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Measuring Innovation Performance and Competitiveness in the Hungarian Micro-regions

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Measuring Innovation Performance and Competitiveness in the Hungarian Micro-regions

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ABSTRACT

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.

The present paper aims to develop an indicator system and a complex method to measure the connection between the innovation performance and competitiveness of local units. We try to demonstrate the determining role of the innovation performance on the regional disparities measured by the competitiveness on sub-regional level with the help of multi-variable data analyzing methods based on a determined system of viewpoints, a correctly chosen theoretical models and statistical data. In the course of our work, using cluster analysis, MDS, factor analysis etc. the 174 Hungarian sub-regions will be classified according to their development phases.

Keywords: innovation performance, regional competitiveness, indicator system, multivariate analysis

1 Introduction

Today the permanent competitive advantage in developed regions derives from creativity, and the introduction of new products, services and processes which have not been replicated by the fellow competitors. We can observe that services having high added value and the intangible assets are gaining ground, which also may cover the high labour costs. For these products the quality, creativity and specialization of workforce on a given field become essentially important thus the quality of production factors are also greatly emphasized instead of their quantity. Based on Bajmócy's (2008) definition these knowledge-based economies are characterized by the growing dependence on information and knowledge as well as the variety of technological change and innovations, which lead to the increase in productivity.

The effective and fast learning becomes very important for enterprises and micro-regions in order to steadily keep their advantage. "The rapid introduction of innovations and new technology **means competitive advantage.**" (Lengyel 2000, p. 980.). The presence of innovations crucially determines the competitiveness of the regions.

The process never sets short-term partial objectives but a social political aim, that is, the increase of local inhabitants' welfare. This – a little high – aim can be achieved by improving competitiveness, which is equivalent to the improvement of productivity according to Porter. However the rate of growth of productivity is primarily dependent on the **innovations**, that is, on new products, but mainly new technologies which enables the enterprise to obtain and strengthen permanent competitive advantages.

2 Theoretical background of the analysis

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 local units. 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 (EC 2004, 2006a, 2006b).

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 (Parkinson et al 2004, 2005, 2006). Sub-regions as administrative-statistical spatial units mostly correspond to the category of local unit as an economic criterion; however, the boundaries of these obviously somewhat differ from the actual economic catchment areas.

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. 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 paper –, 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.

There are several, well known definitions of regional competitiveness, which interpret the approach of competitiveness on territorial units variously. Perhaps, the approach of regional competitiveness, published in the Sixth Periodic Report of the EU is based on the widest consensus: *“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”* (EC 1999. p. 75.). In our research we depend on this standard definition of competitiveness, which is increasingly used in the regional policy of the European Union (Lengyel-Rechnitzer 2000, EC 2004).

3 The theoretical relations between competitiveness and innovation

The above presented standard competitiveness concept have already included the effect of innovation and research development on competitiveness between the lines. Based on Lengyel's (2003) deduction if the wages do not decrease and also not low in an economy, in addition the products are competitive, that is, they are not more expensive than other products and also marketable, this all can be implemented provided there is a constant innovation and technology change in the economy. Thus the productivity is increased by the innovations. Its essential condition is the research development activity and the flow of knowledge.

In terms of our research Porter and Stern's research in 2001 has major importance. The authors undertake to quantify the relationship of innovation and competitiveness with the help of multiple-variable data analysis methods. It is methodologically carried out by that on the basis of the research four subindexes an Innovation Capacity Index is calculated, which is compared by country – obviously by Porter's influence – to the competitiveness index of WEF. From this regression and correlation relationship is quantified.

In terms of our research the most significant part of Porter and Stern's work is that they examined the relationship between the Innovation Capacity Index (ICI), the Competitiveness Index (CI) and the GDP per person. The Competitiveness Index is used in the 2001 analysis of the World Economic Forum. It is not surprising that a strong correlation was shown between the innovation capacity and the competitiveness. They emphasize that utilizing and developing the innovation capacity, to achieve the high level of productivity it is necessary for a given country to have growing and sustainable competitiveness.

The fact that the significant proportion of the countries are placed along the regression line between the two indexes (ICI and CI) indicates that the more innovative the country, the more competitive it is (Figure 1). (In addition, the R^2 index reveals a quite strong relationship: $R^2=0,9028$).

Based on these studies we can state that the innovation becomes an important source of the competitive advantage of the countries but in the case of many countries the many good innovation capacities are in vain if they cannot utilize and turn them into economic value, from which they could increase their income. Here within the frame of the Innovation Capacity Index the bases of innovation are comprehensively examined and they also took the factors into consideration that are needed for the good business utilization of innovation for the enterprises. The development of the innovation capacity has positive relation with the competitiveness and the prosperity of the country. The developed countries have an important role in creating innovations and it is necessary for gaining their competitive advantage, while the innovation strategy of undeveloped countries will be important to connect them to the global knowledge base and take over the developed new solutions (Porter-Stern 2001).

Lederman and Maloney (2003) examined that how it is possible to qualify the effect of R&D costs on GDP growth. In their research they conducted regression calculations based on the base data of 53 countries. To conduct the regression calculations in order to smooth out the occasional outliers of certain years they used five year averages, namely the period between 1975 and 2000. The main finding of the research is quantifying the relationship according to which increasing the GDP proportional R&D expenditure with 1% causes a 0.78 % point increase in the rate of growth of the GDP. Their result is particularly important in terms of our research since it shows that one of the priority indicators of innovation potential, the GDP proportional R&D expenditure can be quantified with and has close relationship with one of the priority indicators of competitiveness, the GDP.

4 The role of innovation in the set of indicators of the most significant competitiveness reports

The objective of the next stage of our research was to review the set of indicators and methodology of competitiveness reports and researches from two aspects: on the one hand, we examined the role and extent of innovation in competitiveness researches (whether its temporal change possibly carries significant information), and the extent of benchmarking reasonably allowed when we intend to conduct an indicator-based analysis on the micro-regions in the Southern Great Plain region. In the study **the set of indicators of 17 international competitiveness reports and competitiveness researches was reviewed** (ACRC (2008), BERR (2008), BERR (2009a), BERR (2009b), BHI (2008), Couto et al (2004), Forfás (2009), IMD (2009), Huggins, R. – Davies, W. (2006), InnoMetrics (2008), Kronthaler, F. (2003), Piech, K. (2008), PSRC (2008), RDC (2003), Snieska, V. – Bruneckiene, J. (2009), WEF (2009), World Bank (2008))

It was found that in all the examined reports dealing with competitiveness the innovation was present. Although the concepts used to define competitiveness are not identical, the role of the growth of productivity is emphasized throughout and the associated innovation also has a great role. At the same time, its weight in competitiveness is different in each analysis.

It can be concluded that various competitiveness analyses have been created in the international literature on national and regional level. The majority of these work with quite a **sophisticated methodology, consistent and established use of concepts and a set of indicators having been refined** for a number of years, the majority of which may also be adapted to national, innovation-centred competitiveness analyses conducted on local regions. In many cases the adaptation is made more difficult by that certain indicators of the competitiveness analyses conducted on the level countries and regions are not available or not interpreted on micro-region level.

The reviewed competitiveness analyses worked with not only different region concept but also with **different competitiveness concept**. Of the reviewed competitiveness studies the IMD, the WEF, the Forfás, the DTI and the BHI give an **own competitiveness definition**, on which they **consistently build** competitiveness analysis, while the examinations of the European Union – also under consistent use of concepts – draw on the standard competitiveness definition as appropriate.

It is instructive that in addition to exactly defining the definition and using the concepts consistently, the WEF and the Forfás also apply a **model** forming the base of the indicator definition and **matching the uttered definition of competitiveness** (diamond-model, Forfás-pyramid) in the course of analysis, which significantly facilitates the clarity of the logical structure of the analysis, therefore its expected acceptability. Consequently, in our view in building the model to be worked out for the purpose of the complex analysis of competitiveness it is appropriate to take this logical structure into account.

After reviewing the set of indicators of the examined analyses we can also conclude that the majority of the applied scorecards use **indexes with both ex post and ex ante character**. The studied analyses work with quite **heterogeneous set of indicators**, which are often based on different logic. However, the appreciation of the role of the **soft data** in the certain set of indicators is definitely remarkable. The greater proportion of the examined analyses in terms of their methodology rather undertook **comparing** and evaluating with the use of **simple statistical methods**, but in the most recent analyses the multi-variable analyses and the pursuit of index formation dominate.

In connection with the reports that are published annually (or at certain intervals) updated we had the opportunity to observe temporal tendencies as well. It outlines the

European Union's intention of increasingly placing the basis of competitiveness on innovation. It can be observed on the change of the set of indicators, which can be clearly detected on the increase of the weight of factor groups and indexes related to the innovation.

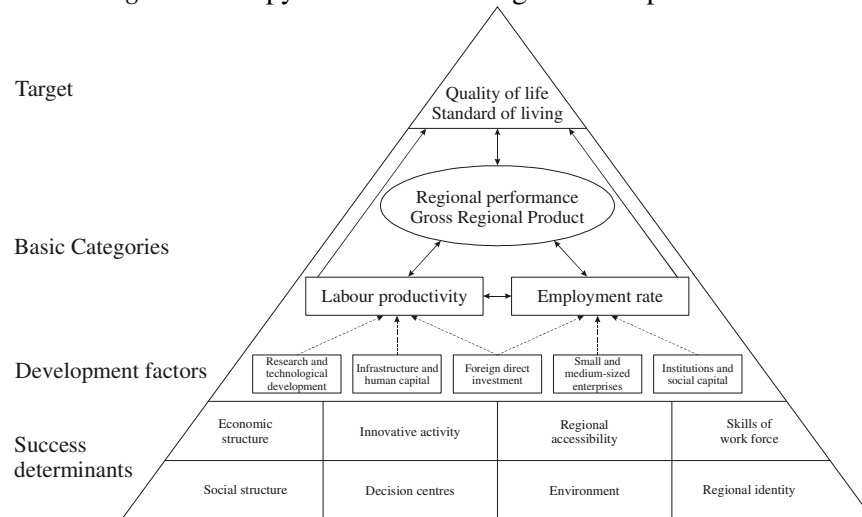
Reviewing the set of indicators it can be found that despite the above mentioned heterogeneity certain lines can be formulated:

1. One of these lines is indicated by undeniably the frequency of occurrence of certain indicators. The number of specific patents can be considered as a dominant index, which appears in 13 of the 17 reviewed set of indicators.
2. The rate of the entire R&D expenditure calculated in GDP % can also be regarded as a highlighted index, however, the demand on breaking the total R&D expenditure down to the R&D expenditures of government, business and higher education sector appears in more and more places.
3. The increase in the weight of output indicators compared to the input indicators also can be interpreted as a tendency. Due to the characteristic of innovation activity there is not under any circumstances a deterministic relationship between the input data and the output data (perhaps not even stochastic), thus the producers of the set of indicators increasingly try to move towards the output indexes, but this data is quite difficult to be produced.
4. The requirement according to which the innovation results should also be utilized in industry appears in more and more competitiveness reports. The indexes which try to quantify the university-industry cooperation have been involved in the set of indicators as a consequence of this.
5. A certain sectoral delimitation appears as a novelty is the most recent competitiveness reports: the high-tech and/or ICT sector is separated in a number of places.

5 Measuring competitiveness based on the Pyramid model

In the course of reviewing competitiveness studies, the clarity, simple structure and refinement of analyses based on certain models became apparent. To carry out an analysis of competitiveness, there are more and more clear-out models, which can serve as the basis of an empirical research. The above mentioned standard definition and the resulting economic indicators enable us to measure competitiveness fairly precisely. 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 (Worldbank 2000), 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 local units, as well. The **pyramidal model of regional competitiveness** seeks to provide a systematic account to describe the basic aspects of improved competitiveness (Lengyel 2003). The development (programming) factors and success determinants placed in the model reinforce prejudice significantly regional disparities (EC 1999). Because of the logical framework (figure 1), and transparency of the pyramidal model based on wide professional consensus, it is serving as the basis of our empirical research. The model is internationally highly respected, it is more and more used as a theoretical basis of several competitiveness reports, spatial documents, decision preparation papers etc (Gardiner – Martin – Tyler 2004, Garlick 2003, GHK 2005). The pyramidal model, with its original logic and figure has been utilized in a governmental document of the United Kingdom (Pike et al 2006), however, the basic model – published in 2000 – has been rethought and developed by several authors during their research (Parkinson et al 2006).

Figure 1 The pyramid model of regional competitiveness



Source: Lengyel (2004).

5.1 Data

We develop the data which forms the basis for the analysis based on the **standard definition of competitiveness and the pyramid model** evolving it. It is important that the final database – which serves the basis for the multi-variable data analysing methods – develops **as a result of a multi-step process** (Lukovics 2008). The methodology of the competitiveness analysis corresponds with the author’s methodology applied to 168 micro-regions, published in 2008 (Lukovics 2008), and we attempt to test, update, actualise and apply it to 174 micro-regions in our present analysis.

In the first step, the **basic data** which may come into consideration in the case of competitiveness analysis on micro-regional level is defined. This data can be defined based on the more profound consideration of the concept of competitiveness and economic considerations, taking the most important observations of the reviewed international and national analyses into account. Featuring this numerous data as actual basic data is restricted by that certain data on micro-regional level is not available at all, thus the **actual basic data** is presented by the basic data that is accessible and available on small regional level.

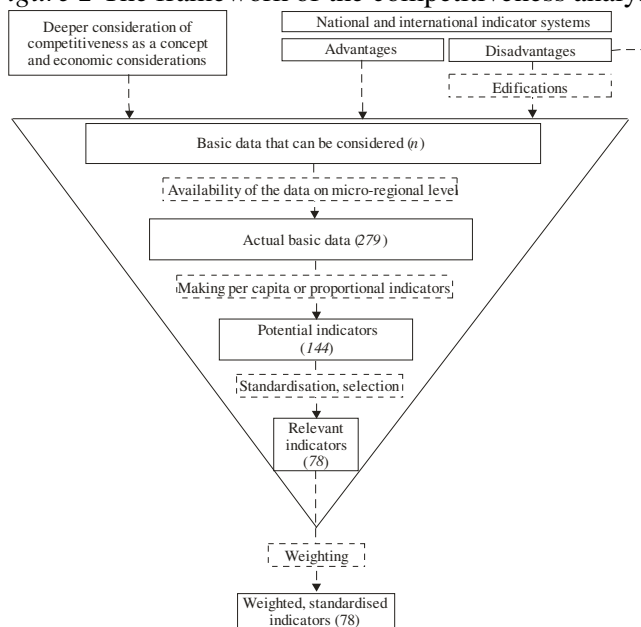
This basic data may be regarded as raw data, from which we can form **potential indicators** with simple mathematical operations. We can get to the **actual, relevant indicators** that finally serve the basis for the analysis by selecting the potential indicators by means of principal component analysis. The data base is finalised after standardising then weighting the relevant indicators (Figure 2).

It must be noted that in the course of selecting the indicators we considered the most important lessons from the set of indicators of international competitiveness studies reviewed in the preceding phases of the research. **We tried to retain the advantageous properties** of the examined analyses, and we studied the properties we regarded as disadvantageous according to whether the deficiencies can be eliminated in the own model to be created. If the answer to this question was positive, we also took the relevant disadvantageous property into consideration in the model, otherwise we rejected it. We intended to feature the indexes that are the most accepted and applied in professional practice – then to test their relevance – in the model. Obviously, the intentions in connection with this were in some measure restricted by the availability of data on small regional level; since the statistical quantifiability of the factors determining the regional differences is rather diverse (Pukli 2006).

The set of indicators consists of data **only from hard, secondary source** – not checked by the analyst separately – despite the fact that we recognise the **importance** and significant information content **of the soft data** used in the international competitiveness studies. We did not have the opportunity in the present research to collect data through questionnaire and interviews in each micro-region, however, the subjective data may undoubtedly play an important role in improving the present methodology.

We used SPSS version 18.0 to carry out all the analyses described in the followings.

Figure 2 The framework of the competitiveness analysis



Source: own construction

5.2 Selection and weighting of variables

The essence and novelty of the methodology is the selection and weighting of indicators (Lukovics 2008). With the help of **principal component analysis** (more exactly, based on the values of the loading variables) we selected those standardised variables as basic category, development factor then success determinant which did not suit appropriately the principal component characterising the certain basic category, development factor and success determinant. The **principal components** characterising the certain basic category, development factor and success determinant **retained the information content of the explanatory variables forming the principal components in 80-81 per cent on average**. Based on this we can draw the conclusion that after selecting the variables the **78 actual standardised variables forming the model can be indeed considered as relevant in terms of our examination**, thus it can serve the basis of the analysis.

Based on the results of the completed principal component analysis, the following indexes remained in our model, taking the selection criteria detailed above into account:

I. Basic categories

Income	1.	Taxable income per taxpayer, HUF, 2007
	2.	Income forming the personal income tax base per inhabitant, HUF, 2007
	3.	Income from employment per taxpayer, HUF, 2007
	4.	Income from corporate enterprises per taxpayer, HUF, 2007
	5.	Gross added value per inhabitant, thousand HUF, 2007
Labour productivity	6.	Profit or loss before taxation per employee thousand HUF, 2007
	7.	Gross added value per employee, thousand HUF, 2007
	8.	Personal income tax base per taxpayer, thousand HUF, 2008
Employment	9.	Employment rate, %, 2008
	10.	Unemployment rate, %, 2008
	11.	Personal income tax payers per 1000 inhabitants, person, 2007
Global integration	12.	Net turnover of export marketing per inhabitant, thousand HUF, 2007
	13.	Rate of export from net turnover of marketing, %
	14.	Number of foreign overnight stays per 1000 inhabitants in public accommodation establishments, overnight stay, 2008
	15.	Number of domestic overnight stays per 1000 inhabitants in public accommodation establishments, overnight stay, 2008

II. Development factors

R&D	16.	Number of research places per 100000 inhabitants, 2008
	17.	Actual number of scientific researchers in R&D places per 1000 inhabitants, 2008
	18.	R&D expenditures per 1000 inhabitants thousand HUF, 2008
	19.	R&D expenses per 1000 inhabitants thousand HUF, 2008
	20.	R&D investments per 1000 inhabitants thousand HUF, 2008
	21.	Patents 2006-2009 per 10000 inhabitants
	22.	Number of public body members of the HAS (Hungarian Academy of Sciences) per 10000 inhabitants, 2007
SME	23.	Number of operating corporate enterprises per 1000 inhabitants, 2008
	24.	Number of registered small corporate enterprises (1-49 employees) per 1000 inhabitants, 2008
	25.	Number of registered enterprises with legal entity per 1000 inhabitants, 2008
	26.	Rate of registered enterprises with legal entity from registered economic organizations, 2008
	27.	Number of registered organizations/number of ceased organizations, 2008
	28.	Amount of equity capital of the small region enterprises per 1000 inhabitants, 2008
	29.	Balance sheet total of the small region enterprises per 1000 inhabitants, 2007
	30.	Amount of subscribed capital of the small region enterprises per 1000 inhabitants, 2007
	31.	Value of the statistical number of enterprises with foreign interest per 1000 inhabitants, 2007
Enterprises with foreign interest	32.	Value of equity capital of enterprises with foreign interest per 1 inhabitant, 2007
	33.	Amount of foreign capital per 1 inhabitant in enterprises with foreign interest, 2007
	34.	Value of net sales revenue of enterprises with foreign interest per 1 inhabitant, 2007
Infrastructure and human capital	35.	Rate of employees having qualifications in higher education within the total number of employees, 2001
	36.	Rate of employees with managerial and intellectual occupations within the total number of employees, 2001
	37.	Rate of people above 25 having college or university degree in the per cent of the equivalent age group, 2001
	38.	Rate of people above 18 having secondary qualifications in the per cent of the equivalent age group, 2001
	39.	Number of telephone mainlines per 1000 inhabitants, 2008
	40.	Number of Internet subscriptions per 1000 inhabitants
	41.	Number of ISDN lines per 1000 inhabitants, 2008
	42.	Total floor-space of flats built during the year per 1000 inhabitants, 2008
Institution and social capital	43.	Rate of disabled pensioners under age limit compared to the 40-59 age group, 2008
	44.	The 2000-2008 year average of domestic migration difference per 1000 inhabitants
	45.	Number of people receiving pension or pension-like benefit per 1000 inhabitants, 2008
	46.	Number of registered nonprofit organizations per 1000 inhabitants, 2008
	47.	Number of full-time students taking part in bachelor's and master's training per 1000 inhabitants, 2008

III. Success determinants

Economic structure	48.	Rate of registered corporate enterprises in property issues, economic service national economic sector (K economic sector, at the end of the year) within the total number of registered corporate enterprises, 2008
	49.	Rate of employees in agriculture, game management, forest management and fishery national economic sector within the total number of employees, 2001
	50.	Rate of employees in service sectors within the total number of employees, 2001
	51.	Rate of intellectual workers compared to the total number of employees, 2001
Innovation culture and capacity	52.	Number of registered readers of workplace, higher education and other libraries per 1000 inhabitants, 2008
	53.	Number of teachers working in higher education per 1000 inhabitants (according to the seat of the institution), 2008
	54.	Number of teachers working in higher education per 1000 inhabitants (according to the affiliated departments), 2008
Accessibility	55.	Daily access, 2007, minute
	56.	In case of optimisation according to time, the length of the fastest way to the small region center in minute 2008
	57.	In case of optimisation according to time, the length of the fastest way to the county seat in minute 2008
	58.	In case of optimisation according to time, the length of the fastest way to the region center in minute 2008
	59.	In case of optimisation according to time, the length of the fastest way to Budapest in minute 2008
Skills of workforce	60.	Inhabitants working locally with at least secondary final exam per 1000 inhabitants, 2001
	61.	Number of people having college or university degree, employed locally per 1000 inhabitants, 2001
Social structure	62.	Rate of population aged 60 and older from the permanent population, 2008
	63.	Rate of population aged 0-18 from the permanent population, 2008
	64.	Number of live births/deaths, 2008
	65.	Vitality index, 2008
	66.	Rate of inhabitants living in settlements with population density over 120, 2008
Decision centres	67.	Rate of inhabitants in the region center from the population of the small region, 2008
	68.	Share of the small region in the national number of operating enterprises with legal entity employing 250 and more persons, 2008
Quality of environment	69.	Share of the small region in the national number of registered corporate enterprises employing 50-249, 2008
	70.	Number of prosecution crimes become known per 1000 inhabitants according to the place of commission, 2008
	71.	Number of economic crimes become known per 1000 inhabitants according to the place of commission, 2008
	72.	Number of room allowed in old people's daytime institutes per 1000 inhabitants aged above 60, 2008
Social cohesion of the region	73.	Number of flats connected to public drainage system per 1000 inhabitants, 2008
	74.	Number of migrations per 1000 inhabitants, 2008
	75.	Number of immigrations per 1000 inhabitants, 2008
	76.	Rate of employees working locally compared to employees going to other counties, 2001
	77.	Rate of leading intellectual employees working locally compared to leading intellectual employees going to other settlements, 2001
	78.	Rate of employees commuting to work daily in the population going to other counties every day, 2001

In accordance with the method of selecting the variables, we used the **principal component analysis to determine the weights**. Determining the weights is based on the following line of thought. If we replace our standardised variables with principal components in the course of an analysis, the principal components give the lower dimensional description and representation of the examined situation. The principal component analysis calculates the value of communalities to each variable as well. Since the communalities are in fact multiple determination coefficients – in a linear regression model where the principal components are the explanatory variables, while the original variables are the result variables –, therefore their roots give the multiple correlation coefficients. The multiple correlation coefficient in general expresses how strong the relationship is between the actual and estimated value of the result variable, that is, how much the result variable and the total of the explanatory variables

change together. **Specifically the multiple correlation coefficients give the extent of how much the certain standardised variables change together with the total of the principal components** – representing the whole model – **that is, with the competitiveness itself, and thus the weight of the certain variables in the model!**

5.3 The complex analysis of the competitiveness of Hungarian micro-regions

In the following, we attempt to **create a picture** of competitiveness about the 174 Hungarian micro-regions **as complex as possible** based on the data determined by the 78 variables appropriately selected, objectively weighted in the model and based on the pyramid model evolving the standard definition of competitiveness. For the complex analysis of the competitiveness of micro-regions, we use basically two kinds of multi-variable data analysing techniques with significantly different logic, the **cluster analysis** and the **multidimensional scaling** so that the results from using one method become comparable with the results of the other method, thus become controllable.

Cluster analysis

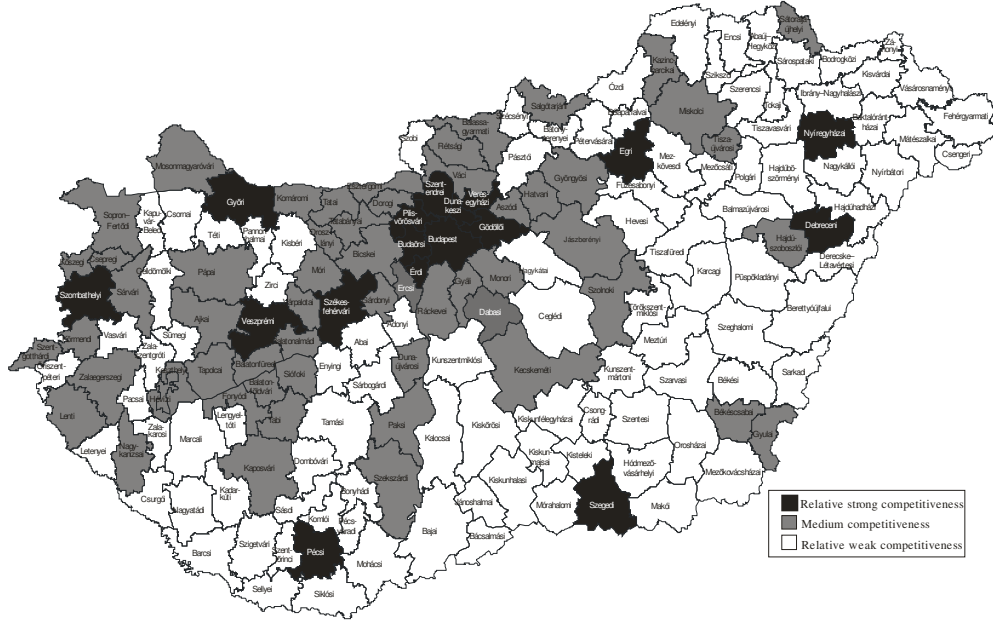
In the case of the three-cluster breakdown the value of the average Silhouette coefficient is 0,3, which indicates an acceptable classification. The output of SPSS also lists that how many objects the process ordered in the certain clusters. 19 objects were taken to cluster number 1, while 55 objects in number 2 and 100 objects in number 3. In the clustering process, all the 168 micro-region presented in the model were classified in exactly one cluster and none of the objects were left out. The classification can be said to be overlap-free and continuous.

The formed clusters can be interpreted with the help of their centers (Székelyi–Barna 2003). According to the chart of the SPSS *Final Cluster Centers*, for the 19 micro-regions belonging to cluster 1 we can find higher value in the case of most variables than the values measured in the other clusters. In the case of cluster 3, we find mainly low values for almost every variable, while cluster 2 gives the value between cluster 1 and 3 per variable in most cases. Based on all this and the theoretical background, the numbering of the clusters according to SPSS can be filled with content as follows:

- **Micro-region with relatively strong competitiveness:** cluster number 1
- **Micro-region with average competitiveness:** cluster number 2
- **Micro-region with relatively weak competitiveness:** cluster number 3

It can be said about **the spatial position of the three competitiveness types** that the micro-regions with relatively strong competitiveness are concentrated in Budapest and its agglomeration, furthermore the micro-regions of the pole towns (with the exception of Miskolc), in addition, the micro-regions of Nyíregyháza and Eger. A significant spatial concentration of micro-regions with average competitiveness developed around the agglomeration of the capital. Further explicit appearance of region type with average competitiveness can be observed in the **micro-regions of county seats and larger towns**. The spatial position of micro-regions with average competitiveness – seems to be – influenced by the trace of the **main transport routes** since a significant region concentration with average competitiveness can be observed along the motorways and the River Danube. According to the findings of our analysis **the proximity to the developed western centres** also positively influences the competitiveness of a certain micro-region: a certain kind of concentration of regions with average competitiveness can also be observed along the **western border**, on the other hand, there are micro-regions with mostly **relatively weak competitiveness on the areas along the eastern border** (Figure 3).

Figure 3 The position of the theoretical competitiveness types in Hungary, 2008



Source: own construction

One-dimensional scaling

The multidimensional scaling (*Multidimensional Scaling, MDS*) does not define clusters but **gives the geometric representation of the objects** (Füstös–Kovács 1989). We carry out the multidimensional scaling with the same **78 weighted standardised variables** as the cluster analysis. However, the two methods have quite different procedures: while the cluster analysis determines *clusters* from the above mentioned 78 variables **without reducing the number of dimensions**, the multidimensional scaling as a data reduction method reaches its output starting out from a distance matrix through **the significant reduction of the number of dimensions** (Lengyel 1999). The dimension reduction has to be implemented in a way that the order of the distance of the elements does not change. That is, if we indicate the true distance of the measured variables with δ_{ij} , and the distance arising in the case of reduced dimension number with d_{ij} , the following has to operate in every case (Székelyi–Barna 2003):

$$\text{if } \delta_{ij} < \delta_{lk}, d_{ij} \leq d_{lk} \quad i=1,2,\dots,l \quad j=1,2,\dots,k \quad (7)$$

Consequently, the S-stress value in the output of the SPSS is the first we have to examine (Ketskeméty – Izsó 2005). The S-stress shows how much the formed d_{ijs} meet the above criterion:

$$S - stress = \sqrt{\frac{\sum_{i=1}^n \sum_{j=1}^n (\delta_{ij} - d_{ij})^2}{\sum_{i=1}^n \sum_{j=1}^n \delta_{ij}^2}} \quad (8)$$

Obviously, it is optimal if its value according to S-stress (8) is as low as possible. As the value of the indicator is zero provided it is true for every couple that after the dimension reduction every element retained its rank position according to the original distances (Székelyi–Barna 2003, Kovács–Petres–Tóth 2006).

The technique of the one-dimensional scaling holds the possibility of developing a **complex competitiveness ranking** if this operation does not involve significant information loss due to excessive reduction of dimension number, and the developed dimension can be

called complex competitiveness indicator. It can be determined based on the indicators forming the basis of the MDS and the direction and strength of the correlation of the developed artificial dimension. After studying these coefficients we can establish that the developed artificial dimension can actually be considered a complex competitiveness indicator, based on which we can determine the competitiveness order of the micro-regions.

Provided we carry out the one-dimensional scaling on all the **78 variables** of the basic categories, development factors and success determinants **collectively**, we receive **the complex competitiveness ranking of the 174 Hungarian micro-regions based on the data of year 2008**. In the case of the complex competitiveness ranking given after conducting the examination the value of the S-Stress is 0,09, which can be qualified as **good**, thus **the model with reduced dimension number probably contains all the relevant information**.

In accordance with our expectations, Budapest leads the ranking, the micro-regions of Budaörs, Debrecen and Szeged come next, the one-dimensional scaling coordinate of which is approximately much lower than that of Budapest and Budaörs. However, these coordinates have to be carefully interpreted since the twice as high coordinate does not mean that the micro-region having twice as high coordinate has twice as high complex competitiveness. The created coordinates are **data that can be interpreted not on ration scale but on difference (interval) scale** according to the logic of MDS.

For this reason, we also assign its competitiveness ranking number to each micro-region. If the MDS coordinates of more micro-regions are identical, that is, they would have the same position in the ranking, we use the average of ranks, the so-called tied rank.

5.2 Extending typing by separation according to the urban-rural dimension

The approaches of international literature to region typing reveal that in studying the competitiveness of regions high attention has to be paid to the **“critical mass” in the region**, that is, the urban or rural character of the region. In accordance with this challenge, in the second step of our analysis we attempt to further refine the picture of the competitiveness of the regions created in the first step according to that the micro-regions listed in the given region type can mainly be considered urban or rural.

Since **the development needs** of these two basic types of micro-regions **are extremely different at all points**, I make an attempt to differentiate each of the three theoretical types of region along the urban-rural dimension.

However, it cannot be defined in an exact way **what can be considered as unambiguous demarcation criterion between the urban and rural regions**. Furthermore, it can be established that it is common to the approaches about the urban-rural delimitations that the urban regions are mainly **city regions**, where **significant concentration of population** can be seen (ESPON 2005). Taking this as a starting point, in the traditional approach the micro-region called urban may be expected that the number of population living there reaches a critical mass. This can be approached with three indicators based on international proposals:

1. **The number of population of the micro-region center at the end of the examined year**: based on the ESPON, the community strategic guidelines between

2007 and 2013¹ and the proposals of OMB (national basic wage), it should reach 50 000 person².

2. **The rate of inhabitants living in settlements with a population density over 120³** in the studied micro-region should be at least 75%⁴.
3. **The rate of inhabitants in the region center** in the population of the micro-region should not be lower than 75%.

If **at least one** of the above described criteria is fulfilled, we talk about an urban region in relation to the Hungarian micro-regions. We must not forget either about one today's dominant tendencies, **the challenges created by knowledge-based economy**. In a region, not only the concentration of population in the classic sense can mean the necessary critical mass for the urban regions, but the knowledge developed in the given micro-region. The first depositaries of creating new knowledge are the higher education institutions, the presence of which in a certain micro-region can be regarded as a kind of critical mass. This is in line with Malecki's idea that competitiveness is basically determined by the presence of the critical mass of certain institutions (Malecki 2002).

4. Based on all this, besides the fulfilment of one of the above defined three indicators, according to the tacit requirements set by the knowledge-based economy, we also consider those micro-regions urban in which **higher education institution is operated**.

It can be said about the spatial concentration of competitiveness and urbanisation level that **17 is urban and 2 (Dabas, Ercsi) is rural** out of the 19 **micro-regions with relatively strong competitiveness**. The capital is **surrounded** in a ring-like way by **urban and rural** micro-regions **with relatively strong competitiveness, and micro-regions with average competitiveness, the 90%-a of which is urban**. Besides the urban regions with average competitiveness are, on the one hand, the **micro-regions of the county seats** (with the exception of Salgótarján), and the **micro-regions of cities**. The micro-regions with average competitiveness (both urban and rural) are concentrated near to the **developed western centers** and the **motorways**. Furthermore it can be said that the regions with average competitiveness are mostly found in the north-western and middle part of the country, while the micro-regions with relatively weak competitiveness are in the northern and eastern border zone (Figure 4).

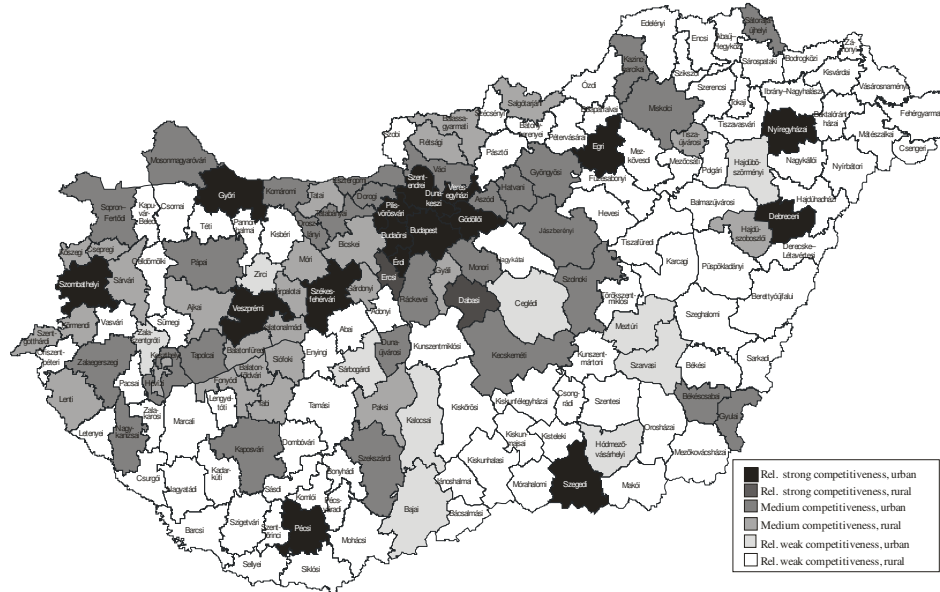
¹ According to the commission communication completed as the background material of CSG Europe is characterised by the multi-center structure of small, average and large towns (EC 2006b), but only the criterion of over 50 000 inhabitants was quantified (EC 2006a).

² We note that according to international standards a **critierion** of a considerably larger **number of inhabitants** is known for the urban regions. On *regional* level the OECD regards those regions as urban where the population of the region center exceeds 500 000 people, while the expected number of inhabitants is 200 000 people in the case of the intermediate type (OECD 2001). Florida (2004) considers the regions with a population of over 700 000 people as urban in his work, however, these values are not related small regional but to 'metropolitan' regions.

³ In the OECD proposal 150 persons per km² appears; the Hungarian statistical office regards 120 people as dividing value.

⁴ According to Csatári (1999) we should calculate with a threshold value of 50%, however, I intend to approach to the proposal of the OECD related to 150 persons per km² with the higher threshold value.

Figure 4 The position of the theoretical micro-region types in Hungary, 2008



Source: own construction

6 The analysis of the innovation performance

The next step of our efforts made to reveal the connections between the competitiveness and innovation performance of Hungarian micro-regions is applying the methodology used in the previous section to the same population. The only significant difference is that we do not analyse the innovation performance based on the 78 competitiveness indicators but we rely on a set of indicators which we develop specifically for measuring the innovation performance.

6.1 Data

We developed the data forming the basis for the analysis according to the procedure presented in the first section to methodologically create the base for comparing the results of the competitiveness analysis and the results of the innovation analysis. Consequently, in this case the final data base is formed **as a result of a multi-step process** as well and served as the input of multi-variable data analysing methods.

In the first step of developing the indicator set forming the basis for the analysis, the **basic data** which can come into consideration in the case of competitiveness analysis on small regional level is defined. This data was represented by the subset of indicator set of international competitiveness reports reviewed in the founding studies of the research which measured factors that can be related to innovation.

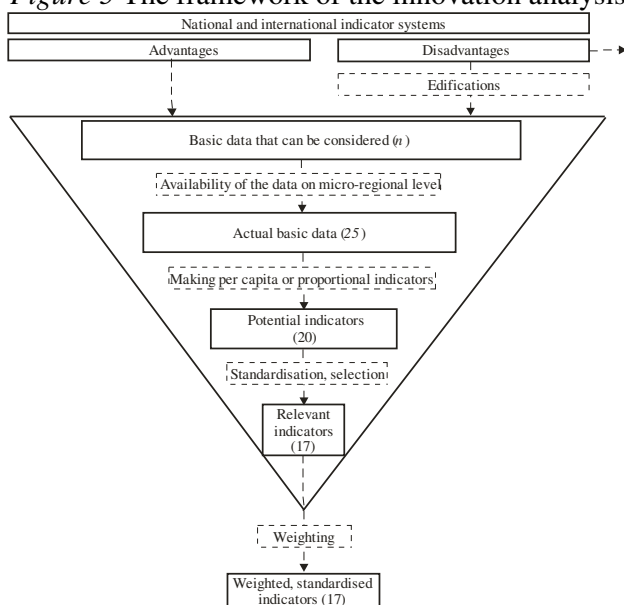
Featuring this numerous data as actual basic data is restricted by that certain data on small regional level is not available at all in Hungary, thus the **actual basic data** is presented by the basic data that is accessible and available on small regional level. We form **potential indicators** from this raw data with simple mathematical operations in an analogous way for the methodology of our competitiveness analysis (Figure 5).

We tried to retain the advantageous properties of the examined benchmark analyses and indicator sets, and we studied the properties we regarded as disadvantageous according to whether the deficiencies can be eliminated in the own model to be created. If the answer to this question was positive, we also took the relevant disadvantageous property into consideration in the model, otherwise we rejected it. We intended to feature the indexes used

in the benchmark indicator sets in the first place – then to test their relevance – in the model. Obviously, the intentions in connection with this were in some measure restricted by the availability of data on small regional level.

The majority of the hard statistical data forming the data base are bought data from the central data base of the KSH (Hungarian Central Statistical Office). In addition, the data base contains data of industrial property and the public body of HAS. The former data was collected from The Gazette of Patents and Trademarks and the latter from the homepage of the public body of HAS and it contains the latest statistical data available at the beginning of 2010.

Figure 5 The framework of the innovation analysis



Source: own construction

6.2 Selecting the variables of the model

In the selection we followed the same method as in the case of the competitiveness analysis for methodological compatibility. **We examined the information content** of the 20 potential indicators involved in the model in the first place to be able to decide how much the given index fits the description of the given phenomenon. After standardisation⁵ the different measure units disappeared, in addition, the expected value of the variables was 0 and the variance was 1 (Hunyadi–Mundruczó–Vita 1999).

We selected those standardised variables with **principal component analysis** that did not fit in the model appropriately. **In the selection of the variables the main criterion** was that the retained **information content should remain at least 70 per cent**. Based on the results of the completed principal component analysis the following indicators remained in our model, taking the selection criteria detailed above (Table 1).

⁵ The standardised variables remained in 15 decimals for the accuracy of the analysis.

Table 1. The final indicator set of the innovation indexes

No.	Name of indicator
1.	Number of research places per 100000 inhabitants, 2008
2.	Actual number of scientific researchers in R&D places per 1000 inhabitants, 2008
3.	R&D support staff per 1000 inhabitants, person 2008
4.	Other manual and non-manual staff per 1000 inhabitants, person 2008
5.	R&D expenditure per 1000 inhabitants
6.	R&D expenses per 1000 inhabitants
7.	Amount of R&D investments per 1000 inhabitants
8.	Source of R&D expenditure is enterprise in total, per 1000 inhabitants, thousand HUF 2008
9.	Source of R&D expenditure is public finance in total, per 1000 inhabitants, thousand HUF 2008
10.	Source of R&D expenditure is nonprofit in total, per 1000 inhabitants, thousand HUF 2008
11.	Source of R&D expenditure is foreign in total, per 1000 inhabitants, thousand HUF 2008
12.	R&D expenses, basic research, per 1000 inhabitants, thousand HUF 2008
13.	R&D expenses, applied research, per 1000 inhabitants, thousand HUF 2008
14.	R&D expenses, experimental development, per 1000 inhabitants, thousand HUF 2008
15.	Patents 2006-2009 per 10000 inhabitants
16.	Trademarks 2006-2009 per 10000 inhabitants
17.	Number of public body members of HAS, per 10000 inhabitants, 2007

Source: own construction

6.3 The complex analysis of the innovation performance of Hungarian micro-regions

In the following, we make an attempt to **create a picture** of innovation performance of the 174 Hungarian micro-regions **as complex as possible** based on the data determined by the appropriately selected 17 variables. For the complex analysis of the innovation performance of micro-regions – in an analogous way to the competitiveness analysis – we use basically two kinds of multi-variable data analysing techniques with significantly different logic, the **cluster analysis** and the **one-dimensional scaling**.

Cluster analysis

For clustering and ranking the micro-regions according to innovation performance first we had to make a restriction to get properly interpretable results. The reason for this is that there are 45 micro-regions among the 174 micro-regions which have zero value according to all the 17 indicators. Consequently there is no innovation performance in these micro-regions, thus it is practical to exclude these objects from the classification in which we intend to type the micro-regions according to the innovation performance. This step assures that the classifications will actually type those micro-regions where substantive innovation performance can be shown, separating them from those micro-regions where no innovation performance is in progress.

It is a legitimate question that why it is necessary to exclude these micro-regions from the analysis since probably the multi-variable methods according to definition separate these micro-regions based on their resemblance from the regions having actual innovation performance. However, this does not happen, and its explanation is that the applied methods are data reduction methods, which due to their character necessarily involve some information loss. The lost information is quite enough to “mix” the 45 micro-regions with no innovation performance within the micro-regions where there is a certain amount of innovation performance.

Consequently, in the course of the cluster analysis we classified the 45 micro-regions where there is absolutely no innovation performance according to the indicators to a separate class and we disregarded it in applying the Two-step cluster analysis. The reason for using the Two-step clustering procedure – as we have written earlier – was that the methodology of the

clustering according to competitiveness and innovation performance should be compatible with each other. Here we also rejected the cluster number (two) considered optimal and offered by the SPSS; since in this case the three-cluster approach gave interpretable result.

In the case of the three-cluster breakdown, the value of the average Silhouette coefficient is 0,6, which indicates a very good classification. Taking the excluded micro-regions from the clustering process into account as well, we can separate four region types: three region types where any kind of innovation performance can be shown and one type where no kind of innovation performance can be shown.

The output of the SPSS lists how many objects the procedure arranged in the certain clusters. 7 objects were taken to cluster number 1, while 28 objects in number 2 and 94 objects in number 3. This picture is completed by the excluded 45 micro-regions. The classification can be said to be overlap-free and continuous.

The formed clusters can be interpreted with the help of their centers (Székelyi–Barna 2003). According to the chart of the SPSS *Final Cluster Centers*, for the 7 micro-regions belonging to cluster 1 we can find higher value in the case of most variables than the values measured in the other clusters. In the case of cluster 3, we find mainly low values for almost every variable, while cluster 2 gives the value between cluster 1 and 3 per variable in most cases. Based on all this and the theoretical background, the numbering of the clusters according to SPSS can be filled with content as follows:

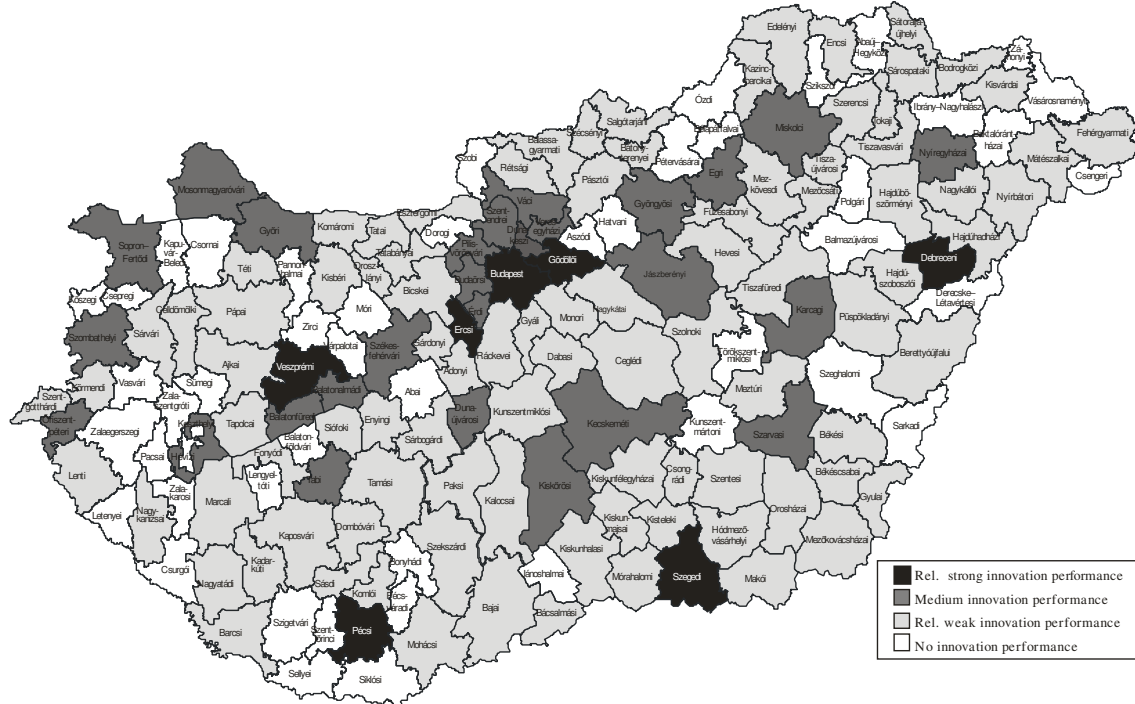
- **Micro-region with relatively weak innovation performance:** cluster number 3
- **Micro-region with relatively strong innovation performance:** cluster number 1
- **Micro-region with average innovation performance:** cluster number 2
- **In addition:** excluded micro-regions: micro-regions having no innovation performance at all

It can be said about **the spatial position of the 3+1 types according to innovation performance**, that the micro-regions with relatively strong innovation performance are primarily the micro-regions of the traditional university towns: the micro-regions of Budapest, Szeged, Debrecen, Pécs and Gödöllő, in addition, the micro-regions of Ercsi and Veszprém belong to this group.

In the case of the region type which can be described with average innovation potential, significant spatial concentration may only be shown in the north-western ring of the capital, in the other cases the involved 28 micro-regions can be found spatially spread, mainly in the micro-regions having higher education institutions. We mention here that due to the GERD-BERD-HERD delimitation it can be established that in some micro-regions (e.g. Óriszentpéter, Győr, Székesfehérvár, Tab, Veszprém, etc.) not the R&D activity financed by public finance source but the corporate R&D activity is dominant.

Out of those micro-regions where there is no innovation performance in progress, a significant spatial concentration developed only on the eastern border of Zala County. Furthermore, it is also conspicuous that these excluded 45 micro-regions are distributed proportionally between the eastern and western part of the country, contrary to the competitiveness types described in the first section, where the concentration of the regions with weak competitiveness could be shown unambiguously along the eastern border (Figure 6).

Figure 6 Region types according to innovation performance, 2008



Source: own construction

One-dimensional scaling

In the case of ranking the micro-regions according to innovation performance we excluded – similarly to the clustering – the 45 micro-regions where there is absolutely no kind of innovation performance in progress according to the indicators. These micro-regions were disregarded while running the MDS.

The technique of the dimensional scaling holds the possibility of developing a **ranking according to innovation performance** if this operation does not involve significant information loss due to excessive reduction of dimension number, and the formed dimension can be called complex innovation performance indicator. We can state based on the indicators forming the basis of the MDS and the direction and strength of the correlation of the developed artificial dimension that the developed artificial dimension can actually be considered a complex innovation performance indicator, based on which we can determine the innovation performance order of the micro-regions.

In the case of the ranking formed after conducting the examination the value of the S-Stress is 0,02, which can be qualified as **excellent**, thus **the model with reduced dimension number probably contains all the relevant information**.

In accordance with our expectations, those seven micro-regions lead the ranking which were taken to the cluster of micro-regions with relatively strong innovation performance in the cluster analysis. However, as we noted while developing the competitiveness ranking, these coordinates have to be carefully interpreted, instead of these we rather assign its innovation ranking number to each micro-region as well. If the MDS coordinates of more micro-regions are identical, that is, they would have the same position in the ranking, we use the average of ranks, the so-called tied rank. Those micro-regions (45 pc) in which there was no innovation performance according to the indicators were taken in the last position of the ranking, the tied rank of which is 152. We obviously cannot assign a coordinate to it since they were not included in the MDS.

7 The comparative analysis of the competitiveness and innovation performance of Hungarian micro-regions

In the following we attempt to reveal the connection between the competitiveness and innovation performance of Hungarian micro-regions by comparing the results of the competitiveness analysis described in the first section with the results of the innovation performance presented in the second section. Here we also emphasise that the two kinds of analyses were carried out according to the same methodology considering the basic principle of compatibility: the selection methodology of the data base and the run analyses are the same, so the results can be compared.

We present the comparison of the results of the studies according to competitiveness and innovation performance in three comparison systems:

1. Firstly, we examine what kind of cluster combinations occur according to competitiveness and innovation performance.
2. Then we study the relationship of the micro-region rankings according to competitiveness and innovation performance.
3. Finally, we examine the relationship of the complex indicators of competitiveness and innovation performance given by the MDS.

7.1 Study of cluster combinations

In studying the cluster combinations we can find that there are only 7 micro-regions out of the 174 micro-regions which can be regarded as relatively strong according to both competitiveness and innovation performance (Budapest, Debrecen, Ercsi, Gödöllő, Pécs, Szeged and Veszprém). On the other hand, it can be said that all the 7 micro-regions with relatively strong innovation performance (Budapest, Debrecen, Ercsi, Gödöllő, Pécs, Szeged and Veszprém) are at the same time micro-regions with relatively strong competitiveness. From the other micro-regions with relatively strong competitiveness, 11 have average innovation performance, while 1 (Dabas) has relatively weak innovation performance. As a consequence, none of the micro-regions with weaker competitiveness than this can be considered to have relatively strong innovation performance.

The 60% of the micro-regions with average competitiveness (33 pc) have relatively weak, while 23,6 % (13 pc) have average innovation performance, while 16,4% (9 pc) are micro-regions excluded from the analysis. The micro-regions with relatively weak competitiveness have typically weak innovation performance (60%), while the 36 % do not have innovation performance.

Examining the cluster combinations from the side of innovation performance it can be stated that each of the micro-regions with relatively strong innovation performance have relatively strong competitiveness. The micro-regions having average innovation performance have typically average (46,4%), and relatively strong (39,3%) competitiveness. The majority of the micro-regions with relatively weak innovation performance (63,8%) have relatively weak competitiveness. The 80% of the micro-regions with no innovation performance have relatively weak and 20% have average competitiveness (Table 3.1.).

In studying the cluster combinations there is a conspicuous tendency that the relatively strong competitiveness mostly goes together with relatively strong innovation rank, and the same is true for the lower rankings as well. All this indicates that there is a kind of quantifiable relationship between the affiliations according to the two criteria.

The value of Cramer's coefficient of association calculated based on the contingency table presented in Table 2:

$$C = \sqrt{\frac{\chi^2}{N \cdot \min\{(r-1), (c-1)\}}} = 0,5$$

C=0,5, which shows that we can draw consequences based on the affiliation according to one criterion about the affiliation according to the other criterion to an average extent, that is, there is a relationship of average strength between belonging to a cluster according to competitiveness and innovation performance.

Table 2 Cluster combinations according to competitiveness and innovation performance, 2008

Name		Clusters of innovation performance				Total
		micro-regions with relatively strong innovation performance	micro-regions with average innovation performance	micro-regions with relatively weak innovation performance	micro-regions with no innovation performance	
Clusters of competitiveness	Micro-region with relatively strong competitiveness	7	11	1	0	19
	Micro-region with average competitiveness	0	13	33	9	55
	Micro-region with relatively weak competitiveness	0	4	60	36	100
Total		7	28	94	45	174

Source: own construction

The question arises whether we are given a more subtle picture of the occurring cluster combinations if we take the urban-rural character of the micro-regions into consideration. It can be stated that examining the cluster combinations from the side of the innovation performance, the micro-regions with relatively strong innovation performance, with one exception, are urban micro-regions having relatively strong competitiveness. The micro-regions with average innovation performance typically have urban character (88,6%). The majority of the micro-regions with relatively weak innovation performance have rural character (72,4%). The 80% of the micro-regions with no innovation performance are rural micro-regions having relatively weak competitiveness.

In studying the cluster combinations there is a conspicuous tendency that the relatively strong competitiveness mostly goes together with relatively strong innovation rank and urban character, and the same is true for the lower rankings with rural character. The value of Cramer's coefficient of association calculated based on the contingency table presented in Table 3:

$$C = \sqrt{\frac{\chi^2}{N \cdot \min\{(r-1), (c-1)\}}} = 0,8$$

C=0,8, which shows that we can draw conclusions based on the affiliation according to one criterion about the affiliation according to the other criterion to a great extent, that is, there is a strong relationship between belonging to a cluster according to competitiveness and innovation performance determined with considering the urban-rural character.

Table 3 Cluster combinations according to competitiveness and innovation performance, 2008

Name		Clusters of innovation performance				Total
		micro-regions with relatively strong innovation performance	micro-regions with average innovation performance	micro-regions with relatively weak innovation performance	micro-regions with no innovation performance	
Clusters of competitiveness	Rural micro-region with relatively strong competitiveness	1	0	1	0	2
	Urban micro-region with relatively strong competitiveness	6	11	0	0	17
	Rural micro-region with average competitiveness	0	3	17	6	26
	Urban micro-region with average competitiveness	0	10	16	3	29
	Rural micro-region with relatively weak competitiveness	0	3	50	36	89
	Urban micro-region with relatively weak competitiveness	0	1	10	0	11
Total		7	28	94	45	174

Source: own construction

7.2 Studying the relationship between the rankings of the one-dimensional scalings

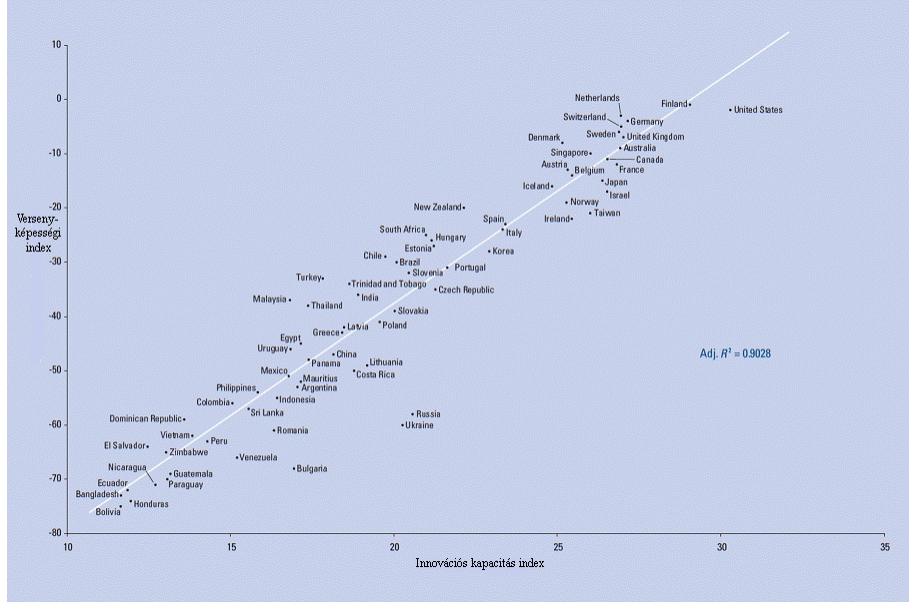
To determine the relationship between the rankings according to competitiveness and innovation performance we can use Spearman's rank correlation coefficient. The value of this index is 0,657, which indicates the significant, positive relationship stronger than the average. It means that, on the one hand, the relationship between the two rankings can be shown, on the other hand, the micro-regions that have a better position in the competitiveness ranking most probably (in general) have a better position in the innovation performance ranking as well.

7.3 Studying the relationship according to complex indicators

The same conclusion can be drawn if we examine the relationship between the complex competitiveness indicator and the innovation performance indicator obtained by the MDS based on those micro-regions where there is some level of innovation performance. At this point the index-number value of the correlation relationship is 0,735, which indicates that the more competitive micro-regions also have greater innovation performance.

We can use the value of the artificial indexes given by the MDS to compare our result with the result of Porter and Stern's analysis. Porter and Stern studied the relationship between the Innovation Capacity Index and the Competitiveness Index. The Competitiveness Index is the index used in the analysis of the World Economic *Forum from 2001*. They showed a strong correlation between the innovation capacity and the competitiveness (Figure 7).

Figure 7 Relationship between competitiveness and innovation performance

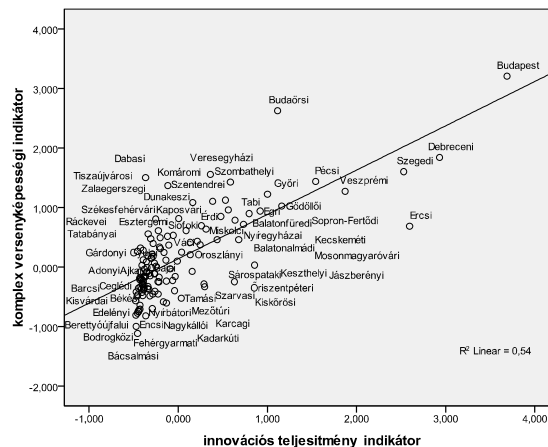


Source: Porter-Stern (2001)

Similarly, examining the relationship between the innovation performance indicator and the complex competitiveness indicator produced by our MDS analysis we can establish that there is a positive, close relationship between our two indicators ($r=0,73$). The fact that in the case of our study we found a slightly weaker relationship between the indicators is due mainly to that the two indexes applied by us and by Stern et al. were built in different methodological ways. It can be stated from the results, similarly to Porter et al., that the higher level of competitiveness requires the higher innovation performance, and vice versa, the higher innovation performance needs higher competitiveness.

We can divide the micro-regions positioned further from the regression line into two groups. The group under the line has better position in terms of their innovation performance than their attained competitiveness. The other group that is positioned further above the line have better overall competitiveness rank that their innovation performance.

Figure 8 Relationship between competitiveness and innovation performance in Hungary



Source: own construction

8 Conclusion

In our study, taking the 174 micro-regions as sampling population, we attempted to analyse the connections between the regional competitiveness and the regional innovation performance in an empirical way.

For this, in the earlier phases of the present study we reviewed how the national and international literature views the connections between innovation and competitiveness, then the focus of our examination was increasingly shifted towards the empirical study. An important step of this process was partly that after reviewing the theoretical connections we reviewed the innovation links of the demonstration models of competitiveness referred to most widely. It is really important that the examination founding the empirical analysis was the review of the methodology and indicator set of 17 international competitiveness reports according to the role that the competitiveness reports mean for the innovation indexes in measuring competitiveness the character of the indexes which they measure innovation with. These establishments were important benchmark example in terms of our research.

The second large phase of the research was running the empirical analysis. Within its framework, we started out from the competitiveness measurement method developed in the University of Szeged Faculty of Economics in 2008. We used this method first to run a competitiveness analysis then to run an analysis according to innovation performance.

The methodological compatibility between the two main parts of the analysis, the competitiveness analysis and the innovation performance analysis, was a very important criterion of the analysis. This meant that we determined the possible indicators based on the international literature during both analyses, and we selected these indicators with a mathematical-statistical method (principal component analysis). As a result, the model contained only the indicators which were relevant in terms of the examination in both cases. First we carried out a cluster analysis then a one-dimensional scaling based on 78 indexes in the competitiveness analysis and 17 indexes in the innovation performance analysis, according to the same methodology in all cases. The methodological compatibility founded the main part of the research, the comparison of the results, in this way the possibility to reveal the connections between the regional competitiveness and the regional innovation potential.

It was clearly proved during comparing the result that there are very important points of connection between the regional competitiveness and the regional innovation potential, which provide several lessons. It was stated that each of the micro-regions with relatively strong innovation performance is a micro-region with relatively strong competitiveness at the same time; in addition, the micro-regions having weak innovation performance and those regions which have no innovation performance are for the most part micro-regions with weak competitiveness at the same time. These connections are also true reversely, thus it was proved based on Cramer's index that on the basis of the affiliation according to one criterion we can estimate the affiliation of a micro-region according to the other criterion with great certainty.

We can improve the accuracy of the estimation if we further sophisticate the competitiveness types with the affiliation according to the urban-rural dimension. The micro-regions with relatively strong innovation performance have not only relatively strong competitiveness but they are also urban, and the other extreme is also true: the micro-regions having no innovation performance are mostly micro-regions with relatively weak competitiveness and urban. By introducing the urban-rural dimension Cramer's index increased to 0,8-ra, which indicates a strong relationship.

Our conclusions drawn from the cluster combinations are supported by both Spearman's rank correlation coefficient calculated on the basis of the competitiveness ranking and the index formed by our MDS analysis quantifying the relationship of the innovation

performance indicator and the complex competitiveness indicator, which both showed a strong relationship between the two examined factors.

Consequently, we managed to show strong relationship between the regional competitiveness and the innovation performance on the example of the Hungarian micro-regions. The innovation performance is a very serious mover of the regional competitiveness, which is furthermore able to start a cumulative process, which constantly feeds back as a result of a circular process: as the innovation performance improves competitiveness, however, through the improvement of competitiveness the microeconomic business environment also improves, which means a good breeding ground for the innovation performance, therefore which will be able to be realised even on higher level. This increases competitiveness again, and the branching process starts.

9 Irodalomjegyzék

- ACRC (2008): *Annual Competitiveness Report Croatia*. National Competitiveness Council, The Institute of International Relations, Zagreb.
- Bajmócy Z. (2008): A regionális innovációs képesség értelmezése és számbavétele a tanulás-alapú gazdaságban. In Lengyel I. – Lukovics M. (szerk.): *Kérdőjelek a régiók gazdasági fejlődésében*. SZTE Gazdaságtudományi Kar Közleményei, JATEPress, Szeged. pp. 26-46.
- BERR (2008): *The 2008 Productivity and Competitiveness Indicators*. Department for Business Enterprise and Regulatory Reform, London.
- BERR (2009a): *The 2009 Productivity and Competitiveness Indicators*. Department for Business Enterprise and Regulatory Reform, London.
- BERR (2009b): *Regional Economic Performance Indicators*. Department for Business Enterprise and Regulatory Reform, London.
- BHI (2008): *Eighth Annual State Competitiveness Report 2008*. The Beacon Hill Institute at Suffolk University, Boston.
- Couto et al (2004): *Competitiveness of Portuguese Regions. A Comparative Analysis*. University of Azores, Azores.
- Csatári B. (1999): *A kedvezményezett kistérségek besorolásának felülvizsgálata*. MTA RKK Alföldi Tudományos Intézete, Kecskemét.
- EC (1999): *Sixth Periodic Report on the Social and Economic Situation and Development of Regions in the European Union*. European Commission, Luxembourg.
- EC (2004): *A new partnership for cohesion - Third Report on Economic and Social Cohesion*. European Commission, Brussels.
- EC (2006a): A Tanács határozata (2006. október 6.) a kohézióra vonatkozó közösségi stratégiai iránymutatásokról (2006/702/EK). *Official Journal*, L 291/11, Luxembourg.
- EC (2006b): *Kohéziós politika és a városok: a városok és az agglomerációk hozzájárulása a régiók növekedéséhez és foglalkoztatottságához*. European Commission, Brussels.
- Florida, R. (2004): *Cities and the creative class*. Routledge, New York, London.
- Forfás (2009): *Annual Competitiveness Report 2009*. National Competitiveness Council and FORFÁS, Dublin.
- Füstös L. – Kovács E. (1989): *A számítógépes adatelemzés statisztikai módszerei*. Tankönyvkiadó, Budapest.
- Gardiner, B., - Martin, R., - Tyler, P. (2004): Competitiveness, Productivity and Economic Growth across the European Regions. *Regional Studies*, 9, 1045-1067. o.
- Garlick, S. (2003): *Growth and Competitiveness in the Gippsland Region: Performance and Determinants 1984 – 2000*. Regional Knowledge Works, Sydney.

- Huggins, R. – Davies, W. (2006): *European Competitiveness Index 2006-07*. Robert Huggins Associates, Wales, United Kingdom.
- Hunyadi L. – Mundruczó Gy. – Vita L. (1999): *Statisztika*. Aula, Budapest.
- IMD (2009): *World Competitiveness Yearbook 2009*. International Institute for Management and Development, Lausanne.
- InnoMetrics (2009): *European Innovation Scoreboard 2008. Comparative Analyses of Innovation Performance*. Pro Inno Europe, Inno Metrics.
- Kovács P. – Petres T. – Tóth L. (2006): *Válogatott fejezetek Statisztikából, Többváltozós statisztikai módszerek*, JATEPress, Szeged,
- Kronthaler, F. (2003): *A Study of the Competitiveness of Regions based on a Cluster Analysis: The Example of East Germany*. Institut für Wirtschaftsforschung, Halle.
- Lederman, D. – Maloney, W. F. (2003): *R&D and Development*. Policy Research Working Paper, 3024, World Bank, Washington.
- Lengyel I. (2000): A regionális versenyképességről. *Közgazdasági Szemle*, 12, 962-987. o.
- Lengyel I. (2003): Verseny és területi fejlődés: térségek versenyképessége Magyarországon. JATEPress, Szeged.
- Lengyel I. – Rechnitzer J. (2000): A városok versenyképessége. In Horváth Gy. – Rechnitzer J. (szerk.): *Magyarország területi szerkezete és folyamatai az ezredfordulón*. MTA RKK, Pécs, 130-152. o.
- Lukovics M. (2008): *Térségek versenyképességének mérése*. JATEPress, Szeged.
- Malecki, E. J. (2002): Hard and Soft Networks for Urban Competitiveness. *Urban Studies*, 5-6, 929-945. o.
- OECD (2001): *Rural regions in EU – exploring differences in economic development*. Organisation for Economic Co-operation and Development, Paris.
- Parkinson, M. et al (2004): *Competitive European Cities: Where do the Core Cities Stand?* Office of the Deputy Prime Minister, London.
- Parkinson, M. et al (2005): *State of the Cities. A Progress Report to the Delivering Sustainable Communities Summit*. Office of the Deputy Prime Minister, London.
- Parkinson, M. et al (2006): *State of the English Cities*. Office of the Deputy Prime Minister, London.
- Piech, K. (2008): *Knowledge- and Innovation-based Competitiveness – Assessing the Position of Poland in Europe*. The Knowledge and Innovation Institute, VÁROS.
- Porter, M. E. – Stern, S. (2001): *National Innovative Capacity*. In *The Global Competitiveness Report 2001-2002*. Oxford University Press, New York.
- PSRC (2008): *Puget Sound Regional Competitiveness Indicators 2008-2009*. Puget Sound Regional Council, Washington.
- Pukli P. (2006): *A KSH szerepe a területi információs rendszerben*. <http://www.mrtt.hu>
Letöltve: 2006. november 5.
- RDC (2003): *Competitiveness and Future Outlooks of the Estonian Economy*. Research and Development Council, Tallin.
- Snieska, V. – Bruneckiene, J. (2009): *Measurement of Lithuanian Regions by Regional Competitiveness Index*. Engineering Economics, Kauno technologijos universitetas, Kaunas.
- Székelyi M. – Barna I. (2003): *Túlélőkészlet az SPSS-hez. Többváltozós elemzési technikákról társadalomkutatók számára*. Typotex Kiadó, Budapest.
- WEF (2009): *The Global Competitiveness Report 2009-2010*. World Economic Forum, Geneva.
- World Bank (2008): *Measuring Knowledge in the World's Economies*. World Bank Institute, Washington.