Comparative Economic Research, Volume 19, Number 5, 2016
10.1515/cer-2016-0038

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The Importance Of Human Capital For The Economic Development Of EU Regions

Abstract

The EU designs its cohesion policy with the primary purpose of reducing disparities in regional development. The success of the policy is largely determined by the identification of factors that contribute to such disparities. One of the key determinants of economic success is human capital. This article examines the relationship between the quality of human capital and economic development of EU's regions. Using spatial analysis methods, the spatial dependencies between the growth of human capital and GDP per capita are investigated.

According to the research results, the highest levels of human capital are typical of the most affluent regions in Western Europe, while its lowest levels are found in the poorest countries that became EU members only recently and in countries in southern Europe, including Greece. The spatial correlation measures confirm that spatial relationships have effect on the regional resources of human capital, showing that regions rich in human capital border on regions that are similar to them in that respect. The results of the spatial growth regression indicate that the amount of human capital in the region has a significant and positive effect on its GDP per capita.

***Keywords**: European Union, regions, human capital, GDP per capita, Moran statistics, spatial regression, economic growth*

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1. Introduction

The EU shows a strong focus on reducing disparities in the development of its member states (external cohesion) and of the regions inside them (internal cohesion). The instrument it uses to this end is cohesion policy addressed to NUTS-2 and NUTS-3 regions. An important element of ensuring socio-economic cohesion is the performance of analyses that enable the identification of factors contributing to variations in regional development with increasing precision. Among the determinants of economic success, human capital is considered one of the most significant, as it can boost or decelerate the process of economic growth.

This article is an attempt to capture the relationship between human capital quality and economic development of EU's regions. In the first part of it, spatial differences in human capital between EU's NUTS-2 regions are presented using a set of selected measures. An analysis of spatial relationships influencing the measures' values is used to identify the spatial pattern characterising the formation of human capital as a factor of economic growth.

In the second part of the article, the results of spatial growth regression accounting for human capital are presented.

2. Human capital and economic growth – a theoretical perspective

Human capital and its role as a factor of economic growth and regional development are discussed frequently and widely. Classical economics viewed labour, land and capital as the primary factors of production. Capital was understood as financial or physical assets that could be used for gainful economic activity. It was observed, however, that the effectiveness with which physical or financial assets were used was determined by the qualifications, competencies and health of humans. This finding led to the formulation of the notion of human capital in the 1960s (Becker 1964).

Human capital theory has become a vital element of in-depth analyses seeking to assess the role played by the quality of the human factor in economic processes. In the literature, human capital is increasingly viewed as one of the key factors in labour productivity (at aggregate as well as individual levels) that helps economies become more innovative and accelerates their growth. The models of endogenous growth have assigned a prominent role to human capital. There are two distinct views on how it contributes to economic growth (Aghion, Howitt, 1992). In the first of them, human capital is regarded as an argument of the production function, an exemplification of which is the Mankiw-Romer-Weil

model (1992) or the Lucas model (1988). According to the second view, human capital enables the creation of innovations and assimilation of new technologies, thus leading to technological development (see Florczak 2007, pp. 126–127).

The outcomes of numerous studies on human capital and economic growth usually confirm that the two are related to each other. The quality of the human factor is widely accepted today as a factor of considerable influence on business results.

Economic development can be considered not only at the national economy level but also in regional terms. Regional development and spatial disparities in the development of regions have been a frequent topic of regional and local studies. The recent decade witnessed a particularly strong rise in their number. Researchers seek to determine what mechanisms, conditions and factors have effect on regional development processes. This great interest in regions is partly due to EU's policy that aims to strengthen regional economies.

As in the case of the national economy, the level of human capital in a region can significantly influence its economic development through productivity and innovativeness. It is thought that raising the amount of human capital and improving enterprises' access to whatever information they might need should be priority in building regional competitiveness and innovativeness (Szultka et al., 2004, pp. 16–17).

It noteworthy that the relationship between human capital and the development of the national economy can be different than that at the regional economy level. The national economy and regional economies differ in that the regions do not have „true" borders and are much more open, so factors of production can be easily moved between them. This particularly applies to workers who gravitate to regions paying higher wages, taking their human capital with them (Golejewska 2012, p. 29).

The definite majority of studies on human capital consider it in the context of national economies. Studies focused on regional economies are much fewer, partly for the lack of reliable regional statistics. The existing empirical studies show, however, that the development of regional economies also benefits from human capital (Di Liberto 2008; de la Fluente 2002).

The importance that the EU attaches to human capital as a major factor in the development of the regions of its member states has been reflected in the goals of the Community's regional policy. Yet, the knowledge of human capital and of its significance for the development of European regions still seems to be incomplete, which substantiates continued research into this field using the spatial analysis methods.

3. Selected concepts of human capital measurement

The concepts of human capital are characterised by ambiguity. Notwithstanding the great number of studies investigating human capital, it is still surrounded by many definitional doubts and controversies. Becker's minimalist definition of human capital (1964), concentrating on education and training, has been extended to account for physical health and other abilities improving individuals' potential for acquiring knowledge and skills (Golejewska 2012, p. 31). While it is true that the diversity of definitions of human capital makes their practical use more difficult, it also provides a better insight in its nature and complicated structure.

According to the OECD definition of human capital, it is "The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (GUS, 2012, p. 20). Based on this definition, human capital can be considered with respect to three different stages of the life cycle: creation, maintenance and use. The first of them – the creation of human capital – is described in terms of population's reproductive capacity, access to healthcare, pre-school education and formal education. The second stage – the maintenance of human capital – is determined by the appropriate access to healthcare, life-long learning or goods of culture. The third stage – the use of human capital – is characterised based on economic activity, employment, patent submissions and design patents, etc.

Because of the uniqueness and multifaceted nature of human capital, many problems are encountered in measuring its value. It is also for this reason that a standard estimation method for human capital has not been proposed yet. There are, however, recognised methods with which it can be measured, for instance an income method and a cost method (Florczak 2006).

As both of them are laborious and the necessary data are frequently unavailable, other methods have also been created. Table 1 shows a range of methods that are used by authors of empirical studies to measure human capital.

The aim of the composite measures of human capital that are widely used today is to create a relatively comprehensive index of human capital.[1] In order to put together a multifaceted description of the region's human capital partial indicators on its demography, health, education, labour market, culture, science, technology and innovations are necessary, as well as economic and social determinants of human capital development. Data shortages cause that empirical analyses usually face problems in accounting for all dimensions of human capital.

[1] Such as the Lisbon Council Human Capital Index (Ederer, Schuler, Willms 2007).

Table 1. Methods for the measurement of human capital

Methods	Focus
Retrospective	cost of creation
Prospective	future income
Akin to retrospective	educational parameters
Benchmarks	competence tests (e.g. PISA, IALS)
Composite measures	combination of indicators characteristic of different approaches with a view to creating an aggregate comprehensively describing a given phenomenon

Source: developed based on I. Miciuła, K. Miciuła 2015, p. 273.

4. Human capital and GDP per capita in EU's regions

This research aimed to investigate how human capital quality and economic development in EU's regions were related to each other. It is based on the 2014 statistics on 283 NUTS-2 regions obtained from the Eurostat website[2].

Because of the available statistical data, the following set of indicators directly describing human capital or having direct influence on its development was adopted. It was divided into the four following groups:

Group	Variable
Science, technology and innovation	• Human resources in Science and Technology; % of total population, • Employment in technology and knowledge-intensive sectors; % of total employment,
Education	• Pupils and students in all levels of education (ISCED 0–6), % of total population, • Population aged 25–64 with less than primary, primary and lower secondary education (levels 0–2); % of total population, • Early leavers from education and training; % of population aged 18–24, • Young people neither in employment nor in education and training, % of population aged 18–24
Demography	• Demographic dependency ratio (expressed as the number of "dependents" aged 0-14 and 65+ for every 100 "workers" (aged 15–64),
Health	• Life expectancy, males, aged less than 1 year, • Life expectancy, females, aged less than 1 year, • Medical doctors per hundred thousand inhabitants

[2] http://ec.europa.eu/eurostat/data/database, accessed in May 2016.

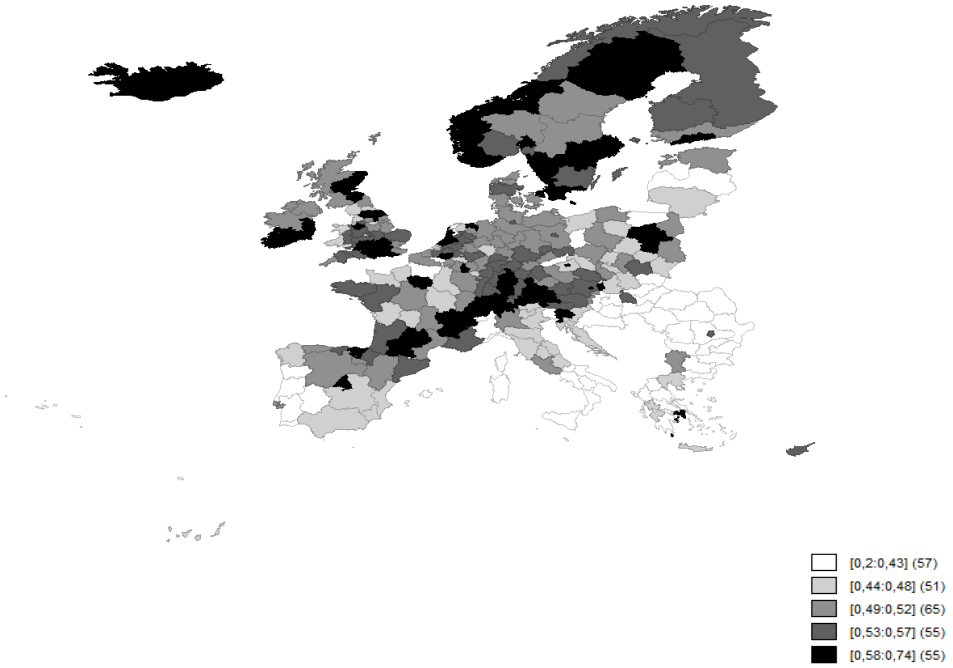
The aggregate measure of human capital for region *i* HC_i was calculated as an unweighted sum of individual diagnostic characteristics z_j after unitarisation:

$$HC_i = \frac{1}{10}\sum_{j=1}^{10} z_{ij} \tag{1}$$

where:

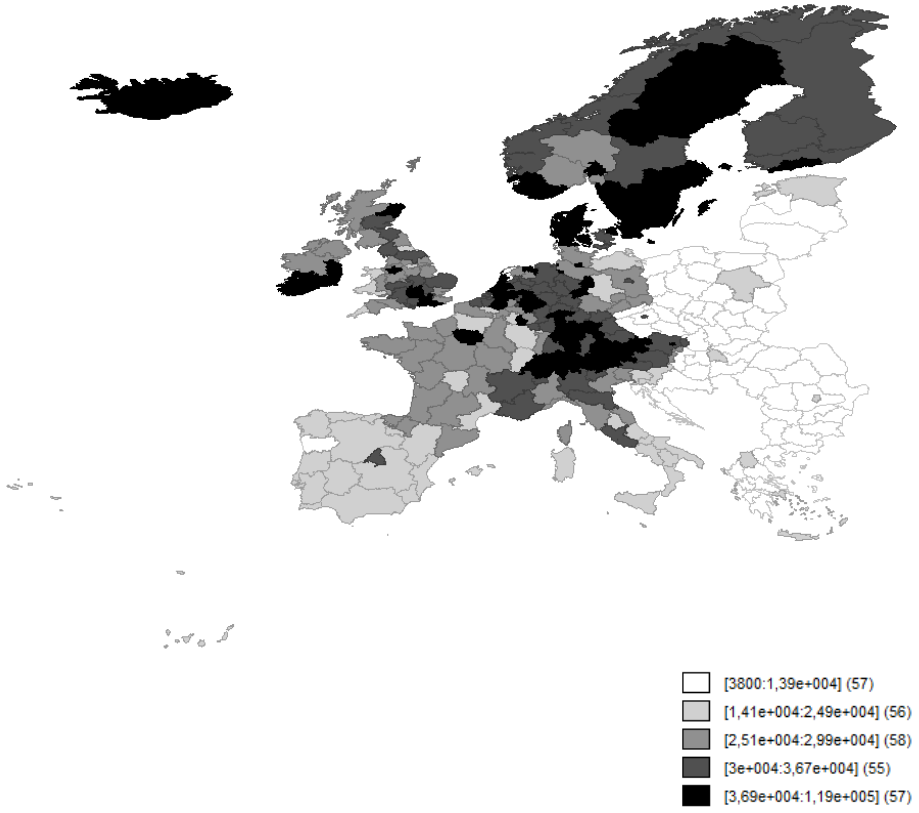
$$z_{ij} = \begin{cases} \dfrac{x_{ij} - \min\limits_i\{x_{ij}\}}{\max\limits_i\{x_{ij}\} - \min\limits_i\{x_{ij}\}} & \text{if variable } x_j \text{ is a stimulant} \\ \dfrac{\max\limits_i\{x_{ij}\} - x_{ij}}{\max\limits_i\{x_{ij}\} - \min\limits_i\{x_{ij}\}} & \text{if variable } x_j \text{ is a destimulant} \end{cases}$$

Figure 1. Human capital level in EU NUTS-2 regions – quintile map



Source: authors' own work.

Figure 2. GDP per capita in EU NUTS-2 regions – quintile map

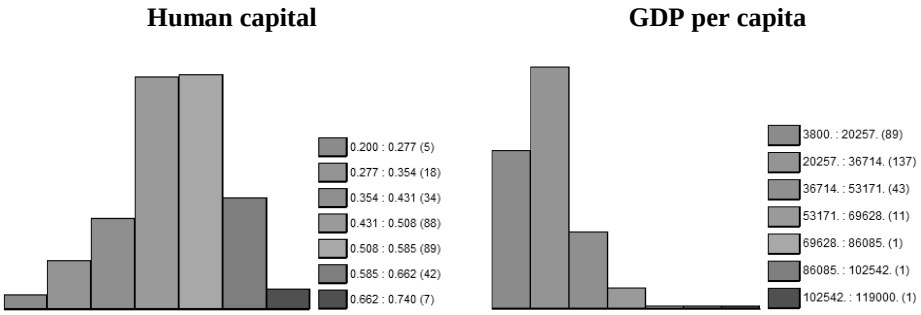


Source: authors' own work.

The calculated measures of human capital range from 0.19 in the Bulgarian region of Severozapaden to 0.73 in the regions of Île de France and Inner London. According to Figure 2, the highest levels of human capital characterise regions in Switzerland, Belgium, Austria, southern Germany, Scandinavia, Iceland, southern England, and some capital regions. Regions where the levels of human capital are predominantly low are situated in Bulgaria, Romania, Greece, southern Italy, western Spain and Portugal. Therefore, the largest resources of human capital are characteristic of Western European regions that are also the most affluent. At the other end, there are poor regions in the new EU member states and in south-European countries, including Greece that in 2014 faced the most severe economic problems. The values of the synthetic measure of human capital show its relatively strong correlation with the level of GDP per capital (a Pearson's coefficient of 0.73). The comparison of graphs 1 and 2 also points to similarity between the distribution of human capital and GDP per capita.

As far as GDP per capita is concerned, greater concentration of its high values can be seen in Germany, Scandinavia and the UK, whereas the regions of countries that became EU members after 2004 and Greece are placed in the quintile where the values of GDP per capita are the lowest.

Figure 3. A histogram of the distribution of human capital and GDP per capita measures



Source: authors' own work.

A comparison of both these variables' histograms provides even more information. An analysis of regions in terms of human capital shows that those with average values of this variable have a clear numerical advantage (63% of regions are placed in two middle intervals and only 4% in the two extreme intervals), but GDP per capita has placed 80% of all regions in the first two intervals.

5. Spatial analysis of the relationship between human capital and GDP per capita

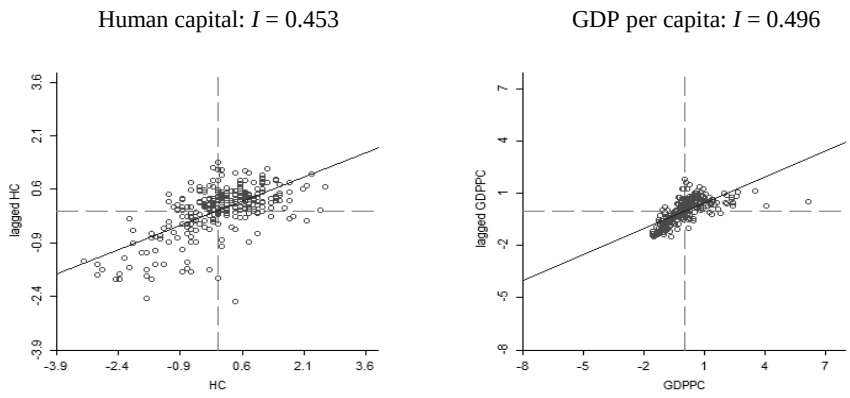
In the next step, the spatial dependencies of the synthetic measure of human capital were investigated. The appropriate analytical procedure starts with the construction of a spatial weight matrix. For the purposes of the study, the queen contiguity weight matrix of 2nd order was adopted. This means that a neighbouring region is one that borders on the considered region as well as the neighbours of the former. The construction of this poses some problems with accounting for the island regions. There are 17 island regions (NUTS-2) in the EU, for instance Sicily, Iceland, and the Canary Islands. As their economies are linked with other regions, in the research they were artificially "assigned" neighbours, i.e. regions that were geographically the closest to them and, if possible, belonged to the same country.

In graphs 3 and 4, Moran's global and local statistics are shown as the so-called Moran's scatter plot (graph 3) and a map of local Moran's statistics (LISA; diagram 4).

The horizontal and vertical axes of the Moran's scatter plot represent, respectively, the values of the considered variable in the region and the spatially-lagged values of the same variable in neighbouring regions. The plot also shows the regression line the slope coefficient of which corresponds to global Moran's I (a measure of global spatial autocorrelation).

The global Moran's I statistics for the measure of human capital was I=0.453 with a pseudo p-value p=0.001 (a randomisation test with 1000 random permutations), meaning that the null hypothesis stating that spatial correlation was not present in the analysed area was rejected. The same was observed for GDP per capita: I=0.496, p=0.001. The concentration of the values of human capital was higher in first quadrant, indicating that regions with high values of human capital were surrounded by similar regions. As far as GDP per capita is concerned, a concentration of regions with low GDP per capita surrounded by similar regions seems to predominate, but the number of regions with high GDP per capita surrounded by similar regions is also high.

Figure 4. Moran's scatter plot

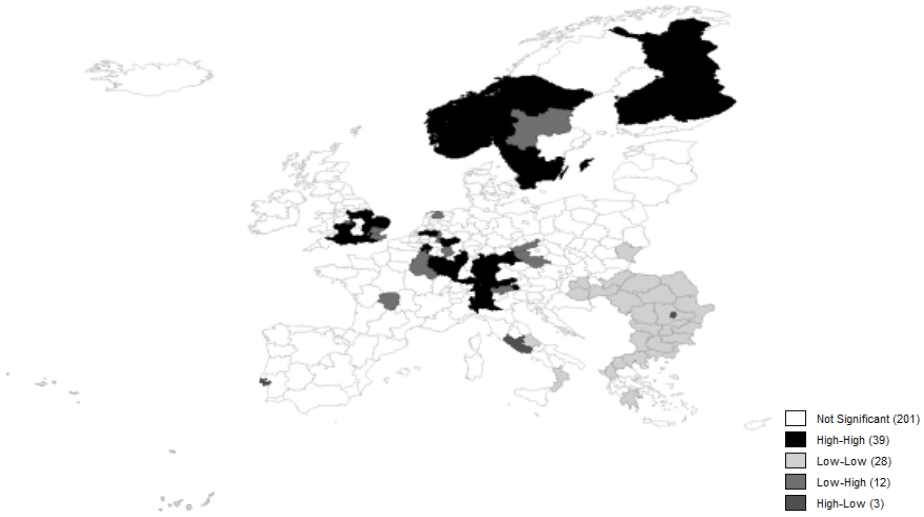


Source: authors' own work.

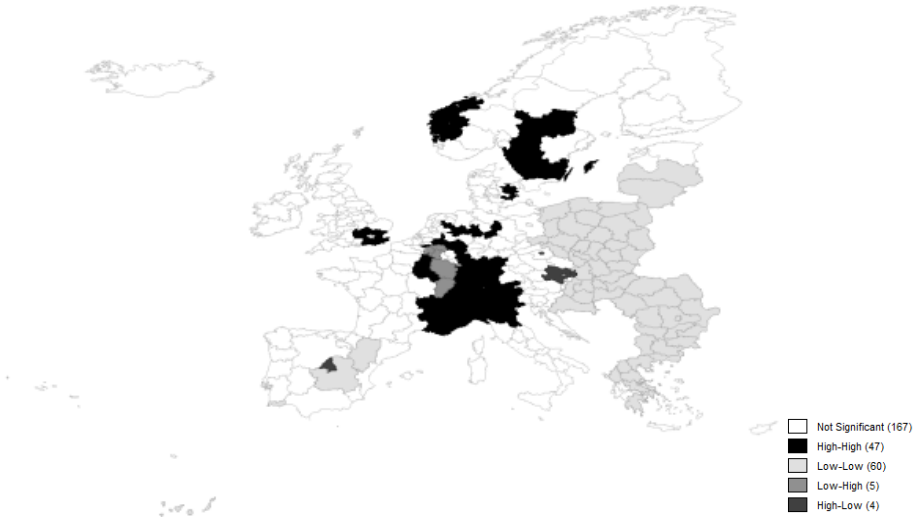
With the LISA values presented in Figure 4, it is possible to infer about spatial correlations between regions and their neighbours. Such an in-depth analysis of spatial dependencies can show whether the region under consideration is surrounded by regions with a similar value of the analysed variable. Figure 4 presents also a map of *p* values for particular LISA statistics calculated with a randomization test with 1000 permutations. The darker the colour, the lower the value of *p*, and therefore the higher correlation between a region and its neighbours.

Figure 5. Local Moran's statistics LISA

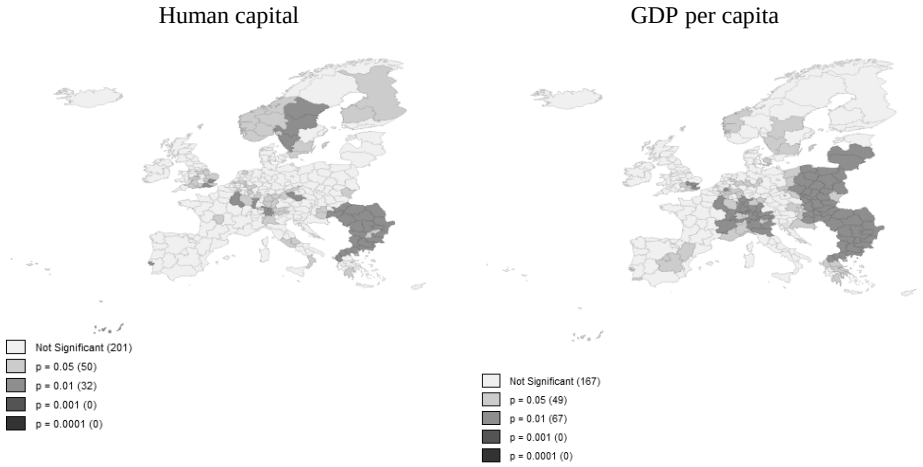
Human capital



GDP per capita



Significance map



Source: authors' own work.

The maps shows that the clusters of NUTS-2 regions with high values of human capital can be found today in Scandinavia (southern Norway, Sweden and Finland), Austria, Switzerland, western Germany and southern England. A large grouping of regions with low values of human capital exists in Bulgaria, Romania and Hungary that are new EU member states, and in Greece and Italy. Two so-called hot-spots (regions characterised by high values of the analysed variable surrounded by regions where its values are low) are Bucuresti-Ilfov and Lazio with the capital cities of Romania and Italy. It can be concluded that capital cities have considerable drawing power and attract students and best educated persons with jobs in technology and knowledge-intensive sectors and easy access to medical care. The low-high regions are few. They are situated in France (Champagne-Ardenne), south-eastern England (Essex, Kent), the Czech R. and the Netherlands (Zeeland). The regions' shortage of human capital can be attributed to the weight of the agricultural sector in their economies.

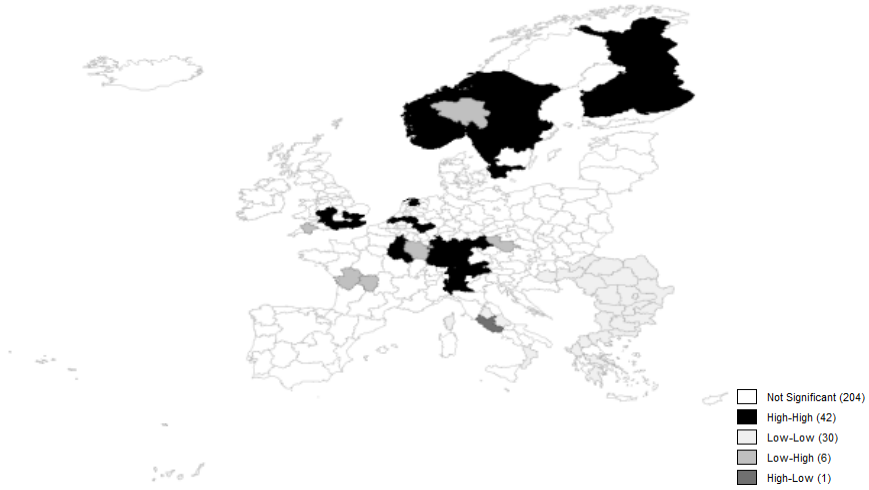
The local indicators of spatial association for GDP per capita (Figure 4) show the presence of two very large clusters of high-high and low-low regions. The first of them comprises the urbanised areas in northern Italy, south-eastern France, Germany, the Netherlands, Belgium, Austria, and all NUTS-2 regions in Switzerland. The second one consists of all NUTS-2 units in Lithuania, Latvia, Poland, Hungary, and Romania, the Czech and Slovak regions that border on them, and most Greek regions. That the regions also belong to the lowest quintile for GDP per capita (graph 2) is a dramatic illustration of the per capita income gap between the new and old members of the EU. A large number of Greek regions in the grouping clearly show the severity of economic crisis faced by the country's economy.

With the Exploratory Spatial Data Analysis it is possible to compare the bordering regions for two features. In this research, the bivariate Moran's statistics was used to compare GDP per capita in a region with the level of human capital in the neighbouring areas. The results of this exercise are shown in graph 5.

Figure 6. Bivariate Local Moran's statistics (BiLISA) maps

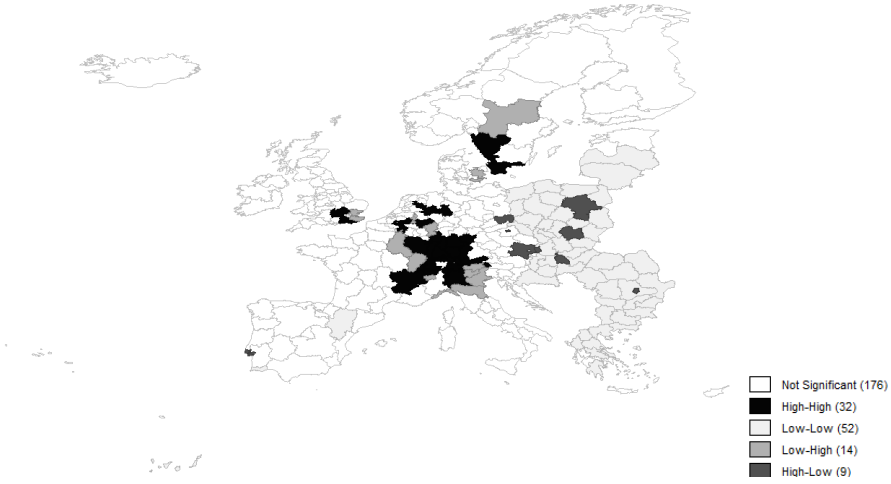
GDP per capita vs. lagged HC

Bivariate Moran's I=0.401



HC vs. lagged GDP per capita

Bivariate Moran's I=0.391



Source: authors' own work.

A comparison of the map with bivariate dependencies (Figure 5) with that showing univariate dependencies (Figure 4) reveals considerable similarity between them. Most clusters consist of regions with high income per capita that are surrounded by regions with high levels of human capital, but the Balkans also show a very large concentration of regions with low values of both variables. This picture and that showing spatial dependencies for GDP per capita are very similar. Only one region with high income per capita (Lazio in Italy, with the capital city of Rome) borders on regions with low resources of human capital. This may mean that human capital is sucked into the capital city. In some EU countries, the NUTS-2 regions with the national capital cities are characterised by a high-low relationship between human capital and spatially-lagged GDP per capita. These are the regions of Közép-Magyarország (with Budapest), Praha, Mazowieckie (with Warsaw), Bucuresti-Ilfov, and Área Metropolitana de Lisboa. The regions are surrounded by areas where low values of per capita income cluster together (Figure 4), which may suggest that in poorer regions the capital cities draw better educated persons with greater force. In graph 5 there are also regions showing a low-high relationship between human capital and spatially-lagged GDP. Most of them border on regions where the relationship is high-high. These regions include Champagne-Ardenne in France, Essex and Kent in south-eastern England, i.e. which are characterised by univariate low-high dependency of human capital. This may mean that large high-high clusters draw human capital also from the neighbouring regions, thus increasing their income per capita to an even higher level.

At the last stage of this empirical study, the influence of human capital on GDP per capita was assessed. To perform the estimation procedure, two spatial regression models (a spatial autoregressive model and a spatial error model) and basic specifications were used.

In the spatial autoregressive model (SAR; otherwise a spatial lag model, SLM) the dependent variable *y* in place *i* is affected by the independent variables in both place *i* and *j*. The model is of the form:

$$y = \rho \mathbf{W} y + \mathbf{X}\boldsymbol{\beta} + \varepsilon, \tag{2}$$

where:
ρ — the autoregression parameter denoting the dependence of the analysed variable in one place on its value in other places;
$\mathbf{W}$ — the spatial weight matrix.

In the spatial error model (SEM), the error terms across different spatial units are correlated. The general form of the SEM model is as follows:

$$y = \mathbf{X}\boldsymbol{\beta} + \varepsilon, \quad \varepsilon = \lambda \mathbf{W}\varepsilon + \xi, \tag{3}$$

where parameter λ is the coefficient of the spatial correlation of residuals.

In the SAR model, spatial lag is suggestive of a possible diffusion process, meaning that the explained variable's value in place *i* is influenced by its values in other places (areas, regions, geographical points). In the SEM model, interactions are enabled by the error term. The SEM model is selected when it is not possible to account for some spatially-autocorrelated variables in the specification.

In the analysis, the explained variable was GDP per capita in region *i* ($GDPPC_i$), $i = 1,\ldots,283$, and the explanatory variables were the following:

- **W**_$GDPPC_i$ – GDP *per capita* in the regions neighbouring the *i*-th region; the neighbourhood was defined according to the queen weights matrix based on contiguity of second order,
- HC_i - human capital – a synthetic measure,
- $FIXCAP_i$ - gross fixed capital formation per capita (in thousands euro),
- $EMPL_i$ - employment (in thousands).

The 2014 data necessary to perform estimations were sourced from the Eurostat website. The results are given in table 2 that for the sake of comparison shows also the results of a model without spatial interactions estimated by OLS.

Table 2. Estimation results

Explanatory variables	Dependent variable: GDP per capita		
	OLS	Maximum Likelihood Method	
		spatial autoregressive model, SAR	spatial error model, SEM
constant	-1922.97 (p = 0.000)	-1968.03 (p = 0.000)	-1295.52 (p = 0.000)
W_GDPPC	—	0.383 (p = 0.000)	—
FIXCAPPC	1912.48 (p = 0.000)	1586.943 (p = 0.000)	1803.175 (p = 0.000)
EMPL	1.695 (p = 0.053)	1.837 (p = 0.018)	2.0755 (p = 0.006)
HC	69500.07 (p = 0.000)	52928.41 (p = 0.000)	57945.45 (p = 0.000)
λ	—	—	0.627 (p = 0.000)
R^2	0.901	0.738	0.761
LR test for spatial dependence		53.71 (p = 0.000)	65.81 (p = 0.000)

Source: authors' calculation.

As expected, region's GDP per capita is positively influenced by its values in the neighbouring regions. This conclusion is based on the results of both estimated models (the estimate of parameter λ in the SEM model is

statistically significant). The influence of region's human capital on its GDP per capita is also strong. A comparison of the results yielded by the model without spatial dependencies with those obtained from the SAR and SEM models has pointed out that the classical model (OLS) overestimates the influence of gross fixed capital per capita (*FIXCAPPC*) and human capital (*HC*) while underestimating that of employment (*EMPL*).

6. Conclusion

The objectives the EU has adopted for its regional policy clearly show that the Community perceives human capital as a factor of significant influence on regional development in its member states. The analysis has confirmed that the level of regional development measured by GDP per capita and the level of human capital in the regions are related to each other, as well as revealing considerable interregional disparities in both these variables.

The highest levels of human capital are observed in the most affluent regions in Western Europe and the lowest ones in the poorest regions of countries that recently joined the EU and of south-European countries, including Greece. The values of the spatial correlation measures have confirmed that the formation of human capital is a spatially-dependent process. Clusters of NUTS-2 regions characterised by high values of human capital can be found in Scandinavia (southern Norway, Sweden and Finland), as well as in Austria, Switzerland, western Germany and southern England. The new EU member states, Bulgaria, Romania and Hungary, but also Greece and Italy, have clusters of regions where the values of human capital are low. The research has showed that in many countries, particularly in the less prosperous ones, the position of the capital cities is so strong that they absorb human capital from the neighbouring regions.

The bivariate spatial analysis has pointed out that the economic development of a region can be driven by its own resources of human capital as well as by those accumulated by the neighbouring regions. Therefore, actions need to be taken to raise the quality of human capital in the less affluent NUTS-2 regions of the European Union, because its generally low level may have adverse effect on regional development.

Considering that the regional economies are much more open than the national economies are and that the factors of production, particularly workers, can easily move between them, not only intra-regional but also inter-regional links influencing their development need to be investigated.

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Streszczenie

ZNACZENIE KAPITAŁU LUDZKIEGO DLA ROZWOJU REGIONÓW UNII EUROPEJSKIEJ

Zasadniczym celem działań Unii Europejskiej (w obszarze gospodarki) jest dążenie do zredukowania różnic w poziomie rozwoju poszczególnych regionów. W celu usuwania regionalnych nierówności gospodarczych UE realizuje politykę spójności

w stosunku do państw oraz regionów. Duże znaczenie dla powodzenia takiej polityki ma określenie czynników determinujących różnice w poziomie rozwoju regionalnego. Wśród czynników determinujących sukces gospodarczy jedno z czołowych miejsc zajmuje kapitał ludzki, mogący dynamizować bądź spowalniać proces rozwoju. W opracowaniu podjęta została próba oceny relacji pomiędzy jakością kapitału ludzkiego a rozwojem gospodarczym w regionach Unii Europejskiej. Zastosowanie metod analizy przestrzennej pozwoliło na zbadanie zależności przestrzennych w kształtowaniu się kapitału ludzkiego i PKB per capita

Jak wynika z przeprowadzonych badań, regiony o najwyższym poziomie kapitału ludzkiego to najbogatsze regiony Europy zachodniej, zaś najniższym poziomem cechy charakteryzują się ubogie regiony państw najpóźniej przyjętych do UE oraz Europy południowej, w tym Grecji. Regiony o wysokim poziomie kapitału ludzkiego sąsiadują z regionami o podobnie wysokim poziomie cechy. Wyniki przestrzennej regresji wzrostu wskazują na istotny, pozytywny wpływ zgromadzonego w podregionie kapitału ludzkiego na PKB per capita.

***Słowa kluczowe**: Unia Europejska, regiony, kapitał ludzki, statystyka Morana, regresja przestrzenna*