "something", which is just created and added to human life, as well as constitutes an inseparable part of human being (Wronowska, 2005, 121).

The concept of human capital is not regarded as a modern fashion, but it is perceived as a necessity for any organization that wants to survive and develop on an unpredictable market. The ability of real management of intellectual resources becomes a necessary condition for any organization, which wants to exist and win on the competitive arena.

Human capital is one of components of the intellectual capital. Sometimes these two notions are used interchangeably. It can result from the fact that human capital is treated as the most important component of intellectual capital (Adamowicz, Apelska, 2013, 205-206). However, it is necessary to remember not to confuse these two concepts and not to use them interchangeably. Intellectual capital, next to financial capital, constitutes a specific kind of pillar on the basis of which regions, organizations or society are functioning. It is also treated as the ability of these three matters to qualitatively new connection of possessed abilities in order to create new values (Edvinsson, Malone, 2001, 39).

Human capital, above all, should be identified with human knowledge. It is an individual, unique attribute of the entity, which may not be the subject of market trade (Wosiek, 2012, 23). This category in the economy is considered in two presentations:

- in narrow perspective – it is the knowledge, education level or individual competence of both skills of citizens in achieving established tasks and social objectives (Bontis, 2004, 20);
- in broad perspective – these are all characteristics that affect the productivity of individuals and at the same time, embodied in the given nation; these includes: knowledge, ability, health level, culture (Wosiek, 2012, 24).

The feature of human capital is fact that it is a part of the man. The resource of human capital is not generated by genetic features of the given population once and for all, but it can be accumulated and enlarged. Human capital cannot be bought, but only generate by investing in a man, in oneself, in goods and services provided by specialized institutions. These services require certain costs, which shall take the form of investment in education, research, health, job-search, collection and processing of information, as well as cost of migration and professional development (Ślusarczyk, 2005, 280-281).

Summing up, the concept of human capital explains this particular role, which is assigned to the man and everything that provides to the organization, regions and the whole economy. Achieving competitive advantage through all of these matters depends on their participants, because they create, modify and even destroy the areas in which they operate. A special position is not already assigned to financial capital, but to knowledge capital. Exactly the man, its knowledge and skills are the greatest wealth of the organization to which belongs.

3. HUMAN CAPITAL IMPACT ON THE COMPETITIVENESS OF REGIONS

Resources, skills and abilities that enable to provide the region advantage over others affect the competitiveness of regions. Competitiveness is, above all, an ability to compete, thus operating methods and survival forms in the competitive environment.

Competitiveness is a priority challenge, whether for regions or organization. The potential of members involved and active in the given area became a crucial factor in building and maintaining a competitive advantage (Marakova, Dyr, Wolak-Tuzimek, 2016, 92-93). Flexibility of human factor also affects it, i.e. ability of quick adaption to unpredictable and changeable environment. It turns out that these resources have an impact on the competitiveness of regions. In economy conditions based on knowledge, the profit is mainly determined by people, rather than money or buildings. Therefore, human capital constitutes the most valuable resource, which among others organizations have.

The human capital is a basic source of competitive advantage, because the rest of enterprise or region assets as measurable more easily undergo standardization and become fully comparable. Human resources are a key strategic resource of the organization and determine its advantage over the competition (Adamowicz, Apelska, 2013, 207-208).

3. 1. Methodology/Methods

Econometric analysis based on the ordinary least squares method was used in the analysis of components impact of the human capital on competitiveness of regions (voivodships) in Poland. Consequently, the study was conducted on panel data. Assuming that index i = 1, 2, …, N of marked areas (voivodships), whereas index t = 1, 2, …, T of time unit, constructed model have a form of (wider Gardiner, Martin, Tyler, 2004)

$$PKB\_i\_t = \alpha\_i\_t + Ob\_i\_t + S\_i\_t + L\_i\_t + v\_i\_t \qquad (1)$$

where: PKB_i_t – dependent variable: gross domestic product total of mln PLN (in current prices),
dependent variables:

Ob_i_t – demographic dependency ratio – number of people in non-productive age per 100 people in the productive age,
S_i_t – students of higher education institutions per 10 thousand populations,
L_i_t – number of people with higher education aged 15 and more (thousand persons),
α_i_t – structural parameter of the model,

v_{it} – total random error (comprising of purely random ε_{it} and individual effect u_i, hence $v_{it} = \varepsilon_{it} + u_i$) (Kufel, 2013)

White's test on heteroscedasticity of residuals, normalcy test of residuals distribution, Durbin-Watson's test and diagnostic tests of panel were used for model verification. Whereas GNU Regression Econometric and Time-Series Library – GRETL software was used for calculations, which provides advanced econometric methods.

3. 2. Results and discussion

Statistical data drawn from the Local Data Bank (www.bdl.stat.gov.pl) were used in empirical studies. Results of described above model were presented in the following tables and graphs, and under them are results of the most important, and at the same time necessary tests.

Table 1. Assigning indexes to individual voivodships and periods.

	i	**t**
1	Łodz	2005
2	Mazovian	2006
3	Lesser Poland	2007
4	Silesian	2008
5	Lublin	2009
6	Podkarpackie	2010
7	Podlasie	2011
8	Świętokrzyskie	2012
9	Lubusz	2013
10	Greater Poland	2014
11	West Pomeranian	
12	Lower Silesia	
13	Opole	
14	Kuyavian-Pomeranian	
15	Pomeranian	
16	Warmian-Masurian	

Table 2. Model 1: Panel OLS estimation using 160 observations
16 cross-sectional data units are included
Time series length = 10, The dependent variable (Y): PKB_i_t

	Factor	***Standard error***	***Student's t-***	***p-value***	
const	77367	12476	6,2013	<0,0001	***
Ob_i_t	−2895,94	413,752	−6,9992	<0,0001	***
S_i_t	−41,533	11,6863	−3,5540	0,0005	***
L_i_t	308,539	5,56832	55,4098	<0,0001	***

The arithmetic mean of the dependent variable	86838,24	The standard deviation of the dependent variable	71577,55
The sum of squared residuals	2,51e+10	The standard error of the residues	12696,04
Coefficient of determination R-square	0,969132	Adjusted R-squared	0,968538
F(3, 156)	1632,586	P-value of F test	1,5e-117
Log-likelihood	−1736,852	Akaike information criterion	3481,704
Schwarz Bayesian Criterion	3494,005	Hannan-Quinn Criterion	3486,699
Autocorrelation of residues - rho1	0,946875	Durbin-Watson status	0,213452

Significance level for three dependent variables was 1%. This shows that demographic dependency ratio, number of students in higher education and number of people with higher education aged 15 are very strong factors affecting GDP in the given regions.

Table 3. White's test for the heteroskedasticity of residues (variability of residual variance)
KMNK estimation, using 160 observations
The dependent variable (Y): uhat ^ 2

	factor	**standard error**	**Student's -t**	**p-value**
const	−4,64458e+09	3,65609e+09	−1,270	0,2059
Ob_i_t	2,85383e+08	2,39212e+08	1,193	0,2347

S_i_t	8,19268e+06	5,21360e+06	1,571	0,1182	
L_i_t	−5,35273e+06	3,35182e+06	−1,597	0,1124	
sq_Ob_i_t	−5,08845e+06	3,99244e+06	−1,275	0,2044	
X2_X3	−151571	161631	−0,9378	0,3499	
X2_X4	186487	110667	1,685	0,0940	*
sq_S_i_t	−6937,55	2359,28	−2,941	0,0038	***
X3_X4	5441,11	2196,69	2,477	0,0144	**
sq_L_i_t	−2029,78	645,611	−3,144	0,0020	***

Coefficient of determination R-squared = 0,177388

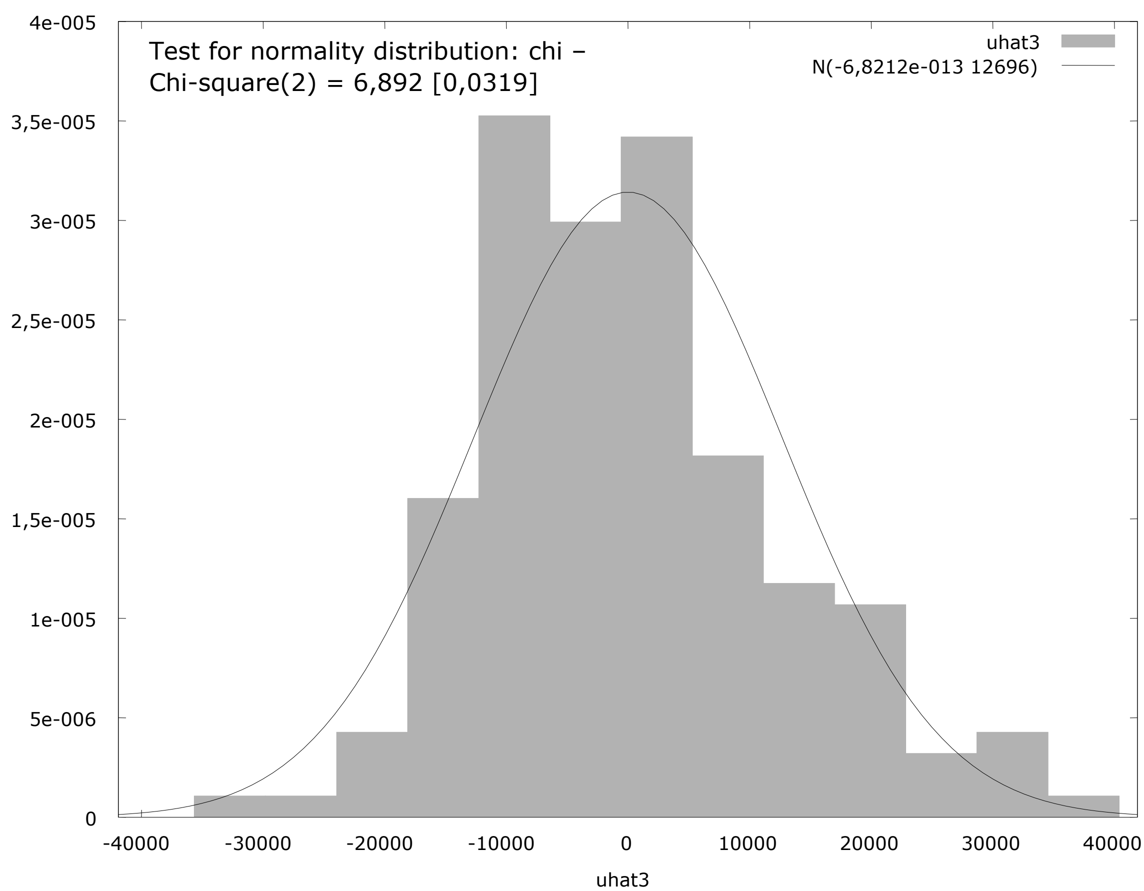

Figure 1. Test for normality of distribution

Table 4. The frequency distribution for uhat1, observations 1-160
the number of compartments = 13, average = -6,82121e-013, stand.dev. = 12696

Intervals	mean	number	frequency	cumulated
< -29810	-32735	1	0,63%	0,63%
-29810 - -23960	-26885	1	0,63%	1,25%
-23960 - -18111	-21036	4	2,50%	3,75%
-18111 - -12261	-15186	15	9,38%	13,13% ***
-12261 - -6411,2	-9336,1	33	20,63%	33,75% *******
-6411,2 - -561,51	-3486,4	28	17,50%	51,25% ******
-561,51 - 5288,2	2363,4	32	20,00%	71,25%*******
5288,2 - 11138	8213,1	17	10,63%	81,88% ***
11138 - 16988	14063	11	6,88%	88,75% **
16988 - 22837	19913	10	6,25%	95,00% **
22837 - 28687	25762	3	1,88%	96,88%
28687 - 34537	31612	4	2,50%	99,38%
>= 34537	37462	1	0,63%	100,00%

The null hypothesis: empirical cumulative distribution has a normal distribution. Doornik-Hansen's test (1994) - transformed skewness and kurtosis:

Chi-square(2) = 6,892 p-value of 0,03187

Collinearity rating VIF (j) - factor of variance inflation

VIF (Variance Inflation Factors) - the minimum possible value = 1,0
Values > 10.0 may indicate a problem of collinearity - variance inflation
Ob_i_t 1,365
S_i_t 1,568
L_i_t 1,838
VIF (j) = 1 / (1 - R(j) ^ 2), where R(j) is a multiple correlation coefficient between the variable 'j' and other independent variables of the model.

Parameters of matrix X'X

1-norm = 58998592
Determinant = 1,9622929e + 018
Indicator of matrix conditioning CN = 1,7008077e-008

Durbin-Watson status = 0,213452, p-value = 7,77156e-016

The next two tables show the diagnostics for a balanced panel of 16 units in the section for 10 periods.

Table 5. Estimated fixed effects (non-random effects) that take into account the diversity of free expression according to the units in the cross section (coefficients, standard errors in brackets, the p value in square brackets)

const:	195,42	(28539)	[0,99455]
Ob_i_t:	-478,65	(742,92)	[0,52044]
S_i_t:	-0,36651	(26,369)	[0,98893]
L_i_t:	296,79	(12,601)	[0,00000]

16 group means including data

Residual variance: 7,1963e + 009/(160 - 19) = 5,10376e+007

The total significance of group means inequality

F(15, 141) = 23,4458 with a p-value 4,41088e-031
(A low p-value means the rejection of the hypothesis H0 that the panel model OLS is the correct one, regarding hypothesis H1 that the model with fixed effects is more appropriate)

Breusch-Pagan's test statistic

LM = 291,891 with a p value = prob (chi-square (1)> > 291,891) = 1,92571e-065
(A low p-value means the rejection of the hypothesis H0 that the OLS panel model is the correct one, regarding hypothesis H1 that the random effects model is more appropriate)

Variance estimators

between = 1,29599e + 008
within = 5,10376e + 007
theta used for quasi-demeaning = 0,801553

Table 6. Estimated random effects allow for a unit-specific component to the error term (coefficients, standard errors in brackets, the p value in square brackets)

const:	28991	(21531)	[0,18009]
Ob_i_t:	-1212,6	(605,97)	[0,04712]
S_i_t:	-24,593	(18,902)	[0,19514]
L_i_t:	299,49	(9,5356)	[0,00000]

Hausman test statistic

H = 5,17692 with a p value = prob(chi-square(3) > 5,17692) = 0,159291
(A low p-value indicates rejection of the null hypothesis of the model with random effects, against alternative hypothesis of the model with fixed effects)

Table 7. Model 2: Panel OLS estimation using 160 observations
16 cross-sectional data units are included
Time series length = 10, The dependent variable (Y): PKB_i_t

	Factor	***Standard error***	***Student's t***	***p-value***	
const	99204,4	14957,8	6,6323	<0,0001	***
Ob_i_t	−3765,84	503,242	−7,4831	<0,0001	***
S_i_t	−18,8823	13,7839	−1,3699	0,1728	
L_i_t	302,901	5,76974	52,4982	<0,0001	***
dt_1	−15701,1	5877,13	−2,6716	0,0084	***
dt_2	−14692,6	5755,02	−2,5530	0,0117	**
dt_3	−9956,51	5638,92	−1,7657	0,0795	*
dt_4	−7297,67	5500,93	−1,3266	0,1867	
dt_5	−8830,01	5337,93	−1,6542	0,1002	
dt_6	−7899,56	5141,67	−1,5364	0,1266	
dt_7	−2238,28	4876,77	−0,4590	0,6469	
dt_8	−1412,45	4652,05	−0,3036	0,7618	
dt_9	−1694,77	4472,29	−0,3789	0,7053	

The arithmetic mean of the dependent variable	86838,24	The standard deviation of the dependent variable	71577,55
The sum of residuals squared	2,30e+10	The standard error of the residues	12495,95
Coefficient of determination R-square	0,971822	Adjusted R-squared	0,969522
F(3, 68)	422,4911	P-value of F	2,2e-107
Logarithm of the likelihood function	−1729,556	Akaike Information criterion	3485,113
Schwarz's Bayesian criterion	3525,090	Hannan-Quinn criterion	3501,346
Autocorrelation of residues - rho1	0,967394	Durbin-Watson statistics	0,195241

To give a better sense of the problem, we also presented the results of panel estimation (least squares method) supplemented with additional variables 0-1 units of time.

Table 8. White's test for the heteroskedasticity of residues (variability of residual variance)
KMNK estimation, using 160 observations
The dependent variable (Y): uhat ^ 2

	factor	**standard error**	**Student's -t**	**p-value**	
const	−8,42951e+09	4,31481e+09	−1,954	0,0532	*
Ob_i_t	6,33053e+08	2,87906e+08	2,199	0,0299	**
S_i_t	−1,90533e+07	6,07259e+06	−3,138	0,0022	***
L_i_t	1,18890e+07	3,88861e+06	3,057	0,0028	***
dt_1	6,29621e+09	1,81752e+09	3,464	0,0008	***
dt_2	6,20307e+09	1,77698e+09	3,491	0,0007	***
dt_3	6,40445e+09	1,72545e+09	3,712	0,0003	***
dt_4	6,30770e+09	1,64760e+09	3,828	0,0002	***
dt_5	6,68069e+09	1,56968e+09	4,256	4,29e-05	***
dt_6	4,77175e+09	1,47041e+09	3,245	0,0015	***
dt_7	3,65306e+09	1,31152e+09	2,785	0,0063	***
dt_8	2,47202e+09	1,16909e+09	2,114	0,0367	**
dt_9	1,10006e+09	1,05668e+09	1,041	0,3001	
sq_Ob_i_t	−1,24112e+07	4,93212e+06	−2,516	0,0132	**
X2_X3	789311	208446	3,787	0,0002	***
X2_X4	−397440	129609	−3,066	0,0027	***
X2_X5	−3,09805e+08	7,71055e+07	−4,018	0,0001	***
X2_X6	−2,98976e+08	7,45131e+07	−4,012	0,0001	***
X2_X7	−2,93526e+08	7,14067e+07	−4,111	7,47e-05	***
X2_X8	−2,83954e+08	6,79178e+07	−4,181	5,72e-05	***
X2_X9	−2,99106e+08	6,35786e+07	−4,705	7,20e-06	**
X2_X10	−2,12071e+08	5,75136e+07	−3,687	0,0003	***
X2_X11	−1,61208e+08	4,91387e+07	−3,281	0,0014	***

X2_X12	−1,09158e+08	4,16804e+07	−2,619	0,0100	**
X2_X13	−4,79651e+07	3,57088e+07	−1,343	0,1819	
sq_S_i_t	−10981,0	2750,35	−3,993	0,0001	***
X3_X4	8474,39	2483,96	3,412	0,0009	***
X3_X5	8,48086e+06	2,02815e+06	4,182	5,71e-05	***
X3_X6	7,78246e+06	1,90151e+06	4,093	7,99e-05	***
X3_X7	6,73087e+06	1,79324e+06	3,753	0,0003	***
X3_X8	6,31318e+06	1,70409e+06	3,705	0,0003	***
X3_X9	6,36761e+06	1,56380e+06	4,072	8,64e-05	***
X3_X10	5,31983e+06	1,43819e+06	3,699	0,0003	***
X3_X11	4,22042e+06	1,22096e+06	3,457	0,0008	***
X3_X12	3,17497e+06	1,02275e+06	3,104	0,0024	***
X3_X13	1,61805e+06	876427	1,846	0,0675	*
sq_L_i_t	−2259,18	687,512	−3,286	0,0014	***
X4_X5	−5,03766e+06	1,02483e+06	−4,916	2,99e-06	***
X4_X6	−4,30646e+06	941443	−4,574	1,22e-05	***
X4_X7	−3,67252e+06	873822	−4,203	5,26e-05	***
X4_X8	−3,37602e+06	819342	−4,120	7,20e-05	***
X4_X9	−3,19464e+06	716781	−4,457	1,96e-05	***
X4_X10	−2,92601e+06	652603	−4,484	1,76e-05	***
X4_X11	−2,12872e+06	539247	−3,948	0,0001	***
X4_X12	−1,57797e+06	443775	−3,556	0,0005	***
X4_X13	−779970	346317	−2,252	0,0262	**

Coefficient of determination R-squared = 0,462387
The test statistic: T ^ 2 = 73,981859, with a p value = P (Chi-square (45) > 73,981859) = 0,004168

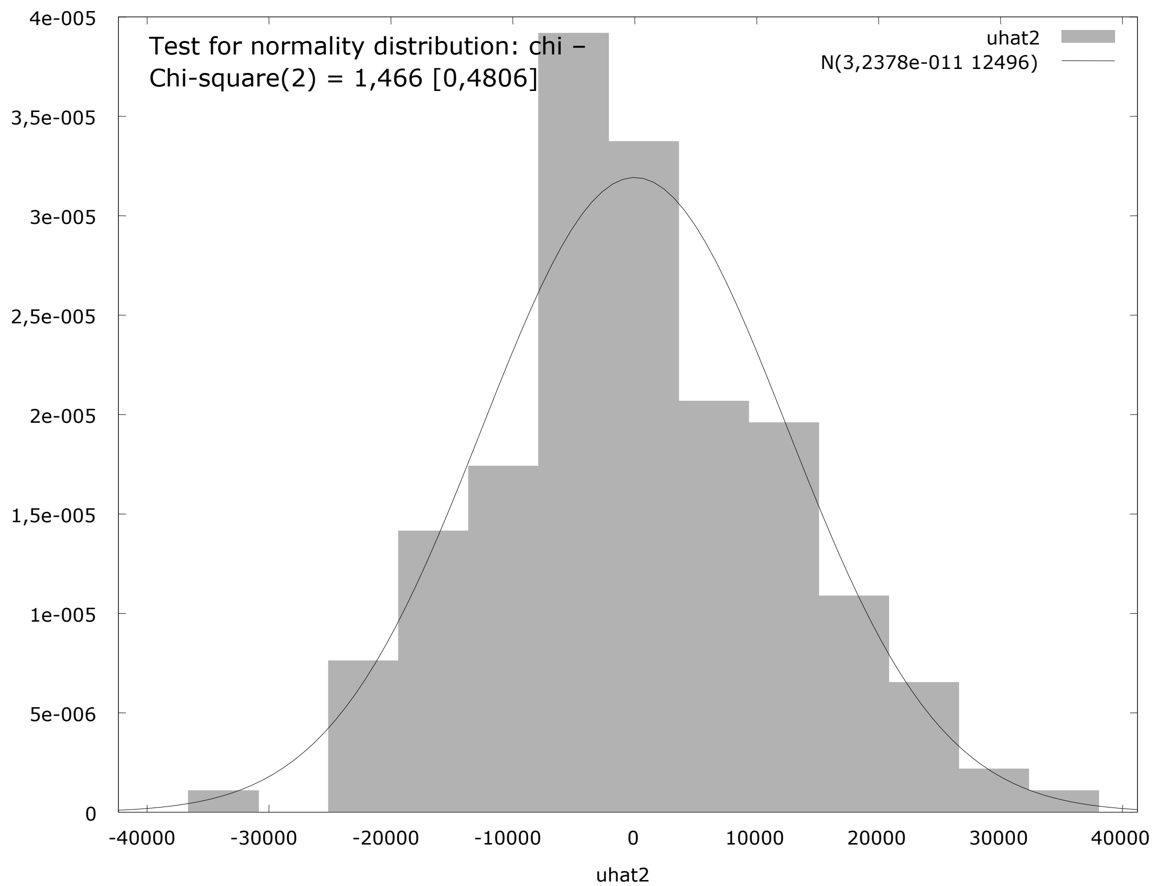

Figure 2. Test for normality of distribution

Table 9. The frequency distribution for uhat2, observations 1-160
the number of compartments = 13, average = 3,2378e - 011, stand.dev. = 12496

Intervals	mean	number	frequency	cumulated	
< -30861	-33733	1	0,63%	0,63%	
-30861 - -25118	-27990	0	0,00%	0,63%	
-25118 - -19375	-22246	7	4,38%	5,00%	*
-19375 - -13631	-16503	13	8,13%	13,13%	**
-13631 - -7888,1	-10760	16	10,00%	23,13%	***
-7888,1 - -2144,9	-5016,5	36	22,50%	45,63%	********
-2144,9 - 3598,4	726,77	31	19,38%	65,00%	******
3598,4 - 9341,7	6470,0	19	11,88%	76,88%	****
9341,7 - 15085	12213	18	11,25%	88,13%	****

15085 - 20828	17957	10	6,25%	94,38%	**
20828 - 26571	23700	6	3,75%	98,13%	*
26571 - 32315	29443	2	1,25%	99,38%	
>= 32315	35186	1	0,63%	100,00%	

The null hypothesis: empirical cumulative distribution has a normal distribution.
Doornik-Hansen's test (1994) - transformed skewness and kurtosis:
Chi-kwadrat(2) = 1,466 with a p value 0,48055

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
Ob_i_t 2,084
S_i_t 2,251
L_i_t 2,037
dt_1 3,185
dt_2 3,054
dt_3 2,932
dt_4 2,791
dt_5 2,628
dt_6 2,438
dt_7 2,193
dt_8 1,996
dt_9 1,845

VIF(j) = 1/(1 - R(j)^2), where R(j) is the coefficient of multiple correlation between the variable 'j' and the other independent variables of the model.

Parameters of matrix X'X:

1-norm = 59062266
Determinant = 5,0939449e + 027
Indicator of matrix conditioning CN = 4,8959207e - 009
Durbin-Watson status = 0,195241
P-value is "very small" (the Imhof integral could not be evaluated so a definite value is not available)

The next two tables show the diagnostics for a balanced panel of 16 units in the section for 10 periods.

Table 10. Estimated fixed effects (non-random effects) that take into account the diversity of free expression according to the units in the cross section (coefficients, standard errors in brackets, the p value in square brackets)

const:	-70176	(39292)	[0,07639]
Ob_i_t:	2057,3	(1179,6)	[0,08349]
S_i_t:	-27,098	(26,344)	[0,30554]
L_i_t:	298,34	(13,209)	[0,00000]
dt_1:	19279	(7735,7)	[0,01393]
dt_2:	18686	(7377,3)	[0,01248]
dt_3:	21529	(6999,6)	[0,00255]
dt_4:	21854	(6546,7)	[0,00110]
dt_5:	17917	(6024,2)	[0,00349]
dt_6:	16648	(5516,7)	[0,00306]
dt_7:	17082	(4583,4)	[0,00029]
dt_8:	12027	(3623,4)	[0,00117]
dt_9:	5156,2	(2753,5)	[0,06333]

16 group means including data:

Residual variance: 6,02949e+009/(160 - 28) = 4,56779e + 007

The total significance of group means inequality:

F(15, 132) = 24,701 with a p-value 3,52263e - 031
(A low p-value means the rejection of the hypothesis H0 that the panel model OLS is the correct one, regarding hypothesis H1 that the model with fixed effects is more appropriate)

Breusch-Pagan's test statistic:

LM = 300,923 with a p value = prob (chi-square (1) > 300,923) = 2,07322e-067
(A low p-value means the rejection of the hypothesis H0 that the OLS panel model is the correct one, regarding hypothesis H1 that the random effects model is more appropriate)

Variance estimators:

between = 1,29599e + 008
within = 4,56779e + 007
theta used for quasi-demeaning = 0,812262

Table 11. Estimated random effects allow for a unit-specific component to the error term (coefficients, standard errors in brackets, the p value in square brackets)

const:	3119,4	(28494)	[0,91298]
Ob_i_t:	-265,11	(915,34)	[0,77251]
S_i_t:	-37,134	(21,427)	[0,08519]
L_i_t:	297,48	(10,02)	[0,00000]
dt_1:	6647	(6614)	[0,31656]
dt_2:	6673,3	(6336,3)	[0,29398]
dt_3:	10266	(6052,2)	[0,09194]
dt_4:	11504	(5707,9)	[0,04568]
dt_5:	8512,5	(5306,9)	[0,11085]
dt_6:	7894	(4853,8)	[0,10602]
dt_7:	10183	(4104,6)	[0,01423]
dt_8:	7278,9	(3368,2)	[0,03231]
dt_9:	2652,7	(2699,7)	[0,32744]

Hausman test statistic

H = 11,9344 with a p value = prob(chi-square(12) > 11,9344) = 0,450964
(A low p-value indicates rejection of the null hypothesis of the model with random effects, against alternative hypothesis of the model with fixed effects

4. CONCLUSIONS

In conclusion, an aim of research was to analyze the impact of selected components of human capital on GDP of Polish voivodships in 2005 and 2014. The panel model was built and annual data were used. Model was estimated with ordinary least squares method.

Analysis results presented in the work enable to formulate the following conclusions:

- panel model is useful to study the components impact of human capital on the competitiveness of Polish voivodships;
- all three studied factors should be ranked among determinants of the competitiveness of regions. Increase in the level of these variables has a positive effect on variability of GDP size;

- demographic dependency ratio, number of students in higher education institutions and number of people with higher education in a statistically significant affects the variability of GDP size of Polish regions.

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