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Measuring Regional Disparities on Competitiveness Basis

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Several economic theories and empirical analyses have been put forth about the nature and principles of regional disparities. Analysts often apply GDP per capita, as a quasi absolute indicator to explore regional disparities, albeit spatial processes have become more and more complicated and complex in the globalized economy. Parallel to the catching-up process of the countries at the national level, there is another spectacular process at the regional and local level: regional disparities are widening because the growth of the most developed sub-regions is increasing while the less favoured sub-regions are lagging behind. Consequently, regional analyses must devote increasing attention to studying sub-regions.

The present paper is aiming to develop a complex method on analyzing regional disparities, based on the notion of regional competitiveness and its closed logical system, correctly chosen theoretical model (the pyramidal model of regional competitiveness) and statistical data. To carry out the analysis, I use K-means cluster analysis, and its output. This is the first time ever that this has been used for this purpose.

Keywords: regional disparities, Williamson-hypothesis, regional competitiveness

1. Introduction

Economic, social and territorial cohesion are increasingly important segments of the European Union's regional policy, deriving from the history of the European integration: "*The Community shall have as its task […] to promote throughout the Community a harmonious, balanced and sustainable development of economic activities"* (EC 1997, Article 2). According to the Treaty of Lisbon, the Union shall promote economic, social *and territorial* cohesion, instead of the former terminology: economic and social cohesion (EC 2007).

At the time of the signing of the Treaty of Rome (1957), there had not been a declared common regional policy, the treatment of regional inequalities started at the national level in the 1960s (Rechnitzer 1998). The multi-step enlargement process of the European Union, and particularly the joining of the Mediterranean countries resulted in deepening spatial inequalities in the European Economic Area.

This, together with the effect of globalization, which increased the importance of locations, made the community-level regulation of the problem inevitable. The article 130 of the 1987 Single European Act declares the main objectives of the common regional policy, out of which the aim of "*reducing disparities between the*

various regions and the backwardness of the least-favoured regions" excels (EC 1987). After forming the central fund system of Structural Funds[1] to treat regional disparities on the basis of uniform principles at the end of 1980s, the Treaty of Maastricht unfolded the concept of cohesion: economic convergence and social cohesion (EC 1992).

The Treaty of Amsterdam devotes a distinct title (XVII.) to economic and social cohesion: "*in particular, the Community shall aim at reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions or islands, including rural areas*" (EC 1997, Article 158). The European Spatial Development Perspective approved in 1999 mentions economic and social cohesion as one of its three main objectives (EC 1999).

The forth cohesion report is already talking about "*economic, social and territorial cohesion*" (EC 2006), and by doing so it highlights an important problem. Namely after the 2004 enlargement serious territorial disparities characterize the whole European Union regarding both output, productivity and employment.

It is also an essential mega-trend that nowadays the local level is sensibly gaining importance as a territorial level that houses core-competences, where the long-term competitive advantages of firms are concentrated, and where local actors are able to give effect to their economic development conceptions. The primary analytical unit of economic advantages is therefore the local unit where one can change their workplace without changing their domicile (Lengyel 2003).

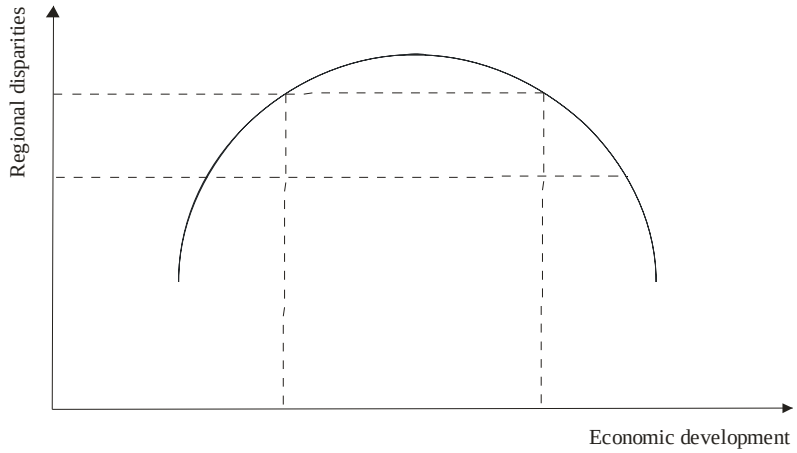
In the present paper, by responding to the above mentioned challenges, we attempt to introduce such an analytical method that is able to detect territorial disparities *of the local level in their complexity, using a multi indicator based approach*. Before this we gain insight into the background of the conventional *single indicator-based* analyses. But first of all we review the *relevant economic theories* that are needed to understand the nature and change of territorial disparities.

2. The nature of territorial disparities' evolution

Despite the fact that the multi-step enlargement of the European Union has drawn attention to regional policy's need for concentrating significant resources to reduce territorial disparities, we must consider the economic regularity well-known as Williamson-hypothesis, which says that *territorial disparities will grow until a certain state of development* (Figure 1). According to Williamson's concept that was put forth in 1965 economic growth first induces regional divergence and in the later phases convergence (Kiss–Németh 2006, Davies–Hallett 2002, Szörfi 2006, Nemes Nagy 2005).

[1] The common denomination of the European Social Fund, the European Agricultural Guidance and Guarantee Fund, Guidance Section, the European Regional Development Fund and the Financial Instrument for Fisheries Guidance.

Figure 1. Williamson curve



Source: Davies–Hallett 2002, Nemes Nagy 2005

In connection with the Williamson-hypothesis we must note that its consequences are inconsistent with the conceptions of certain theoretical schools, moreover the convergent phase of the Williamson curve can be *interpreted in different ways* within the conceptual background of the distinct bodies of theorizing. Zsolt Fenyővári and Miklós Lukovics (2008) reviewed eight theoretical schools in order to examine – among others – the occurrence of territorial convergence within the given theoretical interpretations[2] (Fenyővári–Lukovics 2008):

1. In the *classical economic theory* the efficiency advantages of the regions deriving from the comparative specialization will eventually contribute to the reduction of territorial disparities in a way that is advantageous for all the participating regions.
2. In the *neoclassical economic theory*, due to the presumption of the absolute mobility of the factors of production (including technology), all the inequalities in the model – embracing any kind of developmental disparities between regions – decease in the long run.
3. In the *Keynesian economics* the reduction of regional disparities can not be interpreted as the result of spontaneous market processes. The desirable processes are much more linked to the result of certain intended institutional interventions.
4. *Endogenous growth theory* interprets the productivity growth as an outcome of the spatial diffusion of knowledge and technology, which does not infer any automatism for the reduction of territorial inequalities. However the regional (economic) policy aiming at the deliberate development of the

[2] Similarly, the research of Málovics and Ván (2008) examined the connection between the concept of competitiveness and sustainability from the viewpoint of some highlighted economic theories.

endogenous factors (technology, knowledge and the internal resources of the region) can become efficient means of reducing regional disparities.

5. *New trade theory* states that the spatial variation of productivity derives from the varying levels of regional specialization, agglomeration and cluster formation. The spatial equilibrium shaped by centripetal and centrifugal forces is Pareto-efficient, therefore there exist no market automatisms that would induce spatial disparities.
6. In the *new institutional economics*, due to the constant change deriving from the dynamic interaction of the narrowly meant economic processes and institutional conditions, the deepening or the reduction of territorial disparities can be well interpreted within the frame of the model.
7. The Porterian *corporate strategy economics* originates the regional disparities from the basic industries and clusters of the regions. Since it focuses on the "microeconomic foundations" (the resource munificence of the region gains highlight as well), the reduction of territorial disparities characteristically does not occur through market automatisms.
8. In an *evolutionary economic* view the change in the intensity and extent of a region's innovative activities can significantly shape the regional disparities (Bajmócy 2008). Such changes may occur as a result of spontaneous market processes. Therefore in the evolutionary thinking the reduction of territorial inequalities through the market automatisms can be interpreted.

Numerous successful attempts have been carried out for the empirical verification of the Williamson-hypothesis (Kiss–Németh 2006, Davies–Hallett 2002, Szörfi 2006, Nemes Nagy 2005). Several authors managed to confirm on large samples and long-run time series that from the initial state of relative-underdevelopment regional disparities increase for a while, and when reaching a certain state of development the divergent process turns into a convergent one.

At this point we necessarily come to the question that is to say what is that certain "*state of development*" where the divergence turns into convergence? It is equally important to establish whether in the relatively underdeveloped regions *this point exists at all*, or in the divergent phase the development potential of these regions decreases to such an extent which makes their later close-up impossible.

This threat is much realistic, because the more developed areas have increased ability to become an integral part of the global economy, foreign direct investments also flow first into these regions (Enyedi 2000, EC 2004). This results in the real danger of the widening of the regional inequality gap. "*In Hungary territorial disparities significantly deepened in the early 1990s after the changing of the political system*" (Rechnitzer 2000, p. 13.). This process has not deceased by the early 2000s.

3. Single-variable analysis of the evolution of territorial disparities

One of the most widely used (one might say conventional) method for examining the evolution of territorial disparities is the analysis of the *temporal and spatial change of per capita GDP* (Sala-i-Martin 1996). According to the method we gain a picture about the evolution of territorial disparities by analyzing the dynamics of standard deviation values computed from the natural logarithm of per capita GDP data measured in PPS[3], compared to the Hungarian counties' and regions' averages. If the computed standard deviation values rise year by year, it indicates that the values deviate from their average in a growing extent, therefore the disparities of the observation units' per capita GDP data (measured in PPS) rise year by year.

Considering the Hungarian NUTS-2 level regions, NUTS-3 level counties and LAU-1 subregions as observation units, the growth of territorial disparities can be detected according to the results of a standard deviation analysis of the per capita GDP, measured in PPS on time series from 1996 to 2006. During the analysed time period the curves of both counties' and regions' standard deviation values are positive gradient, thus the observation units' state of development measured in GDP are shifting away from each other, in other words they *show divergence* (Figure 2).

The execution of the standard deviation analysis for LAU-1 sub-regions brings us to similar consequences. We must add however one extremely important notice: instead of the indicator used in case of counties and regions (GDP), we have to apply a similar-in-content indicator, the gross value added[4] (GVA), because GDP data are not available for aggregation-levels lower than counties (NUTS-3). Similarly to the standard deviation of counties' and regions' GDP, the standard deviation of sub-regions' GVA data can be characterized by a positive gradient curve in the 1996-2005 interval. This underlies the *growth of territorial disparities in the sub-region level as well*.

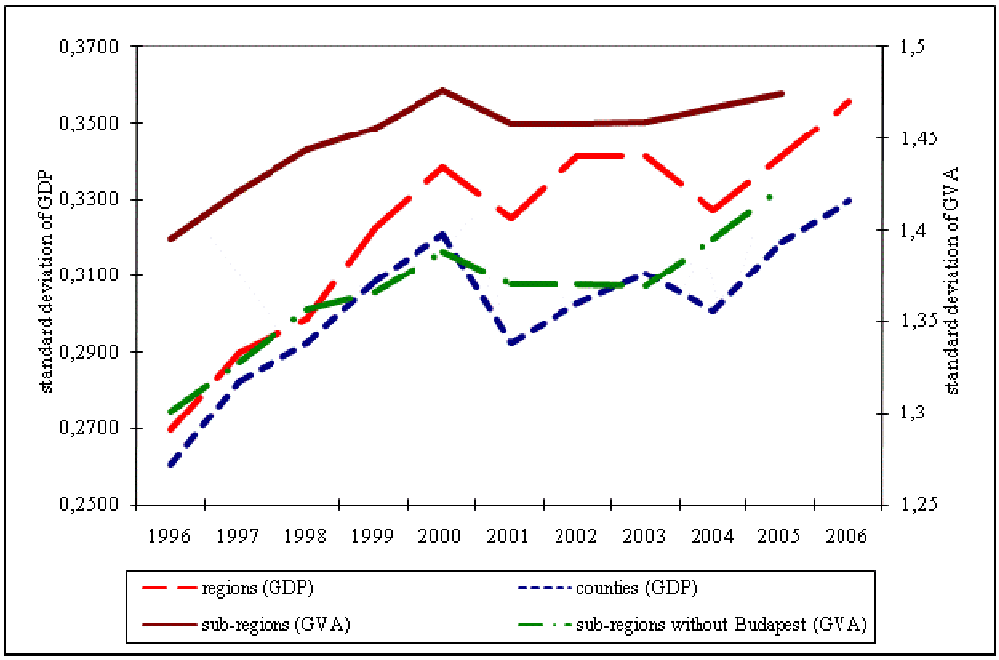
This statement is true both when the population includes all the 168 sub-regions[5], and when the analysis is carried out without the Budapest sub-region. We certainly receive significantly higher standard deviation values for the population that includes Budapest compared to the case when we carry out the analysis without the sub-region of the capital. This also underpins the well-known fact that Budapest and its agglomeration, which excel in the Hungarian spatial system and grow faster than the country average, *significantly contribute to the widening of Hungarian territorial disparities*.

[3] The guiding methodology of GDP computations is ESA 1995. The per capita GDP expressed in PPS (Purchasing Power Standard) is the value computed on the basis of purchasing power parities, expressed in Euro (Eurostat 2004).

[4] The gross value added produced by the economic units adding taxes on products and subsidies, subtracting the charge of financial intermediation results the value of gross value added computed on market prices, the indicator of gross domestic product (GDP).

[5] At the time of this paper's submission the data are not yet available for the 174 new sub-regions defined by Act CVII of 2007.

Figure 2. Change in the regional disparities of the Hungarian regions, counties, sub-regions

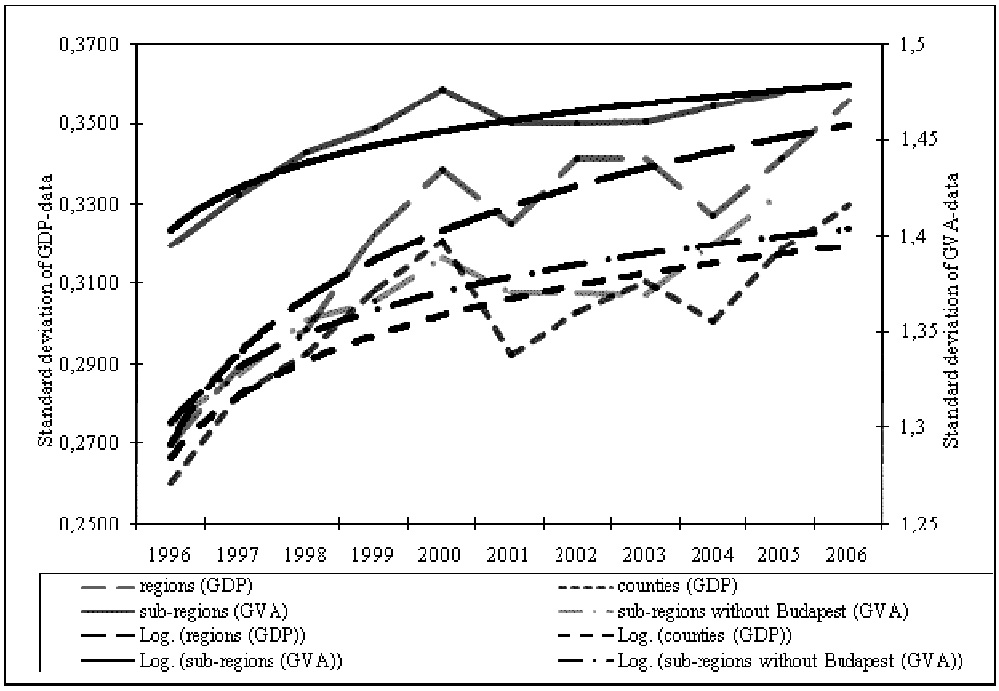


Note: calculated with natural logarithm
Source: own calculations on the basis of HCSO (2009)

The standard deviation values computed both from regional and county GDP, and sub-regional GVA provide the possibility of calculating trend-curves, in other word to demonstrate regularities in the evolution of data points. On the basis of R square as a control indicator it can be declared that the *logarithmic trend* fits well in all the four cases on the empirical data. It delineates in all the four cases the *left side of an U-shape curve* (Figure 3). By comparing these results and the Williamson-curve on the basis of the per capita GDP data we can state, that Hungarian territorial processes are in the divergent phase yet, in all the examined levels of aggregation[6].

[6] A convenient situation would be resulted if the statistical toolbar, by using trend-extrapolation, was able to define the point where the Hungarian territorial processes turn from the divergent to the convergent phase in the certain levels of aggregation. However trend forecast would be misleading in this case, since the logarithmic trend curve fitted on the past empirical data approximates to a zero-gradient linear curve when fitted on future points (where $t \to \infty$).

Figure 3. Logarithmic trend of the change of the Hungarian regional disparities



Note: calculated with natural logarithm
Source: own calculations on the basis of HCSO (2009)

In the foregoing the *examinations of territorial disparities were restricted to the analysis of a single indicator, the GDP per capita (or in sub-regional level the GVA)*. We are convinced that spatial processes are *much more complex* than they could be described by one highlighted indicator. The trend in the literature of spatial analyses apparently shows that *it is insufficient to use single-variable approaches to measure the territorial process*. Instead, the application of complex indicator-systems is required to reach sophisticated conclusions (Lengyel–Lukovics 2006, Lukovics 2007, Lukovics 2008).

4. Methodological background of territorial disparities' multivariable analysis

In the following we demonstrate an approach for analysing territorial disparities that is much more complex than the pure examination of per capita GDP data. The method applies a complex indicator-system which is based on the concept of competitiveness. In order to assure the greatest possible accuracy of the analysis, the criterion of choosing an indicator into the basic indicator-system of the analysis can

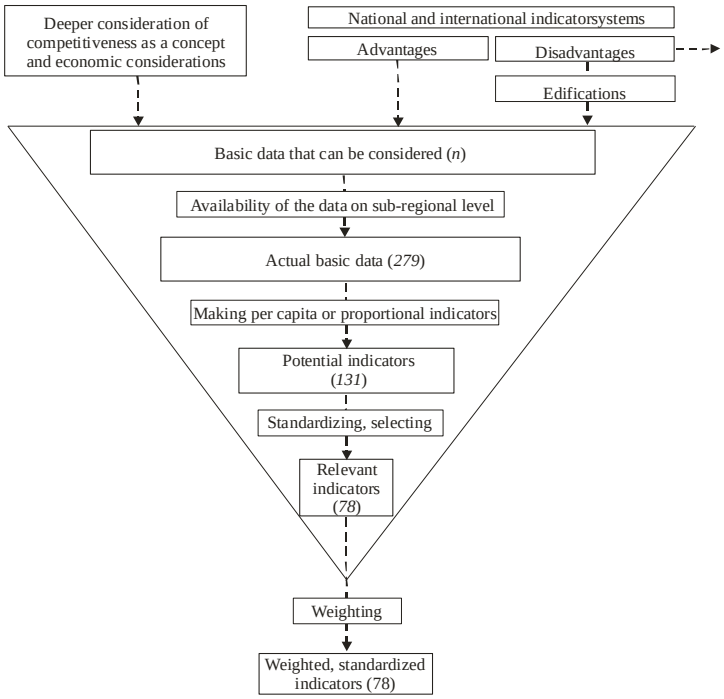
not be based on the subjective considerations of the analyst. It is required to endeavour to minimize the analysts' subjectivity.

Miklós Lukovics and Péter Kovács (2008) developed a methodology for implementing regional competitiveness analyses, which is based on a closed logical system and where the mathematical-statistical background ensures the minimizing of analyst's subjectivity. The closed logical system of the applied method is assured by the fact that indicator selection is coordinated by a model unfolding the standard definition of competitiveness, the pyramid-model.

The data set serving as the foundation of the analysis is designed on the basis of the standard definition of competitiveness, and the pyramid model unfolding it. It is important, that the final database – that serves as the basis of multivariable data analysis methods – *emerges as a result of a multiple-stage* process (Kovács–Lukovics 2006). The first step defines the *basic data* that can be considered in the case of surveying competitiveness on the sub-regional level. These data can be defined on the basis of a deeper consideration of competitiveness as a concept and economic considerations, taking into account the most important experience of the reviewed international and national analyses. The fact that certain data are absolutely unavailable on the sub-regional level limits the inclusion of a great number of data as actual basic data; therefore, *actual basic data* are made up of the basic data available on the sub-regional level. These basic data may be considered as raw data, from which *potential indicators* can be produced with the help of simple mathematical operations. Selecting potential indicators with the help of principal component analysis leads to the *actual, relevant indicators* that finally serve as the basis of the analysis. The database reaches its final form after the *standardizing* and *weighting* of the relevant indicators (Figure 4).

Similarly to the variable-selection method we used *principal component analysis* to make an *objective weighting system*. The determination of the weights is based on the following train of thought. If we substitute the standardized variables with principal components, the principal components represent the model in reduced dimensions. As an output of the principal component analysis we receive the values of the communalities. Since the communalities are practically coefficients of multiple determinations in a linear regression model, where the dependent variable is the given variable, and the independents are the principal components, the square roots of those are coefficients of multiple correlations. In general the coefficient of multiple correlation quantify the correlation between the effective (empirical) and the estimated values of the dependent variable. Thus it also quantifies the correlation between the dependent variable and the set of independent variables. *Especially the coefficient of the multiple correlation means the correlation between the given standardized variable and the set of principal components, which represent the pyramid model. Thus, the coefficients represent the correlation between the variables and the model, namely the weight of the variables.*

Figure 4. Creating the database of the analysis



Source: Lukovics (2008, p. 116.)

After successfully accomplishing selection and weighting we receive a database in a structure that is in line with the pyramid model unfolding the standard definition of competitiveness, and that consists of 78 selected (therefore relevant regarding competitiveness), standardized, and weighted variables. As an empirical application of the developed method, we carried out the complex grouping of the 168 Hungarian sub-region on the basis of their competitiveness. This also provided an opportunity for the multi-variable analysis of territorial disparities.

5. Multi-variable analysis of territorial disparities

The model is expected to ensure *comparability in time*, which means that *beyond the relative competitiveness of the different sub-regions, its changes and through this the change of the regional disparities can also be examined* by introducing the latest statistical data to the database consisting of the selected system of indicators.

I intend to draw conclusions about the evolution of territorial disparities by examining the changes within the complex competitiveness classification of Hungarian sub-regions between two dates: 1998 and 2004. I use the well-known method of cluster-analysis, which, to the best of my knowledge, has not been used

for this purpose before. The closed logical method describable by the objective selection and weighting process of indicators based on the pyramid model of competitiveness also offers a chance *to complete an annual assessment of the changes in the relative competitive position of Hungarian local administrative units* and the changes of the regional disparities.

In our analysis, we compared the types of competitiveness of the different sub-regions in 1998 and in 2004. We studied which are the sub-regions whose competitiveness changed so much in the examined two years that their position assumed in clustering was also modified. Looking at the period between 1998 and 2004, only *ten sub-regions were found* whose ranking in clusters based on complex competitiveness changed by 2004 compared to its state in 1998.

Certain peculiarities must be emphasized though, which significantly influenced my endeavour:

1. Similarly to territorial GDP data, sub-regional GVA data are available also with a two-year delay. At the time of implementing the analysis – in the middle of 2007 – the most up to date territorial GVA data were from 2004. Therefore all the other data included to the database refer to 2004 as well.
2. The Government decree 244/2003 defined 168 sub-regions in Hungary[7] contrary to the earlier 150, which existed in 1998. This hindered the comparison of data in the level of sub-regions, but by aggregating the municipality-level data we managed to create data also for the previous years that are suitable for the new structure.
3. Since the database contains numerous specific indicators, it is very important that population data has significantly changed from 1998 to 1999. The reason for this is the recount of the previous estimated (forward counted) data.
4. The Hungarian Central Statistical Office's (HCSO) registration of enterprises by staff categories significantly changed between 1998 and 2000.
5. The calculation of unemployment rate has been in harmony with the ILO recommendation only since 1998. The HCSO previously provided the data of the Employment Offices (referring to registered unemployed).
6. Certain indicators (the number of ISDN main lines, simplified corporate taxes) are not available for 1998. In these cases I included data from the closest possible year to 1998.
7. Data of the 2004 model deriving from the 2001 population census are displaced by data from the 1990 population census in the 1998 model.

In order to draw conclusions with reference to the evolution of territorial disparities on the basis of change in the complex competitiveness classification of Hungarian sub-regions between 1998 and 2004, first we must carry out the

[7] The Act CVII of 2007, which defined 174 sub-regions, has not been passes at the time of the examination.

classification separately for the two years. I sorted the 168 Hungarian sub-regions for both 1998 and 2004 into three clusters by applying K-means cluster methodology based on 78 selected and weighted indicators in line with the Pyramid-model. For both 1998 and 2004 data less than 10 iterations were sufficient to develop a steady structure, hence the cluster affiliation of the territorial units based on their competitiveness is considered to be unambiguous.

Although the number of objects belonging to each clusters are the same for the two examined year, the distance of clusters from each-other and the membership of the cluster show difference to a certain extent.

If we analyse the evolution of the Euclidean distance of the cluster centres for the given years, we receive a new approach of the examination of territorial disparities (Table 1). Whether the distance of cluster centres rise from one point in time to the other, the relative competitiveness of the region-types move away from each-other. This is equivalent with the statement that territorial disparities increased between the examined points of time, and vice versa.

Table 1. Euclidean distance among the final cluster centers in 1998 and 2004

Cluster	**Relatively weak competitiveness**	**Medium competitiveness**	**Relatively strong competitiveness**
Relatively weak competitiveness		8,672 (8,511)	34,968 (40,772)
Medium competitiveness	8,672 (8,511)		28,997 (35,110)
Relatively high competitiveness	34,968 (40,772)	28,997 (35,110)	

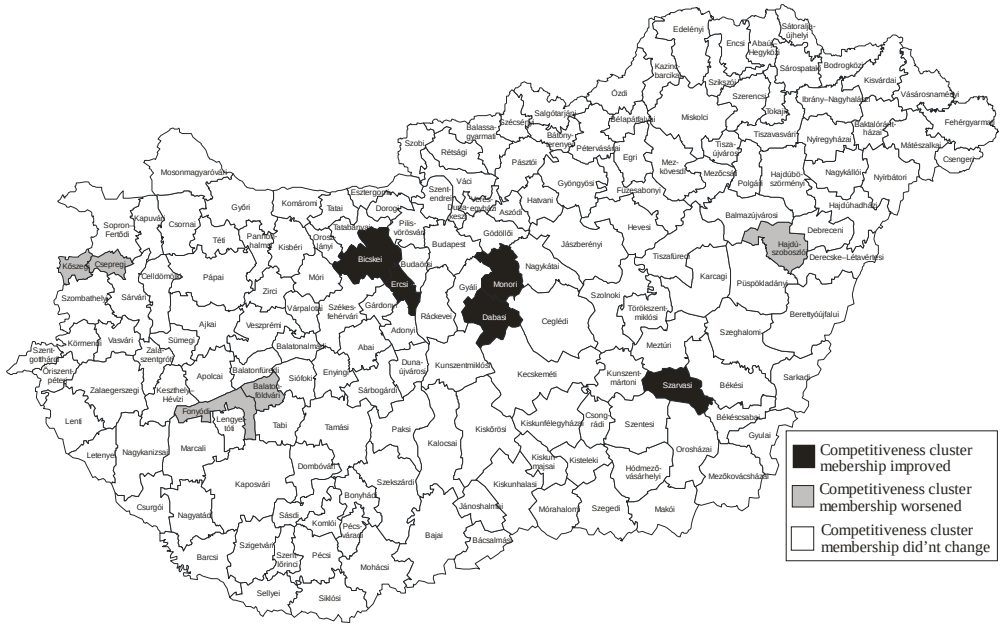
Note: Data of 2004 are in brackets
Source: own calculations

Based on the Euclidean distance of the final cluster centres, it must be underlined that *in 1998 the three clusters were situated closer to one another than in 2004*. Between 1998 and 2004, the distance of the cluster with relatively weak competitiveness and the one with medium competitiveness did not change significantly, however, the Euclidean distance between the clusters of the sub-regions with medium competitiveness and the one with relatively strong competitiveness grew significantly, and the same happened in the case of the clusters of sub-regions with relatively weak competitiveness and those of relatively strong competitiveness. *This observation, in a way, proves the increase of spatial disparities*. This recognition not only shows the growth of spatial inequalities, but also confirms the fact that the cluster of *Budapest* with relatively strong competitiveness *underwent much more dynamical development* in the examined period *than the sub-regions constituting the other two clusters.*

It can be stated about the spatial concentration of competitiveness and urbanization that there is no significant difference between the results based on the data compiled in 1998 and in 2004: the only sub-region with relatively strong competitiveness (the capital) is surrounded by the ring of sub-regions with medium

competitiveness, 90% of which are urban in both years. Furthermore, the urban sub-regions with medium competitiveness are on the one hand the sub-regions of the chief towns of counties and the sub-regions of large towns. Sub-regions with medium competitiveness (urban and rural alike) are concentrated in both years in the vicinity of developed Western centres and highways. Beyond this, it can also be stated that in 1998 and in 2004 a concentration of sub-regions with medium competitiveness can be found in the North-Western and Central regions of the country, while sub-regions with weak competitiveness are situated in the zones along the Northern and Eastern country borders. According to the data compiled in 1998 the dominance of the lake Balaton can be stated: significantly more sub-regions with medium competitiveness concentrated along the lake in 1998, than in 2004.

Figure 5. Change of the competitiveness cluster memberships of the sub-regions (1998-2004)



Source: own calculations

We also studied which are the sub-regions whose competitiveness changed so much in the examined two years that their position assumed in clustering was also modified. Looking at the period between 1998 and 2004, only *ten sub-regions were found* whose membership in clusters based on complex competitiveness changed by 2004 compared to its state in 1998. It should be underlined, that presumably the competitiveness of more than ten sub-regions changed in the examined period, but

the degree of change only resulted in cluster membership changing in case of 10 sub-regions (Figure 5).

From the ten sub-regions mentioned above, five (Bicskei, Dabasi, Ercsi, Monori, Szarvasi) improved its competitiveness cluster membership, five (Balatonföldvári, Csepregi, Fonyódi, Hajdúszoboszlói, Kőszegi) worsened it. The realignment of the competitiveness types is also remarkable: the competitiveness position of the wider Budapest-agglomeration improved.

6. Summary

In the present paper we attempted to introduce a method for analysing territorial disparities based on the concept of regional competitiveness, which analyses the spatial processes by using (within the model)an objectively selected and weighted system of indicators. The essence of the method – beyond the multi-step creation process of the database – is that it analyses the evolution of territorial disparities on the basis of the final output of a multi-variable data analysis (namely the Euclidean distance of cluster centres), contrary to the most commonly used standard deviation values of per capita GDP.

According to both single-variable standard deviation analysis and multivariable examination, regional divergence can be reported in Hungary on a sub-regional level. Sub-regions with relatively high competitiveness increase their competitiveness, while sub-regions with relatively weak competitiveness fall behind. Furthermore it can be stated that the competitiveness of sub-regions in "convergence" regions is much heterogeneous: the competitiveness "engines" of these areas are the sub-regions of county centres and towns with county authorities, while the competitiveness of other, mainly rural sub-regions is weak and degrading in tendency.

These results necessarily call for the continuation of recent research: does the competitiveness potential sub-regions with relatively weak competitiveness degrade to such an extent as a result of the growth in territorial disparities that is may hinder the future catching-up.

It is necessary to survey in these sub-regions the factors that may contribute to the development of their competitiveness. For this purpose those elements of recent selected and weighted set of indicators that map the "development factors" and "success determinants" of the Pyramid-model provide a possibility. As a result of a competitiveness analysis based on the above indicators (that represent the possible directions of development strategies), it can be found out, whether sub-regions with relatively weak competitiveness possess merely a weak ex-post competitiveness, or also a faint catching-up potential.

If the results showed that also the opportunities for improving competitiveness are scarce in the sub-regions of relatively weak competitiveness, there would be a

real danger of the economic degradation of these areas. In this case the realistic aim for these sub-regions is not the catching-up, but the ceasing of further falling-behind.

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