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Types of competitiveness of Hungarian regions: agglomeration economies and endogenous regional development

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Abstract

Nowadays, more and more scholars of regional science are interested in the role of agglomeration economies in the knowledge-based economy. This issue can be dealt with from different points of view: different development types of functional or nodal regions and one has to examine the factors influencing regional competitiveness. To improve competitiveness of regions, different economic development programmes must be applied, which means that the improvement of competitiveness requires different bottom-up strategies based on the different types of regions.

In this paper** we outline our analytical framework: the pyramidal model of regional competitiveness. The pyramidal model is a logical systematization for measuring endogenous regional development and the factors influencing it; the model shall be used to introduce the regional competitiveness function (RCF). After introducing theoretical model, we are going to investigate into the competitiveness of Hungarian urban microregions (LAU1) where firms potentially enjoy localization agglomeration economies. The statistical analysis to underline the classification of microregions by competitiveness types is based on multivariate linear regression models.

Keywords: regional competitiveness, pyramidal model, endogenous regional development, regional competitiveness function

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1. Introduction

Increasing regionalization represents one of the most spectacular processes of the economies that develop and transform as a result of globalization processes: while the (relative) importance of national economies is decreasing, the economic role of regions and cities seems to grow. Global competition has intensified also in space, especially with the growing importance of the agglomeration economies. Interregional competition, which refers to the competition of regions and cities for scarce resources, educated human labor, investments etc. is increasingly prevalent.

It has become one of the major issues of regional science to investigate into the questions of competition among regions, leading to lively debates. As Krugman (1994) stated: there is no competition among regions, because in an international division of labor based on comparative advantages every nation may become a winner, there may be a rising standard of living. Therefore, even when considering regions, it is not competitiveness that is of utmost importance, but we have to focus on the growth rate of productivity. Porter (2007) considers a competition among regions, but this is based on competitive advantages (similarly as for corporations), since these days the importance of comparative advantages is diminishing. As he states: "Competitiveness depends on the productivity with which a location uses its human, capital, and natural resources. Productivity sets the sustainable standard of living" (Porter 2008).

It appears to be generally accepted in regional science these days, that there is some sort of competition among regions, but this may be characterized by different attributes as the competition among corporations or countries (Batey–Friedrich 2000, Chesire 2003, Malecki 2002). Capello states (2007a, xviii): 'Regions compete on absolute rather than comparative advantage". The results of interregional competition are similar to those of the competition among countries: welfare (living standard) improves in the successfully competing regions, employment and incomes (wages) are high, new investments take place, talented young people and successful businessmen migrate there, etc. (Malecki 2004, Polenske 2004). Successfulness in competition, or in other words, competitiveness has been one of the key concepts over the past two or three decades partly due to the acumination of global competition (Camagni 2002).

Competitiveness of regions and cities may be well described by the widely recognized definition of Storper (1997, p. 20): 'The ability of an (urban) economy to attract and maintain firms with stable or rising market shares in an activity while maintaining or increasing standards of living for those who participate in it.' However, definitions of competitiveness are elusive, since they usually cover forms of regional economic growth accompanied by rising standards of living in the region.

Today territorial competitiveness covers both economic growth and economic development. This complex point of view is well demonstrated by the fact that Capello (2007a) emphasizes the connections between territorial competitiveness and local development, as well as regional growth (both for endogenous and exogenous) in her book entitled 'Regional economics'. However, while theoretical approaches of econometric regional growth between 1960 and 1990 were based on increasing productivity and individual welfare indicators as described by traditional neoclassical models, the shift in the 1990s resulted in a definite turn towards strengthening competitiveness (Capello 2007b). In territorial endogenous growth theories regional growth is the result of partly independent mechanisms (Capello 2007b, pp. 757-758): a competitive process, a socio-relational process, a territorial and spatial process, an interactive process, and an endogenous process.

There are several well-known surveys of national competitiveness – two of these are of particular interest. First, the Yearbook of the Institute for Management Development (IMD 2010) containing a yearly competitiveness ranking of countries since 1987. Second, the Global Competitiveness Report of the World Economic Forum (WEF 2010) published annually since 1996.

Besides academic studies, regional competitiveness has become on of the major topics of regional policy, especially in the EU (Camagni – Capello 2010, Lukovics 2009). In recent years, the EU has firmly identified the improvement of regional competitiveness to be the primary objective of regional policy. Regional economic development strategies are especially important for the new member states, since between 2007 and 2013 they will receive significant subsidies from the European Union’s regional development funds to improve the competitiveness of their regions lagging behind.

The modes of improving regional competitiveness and regional economic development strategies are heavily dependent on the type of the given region. This is because regions in different phases of their development are in different positions when it comes to interregional competition. Porter, Delgado and Ketels (2008) classified these phases as: resource-driven stage, investment-driven stage, and innovation-driven stage. These categories are especially important in understanding regional development in transition economies, where regions are hardly in innovation-driven phase (Lengyel B. – Cadil 2009, Lengyel I. 2009b). However, based on agglomeration advantages Budd-Hirmis (2004) points out that metropolitan regions with urbanization agglomeration economies are competing with more emphasis on their comparative advantages, while regions of localization agglomeration economies tend to compete on

competitive advantages. McCann (2008) considers that size of regions is a strong influential factor when it comes to the organization of clusters, which play a very important role in interregional competition: pure agglomeration (urban), industrial complex (local but not urban), and social networks (local but not urban).

The literature on regional competitiveness in the academic and regional policy studies covers three subject areas (Barkley 2008): (1) definitions, conceptualizations, and modeling of competitiveness; (2) measures of competitiveness, estimation of competitiveness indices (ratings, rankings, scores); and (3) benefits and shortcomings of following a strategy to enhance regional competitiveness.

In the second section of this paper the pyramidal model of regional competitiveness. This model is a logical systematization for measuring endogenous regional growth and the factors influencing it; the model shall be used to introduce the regional competitiveness function (RCF). After introducing the theoretical model, we are going to investigate into the competitiveness of Hungarian urban microregions (LAU1) with a population of above 50 thousand citizens. Our statistical analysis to underline the classification of microregions by competitiveness types is based on the multivariate linear regression analysis.

2. Pyramidal model and regional competitiveness function (RCF)

Three major issues emerged in the debates aiming at the interpretation of competitiveness: (1) *how to define regional competitiveness and its factors; (2) what indicators should be used to measure it; and (3) how can regional competitiveness be improved?* These three questions usually lie in the background of other professional debates too; while representatives of regional science concentrate on the first one, the regional economist on the second one, the experts of regional policy tend to focus on the third one.

There were a number of attempts to define the new notion of competitiveness according to new global competition conditions in the mid 1990s. Porter (2007) suggests using prosperity, measured by standard of living and inequality for measuring regional competitiveness. Prosperity, defined by per capita income is decomposed into two factors: labor productivity and labor utilization. Factors influencing labor productivity are: skills, capital stock, and total factor productivity. Factors of labor utilization: working hours, unemployment, workforce participation rate (population age profile).

Huggins (2003) suggested using a three-level model for measuring *competitiveness,* in which each level is based on the previous one: inputs, output, and outcomes. Inputs are described

by three indicators: business density (firms/capita), knowledge based business (per cent of all businesses), and economic participation (activity rates). Output is estimated by productivity (GDP per capita). Outcomes consist of two indicators: earnings (full time wages), and unemployment (ILO).

Kitson, Martin and Tyler (2004) use three indicators for measuring competitiveness: regional productivity, employment and standard of living. They also claim that competitiveness is influenced by hard and soft elements as well. Bases of the regional competitive advantage are: productive capital, human capital, social-institutional capital, cultural capital, infrastructural capital, and knowledge/creative capital.

Stimson, Stough and Salazar (2009) suggest a new conceptual model framework for regional endogenous development. The dependent variable of endogenous growth is measured by two indicators, on one hand by the change of employment or income, on the other hand by employment-based location quotient (LQ). Explanatory variables include, among others, resource endowments (estimated by 13 indicators) and market fit (measured by 4 indicators). Their model includes several indicators for leadership quality, as well as institutions and entrepreneurship.

Stimson, Robson and Shyy (2009) created a model of endogenous growth for Australia's non-metropolitan regions. They considered 27 independent variables in five factor groups: industrial structure and size effect, unemployment, human capital and income, occupational shifts, effects of coastal and inland location effects and of proximity to the metropolitan area.

In the European Competitiveness Report (EC 2008, p. 15): “Competitiveness is understood to mean a sustained rise in the standards of living of a nation or region and as low a level of involuntary unemployment, as possible.” The *standard notion of competitiveness* in the Sixth Regional Periodic Report of EU (EC 1999): ‘*The ability of companies, industries, regions, nations and supra-national regions to generate, while being exposed to international competition, relatively high income and employment levels*’. In other words ’high and rising standards of living and high rates of employment on a sustainable basis’ (EC 2001).

The standard notion of competitiveness obtained in this way cannot be used, however, to identify factors responsible for regional competitiveness or areas, which are to be strengthened or developed by regional development policies and programs for improved competitiveness. Since the notion of competitiveness can be seen as refining that of economic growth, it can often be observed that proposals for improved competitiveness combine traditional means of economic development with methods based on endogenous development.

The standard definition refers to “relatively high income”. This can be measured by means of the per capita GDP and the GDP growth rate. A high employment level is in turn indicated by the rate of employment. These two indicators can be measured independently from one another, but per capita GDP can also be expressed as follows, respectively:

$$\frac{GDP}{total \cdot population} = \frac{GDP}{employment} \times \frac{employment}{working-age \cdot pop.} \times \frac{working-age \cdot pop.}{total \cdot population}$$

The third factor (working-age population / total population) changes slowly over time and is rather a demographic than economic term. These remarks suggest that measuring regional competitiveness can be traced back to two interdependent economic categories:

$$Regional\ income \cong Labor\ productivity \times Employment\ rate.$$

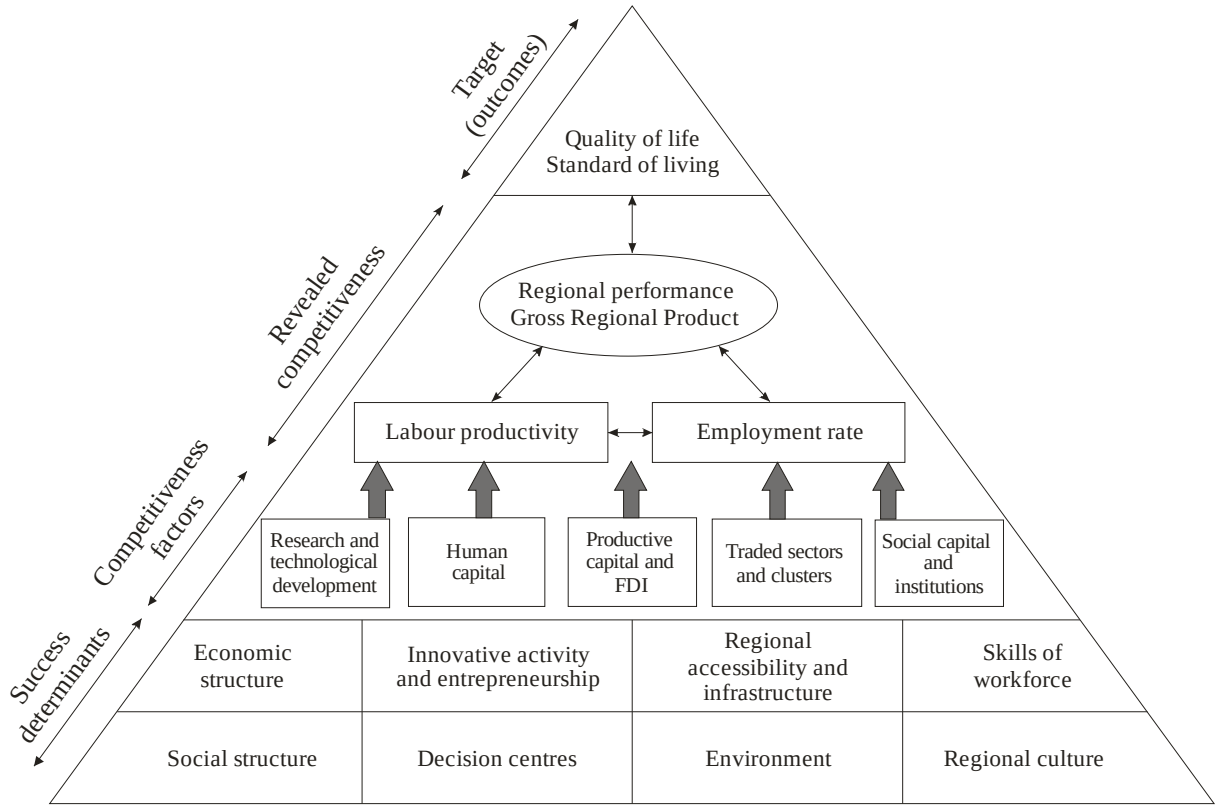
Hence the *substance of regional competitiveness*: the economic growth in the region, which growth is generated by both a *high level of labor productivity* and a *high level of employment*. In other words, competitiveness means *economic growth driven by high productivity and a high employment rate*.

In my opinion, theoretical literature on regional competitiveness as well as regional policy documents are turning from well measurable, hard economic and infrastructural indicators towards more soft indicators, which in turn offer less straightforward measuring possibilities. As laid out in the section describing theoretical approaches, region-specific economic and social qualities, like social capital, knowledge/creative capital and knowledge-intensive business services are gaining more and more in importance (Lengyel I. 2009a). Thus regional competitiveness studies are increasingly influenced by theories of endogenous growth and development.

Our study reviewing the competitiveness of Hungarian microregions is built on the pyramidal model since it is coherent with the above-mentioned findings, and is established on the basis on the inputs- outputs - outcomes relationship (*Figure 1*). Outcomes are the standard of living, the prosperity of any region depends on its competitiveness. Outputs are the basic competitiveness indicators: per capita Gross Regional Product (GRP), labor productivity and employment rate. Sources of competitiveness, inputs influencing regional competitiveness can be divided into two groups of *direct* and *indirect* components. Of particular importance are *competitiveness factors* with a direct and *short-term influence* on economic output, labor

productivity and employment rates. But social, economic, environmental and cultural processes and parameters, the so-called 'success determinants', with an indirect, *long-term impact* on competitiveness are also to be taken into account.

Figure 1. The pyramidal model of regional competitiveness



Source: based on Lengyel, I. (2000, 2004)

Three levels can be distinguished with regard to the objectives of regional development programming and the various characteristics and factors influencing competitiveness:

- *Revealed competitiveness* (or basic categories) (*ex post* indicators, output): these categories measure competitiveness and include income, labor productivity and employment rate.
- *Competitiveness factors* (*ex ante* factors): input factors with an immediate impact on revealed competitiveness categories. These can be used to influence regional competitiveness by means of institutions in short-term programming periods.
- *Success determinants* (social and environmental backgrounds): input determinants with an indirect impact on basic categories and competitiveness factors. These determinants take

shape over a longer period of time and their significance reaches beyond regional policy-making.

The *pyramidal model of regional competitiveness* seeks to provide a systematic account of these means and to describe the basic aspects of territorial competitiveness. 'This model is useful to inform the development of the determinants of economic viability and self-containment for geographical economies' (Pike et al, 2006, p. 26). 'This is an aggregate notion, …, in a regional context, labour productivity is the outcome of a variety of determinants (including the sort of regional assets alluded to above). Many of these regional factors and assets also determine a region's overall employment rate. Together, labor productivity and employment rate are measures of what might be called 'revealed competitiveness', and both are central components of a region's economic performance and its prosperity (as measured, say, by GDP per capita), though obviously of themselves they say little about the underlying regional attributes (sources of competitiveness) on which they depend' (Gardiner – Martin – Tyler 2004, p. 1049).

Competitiveness factors include such constituents of endogenous development theory like social capital and regional specialization, besides traditional factors of production like capital, labor and technology:

- RTD - *Research and technological development (RTD)*: fast introduction of innovations and new technologies creates competitive advantages. Innovation may come from outside the region (e.g. technological transfer), but the competitiveness of the region is most effectively advanced by successful R&D activities, innovations and their fast and wide-ranging distribution. The introduction of innovations and creation of patents may be effectively advanced by knowledge-intensive businesses.
- HUM_CAP - *Human capital*: population of active age, size and age structure of the workforce are important growth factors. However, the education level of the workforce is important as well, especially the rate of people holding tertiary degree.
- CAP_FDI - *Productive capital and FDI*: capital is indispensible for improving the competitiveness of a region. Foreign direct investments usually create new sectors, markets, new technologies and new jobs. It also improves labor productivity and can encourage technological transfer as well.
- TS_CLUST – *Traded sectors, entrepreneurship and clusters*: a strong traded (export-oriented) sector is an important source of competitiveness, which may become even more competitive by clustering. Flexible regional specialization may be furthered by

entrepreneurship and small and medium-sized enterprises (SMEs). Innovative SMEs are flexible and can quickly adapt to market changes, they are principally responsible for generating employment in the region.

– SOC_CAP - *Social capital and institutions*: economic prosperity also presupposes efficient cooperation among firms, governmental and non-governmental institutions. Successful companies also depend on the level of administrative services and public institutions. Social capital is particularly important: trust, reliability, readiness to cooperate, etc.

In order to investigate into the relations between indicators of revealed competitiveness (RC) and competitiveness factors, we intend to introduce the *Regional Competitiveness Function* (RCF):

$$RC = f(RTD, HUM\_CAP, CAP\_FDI, TS\_CLUST, SOC\_CAP)$$

The basic idea of our study: we assume that there is a relationship between competitiveness factors and revealed competitiveness. Causality is to be determined by multivariate regression. Our dependent variable is revealed competitiveness measured by a calculated index, while the 5 competitiveness factors are explanatory variables.

RCF is an extension of traditional regional growth concepts by newest findings of endogenous growth research. The importance of traded sectors and regional specialization is pointed out by Porter (2003, 2008), Stimson, Robson and Shyy (2009), while Acs and Szerb (2007), Fischer and Nijkamp (2009) emphasize the significance of SMEs and entrepreneurship, and Varga (2006, 2007) stress the importance of innovation and knowledge spillover. Sociological research alludes the importance of social capital (and territorial capital), brought to the attention of regionalists by Camagni (2009), Faggian and McCann (2009), Florida (2002) and Glaeser (2008).

The weight of each RCF competitiveness factor in measuring revealed competitiveness was assessed during our study of Hungarian microregions. This assessment excluded the success determinants of the pyramidal model, because we assume that the RCF is mainly useful for describing short-term relationships.

3. Background of competitiveness studies in Hungary

Regional competitiveness studies tend to be relative, i.e. we mostly compare the competitiveness of the chosen regions to each other. It is recommended to choose nodal regions, because workforce commuting, business relationships, etc. do rarely adhere to the spatial distribution of normative regions. It is difficult to gather reliable statistical data about nodal (functional) regions, thus Level LAU1 microregions were chosen this time. We assume that, except for Budapest, microregions are able to provide a good assumption of workforce commute zones (Lukovics 2009, Szakálné Kanó 2009).

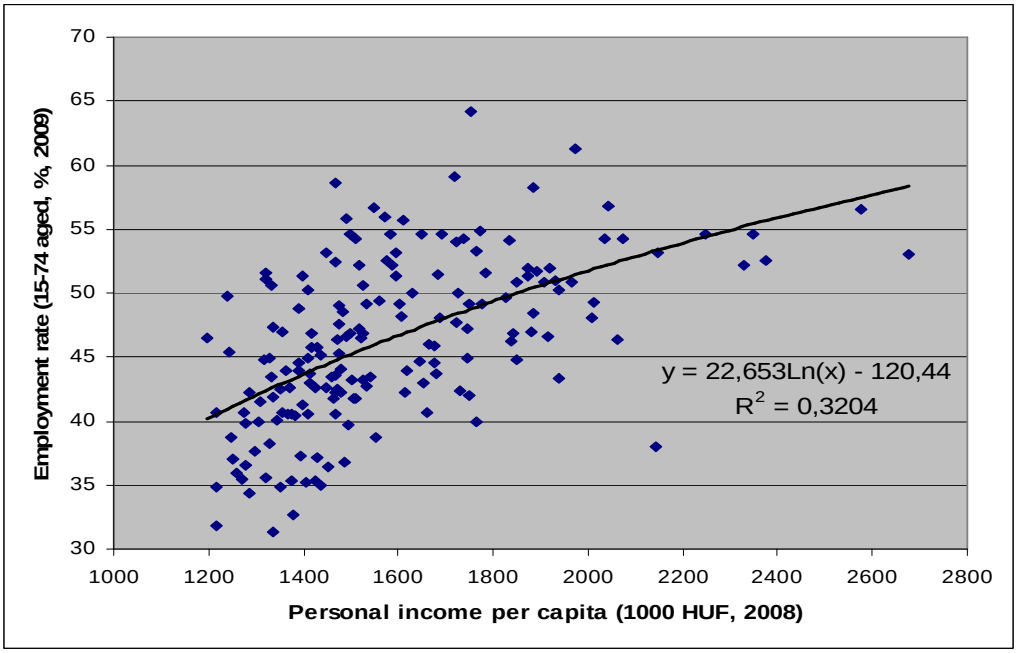
Hungary consists of 7 regions (NUTS 2), 19 counties (NUTS 3) and the capital, as well as 174 microregions (LAU 1) (*Table 1*). Statistical data usable for competitiveness investigations are available for these territorial levels. All LAU1 microregions have an town center. First, the competitiveness of Hungarian regions shall be introduced; afterwards we are going to examine microregions.

Table 1 Territorial levels of Hungary in 2010

Level of territorial units	Number of territorial units
NUTS 1 = macroregion	3
NUTS 2 = region	7
NUTS 3 = county	19 + Budapest (capital)
LAU1 = subregion, microregion	173 + Budapest (capital)

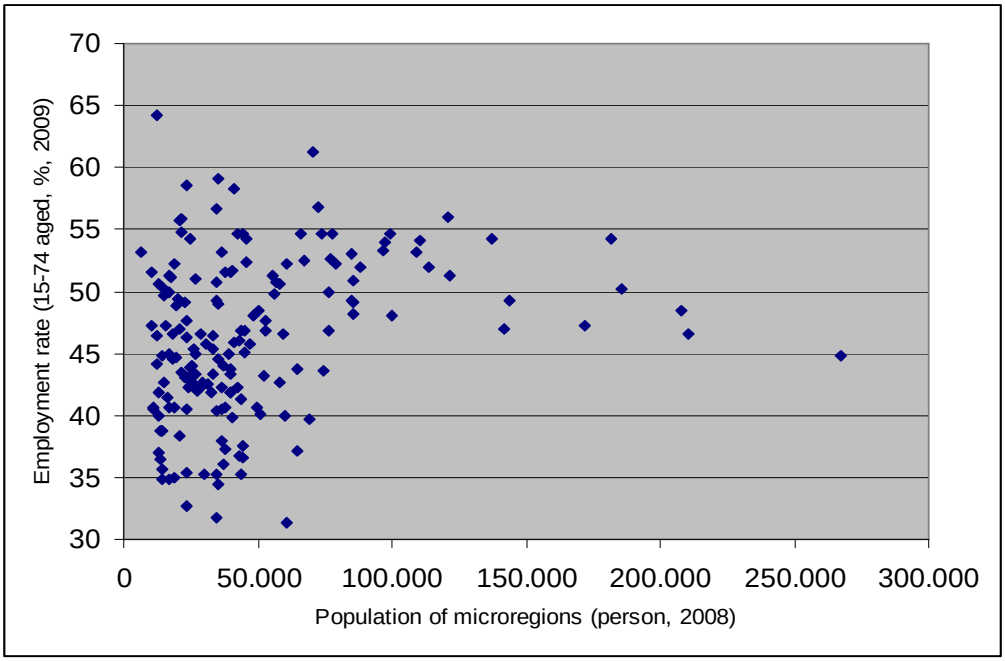
The categories of revealed competitiveness (GDP per capita, employment, labor productivity) show a broad distribution in LAU1 microregions. Economic output (GDP) cannot be measured in statistical microregions; therefore the *personal income tax base* is used. Comparing two basic categories, namely *employment rate* and *personal income tax base per taxpayer*, we can see a strong relationship up to 1.800 thousand HUF, meaning that a higher employment rate results in higher salaries due to demand and supply in the labor market (*Figure 2*). Above this value an intense distribution can be observed, typically ranging from 45 to 55 %. High-income microregions can be found in and around the capital, as well as in some microregions containing major cities.

Figure 2. Relations between employment and personal incomes in LAU1 microregions



Source: Own calculations of authors based on National Employment Office (i) and KSH Territorial Statistical Yearbook.

Figure 3. Employment rate and population of LAU1 microregions



Source: Own calculations of authors based on National Employment Office (http://kisterseg.afsz.hu/index.php) and KSH Territorial Statistical Yearbook.
Note: Without Budapest

Examining *employment rates* in microregions based on their populations, one may get a very diversified distribution (*Figure 3*). Employment rates in microregions with less than 70

thousand inhabitants (four fifth of microregions) are distributed evenly, mostly between 35% and 60%. In those 31 microregions with more than 50 thousand inhabitants in their town centers, employment rates vary between 45 and 55% (in Budapest it is 56.6%). It can be established that the critical mass, population as employees and consumers, as well as more sophisticated business and other urban services are crucially important factors in the development of employment (Bajmócy – Szakálné Kanó 2009).

The Hungarian settlement structure is unipolar, since Budapest (population of 2 million, sphere of attraction of about 3 million) is the only metropolitan region of the country; all other cities are significantly less populated, like Miskolc and Debrecen (both about 207 thousand inhabitants), Szeged (178 thousand inhabitants) and Pécs (164 thousand inhabitants). In my opinion, the reason for Hungarian regions growing so slowly is that provincial cities have a weak economy and are unable to fulfill their role as portal gatekeeper cities (Lengyel I. 2009b).

Our empirical study includes urban microregions potentially able to show agglomeration advantages. The groups of 174 microregions, according to agglomeration economies:

- *Budapest* (population of 2 million): urbanization agglomeration economies (Jacobs' externalities),
- *31 microregions with urban center, as urban regions* (at least 50.000 population of urban centers, sum total 3.6 million population): localization agglomeration economies (Marshall' externalities),
- *142 small (rural type) microregions* (sum total 4.4 million population).

Budapest was intentionally left out of this study due to its highly different characteristics. To sum up, urban microregions with potential localization agglomeration economies were studied by using the pyramidal model.

Our empirical study included the competitiveness of 31 Hungarian urban microregions. Goals of the investigation:

- comparison of these microregions by competitiveness, ranking, establishment of region types,
- to show how the indicators and indicator groups used influence regional competitiveness.

4. Empirical testing of the Regional Competitiveness Function

Our empirical study included the competitiveness of 31 urban microregions. Goals of the investigation:

- comparison of these microregions by competitiveness, ranking, establishment of region types,
- to show how the indicators and indicator groups used influence regional competitiveness.

Our study adheres to the logical construction of the pyramidal model. Revealed competitiveness indicators show recently achieved competitiveness as ex-post indicators. Competitiveness factors point out their contribution to revealed competitiveness. On the other hand, these show 'capabilities', future possibilities as ex ante indicators: by developing these, how the competitiveness of microregions might change in the near future.

Difficulties were liable to occur during the database creation process, because several theoretical categories (like social capital) are not straightforward to operationalize, and it is difficult to obtain reliable and authentic data for all Hungarian microregions (Bajmócy – Lukovics – Vas 2010). Computer analysis was done with SPSS-18.*

Empirical studies of regional competitiveness are often based on the methodological principles of the IMD Word Competitiveness Yearbook (WCY) and the WEF Global Competitiveness Report (IMD 2010, JRC 2010, Lukovics 2008, WEF 2010): subindices are generated from certain indicator groups, which in turn are weighted into a complex competitiveness indicator. We shall follow this methodology in the first part of our study, based on competitiveness factors of the pyramidal model as indicator groups. It is, however, rather problematic that there might be multicollinearity among the indexes. Furthermore, it can be difficult to determine the weighting for each subindex, e.g. IMD uses four equally weighted indicator groups, while WEF's are different for each one. We decided to apply another process in order to eliminate these problems.

The basic idea of our study: we assume that there is a relationship between competitiveness factors and revealed competitiveness. Causality is to be determined by

* Microregional competitiveness indicators and database were collected by Miklós Lukovics, Zoltán Bajmócy and György Málovics, while I was supported by Izabella Szakálné Kanó in performing the computer analysis. I would like to express my gratitude to them.

multivariate regression. Our dependent variable is revealed competitiveness measured by a calculated index, while the 5 competitiveness factors are explanatory variables.

Our multivariate linear regression model:

$$RC= \beta_0 + \beta_1 RTD + \beta_2 HUM\_CAP + \beta_3 CAP\_FDI + \beta_4 RS\_CLUST + \beta_5 SOC\_CAP + \varepsilon$$

The indicators used were set up based on the pyramidal model (see *Appendix 1*):

- revealed competitiveness (RC) is measured by 3 indicators,
- competitiveness factors are described by a total of 34 indicators: RTD (5 indicators), HUM_CAP (9 indicators), CAP_FDI (6 indicators), RS_CLUST (6 indicators), SOC_CAP (8 indicators).

To test RCF, we first calculated the value of revealed competitiveness; afterwards we analyzed it with multivariate linear regression to determine how far competitiveness factors are able to explain the value of revealed competitiveness.

(a) Revealed competitiveness

Microregions may show enormous distortion due to data localization, therefore it might be misleading to calculate GDP, but also major companies are calculated as being a one-point business at their headquarters' location. Therefore we came to the conclusion that 3 out of the revealed competitiveness (PIT_INH: taxable income per capita; GVA_EMPL: gross value added per employee; EMPL_RATE: employment rate) shall undergo principal component analysis to determine the principal component (RC), which shall be used later on as the dependent variable *(see Appendix 2):*

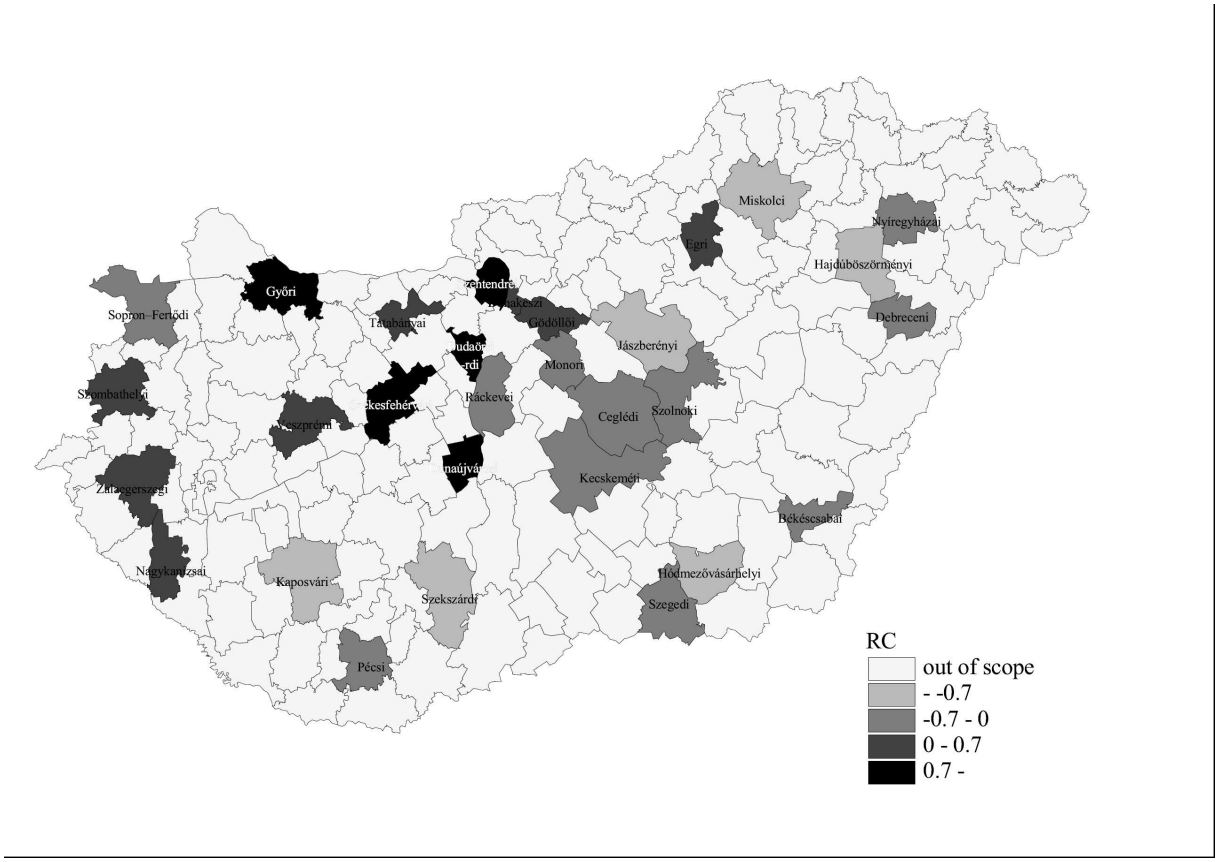
- RC contains 60.7 % of the 3 indicators,
- commonalities: PIT_INH 0,835; GVA_EMPL 0,5; EMPL_RATE 0,485.

Based on principal component analysis we found four types of Hungarian urban microregions (*Figure 4*):

- the most competitive regions are found in Transdanubia (Dunaújváros, Győr, Székesfehérvár) with significant foreign-own manufacturing capacities, as well as in the western agglomeration of Budapest,

- the second type includes all other Northern Transdanubian microregions with some further microregions to the east of Budapest,
- the third type includes other county capital, with poor economy and human capital, as well as in the southern agglomeration of Budapest,
- while the least competitive regions are found in the southern and eastern part of the country with some rural settlements.

Figure 4. Types of microregions by revealed competitiveness



(b) Relationship between competitiveness factors and RC

The analysis included the effect of the 5 competitiveness factors on the dependent variable (RC). Each competitiveness factor was based on 5 to 9 indicators, therefore we performed factor analysis within the indicator group in order to compress information and establish 1 to 2 factors per indicator group (see Appendix 3*):*

- RTD (research and technological development): one single factor, including 68 % of information,

- HUM_CAP (human capital): two factors, one containing 36.8 % (HUM_CAP1), the other 33.6 % (HUM_CAP2) of the information,
- CAP_FDI (productive capital and FDI): one single factor, including 68 % of the information,
- TS_CLUST (regional specialization and clusters): two factors, one explaining 39.3 % (TS_CLUST1), the other 36.1 % (TS_CLUST2) of the information,
- SOC_CAP (social capital and institutions): two factors, one explaining 31,6 % (SOC_CAP1), the other 30.0 % (SOC_CAP2) of the information available.

The above-mentioned 8 factors were used in multivariate linear regression, where RC was considered a dependent variable and the forward method resulted in 2 factors: CAP_FDI and SOC_CAP2. These two factors account for 85.2 % (R^2=0.852) of the dependent variable's (RC) standard deviation.

The model created:

$$RC_i = + 0{,}452\ CAP\_FDI_i - 0{,}615\ SOC\_CAP2_i + E_i$$

The regression model provides adequate explanation for the dependent variable (see *Appendix 3*):

- the Durbin-Watson test result was 2.419 which means that there is no autocorrelation at a significance level of 5 %,
- there is no multicollinearity,
- remainder components show a normal distribution,
- homoscedasticity may be observed.

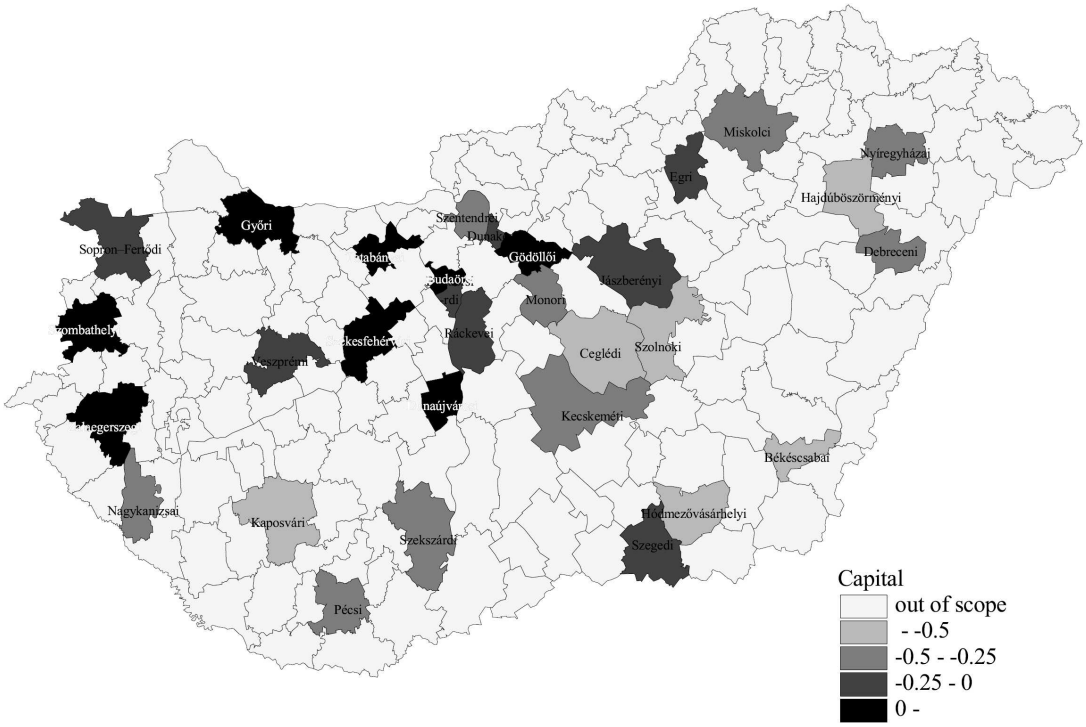
Table 2. Indicators having major influence on the competitiveness of microregions

CAP_FDI	**Component**	**SOC_CAP2**	**Component**
CONS-INH	0.773	PAYER-PIT	-0.653
SHARE-INH	0.936	POOR	0.858
FDI-INH	0.963	CULT	0.029
FDI-CAP	0.962	DIS-PENS	0.731
FDI-EMPL	0.944	DIPL-LOCAL	-0.041
FDI-REV	0.950	CRIME	0.039
		UNEMPL-RATE	0.835
		NONGOV	0.075

Based on these results, these two factors explain the competitiveness of microregions (*Table 2*). The first factor (CAP_FDI) only includes positive variables: a foreign direct

investment, total assets of enterprises (CONS-INH) and paid-in capital of enterprises in the microregion (SHARE-INH). In the second factor (SOC_CAP2): proportion of personal income taxpayers increases, while poverty rate, unemployment rate and disability pensioners reduce competitiveness.

Figure 5. Microregions by CAP_FDI factor



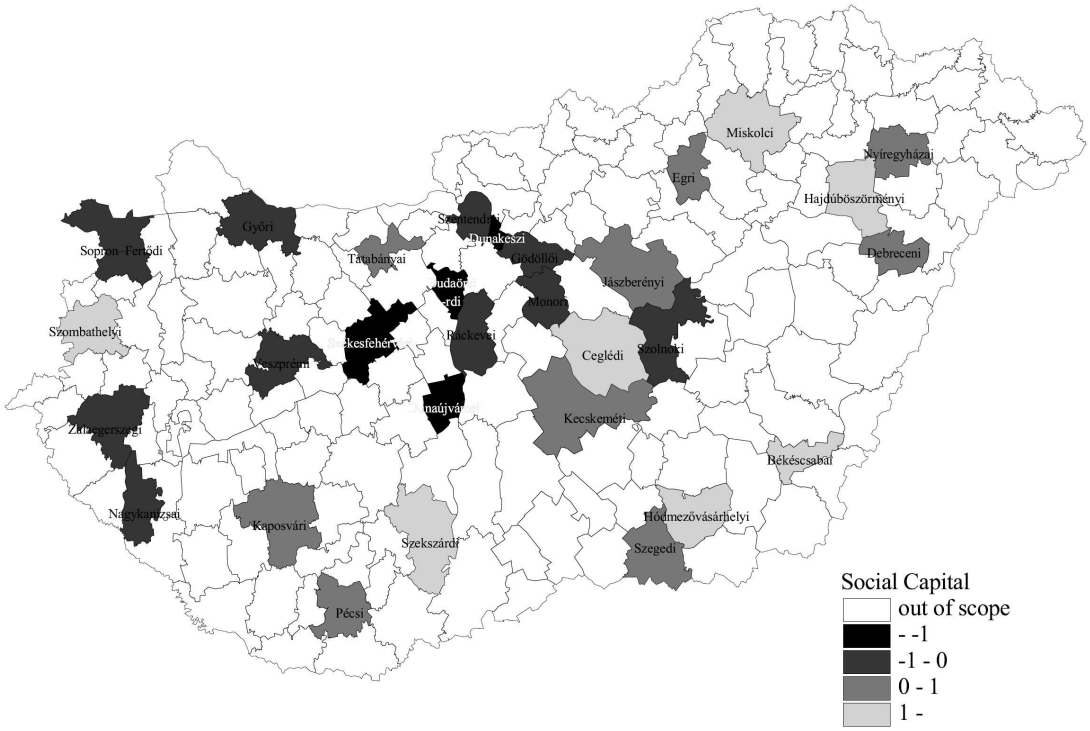
Microregions may be classified based on productive capital and FDI and even their spatial distribution may be determined (*Figure 5):*

- most competitive regions, similarly to revealed competitiveness, are found in manufacturing centers of Western Transdanubia and in smaller centers around Budapest,
- the next category is also dominated by regions around Budapest, but a few major cities also appear from other regions of the country,
- the third group is characterized by country capitals from everywhere around the country,
- while the least competitive regions are found in the south and the east of Hungary.

Classification of microregions based on social capital is similar to the previous ones (*Figure 6*). Social capital is quite strong around the capital and in western parts of the country,

while it is practically missing in other regions. It has to be noted, that variables included in the factor, like unemployment rate, poverty rate, number of disability pensioners under retirement age, etc. not only describe social capital, but may also be linked to human capital.

Figure6. Microregions by SOC_CAP$_2$ factor



(c) *Relationship between RC and the factors created from the indicators*

There may be multicollinearity among the indicator groups of the five competitiveness factors. Therefore we used a different methodology to review and test the relationship between the RC dependent variable and each of the 34 indicators considered: we performed factor analysis on the 34 indicators to generate independent factors. These factors were used in multivariate linear regression. This was especially beneficial because it enabled us to test the structure of the pyramidal model. However, it bears the disadvantage that one has to find an explanation afterwards for each factor based on the indicators included.

Factor analysis was performed for 34 variables with 4-5-6-7-8 factors; obviously, the higher the number of factors, the better they were able to explain standard deviation (*Table 3*).

We performed multivariate linear regression in each case, and found the best alignment for 5 factors (see *Appendix 4*):

- the Durbin-Watson test result was 2.194 which means that there is weak autocorrelation at a significance level of 5 %,
- there is no multicollinearity, remainder components show a normal distribution,
- homoscedasticity may be observed.

Table 3. Factor weights for 34-indicator factor analysis

Factors	**4 factors**	**5 factors**	**6 factors**	**7 factors**	**8 factors**
1	23.58	22.26	22.15	22.31	22.34
2	21.53	20.76	20.46	20.19	20.30
3	16.13	16.47	14.61	14.91	14.82
4	9.85	9.58	8.95	8.89	8.66
5	-	8.15	8.75	8.78	6.56
6	-	-	6.42	4.98	5.52
7	-	-	-	4.45	4.89
8	-	-	-	-	4.38
Total	**71.09**	**77.22**	**81.34**	**84.51**	**87.47**

These five factors account for 81.1 % (R^2=0.811) of the dependent variable's (RC) standard deviation. Our calculations resulted in the following multivariate linear regression model:

$$RC_i = + 0{,}213\ F1_i + 0{,}665\ F2_i + 0{,}421\ F3_i + 0{,}301\ F4_i + 0{,}236\ F5_i + E_i$$

The interpretation is complicated by the fact that each indicator may be present in more than one factor; therefore, it is recommended to consider components with an absolute value of 0.5 (*Table 4*).

Table 4. Factor components

Factor1		**Factor2**		**Factor3**		**Factor4**		**Factor5**	
DIPL_EMPL	0.887	FDI_EMPL	0.940	MIGR	0.885	EXP_GVA	0.794	CULT	0.692
SERVICES	0.876	FDI_REV	0.939	BIRTH_MORT	0.795	CLUST_PROP	0.787	SEC_EMPL	0.677
SELF_EMPL	0.863	FDI_INH	0.933	VITALITY	0.694	PAYER_PIT	0.656		
MANAG_EMPL	0.850	FDI_CAP	0.931	PATENT_OUT	0.595	EXP_INH	0.636		
DIPL-LOCAL	0.817	SHARE-INH	0.918	SME_INH	0.660				
KIMS	0.791	CONS-INH	0.725	KIBS	0.569				
NONGOV	0.716	EXP_INH	0.626	YOUNG_INH	0.527				
R&D_INH	0.594	KIBS	0.559	POOR	-0.518				
CRIME	0.515	SME_INH	0.505	ENTRE	-0.520				
SCHOOL	-0.752			DIS_PENS	-0.650				
				UNEMPL_RATE	-0.688				

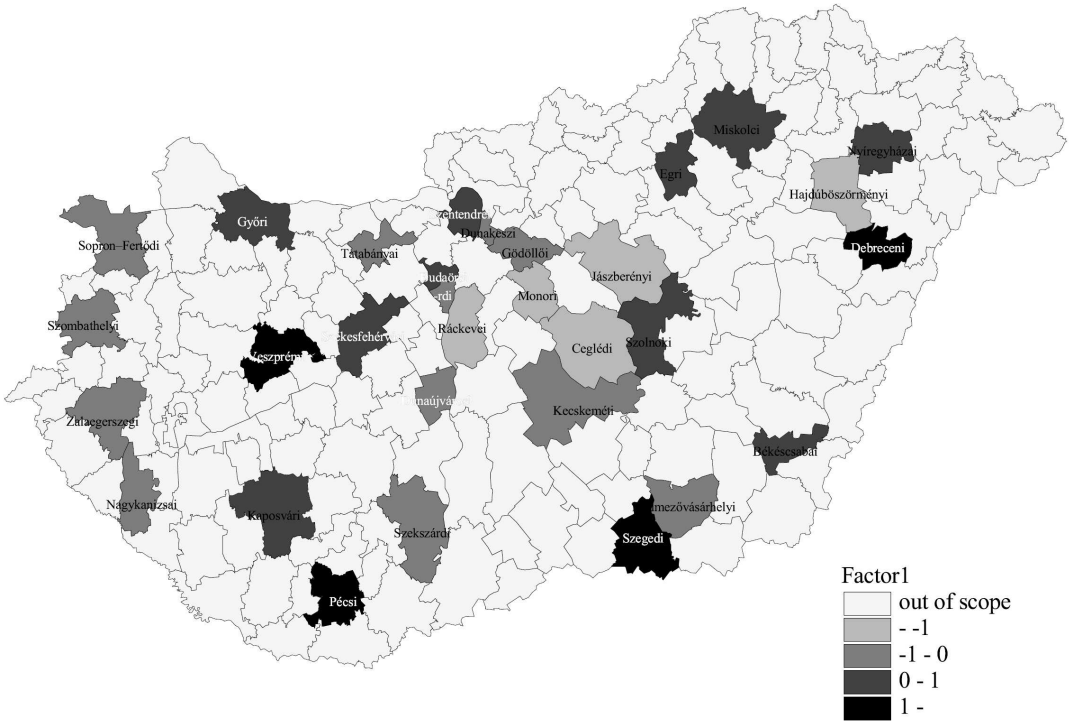
Indicators of the pyramidal model's competitiveness factors appear in several calculated factors as components (*Table 5*). The model's research and technological development element is only linked to one factor; I attribute this to the fact that among the studied 31 microregions, there is research and development only in few university towns. Indicators of human and social capital appear in several factors, especially because these are difficult to operationalize.

Table 5. Relationship between the competitiveness factors and the calculated factors

Competitiveness factors	**Factor1**	**Factor2**	**Factor3**	**Factor4**	**Factor5**
Research and technological development	x				
Human capital	x		x		x
Productive capital and FDI		x			
Regional specialization and clusters		x		x	
Social capital and institutions	x		x		x

Revealed competitiveness is most broadly influenced by the 2nd factor, dominated by productive capital and FDI, as well as regional specialization (entrepreneurship). This factor expresses one of the elements to the pyramidal model (Productive capital and FDI), complemented by a few indicators of other elements. Spatial distribution of microregions based on this factor shows exact conformity with *Figure 5*.

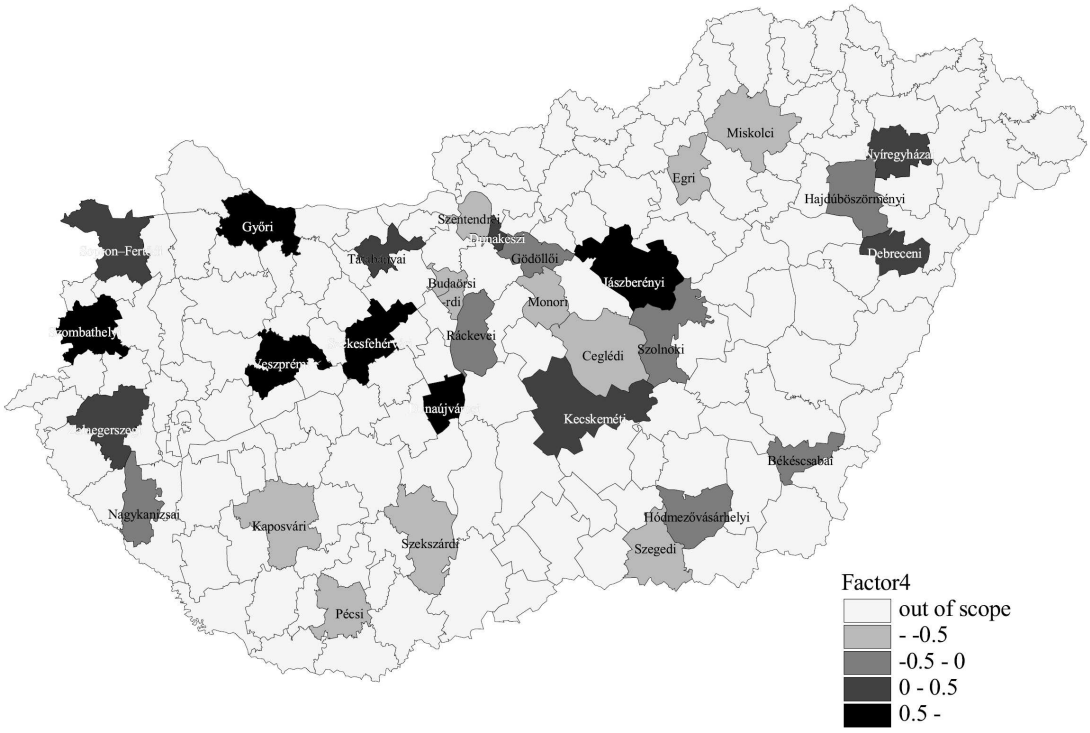
Figure 7. Research and technological development, and human capital



Factor1 contains research and technological development, human capital and social capital indicators (*Figure 7*). Microregions that are strong on this factor are usually in university towns, distributed quite evenly around the country; sometimes even being the centers of less developed regions. Compared to previous results it is salient that highly competitive microregions of Transdanubia show weak competitiveness on human capital and RTD values.

Factor4 is linked to the pyramidal model's regional specialization and clusters element. This indicates the spatial distribution of Hungarian manufacturing industries (*Figure 8*). It is interesting to see that manufacturing industries with export capabilities are located in Northern Transdanubia and beyond the daily commute zone of Budapest's agglomeration.

Figure 8. Territorial distribution of the regional specialization and clusters factor



The RCF was tested for 31 Hungarian microregions based on the pyramidal model. I think that both analyses rendered useful results for regional policy-makers and for fine-tuning the model itself.

5. Summary

The aim of this study was to apply the pyramidal model of regional competitiveness and perform a study of LAU1 microregions with potential localization agglomeration economies. The pyramidal model rests of endogenous growth factors, and it reflects on competitiveness advantages and disadvantages besides measuring competitiveness itself. Influencing factors of competitiveness have been modeled by the Regional Competiveness Function, created by multivariate linear regression models.

Hungary has shown a slow economic growth for about a decade and employment figures have also been falling behind the EU-average. These factors together demonstrate that the Hungarian economy's lacking competitiveness. Data shows that the area around Budapest is still growing dynamically, well exceeding the EU-average, while other parts of the country are able to stagnate at best. Regional differences in the country are enormous, among the major ones in the EU. Our research was based on the question why these provincial regions are unable to gain more competitiveness.

The aim of our empirical study was to analyze those provincial LAU1 microregions, which have an urban population of at least 50 000. The Regional Competitiveness Function was estimated in two ways, because in our opinion, both methods are useful and are able to amend each other in regional competitiveness studies. In the future, however, it will be more beneficial to examine nodal regions, which are a much better representation of business and institutional relationships.

Our empirical results show a good representation of Hungarian region types in their specific developmental phases:

- *Budapest and microregions around it*: this region, housing about 3 million inhabitants, is developing quickly, offering wide-ranging urbanization advantages.
- *Manufacturing microregions*: significant FDI and export, high employment, weak RTD and human capital. These regions are located at the northwestern border and are well integrated into the EU economy, however, their labor productivity is low and foreign-owned companies do not have a wide supply base in the region. These are remote controlled regions unable to vitalize their own economies, because their human capital and innovation capacity required for higher value-added products and services and innovation is quite weak.
- *University towns*: excellent human capital and state-financed RTD, but a low level of export capabilities in the business sector, low levels of productive capital, labor

productivity and employment. These microregions are distributed around the country. They are unable to vitalize the economy of their broader region because there are no significant enterprises in the region.

- *Remaining urban microregions*: weak human capital, low levels of export capability, usually encircled by rural settlements.

The weak performance is the Hungarian economy is partially an outcome of inadequate regional policy. There is an enormous need for decentralized territorial development in order to strengthen the competitiveness of provincial urban regions, which should also enable them to execute bottom-up development strategies more strongly adhering to the unique characteristics of each microregion.

There is still a long way to go towards the establishment of a Regional Competitiveness Function. The road is full of conceptual and methodological barriers. However, there is an explicit need for a better understanding of regional development in less prospective European countries. We believe that the synthesis of endogenous growth theories and regional competitiveness studies would benefit a more refine framework for empirical analyses to do this and the potential outcome for it is a better policy framework. Therefore, we aim to establish a research program and extend our interest to other transition economies and intend to test RCF in more developed countries as well. The extension of analysis over time will be a later step in the establishment of RCF.

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Appendix 1

Variables of the competitiveness study

Revealed competitiveness

Incomes (well-being):

PIT-INH Taxable income per capita, HUF, 2007

Labor productivity:

GVA-EMPL Gross value added per employee, thousand HUF, 2007

Employment:

EMPL-RATE Employment rate, %, 2008

Competitiveness factors

Research and technological development:

R&D-INH R&D expenditures per 1000 inhabitants, thousand HUF, 2008

PATENT Number of patents between 2006 and 2009 per 10000 inhabitants

PATENT-OUT Intensity of outbound relations (what percentage of co-invention relationships are held by the region), between 2006 and 2009

KIBS Number of registered high-tech enterprises per 1000 inhabitants, 2008

KIMS Number of knowledge-intensive and financial service providers, KIMS + KIFS per 1000 inhabitants, 2008

Human capital:

MIGR Net migration rate as an average of the years between 2000 and 2008 per 1000 inhabitants

YOUNG-INH Percentage of population below 18 years of age in the entire permanent resident population, 2008

BIRTH-MORT Birth rate/mortality rate, 2008

VITALITY Vitality index, 2008

DIPL-EMPL Rate of employees with tertiary education in the entire workforce, 2008

MANAG-EMPL Rate of managerial and intellectual employees in the entire workforce, 2008

SEC-EMPL Rate of employees above 18 years of age, holding a secondary education diploma in the entire workforce of this age category, 2008

SELF-EMPL Self-employment rate in the entire workforce, 2008

SCHOOL Rate of population between 18 and 24 years of age, holding only primary education certificates, 2001

Productive capital and FDI:

CONS-INH Total assets of enterprises in the microregion per 1000 inhabitants, 2007

SHARE-INH Paid-in capital of enterprises in the microregion per 1000 inhabitants, 2007

FDI-INH Equity held by foreign enterprises, per inhabitant, 2007

FDI-CAP Foreign equity in foreign-owned enterprises, per inhabitant, 2007

FDI-EMPL Statistical workforce of foreign-owned enterprises, per 1000 inhabitants, 2007

FDI-REV Net revenue of foreign-owned enterprises, per inhabitant, 2007

Traded sectors, entrepreneurship and clusters:

CLUSTER-PROP Rate of workforce employed by clusters of at least 500 employees in comparison to the microregion's entire workforce, 2005

EXP-GVA Rate of exports in comparison to gross value added, 2007

EXP-INH Net export income per inhabitant, 2007

SME-INH Number of registered small enterprises (1 to 49 employees) per 1000 inhabitants, 2008

ENTRE Number of newly registered enterprises/number of dissolved enterprises, 2008

SERVICES Rate of service industry workforce in comparison to the entire workforce, 2008

Social capital and institutions:

UNEMPL-RATE Rate of unemployment, 2008

NONGOV Number of registered non-profit organizations per 1000 inhabitants, 2008

CRIME Number of revealed felonies per 1000 inhabitants in regards of the perpetration's location, 2008

DIPL-LOCAL Number of locally employed workforce holding tertiary education per 1000 inhabitants, 2001

DIS-PENS Number of disability pensioners in the entire workforce below the official retirement age, 2008

CULT Number of cultural institutions per 1000 inhabitants, 2008

POOR Poverty rate (where the annual family income is below 600 thousand HUF), 2007

PAYER-PIT Number of personal income taxpayers per 1000 inhabitants, 2007

Appendix 2

Principal component of revealed competitiveness

Communalities

	Initial	Extraction
EMPL-RATE	1,000	,485
GVA-EMPL	1,000	,500
PIT-INH	1,000	,835

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,820	60,676	60,676	1,820	60,676	60,676
2	,875	29,166	89,842			
3	,305	10,158	100,000			

Component Matrixa

	Component
	1
EMPL-RATE	,697
GAV-EMPL	,707
PIT-INH	,914

Appendix 3

Factor analysis of competitiveness factors/subfactors

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
RTD	3,403	68,057	68,057	3,403	68,057	68,057
HUM_CAP1	3,309	36,766	36,766	3,309	36,766	36,766
HUM_CAP2	3,028	33,646	70,412	3,028	33,646	70,412
CAP_FDI	5,121	85,346	85,346	5,121	85,346	85,346
TS_CLUST1	2,356	39,273	39,273	2,356	39,273	39,273
TS_CLUST2	2,167	36,117	75,390	2,167	36,117	75,390
SOC_CAP1	2,530	31,623	31,623	2,530	31,623	31,623
SOC_CAP2	2,400	29,996	61,619	2,400	29,996	61,619

Regression with two factors

Variables Entered/Removedb

Model	Variables Entered	Variables Removed	Method
1	CAP_FDI SOC_CAP2a	.	Enter

Model Summaryb

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,923	,852	,841	,39832670	2,419

ANOVAb

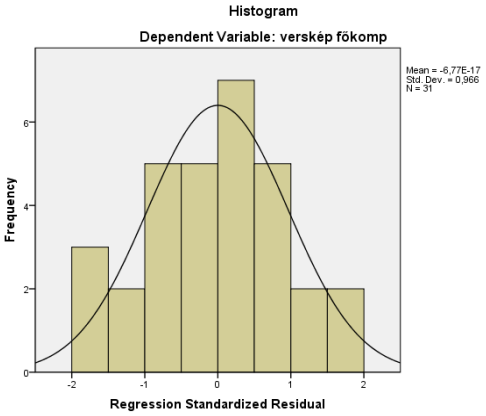
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	25,557	2	12,779	80,539	,000
	Residual	4,443	28	,159		
	Total	30,000	30			

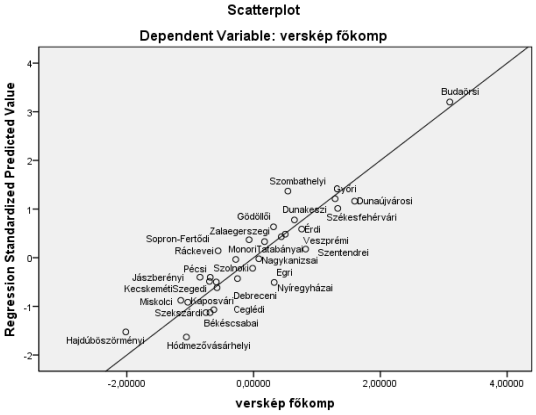
Coefficientsa

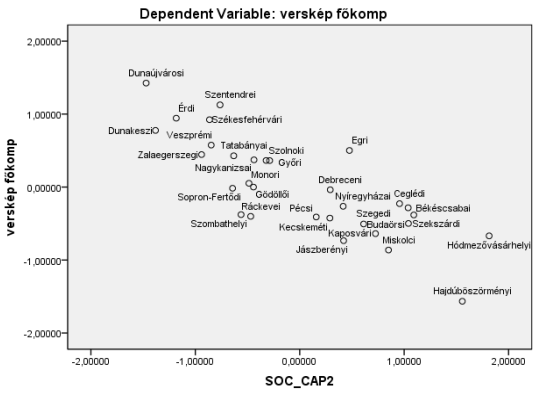
Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	,000	,072		,000	1,000		
	SOC_CAP2	-,615	,083	-,615	-7,391	,000	,765	1,308
	CAPITAL	,452	,083	,452	5,437	,000	,765	1,308

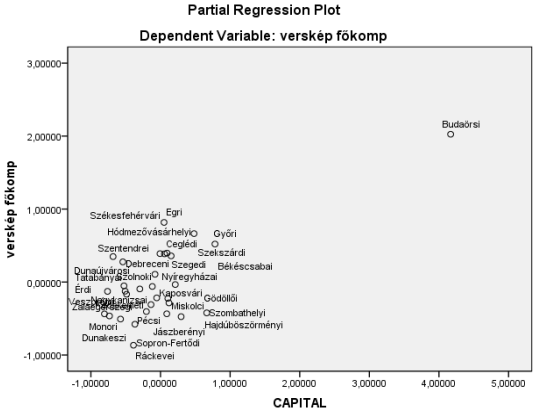
Collinearity Diagnosticsa

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	SOC_CAP2	CAP_FDI
1	1	1,485	1,000	,00	,26	,26
	2	1,000	1,219	1,00	,00	,00
	3	,515	1,698	,00	,74	,74


Histogram
Dependent Variable: verskép fökomp
Mean = -6,77E-17
Std. Dev. = 0,966
N = 31
Frequency
Regression Standardized Residual


Scatterplot
Dependent Variable: verskép fökomp
Regression Standardized Predicted Value
verskép fökomp


Partial Regression Plot
Dependent Variable: verskép fökomp
verskép fökomp
SOC_CAP2


Partial Regression Plot
Dependent Variable: verskép fökomp
verskép fökomp
CAPITAL

Appendix 4.

Factor analysis of indicators of competitiveness factors

		RC	Rotated Factor1	Rotated Factor2	Rotated Factor3	Rotated Factor4	Rotated Factor5
RC	Pearson Correlation	1	,213	,665	,421	,301	,236
	Sig. (2-tailed)		,250	,000	,018	,100	,201
	N	31	31	31	31	31	31

Model Summaryb

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,901	,811	,774	,47563074	2,194

ANOVAb

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24,344	5	4,869	21,522	,000
	Residual	5,656	25	,226		
	Total	30,000	30			

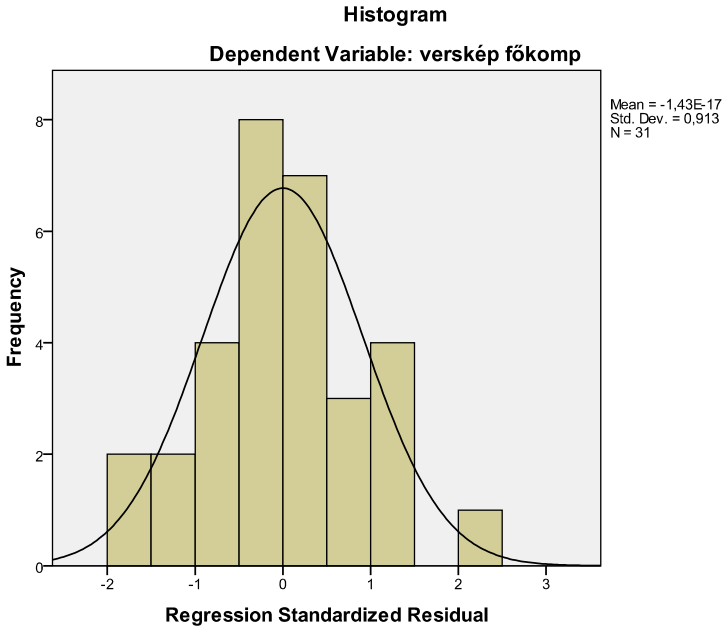
Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Rotated Factor1	,213	,087	,213	2,454	,021
	Rotated Factor2	,665	,087	,665	7,663	,000
	Rotated Factor3	,421	,087	,421	4,843	,000
	Rotated Factor4	,301	,087	,301	3,467	,002
	Rotated Factor5	,236	,087	,236	2,719	,012

Correlations

		RC	Rotated Factor1	Rotated Factor2	Rotated Factor3	Rotated Factor4	Rotated Factor5	Unstandardized Predicted Value	absres5
absres5	Pearson Correlation	,027	-,119	-,054	-,011	-,043	,212	-,032	1
	Sig. (2-tailed)	,887	,522	,772	,951	,820	,252	,863	
	N	31	31	31	31	31	31	31	31

Histogram of RC (Revealed Principal Component)



Scatterplot: RC dependent variable