Regional and Business Studies (2016) Vol 8 No 2, 25-38
Kaposvár University, Faculty of Economic Science, Kaposvár

LOCAL HUMAN CAPITAL INDEX IN THE SOUTH TRANSDANUBIAN REGION

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ABSTRACT

The authors addressed the spatial analysis of the human capital of settlements in the South Transdanubian region. It is widely agreed by researchers that especially endogenous regional development relies highly on local assets, among them local human capital. On the other hand there are several indicators in use for measuring spatial allocation of local capital or human capital without a consensus among researchers. Human capital has already been studied from several aspects and reviewing these studies made us confident to work on the topic further. The authors focused on the feasible development of a complex indicator which reflects the spatial allocation of human capital potential in the South Transdanubian region in order to identify the settlements with pulling effect on their surrounding settlements and those areas which are either outliers or negatively affect their neighbourhoods. It was found that local human capital of the Southern Transdanubian settlements had to some extent clear spatial patterns, which is mainly induced by the role of central settlements. Although in some cases the pulling effect of these bigger cities is not unambiguous, not all of their neighbouring settlements benefit. On the other hand, the majority of the settlements does not belong to either positive or negative clusters, and only a few cases were seen as outliers, too.
Keywords: spatial autocorrelation, Hungarian settlements, local human capital index

INTRODUCTION AND AIM OF RESEARCH

The authors focused on the development of a potential indicator which, according to our initial intention, describes the local human capital of settlements in the Southern Transdanubian region.

The aim of the research was to compose a complex indicator which contains several pieces of information of the human capital - starting from the population base up to the availability of local jobs.

It can be seen that due to the selective pattern of regional growth various development paths of single regions are emerging even worldwide. Definition of possible growth strategies for each territorial unit must necessarily rely on local assets (*MTA*, 2001) and potentials and their full exploitation: in short, on what is called 'territorial capital'. (*OECD*, 1999; *OECD*, 2010) The literature of endogenous development is wider than what is possible to overview in this article, but it can be agreed that increasing attention is paid to „intangible, atmosphere-type, local synergy and governance factors". In the last few years these theories were re-interpreted as social capital, relational capital or knowledge assets (*Camagni*, 2008; *Camagni and Capello*, 2008).

Camagni in his work attempting to incorporate the elements of territorial capital (*Figure 1*) into a materiality – rivalry matrix – rates human capital as a factor with private and intangible goods.

Figure 1

Camagni's classification of Local Capital elements

Rivalry	Tangible goods (hard)	Mixed goods (hard + soft)	Intangible goods (soft)
High rivalry (private goods)	Private fixed capital stock Pecuniary externalities (hard) Toll goods (excludab.) *c*	Relational private services operating on: - external linkages for firms - transfer of R&D results University spin-offs *i*	Human capital: - entrepreneurship - creativity - private know-how Pecuniary externalities (soft) *f*
(club goods) / (impure public goods)	Proprietary networks Collective goods: - landscape - cultural heritage (private "ensembles") *b*	Cooperation networks: - strategic alliances in R&D and knowledge - p/p partnerships in services and schemes Governance on land and cultural resources *h*	Relational capital: - cooperation capability - collective action capability - collective competencies *e*
(public goods) / **Low rivalry**	Resources: - natural - cultural (punctual) Social overhead capital: - infrastructure *a*	Agencies for R&D transcoding Receptivity enhancing tools Connectivity Agglomeration and district economies *g*	Social capital: - institutions - behavioural models, values - trust, reputation - associationism *d*

Materiality

Source: *Camagni* (2008) p. 6

Human and social capitals are defined more deeply in a research focusing on the identification of patterns of economic growth and territorial capital growth (*Jóna*, 2015). The author formulated available variables in the two forms of capital among others in order to find out the interrelationship of stable and rapid growth of regions with local capital forms. The author underlines that in many cases interactions for policy objectives are contradictory to stable growth and it is seen from his work that human local capital and more over social local capital serves stable growth better than rush economic growth.

After having already spoken about the regional context of territorial capital, we want to refer here to *Bodnár's* point of view (*Lengyel and Vas* (eds), 2013). The special approach of endogenous development and its concept for rural regions is important because these are unique territorial spaces in terms of economic abilities,

social features and the settlement structure. We agree *Bodnár* that the meaningful changes have taken place, having created functions other than agrarian production for rural regions, they highlight the role of territorial capital in the development of rural areas such as the Southern Transdanubian Region.

Despite the fact that human factor is an important element of local capital and it can be seen in many aspects of it – social, human, infrastructural, relational, cultural, etc. – there is not any agreement or common way to measure it. *T. Kiss* (2012) classifies various indicators that are more or less widely used to measure the embodied knowledge and skills of individuals but at the end she emphasises that such indicators are always tailor-made for individual research objectives, but still rely on the most important factor of it, namely the schooling, the educational level of the population.

Among the methods and complex indicators developed for measuring local human capital the most inspiring for us was the Local Human Development Index of *Szendi* (2015). The author made attempts to develop a complex indicator for local territorial units in order to see centre – periphery relations and to identify the 'pulling' regions with the means of spatial autocorrelation method. In her work she adopted the UNDP methodology (*UNDP*, 2013 38-44. p.) for the indicators available at regional level. The author found that the education level besides life expectancy had a significant effect in the two Central Eastern European countries analysed.

Further studies dealt with the education level and its spatial imbalances (just to mention the most known research groups, *Forray and Híves* 2013; *Nemes Nagy* 2003; *Rechnitzer* 2009; *Rechnitzer–Smahó* 2005; *Kertesi–Varga* 2005; *Obádovics-Kulcsár*, 2003). Most importantly we refer here to the paper of *Sánta et al.* (2015), because they regard qualified human capital as one of the most important economic development theories, especially those with endogenous trend (*Gál et al*, 2010; *Stimson et al.*, 2006; *Todaro and Smith* 2009; *Varga* 2009; *Romer*, 1994). Other authors also used the simplification that human capital of a given region is best described by the education level of the population, but agreed with the phenomenon that the educational level is in close relationship with better jobs, at the end with higher employment (*Ambrus and Varsányi* 2011, *Kézdi*, 2004) among other benefits.

As we have seen above, imbalances of educational level lead to disparities in the local human capital on one side. It made us interested in whether the local population's availability and employment indicators in a complex way are influenced by a spatial pattern, too.

The authors of the current paper have been committed to that the analysis should focus on the settlement level and we chose our wider region for the study. The focus on the settlement level for studying imbalances was not only a continuation of earlier researches (*Sarudi et al.*, 2011; *Honfi and Horváthné Kovács*, 2008) but was justified by the extremely detailed and wide review of methods for the classification of regional units in the work of *Pénzes* (2014) reviewed by *Nagy* (2015), too. In his work *Pénzes* warns that micro regional level of analysis is not easy if the researcher wants to see chronological changes due to the continuous changes of the administrative units.

It was not a question to use a complex or composite indicator for the objectives of our study. The literature and development strategies, papers (e.g. OECD, WHO,

Worldbank, etc.) developed and applied various complex indicators with the intention to incorporate a number of important pieces of information in a single, interpretable indicator for policy uses (*Horváthné Kovács and Nagy*, 2015). *Pénzes* also introduces and compares the benefits of various methods for complex indicator development and he regards standardization method as most ideal. We agree that in case of high number of original variables factor reduction is necessary to eliminate autocorrelation of factors. After having studied the settlement level data (T-STAR) of Hungarian Central Statistical Office (*HCSO*, 2014) and due to the limited range of variables we decided on a reasonable selection of those variables which we wanted to test against spatial autocorrelation in the Southern Transdanubian region. We agree with *Pénzes* that the spatial autocorrelation results may reveal deeper relationships and believe also that it contributes to the understanding if and how certain regional centres influence their surroundings in terms of their local human capital, which - as we have seen previously - in the end is an important factor of the regions' endogenous development from several points of view.

MATERIALS AND METHODS

The territory of the research was analysed on the basis of the settlement data available in Dissemination Database of the Hungarian Central Statistical Office (*HCSO*, 2014). It covered the settlements of the Southern Transdanubian region and included a set of panel data regarding population, population movements and employment figures for year 2014 (*Table 1*).

Table 1

List of variables, n=612

Geographic area T-Star 2014
Area of the settlement
Resident population at the end of the year (data calculated further from finalized data of the population census) (capita)
Number of live births (capita)
Number of arrivals due to migration (permanent and temporary together) (treatments)
Number of departures due to migration (permanent and temporary together) (treatments)
Number of children and children that have come of age, found to be disadvantaged
Number of registered enterprises - GFO'14
Number of registered limited liability companies (pieces)
Number of registered job-seekers, total (capita)
Number of job-seekers registered over 180 days, total (capita)
Number of registered job-seekers, manual workers (capita)
Number of registered job-seekers, non-manual workers (capita)

Source: Filtered from HCSO online database

The database was aligned in the following structure (*Table 2*).

Table 2

Structure of initial database

	Area	Variable 1	Variable 2	...	Variable 612
1	Settlement 1				
2	Settlement 2				
...	...				
612	Settlement 612				

The methodology of data processing consisted of two steps: in Step 1 the variables were composed into a joint index. The Index composition followed a standardi-zation process of the initial variables; then a composite indicators of the so called Population Power and Employment Power were created, which two indicators were used in the Composite Index of Local Human Capital (LHCI). In Step 2 the LHCI variable of settlements were used in GIS based analysis (*Anselin and Bera*, 1998) (spatial autocorrelation), where we wanted to point out the clusters of settlements with stronger human capital power and whether there is a relationship (*Dusek*, 2004; *Varga*, 2002) between the geographical location of settlements and their human capital supply. On the other hand, this tool enables us to identify the areas lagging behind, where both the settlement and its surrounding suffer from low LHCI. Further results of the applied spatial autocorrelation method were expected to highlight the outlier settlements of the region.

RESULTS

Index composition for local human capital

The aim of index composition was to compose various pieces of information into one single indicator that is easy to interpret and illustrate, also appropriate for further numeric methods. The method index composition is widely spread from field-to-field (e.g. environment, innovation capacity, *Bajmóczy et al*, 2010.) and institution-to-institution, but all of them have a concern to create a single variable (key variable, head variable) which carries several pieces of various information at the same time. We followed basically the methodology described by *Szendi et al.* (2015), mainly because the similar topic of interest (human indicator).

By calculating the standardized variables we created a dimensionless variable set taking on values between 0 and 1 (1).

$$x_{norm} = \frac{x_i - x_{min}}{x_{max} - x_{min}} \quad (1)$$

In the further steps we incorporated the standardized variables into composite indicators. The method used in the formula was the weighted average (*Molnár*, 2015). In order to make our standardized variables applicable in the formula they had to be transformed in a way to take on values between 1 and 2 (in order to avoid multiplying with a zero value).

The initial set of indicators were either individually used in the standardized variables (ratio kind variables) or two or three of the individual initial variables were jointly used (*Table 3*) in order to compose the information content into one-one indicator (index).

Table 3

The composition of indicators

Composite index	Sub index	Standardised variables	Initial variables
Composite index of LHCI	Sub index for Population Power	Population Index	• Population at the end of the year (data calculated further from finalized data of the population census) (capita)
		Birth Ratio	• Number of live births (capita)
		Migration Balance	• Number of arrivals due to migration (permanent and temporary together) (treatments) • Number of departures due to migration (permanent and temporary together) (treatments)
	Sub index for Employment Power	Disadvantaged Child Ratio	• Number of children and children that have come of age, found to be disadvantaged
		Local Employment Power Index	• Number of registered enterprises - GFO'14 • Number of registered limited liability companies (pieces)
		Unemployment Ratio	• Number of registered job-seekers, total (capita) • Number of registered job-seekers, manual workers (capita) • Number of registered job-seekers, non-manual workers (capita)
		Long Unemployment Ratio	• Number of job-seekers registered over 180 days, total (capita)

Finally we created 7 kinds of derived variables and these were used in the composition of sub-indices for Population Power (1, 2, 3, 4, 5) and for Employment Power (6, 7, 8, 9, 10).

The formulas used in the creation of standardized variables as well as of the sub indices are shown respectively in the following session.

Formulas used in composition of sub index for Population power (PPI)

In the first step the population sub index (2) was calculated:

$$P_I = 1 + 99 * \frac{pop_i - pop_{min}}{pop_{max} - pop_{min}} \quad (2)$$

In calculating the birth ratio index, first the ratio of number of live births and population was calculated. After it the birth ratio index (3) was used according to the formula below.

$$BR_I = 1 + \frac{br_i - br_{min}}{br_{max} - br_{min}} \quad (3)$$

The migration balance index (4) used the immigration and migration values as its ratio.

$$MB_I = 1 + \frac{mb_i - mb_{min}}{mb_{max} - mb_{min}} \quad (4)$$

The *complex index of population power* (5) was then the geometric average of the three indicators derived above.

$$PPI = \sqrt[3]{P_I * BR_I * MB_I} \quad (5)$$

Formulas used in composition of sub index for Employment power (EPI)

Prior to calculating the disadvantaged child index (6), the ratio of disadvantaged child and population was calculated.

$$D_I = 1 + \frac{dcr_i - dcr_{min}}{dcr_{max} - dcr_{min}} \quad (6)$$

In a similar way, the unemployment index (7) and the long unemployment index (8) were calculated.

$$UE_I = 1 + \frac{uer_i - uer_{min}}{uer_{max} - uer_{min}} \quad (7)$$

$$LUE_I = 1 + \frac{lr_i - lr_{min}}{lr_{max} - lr_{min}} \quad (8)$$

As the number of local companies and the number of private companies were separately available, we first added the two numbers, and the ratio of the total companies and population gave the local employment power index (9).

$$LE_I = 1 + 9 * \frac{le_i - le_{min}}{le_{max} - le_{min}} \quad (9)$$

The complex index of employment power (10) was then the geometric average of the four indicators derived above, where the reciprocal values of the disadvantaged child index and the indexes of unemployment were put in the calculation.

$$EPI = \sqrt[4]{\frac{1}{D_I} * \frac{1}{UE_I} * \frac{1}{LUE_I} * LE_I} \quad (10)$$

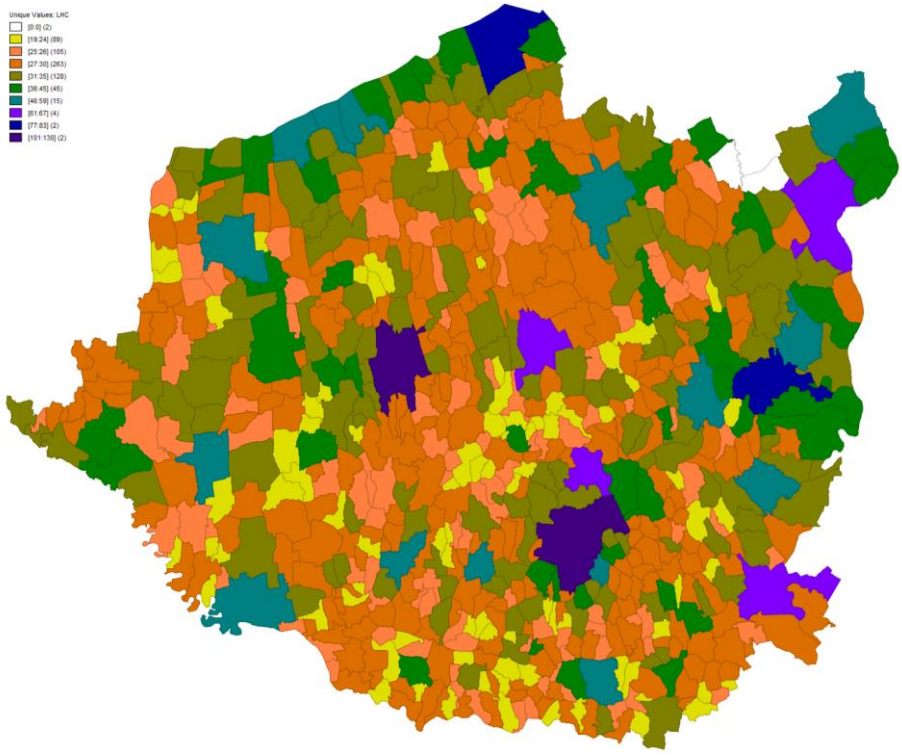
In the final step the Composite index of Local Human Capital (LHC) was calculated (11).

$$LHC = {}^1/_3\, EPI * {}^2/_3\, PPI \quad (11)$$

In the end of the process all settlements in the initial database were assigned with the LHC indicator (*Figure 2*).

Figure 2

Individual values of Local Human Capital of the settlements of the South Transdanubian Region



Source: Based on HCSO data

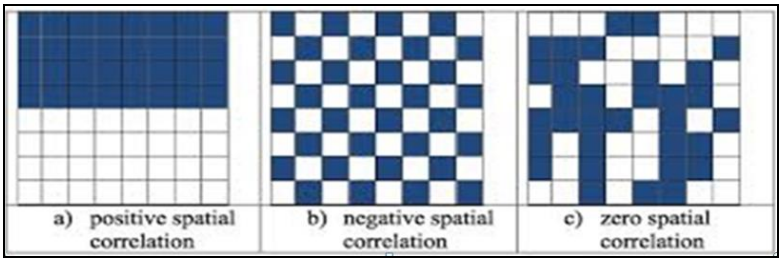
Spatial autocorrelation of local human capital of settlements in the Southern Transdanubian Region

In *Figure 2* the reader may recognize groups of settlements with substantially darker or lighter colours, which raises the issue of spatial autocorrelation. Originally, autocorrelation is detected in time series but later spatial analysis overtook the tool in order to reveal geographic patterns in socio-economic indicators (*O'Sullivan and Unwin*, 2003).

Basically three kinds of spatial autocorrelation exist. Autocorrelation is positive when similar values cluster together and negative when dissimilar objects form groups. The third case is when there is not autocorrelation or it is very low (close to zero), which means that the objects analysed taking on values randomly, without any geographically significant pattern. The three types of spatial autocorrelation are schematically shown in *Figure 3*.

Figure 3

Schemes of spatial autocorrelation cases



Source: *O'Sullivan and Unwin*, 2003

The fundamental issue of the analysis is that the autocorrelation measure is a 'regression' type of measure, where the explanatory variable is the Initial variable of the spatial units and the result variable is the so called 'lagged' variable calculated from the Initial variable of the neighbouring spatial units. The method applied is the weights matrices, in this process we need to define the weights referring to the neighbourhood. The design of neighbours may follow a bishop, queen or rook contiguity or *k* nearest neighbours or by considering the distance of spatial units.

The measure indicator for spatial autocorrelation can be the Moran's statistics. Local Moran's I indicate the slope of the regression line fitted in the Initial variables and the lagged variables, in case of strong autocorrelation the statistics is close to 1 or -1.

Various pieces of software exist for the analyses of geographic information systems. We chose the free download open source software GeoDa for our aims. In the first step a shape file was created for Southern Transdanubia by using administrative shape file for Hungarian settlements (*data2.openstreetmap.hu*). After the merging of the shape file of settlements with the database of LHC indicator (see Chapter *Index Composition for Local Human Capital*) we created and used a weights file (.gal extension) with the method of Queen Contiguity.

We used Moran's statistics as the measure indicator for spatial autocorrelation. Local Moran's I indicates the slope of the regression line fitted in the initial variables and the lagged variables (derived from the weights and Initial LHC). The following diagram (*Figure 4*) indicates the relationship of initial and lagged LHC and the Local Moran's statistics on a Moran scatter plot.

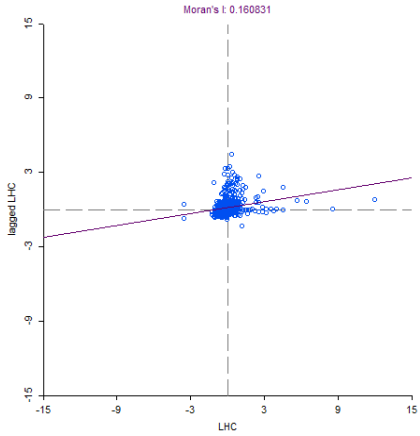
The variable of our interest is on the *x*-axis, while the spatial 'lag' on the *y*-axis. The slope of the regression line (0.16) is the Moran's I statistics for LHC using a queen contiguity weights definition.

We can state that the Southern Transdanubian settlements have very little clustering features regarding their local human capital and neither there are many outliers.

Figure 5 illustrates the further results of the spatial autocorrelation analysis of the Local Human Capital of South Transdanubian settlements. Basically, there was not any autocorrelation found for the majority of the 612 settlements.

Figure 4

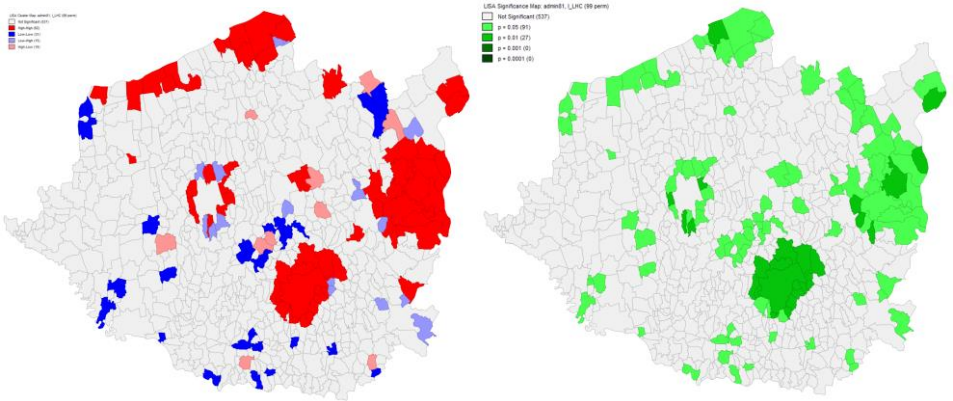
Local Moran's scatter plot on spatial autocorrelation of local human capital of settlements



Source: Based on HCSO data

Figure 5

LISA Cluster Map and Significance Map of LHC



Source: Based on HCSO data

Our results – although on a different regional level – are only little in line with the results of *Szendi* already mentioned above. In her work she found that the spatial autocorrelation LHDI (Local Human Development Index, built on the health, education and well-being dimensions) is basically not significant in the micro regions of Southern Transdanubia. However *Szendi's* analysis was not sensitive enough to clarify the role of central settlements and reflects only that Pécs micro region is a positive outlier.

We found that there are clear but smaller clusters of settlements with higher human capital potential – basically these are micro regional centres and the capital cities of the three counties. Szekszárd together with 12 settlements forms the hot spot of the region, as well as Pécs plays a pivotal role in the life of the surrounding settlements. Surprisingly, some of the shore settlements of Lake Balaton (Zamárdi, Balatonboglár, Fonyód) and their neighbours also have higher potentials, but Siófok as the 'capital' of the southern lake shore has not got a significant role in grabbing upwards its neighbours regarding their local human capital. Another surprise in this term was Kaposvár that was found to have no significant effect on its surrounding settlements as a few of its neighbours were found with lower while another ones with significantly higher LHC potential. It can be explained in a way that the proximity of a town on its own does not provide an adequate pulling effect, another factors play a role in the diverse potential of the neighbouring settlements.

In the future our LHC indicator can be tested for the whole of Hungary and it is reasonable to develop it further in terms of complexity in order to incorporate further dimensions of human capital.

CONCLUSIONS

It can be seen that, due to the selective pattern of regional growth, various development paths of single regions are emerging even worldwide. The definition of possible growth strategies for each territorial unit must necessarily rely on local assets (*MTA*, 2001) and potentials and their full exploitation: in short, on what is called 'territorial capital'. (*OECD*, 1999; *OECD*, 2010). It is widely agreed by researchers that especially endogenous regional development highly relies on local assets, among them on local human capital. On the other hand, there are several indicators in use for measuring spatial allocation of local capital or human capital without a consensus among researchers. Human capital has already been studied from many aspects and reviewing these studies made us confident to work on the topic further. The authors focused on the development of a potential indicator which, according to our initial intention, describes the local human capital of the settlements in the Southern Transdanubian region. The aim of the research was to compose a complex indicator which contains several pieces of information of the human capital - starting from the population base up to the availability of local jobs. It was found that the local human capital of the Southern Transdanubian settlements has to some extent clear spatial patterns, which is induced mainly by the role of central settlements. Although in some cases the pulling effect of these bigger cities is not unambiguous, not all of their neighbouring settlements benefit. On the other hand, the majority of the settlements does not belong to either positive or negative clusters, and only a few cases were seen as outliers, too. In the future our LHC indicator can be tested for the whole of Hungary and it is reasonable to develop it further in terms of complexity in order to incorporate further dimensions of human capital.

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