THE IMPACT OF INTELLECTUAL CAPITAL ON THE COMPETITIVENESS OF POLISH REGIONS

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Abstract

The direction of changes taking place in a global economy in recent years, indicates a transition from an industrial economy to a knowledge-based economy. Increasing the investments only in fixed assets is no longer a sufficient way to ensure sustainable economic growth. Nowadays, a factor that also determines the development is intellectual capital.

The degree and the prospect of the intellectual capital development, make up an important research issue in both economic theory and business practice. Despite different views among economists about the importance of economic growth factors, the relevance of intellectual capital is considered crucial in achieving a competitive advantage.

The aim of the article is to analyze the intellectual capital and its impact on the competitiveness in Polish regions. To achieve the objective, an analysis of statistical data was made and a panel model estimated on a classical method of least squares was built. For calculations, the GRETL program was used.

Key words: intellectual capital, the competitiveness of regions, regions in Poland

JEL Code: C19, J24, O15

Introduction

Place of a human in economical processes is a subject of considerations of many authors. However very often they were expressing lash thoughts which with a running time were evolving to finally become a basis of creation of a new research area, important due to the economic development, what is the intellectual capital (Zakery, Afrazeh, 2017, p. 102).

Human resources are a basis of functioning of every organization, country and region. A quality of the human factor, i.e. his skills, knowledge and competences can contribute to achieve or in opposite to lose a profitable competitive dominance on a market. Actually a factor which have more and more significant meaning to achieve a competitiveness is an ability to using immaterial resources i.e. the intellectual capital (Skrodzka, 2015, p. 7, 11).

The regional development is perceiving as a systematic improvement of competitiveness of economic subjects and as a rising of regional economic potentials what contribute to develop a country (Wolak-Tuzimek, 2016, p. 2058-2059). Many scientists prove connections of material resources with an economic development of a region (see Lament, 2016, pp. 1033-1035). Then we can say it is a regional development in a category of resources. However after reaching of some determined level, further development is directed only by intellectual resources. They have a huge impact on a competitiveness of regions (Marakova, et. al., 2016, p. 92-93).

The goal of the paper is an analysis of the impact of the intellectual capital on a competitiveness of regions in Poland. The paper has been divided to three parts. In the first, theoretical capture of the intellectual capital is presented. In the second part an aspect of a model construction is elaborated. Finally in the last part estimating results of the constructed model are presented and described. The whole is finished with a summary, what include conclusions which are a synthesis of preferential remarks emerging from the carried research.

1 Theoretical capture of the intellectual capital

The intellectual capital is category of a capital, which refers to capture the knowledge as a resource and a factor of a production. It should be highlighted that in the literature dedicated to the intellectual capital there many ambiguities exist, connected with a definition, with an identification of terms and with measure methods (Wosiek, 2012 p.7).

The intellectual capital is still not finally recognised and described. Thus there exist a big need to undertake scientific researches in this area (Wolak-Tuzimek, et. al., 2015, p. 76-77). Currently we can meet many interpretations of this term. Chosen definitions of the intellectual capital of an enterprise and a region are presented in the tables 1 and 2.

Tab. 1: The intellectual capital of an enterprise

Author	Definitions of the intellectual capital of an enterprise
T.A. Stewart (1991)	An intellectual material, knowledge, information, intellectual property and experience which can be used for creating a wealth.
L. Edvinsson i M. S. Malone (1997)	A knowledge, experience, technology, relations with clients, professional skills, which gives a competitive advantage on a market.

J. Nahapiet, S. Ghoshal (1998)	A knowledge and abilities of a given community. An enterprise constitutes an intellectual community. Elements of the intellectual capital are an organizational culture, and a social capital.
S. Harrison i P.H. Sullivan (2000)	A knowledge that can be turned into a value.

Source: (Wosiek, 2012, p. 17).

Tab. 2: The intellectual capital of a region (country)

Author	Definitions of the intellectual capital of a region (country)
Y. Malhotra (2003)	"Hidden resources" of a nation that are a basis of increase of its economic potential, its prosperity and position in the world,; an ability of a region to generate new values based on existing resources.
N. Bontis (2004)	Includes hidden values of citizens, of enterprises, of institutions, of societies and regions that are present and potential sources of wealth generating.
G. Schiuma, A. Lerro, D. Carlucci (2008)	A group of knowledge assets, that are ascribed to a particular region and that in significant way, are determining a machinery of creating of values in a region.

Source: (Wosiek, 2012, p. 18).

Despite of lasting disputes among scientist concerning to the elaborated definitions, there can be found many common features. Authors refer most of all to a knowledge and competences of units and all communities. They are all compatible too, that this capital is unobservable and it is a basis of building a competitive advantage and of market values creating (Rodrigues, 2017, pp. 2-4).

Elements that create the intellectual capital were not determined so far. In the subject literature mostly meeting is a structure of the intellectual capital consisting of capitals: human, structural and relational.

A human capital is determining as skills of an employee to fulfilling tasks, solving problems appearing in an enterprise and it is also an ability of creating interpersonal relations based on understanding and a trust. A human capital represent a source of a knowledge generating in an enterprise. A fundamental feature of a human capital is that it isn't enterprise's property but only it is using by an enterprise during period of employee's employment. In case when an employee leaves an organization, some skills and abilities are lost (Beyer, 2012, p. 247-248).

A next component, the structural capital, is a structure that support an effectiveness of employees. This capital include technologies, organizational culture, methods and conceptions of managing, data basis, formal and informal procedures, communication systems and IT systems, patents, copyright laws, project laws, trademarks and service's marks, enterprise's innovativeness, ability to organizational learning, processes of strategies creating and a style of managing, which allow functioning of an enterprise - i.e. all the things that stay in the office when employees go home.

The relational capital determines a level of market's recognition and a range of relation of an enterprise with it's contractors. It includes such elements as: a trademark, clients and their loyalty, distribution channels, agreements, contracts and deals with subcontractors, trade partners, investors, banks, public institutions, etc. The relational capital is also a knowledge of competitors' strategies and external conditioning, including an economic situation of a country and a policy of a government (Bombiak, 2013, p. 74).

2 Model construction

The research was conducted on panel data, i.e. data that are observed in at least two dimensions (Górecki, 2013). This data type is a two-dimensional variable, conditioned by the time and the space. Thus in the work, an influence of selected factors of the intellectual capital on the PKB in each of sixteen Polish provinces in years from 2005 to 2014, had been examined. With an assumption, that with use of the index i = 1, 2, …, N subsequent areas (provinces) were marked, and with use of the index t = 1, 2, …, T units of the time (see the tab. 3), thus the constructed model is:

$$PKB_{it} = \alpha_{it} + Ab_{it} + N_{it} + Na_{it} + v_{it} \qquad (1)$$

where: PKB_{it} – explained variable: gross domestic product in general in milliards of PLN (current prices)

explaining variables:

Ab_{it} – study graduate of the master level (persons)

N_{it} – investment expenditures of a private sector on a single resident in PLN

Na_{it} – internal expenditures on B+R convert on a 1 single resident in PLN

α_{it} – structural parameter of the model

v_{it} – combined random mistake (consisting of a random part ε_{it} and of an individual effect u_i, hence

$v_{it} = \varepsilon_{it} + u_i$) (Kufel, 2013).

Tab. 3: 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	

Source: opracowanie własne

3 Results of model's estimation

In the empirical researches a statistical data were used which were drew from the website of the Local Data Bank (www.bdl.stat.gov.pl). Results of the above described model are presented in the subsequent tables and on the graph. Below of them, the most important thus necessary tests' results, are presented.

Estimation with use of a classic method of the smallest squares (KMNK) is treated as a permissible when an individual effect do not occurs and a panel is treated as a set of cross section data (Kufel, 2013, p. 174). This is the situation that takes place in the examined model.

Using the econometric programme GRETL the evaluation presented in the table 4 was achieved. It includes characterizing and describing numbers of results of panel estimations by the method of the smallest squares.

Tab. 1: 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	39972,2	6255,78	6,3896	<0,0001	***
Ab_i_t	4,34054	0,317528	13,6698	<0,0001	***
N_i_t	16,2855	2,56668	6,3450	<0,0001	***
Na_i_t	102,707	16,6974	6,1511	<0,0001	***

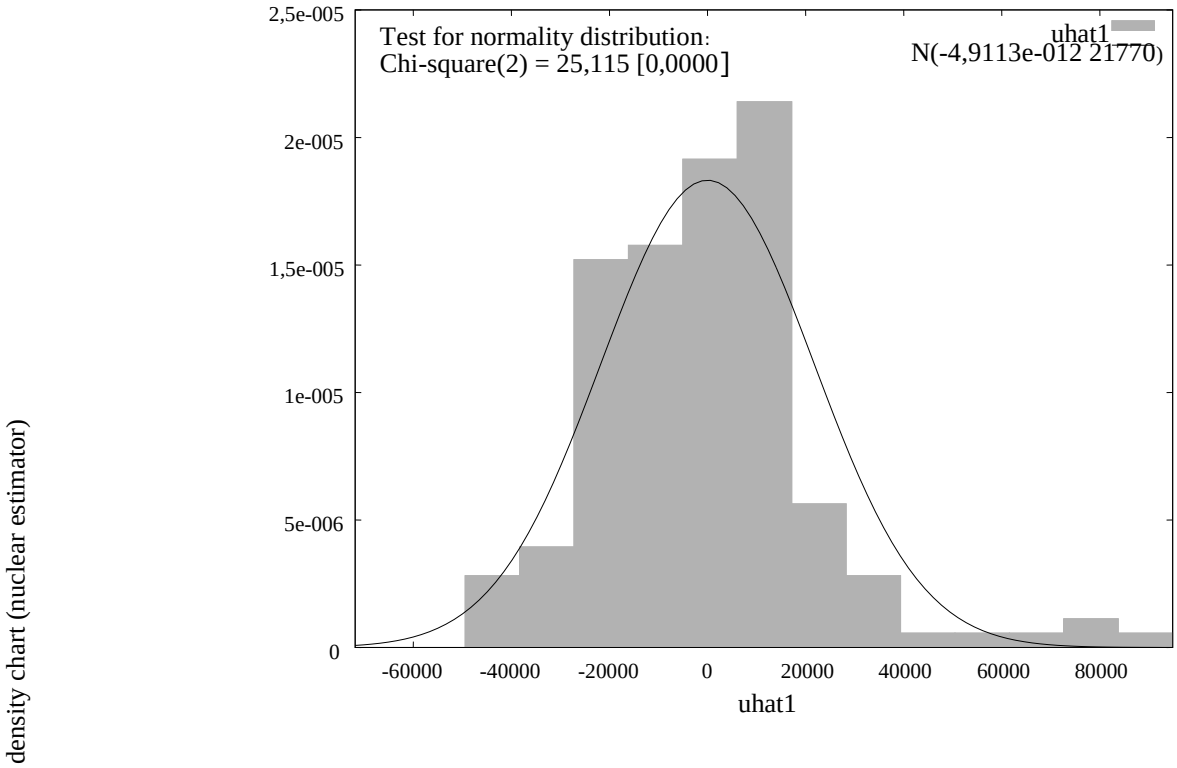
The arithmetic mean of the dependent variable	86838,24	The standard deviation of the dependent variable	71577,55
The sum of squared residuals	7,39e+10	The standard error of the residues	21770,06
Coefficient of determination R-square	0,909240	Adjusted R-squared	0,907495
F(3, 156)	520,9415	P-value of F test	4,96e-81
Log-likelihood	1823,131	Akaike information criterion	3654,263
Schwarz Bayesian Criterion	3666,563	Hannan-Quinn Criterion	3659,257
Autocorrelation of residues - rho1	0,975544	Durbin-Watson status	0,190684

Source: on the basis of the program GRETL.

Significance level for three dependent variables was 1%. Study graduate of the master level, investment expenditures of a private sector on a single resident and internal expenditures on B+R convert on a 1 single resident are very strong factors affecting GDP in the given regions. White's test for residual heteroscedasticity (residual variance variability): Null hypothesis: heteroscedasticity of residues is absent. Test statistics: LM = 31,3686 with a value = P(Chi-square(9) > 31,3686) = 0,000255866

Test for residual normality: Null hypothesis: the random component has a normal distribution. Test statistics: Chi-square(2) = 25,1154 with value P = 3,51764e-006 (wider Błażejowski, et. al., 2016, p. 168-169).

Fig. 1: Test for normality distribution



Source: on the basis of the program GRETL.

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: Ab_i_t = 2,586, N_i_t = 2,414, Na_i_t = 3,517.

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.

Matrix properties X'X: 1-norm = 4,8119967e+010, determinant = 3,307672e+026.

Indicator of matrix condition CN = 2,5123078e-010.

Durbina-Watsona statistics= 0,190684, p-value is "very small" (the Imhof integral could not be evaluated so a definite value is not available)

Tab. 2: 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**	**Value p**
const:	36469	(11152)	[0,00135]

Ab_i_t:	0,14923	(0,70016)	[0,83152]
N_i_t:	4,7759	(1,6622)	[0,00469]
Na_i_t:	172,99	(9,9792)	[0,00000]

Source: on the basis of the program GRETL.

16 group means including data: Residual variance: 1,4581e+010/(160 - 19) = 1,03411e+008.
The total significance of group means inequality: F(15, 141) = 38,2634 with a p value 3,71231e-042.
(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 = 298,71 with a p value = prob(chi-square(1) > 298,71) = 6,29106e-067.
Variance estimators: between = 3,40026e+008, within = 1,03411e+008, theta used for quasi-demeaning = 0,825608 (wider Lucchetti, 2011, p. 10-12).

Tab. 3: Estimated random effects allow for a unit-specific component to the error term

	Coefficients	**Standard errors**	**Value p**
const:	-1968,3	(9009,7)	[0,82735]
Ab_i_t:	2,5813	(0,45775)	[0,00000]
N_i_t:	6,8704	(1,7179)	[0,00010]
Na_i_t:	172,66	(10,566)	[0,00000]

Source: on the basis of the program GRETL.

Hausman test statistic: H = 27,5678 with a p value = prob(chi-square(3) > 27,5678) = 4,4755e-006.
(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).

Tab. 4: Model 2: Estimated fixe effects, 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	36469	11151,6	3,2703	0,0014	***
Ab_i_t	0,149234	0,700156	0,2131	0,8315	
N_i_t	4,77588	1,66216	2,8733	0,0047	***
Na_i_t	172,986	9,97919	17,3347	<0,0001	***

The arithmetic mean of the dependent variable	86838,24	The standard deviation of the dependent variable	71577,55
The sum of residuals squared	1,46e+10	The standard error of the residues	10169,13
Coefficient of determination R-square	0,982101	Adjusted R-squared	0,781256
F(3, 68)	429,8003	P-value of F	1,4e-113
Logarithm of the likelihood function	1693,255	Akaike Information criterion	3424,510
Schwarz's Bayesian criterion	3482,938	Hannan-Quinn criterion	3448,236
Autocorrelation of residues - rho1	0,630706	Durbin-Watson statistics	0,622139

Source: on the basis of the program GRETL.

Joint test on named regressors: Test statistics: F(3, 141) = 167,863, with a p value = P(F(3, 141) > 167,863) = 2,4634e-046.

Test for the variation of free expression in groups:

Bull hypothesis: Groups have a common free expression.

Test statistics: F(15, 141) = 38,2634, with a p value = P(F(15, 141) > 38,2634) = 3,71231e-042.

Tab. 5: Model 3: Estimation of random effects (GLS), used transformation Nerlove'a, 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	21921,2	14485,3	1,5133	0,1322	
Ab_i_t	1,07851	0,6014	1,7933	0,0749	*
N_i_t	5,48045	1,62024	3,3825	0,0009	***
Na_i_t	173,629	9,81235	17,6950	<0,0001	***

The arithmetic mean of the dependent variable	86838,24	The standard deviation of the dependent variable	71577,55
The sum of residuals squared	1,86e+11	The standard error of the residues	34406,44
Logarithm of the likelihood function	1896,876	Akaike Information criterion	3801,752
Schwarz's Bayesian criterion	3814,052	Hannan-Quinn criterion	3806,746

Source: on the basis of the program GRETL.

'Within' variance = 9,11311e+007.

'Between' variance = 3,40026e+008 theta uses it quasi-demeaning = 0,926789.

Breusch-Pagan's test statistic: Null hypothesis: Eror ariance in unit = 0.
Asymptotic test statistic: Chi-square(1) = 298,71 with a p value = 6,29106e-067.
Hausman test: Null hypothesis: Estimator UMNK (GLS) is compatible.
Asymptotic test statistic: Chi-kwadrat(3) = 9,59701 with a p value = 0,0223214.

Conclusion

To sum up, the goal of researches was to conduct an analysis of impact of selected components of the intellectual capital on the PKB of sixteen Polish provinces in years from 2005 to 2014. The panel model was constructed and an annual data was used. Estimation of the model were conducted with use of the smallest squares method with use of the GRETL programme.

Presented results of the work allow to formulate following conclusions:

- the model panel is useful to research an impact of the intellectual capital components on a competitiveness (PKB) of provinces in Poland;
- to the factors which determine a competitiveness of regions should be counted the three examined indicators. Increase of a level of these variables have a positive impact on change of the PKB value. Thus it occurs as an advantageous correlation;
- in a statistically important way, a number of master level graduates, amount of investment expenditures of a private sector on a single resident, and internal expenditures on B+R convert on a 1 single resident, affects a variability of the PKB values of Polish regions.

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