Analyzing the Competitiveness of Sub-regions

Thesis of Doctoral Dissertation

Supervisor:
Prof. Dr. Imre Lengyel D.Sc.
Head of Institute and Division
University of Szeged
Faculty of Economics and Business Administration
Institute of Economics and Economic Development

Author:
Miklós Lukovics
University of Szeged
Faculty of Economics and
Business Administration
Doctoral School in Economics

Szeged, 2007

I. History and the objectives of the research

It is well known that today's dominant process of **globalization also exercises a strong influence on economic formulations**. The spatial organization of economic activities embodying companies' long-term competitive advantages plays an increasingly marked role in terms of successful performance in the market competition. Globalization redefines the roles played in the international division of labor; consequently, spatial units are forced to engage in specialization. All this leads to a reinterpretation of the significance assumed by local conditions, as well.

Besides globalization, or rather, parallel with it, **knowledge-based economy** seems to represent a highly important ground-gaining force – quasi becoming a trendy buzzword – that attracts increasing attention in developed countries, although its forms vary in different regions owing to the differing situation and set of conditions of the given area and the new type of international specialization emerging as a result of global competition. All this is a fundamental factor at the level of sub-regions, since competitiveness is determined by knowledge base on the local level.

An obvious consequence of the above said lies in the fact that the upvaluation of the local level exercises an increasing effect as the domain giving space to key problems, where the long-term competitive advantages of companies are concentrated and where local players can realize their ideas on economic development by joint action. In fact, **sub-regions** are the primary examination areas of economic advantages, within which changing jobs is possible without having to change residence (within the same commutation area). Consequently, regional analyses must devote increasing attention to studying sub-regions.

Based on international experience, it can be said that **considering the starting position and conditions of sub-regions, different region types are likely to host highly different development paths**, and economic development based on knowledge production can be expected to occur only in few regions. However, this is a natural attribute of globalization, since by today, besides countries, the economy of sub-regions also undergoes strong specialization due to the scarce amount of resources and the different extent of their availability in different regions. The vast majority of sub-regions lack the critical mass of the factors of knowledge-based economy (city size, preparedness of workforce, quality of

infrastructure), innovation capacity and specializations, higher education capacity and quality, etc.

The concept of competitiveness that, due to the special attributes of global competition, has become one of the central terms in economics, offers an opportunity for the analysis of sub-regions. International literature obviously ties analyzing the spatiality of economic influences to **competitiveness** and thoroughly designed models are available especially for the analysis of countries' competitiveness. The European Union's 2007-2013 programming period also devotes special attention to competitiveness as well as improving its influencing factors in order to facilitate cohesion and catching up.

Excellent competitiveness reports are completed each year at country level, however, in the case of studying regional competitiveness, focus must fall on smaller and smaller spatial units. Towns and town areas constitute the obvious basic units of such analyses, since the competitiveness of a country or region is mostly determined by towns, whose competitiveness tends to significantly exceed the competitiveness of the areas situated among them. International surveys dealing with the competitiveness of towns have also pointed out that the competitiveness of towns is also defined by the agglomeration area surrounding the town core that can be regarded as a nodal region, and therefore, is difficult to handle in the case of empirical analyses. Local administrative units as administrative-statistical spatial units mostly correspond to the category of sub-region as an economic criterion; however, the boundaries of these obviously somewhat differ from the actual economic catchment areas.

The outstanding role of precise situation analysis with development purposes is beyond doubt, as the different nature of the starting conditions demands different interventions and strategies of economic development in the different regions. In order to achieve successful long-term performance in the global competition, regions characterized by differences in competitiveness must follow different paths. In fact, deriving from their significantly different departing positions, they cannot be handled with the help of a standard action plan on economic development. Beyond competitiveness types, increasing emphasis must also be lent to the position that the examined region assumes along the urban-rural dimension in harmony with international practice, since mainly large towns and their catchment areas prove to be successful in the global competition.

The aim of the dissertation is to introduce a possible method based on a closed logical system that focuses on **analyzing competitiveness** in sub-regions and elaborating **their situation analysis with the purpose of development**. In the frameworks of applying

this empirical method, I classify Hungarian local administrative units in **competitiveness types** with the help of multivariable data analysis methods. I apply a **so far unprecedented selecting and weighting method** following the logic of duly selected theoretical models. The types of Hungarian local administrative units developed along the dimension of regional competitiveness and the **urban-rural dimension** constitute the final output of the analysis.

Taking into account the outlined global boundary conditions and the research goal, the dissertation makes an attempt to test the following hypotheses:

Hypothesis 1: Relying on the apparently growing importance of the concept of competitiveness at the level of the European Union and the results of international research in the area of competitiveness, **today the competitiveness of sub-regions seems to become an increasingly measurable category**.

Hypothesis 2: Due to its logical structure, manageability, transparency and wide recognition, **the pyramid model of regional competitiveness is suitable to construct the basis of analyzing the competitiveness of sub-regions**.

Hypothesis 3: **The measurement of regional competitiveness allows for the development of a model following a closed logical system** that in the course of selecting and weighting indicators can eliminate the distorting effects of the analyst's subjectivity as much as possible.

Hypothesis 4: The developed method of typisation is adaptable to help the **classification** of Hungarian local administrative units **in competitiveness types**.

II. The structure of the dissertation

The dissertation consists of three major logical units that can be divided to further five chapters. The first two major parts include the introduction and establishment of the competitiveness analysis and typisation based on the pyramid model.

1. **The first major logical unit** (Chapter 1 and 2) **reviews the most important terms** discussed in the dissertation. Since the dissertation uses three categories (regional competitiveness, knowledge-based economy and urban-rural dimension), whose content is not clearly defined, what is more, the terms regional competitiveness and knowledge-based economy are also highly debated, the dissertation must definitely take a position concerning these categories. Beyond taking a position, it is also

significant to **introduce the definitions** that constitute the basis of empirical analysis, since the selected approach is also accompanied by the methodology applicable in the course of empirical analysis. A variety of thorough national papers have been published on spatial competition and the conceptual approaches of regional competitiveness, therefore, the reviewing chapter concentrates exclusively on the milestones assuming special importance concerning the research goal of the dissertation. Selected from the set of **useful demonstration models** published on regional competitiveness, this chapter introduces the RCC model, the competitiveness hat, competitiveness tree and the pyramid model of competitiveness. Finally, the reviewing section introduces the **attempts to create the typology of regions** that I strongly lean on in the course of my empirical analysis.

2. **The second large logical unit** (Chapter 3 and 4) reviews the methodology and set **of indicators** of the most significant analyses on competitiveness and development published in the national and international literature, and this part also justifies why sub-regions were selected as the basic units of my analysis. Chapter 3 analyzes widely known and recognized international competitiveness reports, the majority of which focus on countries and regions, nevertheless, prove very interesting and relevant for the objective of the dissertation in methodological terms. Chapter 4 introduces the process, in which sub-regions (or the corresponding spatial units) gained importance both in the European Union and in Hungary, and also describes the present situation of local administrative units in Hungary's spatial hierarchy. Furthermore, it reviews the most widely cited indicator-based national analyses on local administrative units, part of which analyze development, while another smaller portion of them complete competitiveness surveys.

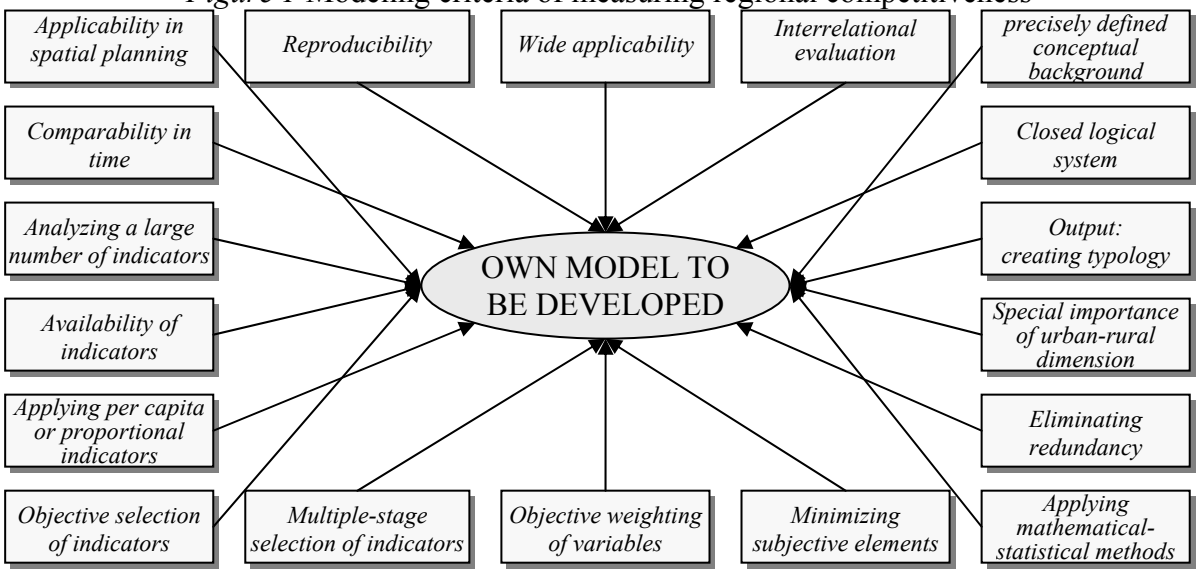
3. **The third major logical unit** (Chapter 5) is the "soul" of the dissertation. After describing the most important information related to the database, Chapter 5 introduces the novel method based on the standard (extended) notion of competitiveness published in the European Union's 6th periodic report and the pyramid model that **analyzes the competitiveness of sub-regions based on an objectively weighted system of indicators, adapted to the basic categories, development factors and success determinants of the pyramid model and only containing relevant indicators according to the model**. In the course of developing the method, I strongly leaned on the advantageous features of the 13 international and

17 national surveys of development and competitiveness, while trying to eliminate their explored disadvantages. This resulted in the **features** that the model can definitely be expected to produce. The dissertation uses the developed method to analyze the competitiveness of the 168 Hungarian local administrative units, and applying multivariable data analyzing methods, **classifies** Hungarian local administrative units **in competitiveness types** based on data compiled in 2004 and also discusses the possibility of dynamizing the model.

III. Methodology of the research

The dissertation **introduces a possible method of assessing regional competitiveness using the example of local administrative units**. At the same time, the analysis method based on the pyramid model unfolding the European Union's standard definition of competitiveness also offers a chance **to create a typology of the spatial units and elaborate situation analyses with development purposes**. While considering my own methodology to be developed and constructing the model I intended to unite all the advantages of the methods introduced above, and at the same time to eliminate the elements – that I define as disadvantages – that failed to support the construction of a reliable and realistic comprehensive picture of the spatial units to the necessary extent. Based on this, it could be determined what features my model designed for quantifying regional competitiveness is expected to fulfill (Figure 1).

Figure 1 Modeling criteria of measuring regional competitiveness

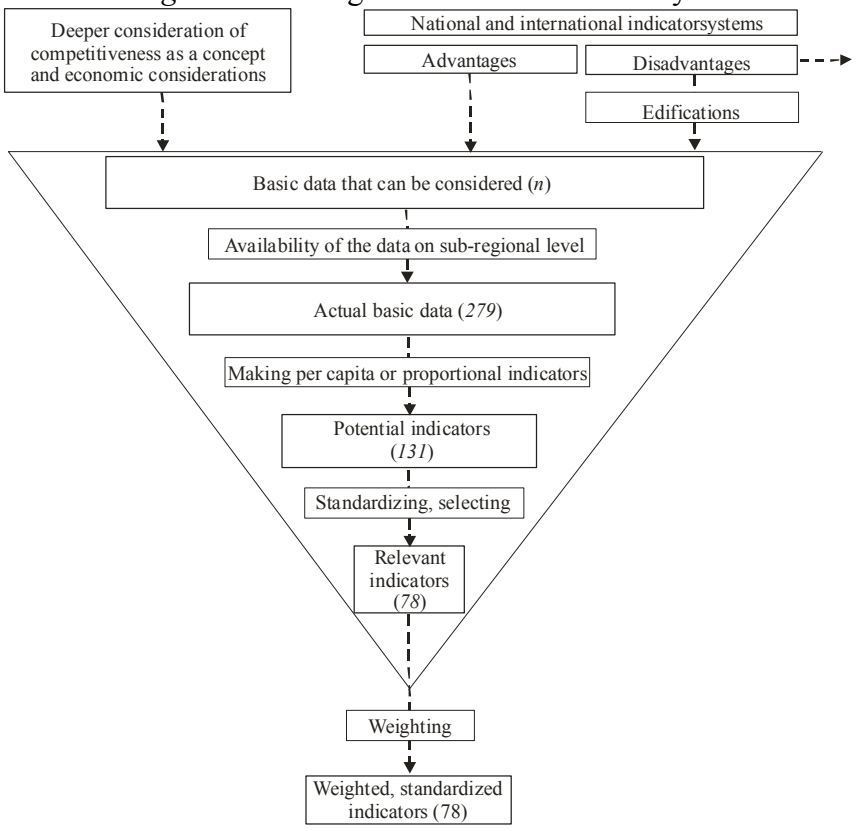


Source: own construction

The database

The data set serving as the foundation of the analysis is designed based on the standard definition of competitiveness and the pyramid model unfolding it. It is important, that the final data base – that serves as the basis of multivariable data analysis methods – **emerges as a result of a multiple-stage process**. 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 based on 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 components analysis leads to the **actual, relevant indicators** that finally serve as the basis of the analysis. The database reaches its final form after **standardizing** and **weighting** relevant indicators (Figure 2).

Figure 2 Creating the database of the analysis



Source: own construction

The set of indicators consists exclusively of data **deriving from hard, secondary sources** – not checked by the analyst –, although we recognize the **importance** and significant information content **of soft data** used in international surveys on competitiveness. The present research did not offer a chance for data collection in the different sub-regions via questionnaires and interviews, however, subjective data may also play an important role in further developing the present methodology.

The selection of variables

Using **principal component analysis** for each basic category, development factors and success determinants, we left those variables, which had a bad goodness of fit in the representing principal component(s). Version 13.0 of SPSS was used to carry out the analysis. **The main aspect of the selection of the variables was** marking each basic categories, development factors and success determinants **possibly with one, but maximum with two** principal components, which has **at least 70% amount of information**. In each basic category, development factor and success determinant the numbers of the principal components were determined by the eigenvalues of the correlation matrix of the marking variables, which are greater then 1. If the result of principal component analysis was one principal component we attempted to grow the amount of information of that by leaving those variables, which has low communality. Namely the low communality means that the principal component less interpret the variance of the variable. So the principal component less keeps the amount of information of the variable.

Naturally, there are such development factors and success determinants, for example the infrastructure and the human capital, which can't be marked with one 'good' principal component. We analyzed the connection between the variables and the principal components by the **loading variables**[1]. If the researcher couldn't determine the means of the principal components, there isn't right the application of the principal components method. If we could that, we determined the means of the components by separating the variables, thus each development factors and success determinants. If we couldn't that, we attempted with the selection of the variables. Thus each development factors and success determinants were marked with right numbers of principal components according to theirs amount of information.

[1] The loading variables quantify correlation between the variables and the principal components.

At the end of the selection process of the variables, the value of the *Red* indicator has been calculated. This indicator quantifies the percentage of collinearity and **the proportion of data with a useful content** compared to the database of the given size and with minimum redundancy. The value of the *Red* indicator approximately 0,42. It means that the proportion of data with a useful content is 58%. So **our method doesn't draw down significant information loss**.

Weighting variables

The logic of the standard definition of compatitiveness and the one of the pyramid model **implicitly requires that the variables affecting the region's competitiveness in different ways and with different relevance should be included in the model with different weight**. Accordingly we determined the weights of the 78 selected variables. The base of this process was a weighting method, which was published by Porter in the Global Competitiveness Report, one of the most highlighted publications on competitiveness. Porter (2003) constructed two sub-indexes[2]. The weights were determined from the coefficients of a multiple regression of the sub-indexes on GDP per capita. The pyramidal model marks the competitiveness by an indicator system, thus we used a complex model. We also defined principal components, as indicators and we attempted for defining the objective weights of those. Our weight system and examination **could be an advance in the effort of making commensurable the competitiveness**. Opposite of Porters' GDP/capita the pyramid model hasn't metric dependent variable, thus we didn't analyze the causality.

Similarly to the variables selection method we used **principal component analysis** to make an **objective weight system**. The determination of the weights is base on the following train of thought. If we substitute the standardized variables with principal components, the principal components represent the model in reduced dimension. One of the outputs of the principal component analysis are the values of the communalities. As the communalities practically are 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**

[2] Index of the national business environment, and the index of the company operations & strategy was defined by Porter, which based on 16 and 31 variables.

multiple correlation means the correlation between the given standardized variable and the set of principal components, which represent the pyramid model. Thus, the coefficients mean the correlation between the variables and the model, namely the weight of the variables.

The question of how objective the different weights may be considered also emerges. Or is it possible to measure "subjective" categories in an objective way at all? Obviously, the **weight of the different variables and categories can be objective within the given model** in the sense that their definition – contrary to former surveys – does not include subjective elements.

IV. The analysis carried out in the dissertation

In my dissertation, I introduce **one possible application** of the designed method, in the framework of which I make an attempt to provide the complex analysis of the competitiveness of 168 Hungarian local administrative units based on the latest available data collected in 2004 as well as formerly compiled information. In the course of the analysis our intention was to proceed as thoroughly as possible, therefore, I examined the same question using **various methods and means**.

For the complex analysis of the competitiveness of sub-regions I apply **cluster analysis and multidimensional scaling,** two multivariable data analyzing techniques with significantly different logics so that the results produced with one method can be comparable with the results of the other one, ensuring controllability this way. **Strong internal control is an organic part of the analysis**, since results are calculated in various ways to minimize errors of calculation that can occur in the course of the analysis. For example, **I complete cluster analysis** both based on the **78 selected and weighted variables** and the **22 principal components** created in the selection of variables. Furthermore, in multidimensional scaling I will also strive to produce the **widest possible combination** of the results of one-dimensional and two-dimensional analyses in order to achieve the most complex picture on competitiveness.

Cluster analysis

Despite the fact that the vast majority of works developing a typology of regions introduced in Chapter 2 and recognized in reputed professional circles distinguish three theoretical region types, we **may have doubts** whether it is really right to classify the 168

Hungarian local administrative units in three clusters subserviently accepting theoretical guidelines **without reservations**. Especially if we stop to consider what a strong influence the capital sub-region exercises on typology. First, I organized the 168 local administrative units in **three** adequately homogeneous groups, since the majority of works dealing with the typology of regions introduced in Chapter 2 distinguished three region types.

Subsequently, I studied the results of classifying local administrative units in four or five clusters in order to produce a complex picture about the classification of the given sub-regions based on region types. By doing so I sought an answer to the question of whether it is possible that increasing the number of distinguished clusters within the K-Means clustering method significantly changes the classification of the given sub-regions in the given competitiveness types. If, as a result of our analysis, the answer to this question is yes, then it is not practical to represent the competitiveness of the 168 Hungarian local administrative units in three clusters, but it is advised to include more clusters instead.

Since 93.5% of the sub-regions were not classified differently in the case of three or four clusters, typisation proves more obvious, and **I support relying on classification in three clusters** adding the remark that **the results of the four-cluster method must definitely be considered** in evaluating the competitiveness of the 11 sub-regions that were classified differently by the two methods.

In the case of distinguishing five clusters, **83.4% of the sub-regions can still be clearly linked** to the basic types distinguished in the case of defining three clusters. However, the **drawback** of the method – similarly to the four-cluster method – lies in the fact that it is rather difficult to define the relative position of the two created clusters based on mathematics and statistics, furthermore, cluster 2 is highly **heterogeneous** despite including a small number of elements. Consequently, **I insist on supporting** the clearly definable and interpretable **three-cluster method**, at the same time **noting** that the results of the four- and five-cluster method must be considered in the course of evaluation. A further conclusion deriving from the results of the four- and five-cluster method is that **the competitiveness type of 83.4% of the Hungarian local administrative units may be concerned relatively clear-cut**.

I also examined **whether it makes sense to further increase the number of clusters to be created**. **Based on the result of** the so-called **hierarchical clustering method, it became obvious that in the present case** setting up **more than five clusters is not advised**.

So cluster analysis made possible the organization of the objects in relatively homogeneous groups, although no other data than the Euclidean distance of the given sub-regions from the cluster center can be clearly defined. Both the graphic chart exploring the homogeneity of cluster analysis and the final result of the clustering method fail to produce an answer to the question of which are the sub-regions that were classified to belong in the cluster with relatively weak competitiveness, but compared to their cluster members stand closest to a region type with higher competitiveness. **Consequently, the analyst does not have any information on the relative distance of the given sub-regions either *within clusters* or *among them***.

Multidimensional scaling

This need of information is met by multidimensional scaling that was also performed in various ways. Represented in a two-dimensional space, **two-dimensional scaling** completed based on 78 standardized and weighted variables resulted in a reduced dot-diagram that displayed the **relative position** of the 168 Hungarian local administrative units in complex terms of competitiveness. After completing two-dimensional scaling, the value of the control indicator of the method qualifies as **excellent** (S-stress=0,05), so the model with a reduced number of dimensions **probably contains all relevant information**.

The results of two-dimensional scaling may be further interpreted and completed if, based on the pyramid model, **we divide the 78 variables in the basic categories representing realized competitiveness and the variables of the basic development factors and success factors**. If we complete one-dimensional scaling separately in the two groups of index-numbers divided this way[3], then, the logic of the pyramid model leads us to the possibility to define objectively whether a given sub-region assumes a better position in the national hierarchy based on its realized competitiveness or its future development potential.

In general terms, it can be stated that **there is no significant difference** in the realized competitiveness of sub-regions and their development potential – except for the few outstanding cases described. Rankings of basic categories, basic factors and success factors **are in rough correspondence with one another**, which is also justified by the 0.76 value of Spearman's rank correlation coefficient.

[3] The S-Stress value of one-dimensional scaling created from the variables of basic factors is 0.12 (the indicator is interpreted as *acceptable* in the interval between 0.1 and 0.2), while the S-Stress value of one-dimensional representation based on basic factors and success factors is 0.9 (the indicator is interpreted as *good* in the interval between 0.05 and 0.1).

At the same time, the technique of one-dimensional scaling implies the possibility of developing a **rank of complex competitiveness** in the event if this operation is not accompanied by significant information loss deriving from excessive fractal reduction. If one-dimensional scaling is completed **jointly for the total of 78 variables** of the basic categories, basic factors and success factors, **it results in the complex competitiveness ranking of the 168 Hungarian local administrative units based on 2004 data**. In the case of the complex competitiveness ranking emerging from the survey, the S-Stress value is 0.1, which may be considered **good**, so **the model with a reduced number of dimensions probably includes all relevant information**.

In harmony with our expectations, Budapest leads the complex competitiveness rank, followed by the Debrecen, Szeged and Pécs sub-regions, whose coordinate based on one-dimensional scaling is approximately half of the Budapest value in numerical terms. However, these coordinates must be interpreted cautiously, since a double coordinate does not mean that the sub-region having such double coordinate assumes double complex competitiveness. In fact, according to the logic of MDS, the produced coordinates **are data interpretable on an interval scale instead of a proportional one**.

Comparing the results of the cluster analysis and the multidimensional scaling

Subsequently, I compared the results of cluster analysis and multidimensional scaling. The three clusters circumscribable in the two-dimensional map **contain the same elements** as the clusters emerging from cluster analysis. Similarly, the four groups circumscribable in the two-dimensional map are also in correspondence with the **four clusters** set up using the K-Means clustering method. **The difficulty** concerning the interpretation of one of the clusters **already outlined in the case of four-cluster analysis** becomes apparent from the graphic chart of two-dimensional scaling. In the event of setting up five clusters, three clusters **could not be circumscribed in a responsible manner**, since their coordinates according to *x* and *y* overlap so much that their graphic distinction could not be carried out with the necessary accuracy.

This survey highlighted the fact that **cluster analysis in itself is not enough for determining competitiveness types**; these can only be defined in a responsible manner by using other methods, as well. The graphic chart of MDS provides excellent help for the development of a picture on complex competitiveness and the accurate interpretation of the results. Based on the above, it can be clearly stated that in the case of distinguishing three clusters the results of various methods applying different logics produced the most accurate

correspondence. Consequently, **I decided to distinguish three competitiveness types** in the end, accepting the recommendations of works dealing with the typology of regions.

Dynamizing of the model

The model is expected to ensure **comparability in time**, which means that **beyond the relative competitiveness of the different sub-regions, its changes can also be examined** by introducing the latest statistical data to the database consisting of the selected system of indicators. This aspect assumes importance especially because of regular future surveys; however, taking certain limitations into account, it is also possible to retrospectively map out the competitiveness of the 168 Hungarian local administrative units as well as its changes.

In our analysis, we compared the competitiveness types of the different sub-regions in 1998 and 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.

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**. Annual one-dimensional scalings as the sub-regional comparison of the complex competitiveness rankings help identify the sub-regions that assumed worse ranking (or in other words, whose relative competitiveness deteriorated), the ones that achieved better position (whose relative competitiveness improved) and the ones that kept their rank in the two examined years.

Based on the Euclidean distance of the final cluster centers, it must be underlined that **in 1998 three clusters were situated closer to one another that 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 ones with relatively strong competitiveness grew significantly, and the same happened in the case of the clusters of sub-regions with relatively weak competitiveness and the ones with 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**.

Urban-rural dimension

Responding to the challenges of the spatial organizing forces introduced in Chapter 2 of the dissertation, empirical analysis is complemented by **a typology along the urban-rural dimension** that differentiates the competitiveness types based on their critical mass necessary for their development potentials. Major approaches in the typology of regions highlight the fact that, in the course of analyzing regional competitiveness, **special emphasis must be placed on the "*critical mass*" present in the region**, or in other words, the urban or rural character of the region. In harmony with this challenge, the second step of the present research makes an attempt to further differentiate the picture on regional competitiveness developed in the first step based on whether the sub-regions classified in the given region type are considered urban or rural.

It can be stated that the approaches examining urban-rural distinctions are similar in the respect that urban regions are predominantly **regions of large towns** where **significant population concentration** may be observed. Departing from this, the traditional approach expects sub-regions called urban to have a number of population that reaches a critical mass. Based on international recommendations, this can be approached with three indicators:

1. **The number of population in the center of the sub-region at the end of the examined year**: based on ESPON, the community strategic guidelines between 2007 and 2013 and the recommendations of OMB it should reach 50 000 persons.
2. **The proportion of inhabitants living in settlements with a population density of more than 120** in the examined sub-region should be at least 75%.
3. **The population rate of the sub-regional center** in the population of the sub-region should not be lower than 75%.

In the event that **at least one** of the above criteria is met, we can talk about an urban region in Hungarian sub-regional terms. However, we should not forget about today's ruling tendency, or in other words, **the challenges of knowledge-based economy**. In fact, in a region it is not only population concentration in the classical sense that can represent the critical mass necessary for urban regions, but also the knowledge produced in the given sub-region. The most important depositaries of creating new knowledge are higher education

institutions, whose presence in a given sub-region can also be interpreted as a type of critical mass. All this is in line with Malecki's idea, according to which competitiveness is basically determined by the presence of a critical mass of institutions.

4. On the basis of this, beyond the fulfillment of one of the three indicators defined above, I also consider sub-regions **with a higher education institution** to be urban in line with the implied criteria of the knowledge-based economy.

V. Research results

Following its research objective, the dissertation sought an answer to the fundamental question of how **the measurement and typisation of competitiveness in sub-regions could be achieved by minimizing the analyst's subjectivity**, and this way promoting the development of **spatial situation analyses with development purposes**. While answering this question, I introduced a possible method that analyzes the complex competitiveness of the different spatial units in a closed logical system. Based on the research goal, the efforts to answer the proposed problems, the results of empirical surveys and **the outlined four hypotheses**, the following observations can be made:

Thesis 1: **The competitiveness of sub-regions is a measurable category; multivariable data analysis methods can be successfully applied in the course of analyses and it is possible to produce competitiveness analyses that are much more complex than simple statistical analyses.**

Relying on the apparently growing importance assumed by the concept of competitiveness at the level of the European Union and the results of international research in the area of competitiveness, today the competitiveness of sub-regions seems to become an increasingly measurable category. On one hand, the majority of the reviewed Hungarian and international studies on competitiveness examine an aggregation level larger than sub-regions; on the other hand, measurement mostly relies on simple data analysis methods and is limited to a comparison based on these. However, in my understanding, regional competitiveness is a much more complex and complicated concept that does not allow such simple methods to represent the competitiveness of spatial units in a sufficiently differentiated manner.

For the measurement of the competitiveness of sub-regionss, the novel model introduced in the dissertation ensures realizing the objective of minimizing the

analyst's subjectivity in the course of the analysis by applying various methods with significantly different logics jointly and complementing one another. Accordingly, in the course of selecting variables and weighting, I applied principal components analysis, while in the framework of the empirical application of the developed method, I used hierarchical and K-Means clustering methods as well as one- and two-dimensional scaling. With the help of one-dimensional scaling developing a complex competitiveness rank of sub-regions also became possible.

So the competitiveness of sub-regions can be defined and measured, they can be compared based on their competitiveness, and it is also possible to set up their competitiveness rank. This, in my judgment, **leads to the justification of the first hypothesis, so that is accepted**.

Thesis 2: **The pyramid model of regional competitiveness can be used to construct the basis of analyzing the competitiveness of sub-regions.**

In the course of reviewing competitiveness studies, the clarity, simple structure and refinement of analyses based on certain models became apparent. Following the review of the structure, elements and logic of various demonstration models, the dissertation successfully argued for the use of the pyramid model as the basis of analysis. In fact, the pyramid model is built upon the standard definition of competitiveness selected as the basis of the analysis, it follows the structure of input-output-outcome corresponding to the relevant international recommendations, its structure follows a simple but at the same time strict logic, and its elements can easily be transformed into indicators at the level of sub-regions, as well. From the aspect of analyzing sub-regions, the strength of the model lies in integrating a great number of factors outside economy. It is exactly this level that proves especially heterogeneous in the case of sub-regions; therefore, in the empirical analyses of sub-regions, examining input factors must receive great emphasis.

Consequently, due to its logical structure, manageability, transparency and wide recognition, the pyramid model of regional competitiveness qualifies for becoming the basis of a competitiveness analysis and revealing causalities as it is also demonstrated by international examples. All this is especially true in regard to sub-regions: based on the results of international and Hungarian efforts to measure regional competitiveness and on the pyramid model, the competitiveness of sub-regions becomes objectively and comparably measurable and assessable in the

model. In my opinion, this type of methodological approach is ideally applicable for competitiveness analyses on the county and sub-regional level, reviewing the logical interrelations of economic questions and effects and developing strategic programs. As a logical consequence of all this, the **second hypothesis is accepted**.

Thesis 3: **A competitiveness survey can be regarded clean-cut if it relies on a precisely defined and widely accepted definition and on measurable economic categories retraceable to it, follows closed logic and can eliminate the distorting effects of the analyst's subjectivity to the greatest possible extent.**

In the case of any empirical analysis, it is especially important to define the concepts that the analyst intends to rely on in his or her research. This statement is especially true for competitiveness analyses, since the concept of regional competitiveness constituting the object of the analysis is a controversial term – as I demonstrated it in my dissertation –, and, on the other hand, it can be interpreted in various ways. Since regionalists also tend to accept approaches of regional competitiveness with highly different content, in competitiveness analyses it is really important to precisely express the definition, based on which analysis is carried out. In fact, the selected concept strictly determines the further logic of the analysis as well as its applicable method.

The final output of the analysis becomes less attackable if the selected definition receives wide recognition among professionals, and the analysis is characterized by a consistent use of concepts. The theoretical foundedness of the analysis may largely grow if a solid and also widely accepted pattern that is built on the selected concept and this way coordinates the formation of indicators in a closed logical system can be inserted between the applied concept and the final indicators. Depending on the selected concept and the goal of the analysis, the diamond model, pyramid model, the competitiveness cylinder, etc. can serve this objective.

In the model developed by the dissertation and built on the standard definition of competitiveness and the pyramid model unfolding it, the major role in selecting potential indicators was assumed by economical considerations and a deeper understanding of the concept of competitiveness as well as the experiences of the indicator set outlined in the 13 international and 17 Hungarian studies analyzed. The selection of indicators occurred based on the communalities and loading variables of principal components analysis, while weighting was based on the roots

of the communalities of principal components analysis. Obviously, the weight of the different variables and categories may be considered objective within the given model in the sense that the definition of these – contrary to former surveys – does not contain subjective elements.

Typisation based on selected and weighted variables highlighted that cluster analysis in itself is not enough for the definition of competitiveness types, since these types can only be responsibly defined with the support of other methods.

Since the primary novelty of the dissertation lies in the developed method itself, **the dissertation successfully reinforced the third hypothesis, as well**.

Thesis 4: **The developed typisation method is suitable to classify Hungarian local administrative units in competitiveness types.**

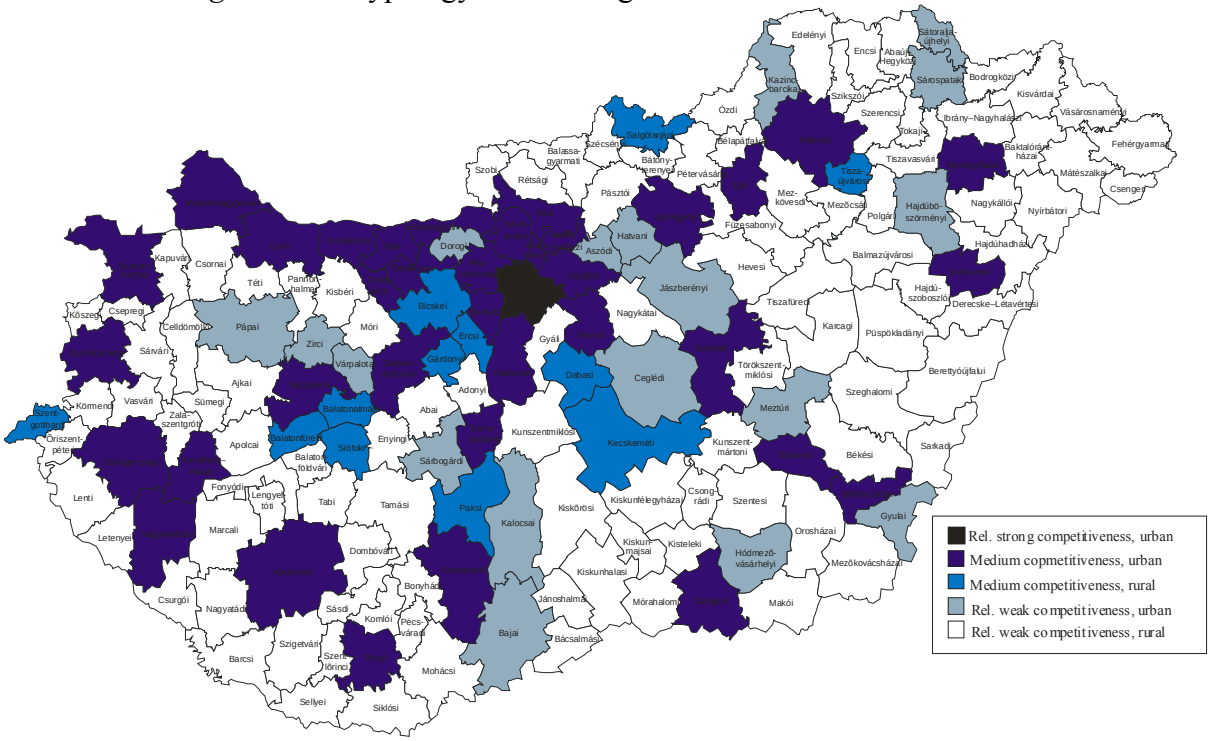
In the empirical application of the developed method, I classified Hungarian local administrative units in competitiveness types with the help of multivariable data analysis methods. In the course of developing a typology of the sub-regions in terms of complex competitiveness, I applied cluster analysis as well as one- and two-dimensional scaling performing the analyses in various different ways. Since the various techniques using methods with different logics led to the same result, it is probable that the competitiveness of Hungarian local administrative units could be mapped realistically. Based on this, it makes sense to suppose that the applied theoretical model and the methodology based on it are suitable for making regional competitiveness measurable. In the efforts to make regional competitiveness measurable, maybe choosing, objectively selecting and attempting to weight the variables relying on the pyramid model as a logical frame meant a step forward.

Among Hungary's local administrative units, the analysis distinguished 1 urban sub-region with relatively strong competitiveness, 36 urban sub-regions with medium competitiveness, 12 rural sub-regions with medium competitiveness, 18 urban sub-regions with relatively weak competitiveness and 101 rural sub-regions with relative weak competitiveness. It can be said about the spatial concentration of competitiveness and urbanization that – based on the data compiled in 2004 – the only urbanized sub-region of the capital with relatively strong competitiveness is surrounded by the ring of sub-regions with medium competitiveness, 90% of which are urban. Furthermore, the urban sub-regions with medium competitiveness are on

one hand the sub-regions of the chief towns of counties (with the exception of Salgótarján) and the sub-regions of large towns. Sub-regions with medium competitiveness (urban and rural alike) are concentrated in the vicinity of developed Western centers and highways. Beyond this, it can also be stated that 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 (Figure 3).

It has also become clear that for the determination of competitiveness types the data set, indicators and the situation analysis based on them provided by simple statistical analyses are not sufficient, but data and the indicators producible from them must be organized to also serve the foundation of regional, county, sub-regional and settlement level programs of economical development. In fact, "a good diagnosis is the token of successful therapy", which means that the assessment of real conditions obviously facilitates spatial planning and the development of spatial strategies, priorities and programs most corresponding to the competitiveness, characteristics and starting position of the given region types. For the past one and half decades it has become widely accepted in the practice of the European Union that planning, harmonized developments, a preliminary assessment and interim evaluation of the effects of developmental actions and projects strengthening or weakening one another are essential in the different regions. These surveys become clear cut and their results are acceptable if they are built on precise data and supported by professional analyses. This requires targeted data collections as well as developing and analyzing precisely defined indicators. Without thorough diagnosis, "ad hoc" therapies based on "visual inspection" are almost surely bound to fail. Consequently, the developed method is suitable to constitute the basis of classifying Hungarian local administrative units in competitiveness types, which means **the justification of the fourth hypothesis**.

Figure 3 The typology of the Hungarian local administrative units



Source: own counstruction

VI. Major publications in connection with the theme of the dissertation

A. Books and book chapters

Lukovics M. (2004): A regionális identitás szerepe a regionális gazdaságfejlesztésben. In Czagány L. – Garai L. (szerk.): *A szociális identitás, az információ és a piac*. SZTE Gazdaságtudományi Kar Közleményei, JATEPress, Szeged, 214-228. o.

Lukovics M. (2005): A magyar régiók felzárkózási lehetőségei az Európai Unióban. In Kormányos J. (szerk.): *XXVII. OTDK Közgazdaságtudományi Doktorandusz Szekció Tanulmánykötet*. Akadémiai Kiadó, Budapest, 157-172. o.

Lukovics M. (2005): Innovációs képesség: a regionális gazdaságfejlesztés alapja. In Buzás N. (szerk.): *Tudásmenedzsment és tudásalapú gazdaságfejlesztés*. SZTE Gazdaságtudományi Kar Közleményei, JATEPress, Szeged, 74-86. o.

Lukovics M. (2006): Az építőipar helyzete és az építési piac térbelisége. In Lengyel I. – Rechnitzer J. (szerk.): *Kihívások és válaszok: a magyar építőipari vállalkozások lehetőségei az Európai Uniós csatlakozás utáni időszakban*. Novadat, Győr, 15-47. o.

Lukovics M. (2007): A Dél-Alföld versenyképességéről, avagy hol mutatkozik kitörési pont. In Lengyel I. (szerk.): *A Szegedi Tudományegyetem lehetőségei a tudásalapú helyi gazdaságfejlesztésben*. JATEPress, Szeged (megjelenés alatt), 24 o.

Lukovics M. (2007): Az EU 2007 – 2013-as programozási időszakának alapkérdései a SZTE, valamint a Dél-alföldi Régió szempontjából. In Lengyel I. (szerk.): *A Szegedi Tudományegyetem lehetőségei a tudásalapú helyi gazdaságfejlesztésben*. JATEPress, Szeged (megjelenés alatt), 20 o.

Lukovics M. (2007): University of Warwick (Egyesült Királyság) szerepe a helyi tudásalapú gazdaságfejlesztésben. In Lengyel I. (szerk.): *A Szegedi Tudományegyetem lehetőségei a tudásalapú helyi gazdaságfejlesztésben*. JATEPress, Szeged (megjelenés alatt), 20 o.

Besze T. – Lukovics M. (2007): Some aspects of the Hungarian territorial and urban development. In Lengyel, I. (ed): *The Opportunities of the Szeged University in the knowledge-based local economic development*. JATEPress, Szeged (megjelenés alatt), 15 o.

Lukovics M. (2007): A tudásalapú gazdaság térségtípusainak lehetséges fejlesztési irányai Magyarországon. In Farkas B. (szerk.): *A lisszaboni folyamat és Magyarország*. JATEPress, Szeged (megjelenés alatt), 20 o.

B. Publications in scientific journals

Lukovics M. (2004): Regionális gazdaságfejlesztés: eltérő fejlettségű megyék versenyképességének összehasonlító elemzése. *Tér és Társadalom*, 4, 149-168. o.

Lukovics M. – Deák I. (2005): Kontrolling a kutatás-fejlesztésben. *INCO*, 11, 19 o.

Deák I. – Lukovics M. (2006): A vállalati K+F támogatása controlling eszközökkel. *Vezetéstudomány*, 4, 39-47. o.

Lukovics M. (2006): A magyar megyék és a főváros versenyképességének empirikus vizsgálata. *Területi Statisztika*, 2, 148-166. o.

Lukovics M. – Somosi S. (2006): A maastrichti konvergencia-kritériumok statisztikai módszertanának és teljesíthetőségének áttekintése és kritikája. *Gazdaság és Statisztika*, 5, 22-36. o.

Lukovics M. (2006): A Possible Method of Measuring the Competitiveness of Hungarian Counties. *Gazdálkodás* (special edition), 17, 54-62. o.

D. Conference proceedings

Lukovics, M. (2004): *New Trends of the EU-Cohesion Policy in the Programming Period 2007 to 2013*. 3rd International Conference for Young Researchers, Szent István Egyetem, Gödöllő, 442-448. o.

Lukovics M. (2004): *Versenyképesség és kohézió az Európai Unió új kohéziós politikájában*. In Hodúr C. et al. (szerk.): A VI. Nemzetközi Élelmiszertudományi Konferencia előadásai. SZTE SZÉF, Szeged, 7 o.

Lukovics M. (2004): *„Fejlett" magyar régiók az európai gazdasági térben*. A versenyképesség regionális, vállalati, intézményi dimenziói. Széchenyi István Egyetem, Győr, 11 o.

Lukovics M. (2005): A gazdasági szerkezet és a regionális elérhetőség szerepe Békés megye versenyképességében. In Nagy E. – Nagy G. (szerk.): *Az Európai Unió bővítésének kihívásai – régiók a periférián*. Nagyalföld Alapítvány, Békéscsaba, 270-276. o.

Lukovics, M. (2005): Competitiveness and Cohesion in the European Economic Space. In Lehoczky L. – Kalmár L. (szerk.): *5th International Conference of PhD Students: Economics I.* University of Miskolc, Innovation and Technology Transfer Centre, Miskolc, 141-146. o.

Lukovics M. (2005): A Dél-Alföld versenyképessége a jövedelmek alapján. In Nagyné Fehér I. (szerk.): *Erdei Ferenc III. Tudományos Konferencia II. Kötet*, Kecskemét, 1047-1051. o.

Lukovics, M. (2005): Cohesion Possibilities of Lagging Behind Regions in the Enlarged European Union. In Vincze M. (ed.): *The Impact of European Integration on the National Economy – Regional and Rural Economics*. Risoprint, Cluj-Napoca, 68-75. o.

Lukovics, M. (2005): Klaszteranalízis a magyar megyék versenyképességéről. In Gulyás L. – Baló T. (szerk.): *Európai Kihívások III. Tudományos Konferencia*. Szeged. 93-97. o.

Lukovics M. (2006): How to Measure the Competitiveness of the Hungarian Counties? *4th International Conference for Young Researchers, Volume II*, Szent István Egyetem, Gödöllő, 361-368. o.

Lengyel, I. – Lukovics, M. (2006): An Attempt for the Measurement of Regional Competitiveness in Hungary. Paper presented at the "*Enlargement, Southern Europe and the Mediterranean*" 46th Congress of the European Regional Science Association, Volos, Greece, 29 o.

Kovács, P. – Lukovics, M. (2006): Classifying Hungarian Sub-regions by their Competitiveness. "*Globalization Impact on Regional and Urban Statistics"* SCORUS 25th Conference on Urban and Regional Statistics and Research, Wroclaw, Poland, 12 o.

Kovács P. – Lukovics M. – Petres T. (2006) : *A Petres-féle Red mutató alkalmazásának lehetőségei*. Közgazdaságtudományi, vezetés- és vállalkozástudományi konferencia kötete, Dunaújvárosi Főiskola, Dunaújváros. (megjelenés alatt), 14 o.

E. Other Publications

Bajmócy Z. – Imreh Sz. – Lengyel I. – Lukovics M. – Rechnitzer J. (2005): A Csongrád megyei kistérségek gazdasági szerkezetátalakításának tervezése és menedzselése. Kistérségi gazdaságfejlesztési módszertani útmutató. Munkaanyag.

Lengyel I. – Lukovics M. (2005): A Dél-alföldi Régió helyzetelemzése. DARFT Regionális Fejlesztési Ügynökség, Szeged. Letölthető: http://www.del-alfold.hu

Bajmócy Z. – Lukovics M. (2005): Szeged általános helyzetképe, versenyképessége c. fejezet a Szeged BIOPOLISZ Növekedési Pólusprogram Koncepciója c. munkaanyagban.

Bajmócy P. – Bajmócy Z. – Lukovics M. (2004): Békés megye versenyképessége. Békés Megyei Területfejlesztési Tanács, Békéscsaba.

Lengyel I. – Farkas F. – Vilmányi M. – Bajmócy Z. – Lukovics M. (2006): Pólus kézikönyv. Nemzeti Fejlesztési Hivatal, Budapest.

Lukovics M. (2006): A nagyprojekt gazdasági környezete, hatásvizsgálata. In Mikó T. (szerk.): Biopolisz Egészségipari Park megvalósíthatósági tanulmánya, Szeged.

Lukovics M. (2006): Beszámoló az Európai Regionális Társaság 46. kongresszusáról. Tér és Társadalom (megjelenés alatt)

Lukovics M. (2006): Térségek fejlettségének, versenyképességének vizsgálata Magyarországon. In Lengyel I. (témavezető): *Versenyképesség és foglalkoztatás – Javaslat gazdasági hatások területi értékelési módszertanára a Dél-Alföldön.* SZTE GTK KGI, Szeged.