Innovation Performance and Competitiveness in the Hungarian Sub-regions

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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 prepare the development of 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.

Keywords: regional competitiveness, innovation performance, creativity, spatial 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

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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 small 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.

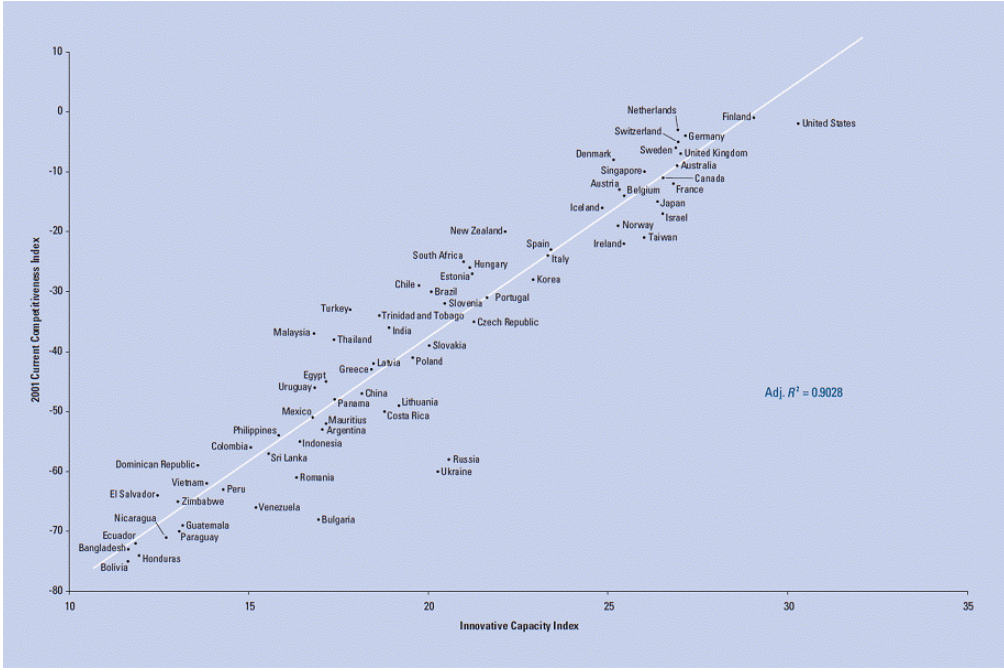
In terms of our research Porter and Stern's research in 2001 has major importance. The authors undertake to quantify the relationship of innovation and competitiveness with the help of multiple-variable data analysis methods. It is methodologically carried out by that on the basis of the research four 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).

Figure 1. Relationship between competitiveness and innovation



Source: Porter-Stern (2001)

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 some demonstration models of competitiveness

In this section we review the demonstration models which make the wide range of factors influencing regional competitiveness graphic through the extending the concept of competitiveness and including the *development side* in the examination. It is important that of all the demonstration models to be presented the competitiveness top hat, the competitiveness tree and the pyramid-model are all rely on the standard definition[4] of competitiveness, thus it is expected to form an organic whole with the ideas written in the previous section.

4.1. The competitiveness hat

A research group of the University of Cambridge attempts to synthesize the various definitions of competitiveness (Martin et al 2003). They find that despite the diverse approaches, some issues which have to be considered as distinctive feature of regional competitiveness can be taken out from the international literature. These factors are systematized by the regional competitiveness hat, which consists of four different levels: regional result, regional output, regional intermediate output and the factors of regional competitiveness[5].

[4] The standard concept of competitiveness is used by, for example, the Department of Trade and Industry (DTI) in the United Kingdom, in addition this approach appears in the study titled Benchmarking the Competitiveness of European Industry.

[5] The experts of World Bank in working out the urban and local economic strategies in 2000 separated three types of the examined indicators, which approach have become widely accepted in the European Union: the input indicators, the output indicators and the outcomes (Worldbank 2000). This three way subdivision or its further consideration can be observed in quite many approaches circling the concept of regional competitiveness with the use of indicators.

The factors that can be associated with innovation are placed on the brim of the top hat, between the secondary factors. Three such factors can be named, however, their exact role are not detailed by the model (Martin et al 2003):

1. Technology:
2. Innovativity
3. Knowledge infrastructure

4.2. The competitiveness tree

The research group of ECORYS under Jan Maarten de Vet's (2004) direction created a graphic demonstration model of the regional competitiveness similarly to the competitiveness top hat (Figure 3.). According to the authors' ideas, the tree as an organic whole characterizes the cyclicness of the competitiveness concept. This metaphor is filled with content by that the quality of the soil and the efficient functioning of the roots, the trunk and the branches determine the strength of the tree and the quality of the fruits.

This metaphor is accordance with our findings to a great extent, according to which innovation is one of the particularly important influential factors of competitiveness, since it is placed in the root of the competitiveness tree, which determines the strength of the tree and the quality of the fruits, which may in itself be corresponded with competitiveness.

This is a dynamic process, since the fertility of the soil is partly determined by the extent to which the falling fruits revitalize it. As a result, the "fruit" of competitiveness (welfare, sustainability, etc.) is unambiguously determined by the categories, such as innovation, which affect the competitiveness on different levels and to different extent.

4.3. The pyramid-model of competitiveness

The **pyramid-model** of the competitiveness of regions is based on the standard definition of competitiveness, which is a convenient conceptual approach, since it highlights two measurable economic categories: the levels of income and employment (Lengyel 2000).

To improve the competitiveness the *simultaneous* development of research, innovation, education and training, in addition, the spread of scientific and technological knowledge and its appearance in the competitive advantages of the enterprises operating in the region are essential. Besides the public research institutes, the enterprise research institutes have a crucial effect on the competitiveness of a region. Generally speaking, there is no significant companies' R&D activity in the relatively undeveloped regions. Provided that there is no public research institute which could provide the knowledge necessary for technological catching up, taking over the technology becomes emphasized, that is the technology transfer. As a result, the in-

novation results may also arrive from outside the region (for example technology transfer), but the competitiveness of the region is decisively promoted by the effective R&D activity, the creation of innovations and their extensive, **rapid spreading** in the region[6]. This can have decisive impact on the region and the competitiveness of its enterprises.

The innovation not only has a distinguished position among the basic factors, but also among the long-term influential success factors. That is, as a result of the logic of the Pyramid-model the *innovation affects* a welfare of a region *in two ways*: on the one hand, strengthening the development of research and technology directly improves the competitiveness of a region, while the existence of innovation culture indirectly contributes to all this.

One success factor is formed by the "**Innovation culture and capacity**". In the successful regions many patents are obtained, there are extensive innovation activities and the spread/diffusion of innovations is efficient. Only few regions are able to perform high technology R&D activities, but the majority can also be successful in traditional manufacturing industries by the use and rapid adaptation of new technologies. The innovation culture and skill are necessary for a region to respond with adequate adaptation strategy to any kind of technical, business, environmental, etc. change, and to be able to turn the innovation challenges to its own advantage. The innovation ability does not only mean the capacity of research and development institute or university but especially that of the enterprise, the prepared, innovative small and medium enterprises in the new market sectors and prospering branches.

4.4. Competitiveness and innovation in the operational programme of EU 246

On behalf of the European Union, the report that examines the potential of the regional policy instruments of the European Union in the framework of a quite large empirical research and focusing on the objectives of Lisbon and Göteborg, was completed on 22nd June 2009. the analysis examines the policy instruments of cohesion in 27 EU member states, through analysing 246 operational programmes which are supported by either the European Regional Development Fund or the Cohesion Fund or the National Strategic Reference Frameworks of the given countries.

The analysis includes several important findings that highlight important connections in terms of our research. One of the most important overall connection is that the Convergence as well as the Competitiveness and employment programmes promoting the first two objectives of the Structural Funds both contribute to achieving the objectives of Lisbon and Göteborg. It is accomplished by promoting innova-

[6] The WEF uses the technology index to calculate the economic creativity index. However, in this the emphasis in placed on the *existence* of innovations, regardless if it is from own development or external source (Lengyel – Deák 2001).

tion, supporting the enterprises and strengthening the synergy between growth and environmental protection.

According to the other quite significant metaphorical finding of the document, six roads lead to Lisbon and Göteborg. These roads are arranged into two main groups, the competitiveness main group and the convergence main group, within which there are 3 roads respectively. These roads summarize the focus of the reviewed operational programmes based on the budget and the programmes of regional policy.

1. Competitiveness roads:

- The first of the competitiveness roads is innovation, R&D and entrepreneurial skill. The writers of the study identify this strategy primarily with the relatively small countries, which can be characterized by small regional differences and their GDP per person exceeds the EU average.
- The second competitiveness road is focused on the increase of employment, the urban renewal and the energy, also with R&D and innovation relationship. This strategy was found mainly in the case of countries having GDP more than the EU average, but the regional differences of these countries are bigger than that of the countries of the first road.
- The third competitiveness road focuses on the economic and environmental synergies through priorities such as renewable energy, urban and rural developments and tourism. This strategy was found primarily in the case of larger countries divided by regional differences and having average GDP level.

2. Convergence roads:

- The road focused on growth and employment: recognizing the importance of transport accessibility and employment. This road includes the stimulation of innovation and entrepreneurial skill in the operational programmes, but with less intensity than in the competitiveness roads. This strategy can be experienced in the relatively developed cohesion countries having strong central region, where the GDP per person is slightly under the EU average. The analysis ranks Hungary, along with Portugal, the Czech Republic, Slovenia, Malta and Cyprus in this category.
- Developing human resource and institution capacity through the stimulation of knowledge, in addition, providing better access to innovation and the programmes improving entrepreneurial skill in the interest of improving the quality of labour force and attaining sustainable development. This strategy dominates mainly in smaller cohesion countries where the GDP/person is lower than the EU average.
- Regional cohesion: mostly the development of infrastructure dominates in the interest of bridging the urban-rural gap. This strategy primarily dominates in large, polycentric countries characterized by regional inequalities with low GDP per person.

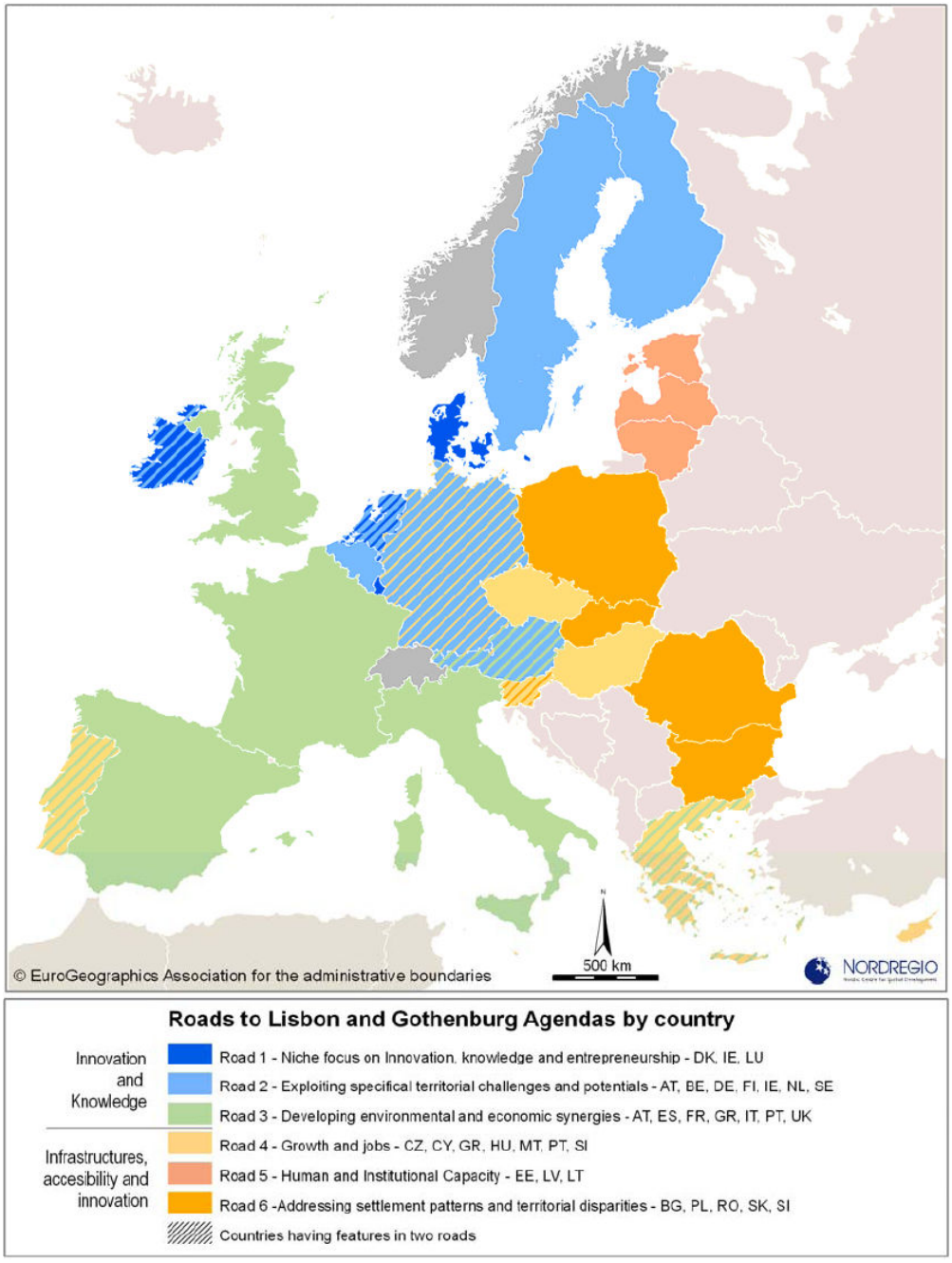
The consequence can be drawn from the logic of the 6 roads that the innovation as a condition can be assigned to both the competitiveness (objective 2) and the convergence (objective 1) priorities, but with different meaning and intensity.

In the *Regional competitiveness and employment* operational programmes strong Lisbon-orientation can be observed, the emphasis is on the innovation, knowledge and technology. The member states where there are predominantly objective 2 regions the priorities related with innovation and entrepreneurial skill clearly dominate in the competitiveness and employment operational programmes (R&D expenditure, innovation grants).

In the *Convergence* operational programmes the transport infrastructure objective is present in the largest rate, but the CSG priority of innovation and entrepreneurial skill does not suffer significant disadvantage compared to this objective.

It is quite important to emphasize a very significant difference: it is unequivocally the creation of knowledge that is meant by the innovation priorities in the Competitiveness and employment operational programmes, which increases the competitiveness of the regions. By contrast, the innovation priorities of the Convergence operational programmes primarily mean the preparation for receiving the innovation results from outside the region, which is mainly necessary to stop further dropping behind, in addition, in the case of its success it is necessary to start catching up. Based on this logic it can be stated that developing new results is necessary but not sufficient condition for competitiveness. The member states according to the ways are spatially concentrated (figure 2).

Figure 2. The spatial position of the six roads in the European Union



Source: EC (2009)

5. The key factors determining innovation potential: knowledge and creativity

The previous sections show clearly that science have already achieved quite fine results in the process of revealing the relationship of competitiveness and innovation. It was clearly justified that the two concepts are in fairly close relationship with each other. Many of the analyses revealing the relationship between innovation and competitiveness find that the examination of the relationship between the two concepts has to be extended: they highlight the knowledge or the creativity (or both) as the input of innovation. This section aims to carry out this extension towards knowledge and creativity, and to extend the connections revealed in the previous sections to the definition of competitiveness-innovation-creativity-knowledge.

According to De Bono (1990) the creativity is the ability to reach several innovative solutions with using unusual methods. Csikszentmihályi (1997) defines creativity as the ability to communicate irregular thoughts, which forms new ideas and helps to create complex solutions through examining reality from different approaches. Overall, according to the most accepted characteristics the creativity is an ability that is necessary for problem solving, seeking different alternatives, utilizing resources as effectively as possible and distinction. The owner of creativity as a characteristic, the creative person notice the problems sooner due to the features listed earlier, and his/her freedom of thought enables him/her to develop more efficient and new solutions (O'Rafferty–O'Connor–Curtis 2009).

In our opinion, creativity is a special human attribute that can be mostly characterized by curiosity, desire for knowledge, tendency for self-realization and "not thinking in patterns". It is important to underline that the efficient solutions promoting development are formed if the creativity is accompanied by sufficient knowledge (Florida 2002).

Several studies show the positive impact of the R&D activity as the activity promoting innovation on the economic growth and productivity. Guellec and Pottelsberghe (2001) examined the long-term effect of the different types of the R&D related to the productivity based on the data of the period between 1980 and 1998 for the certain countries of OECD. They concluded that the R&D of both the public sector and the private sector and foreign countries has significantly positive effect on the increase of productivity.

Kakko and Inkinen (2009) show the close relationship of the "homo creativus" and the innovation through comparing the features of innovation with the characteristics of creative people, thereby they demonstrate the clear relation according to which creativity, the creative people's added value is one of the crucial factors of developing innovations.

Several researches proved the positive impact of innovation and R&D activities on influencing incomes. In Porter's theory the innovation means the basis of productivity and it will become the determiner of competitiveness, the aim of which is increasing welfare. At the same time it has to be highlighted that in order for the

increase of productivity as a result of innovation not to be at the expense of employment, the human resource have to continuously train itself to be creative and able to exploit opportunities. This is particularly important in knowledge-based economies.

In Huggins and Izushi (2008) model the base of knowledge is essentially important for the economy to develop innovations. They call it the base and the recipe of innovation. In developed economies utilizing knowledge to create some kind of novelty or innovation greatly contributes to the competitive advantage of the enterprises. Thus in the modern economies the knowledge becomes the key factor of the innovation. However, they emphasize that economic seizure of knowledge is very difficult; it cannot be characterized by a single index.

The World Bank's examination of knowledge-based economies the innovation and knowledge also appear as the main influences of competitiveness. The aim of their survey is to help the countries to exploit knowledge more in order to become knowledge-based economy. The 4 factors examined (ICT infrastructure, economic-institutional structure, innovation system, human resource development) are taken into account with equal weight, emphasizing that all of them are equally important to exploit knowledge. The World Bank does not highlight the innovation, but put emphasis on the utilization of knowledge as a key determinant. Since a strong positive relationship was shown between the development, the rate of growth of development and the knowledge-base of an economy, the knowledge and its utilization have become the key to future development.

With the special focus on knowledge-based economies the role of knowledge and creativity also appreciate. Taking Florida's work (Florida 2002), Huggins-Izushi's theory, Huggins and Davies's ideas (Huggins-Davies 2006), and Swann and Birke's model (Swann-Birke 2005) into consideration, we can observe that more and more people, going beyond innovation, place great emphasis also on its input factors, knowledge and creativity in terms of competitiveness.

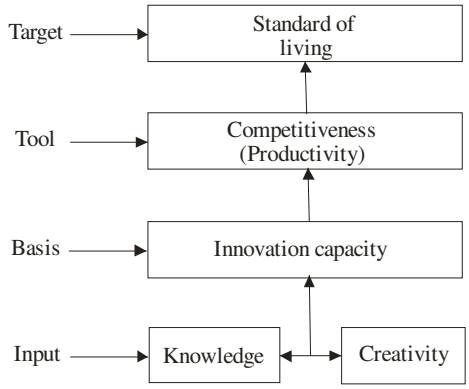
It supports the important role of knowledge and innovation that the EU also puts great emphasis on them. As early as in 2000 it emphasized the highlight of knowledge-based economy in the framework of Lisbon Strategy. One of the Community Strategy Guidelines the development of knowledge and innovation serving growth, and VIK Program the innovation efforts receive the most sources. The importance of innovation performance is shown by that it is annually surveyed in the framework of EIS. Recognizing the significance of knowledge needed for innovation the year of 2009 was named the European Year of Creativity and they also conducted its survey, which was summarized in the document titled Design, Creativity and Competitiveness.

Based on the above presented findings of international literature it can be clearly stated that **there is a clear and strong relationship between competitiveness and innovation**, in addition, that **the relationship is two-directional** (Carayannis – Gonzalez 2003). The dominant direction is that the existence of innovation

results strengthens the competitiveness of the region (that is the innovation affects competitiveness), however – as the competitiveness tree also demonstrated – **there is a feedback** in the structure as well, since in the competitive regions the local business environment further intensifies, which provides further drive for the innovation.

Furthermore, it can be stated that the most recent international research findings are directed towards that **the input side of the innovation capacity is increasingly highlighted**, and the research findings extend the examination clearly towards **knowledge and creativity**. In our opinion, to create new findings both knowledge and creativity are necessary. The knowledge is necessary but not sufficient condition for the creation of innovation results, because the static way of thinking built on patterns is not adequate for creating innovation results. The same can be said about creativity: the creativity is also necessary but not sufficient condition for the creation of innovation results, behind the way of thinking searching for new directions there has to be serious knowledge and professional competence to realize it in some kind of result. Based on this, completing Porter's line of thought with knowledge and creativity we receive the logical structure of knowledge-based economy development (Figure 3).

Figure 3. The logical structure of knowledge-based economy development



Source: Own construction based on Lengyel (2002)

6. 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 small 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 small 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 (Chart 1.):

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.

7. The ideas related to the possibility of measuring the competitiveness and innovation performance in Hungarian small regions

Since both the competitiveness and the innovation performance are complex concepts, neither can be characterized by a single index. Instead, indicator systems as well as factors and indicators formed from basic indicators by multi-variable data

analysis techniques have to be used to measure and characterize them. To produce them a complex, high quality database is needed based on which these indicators and indicator systems can be created. However, the existing databases leave a lot to be desired. Since the success of data analyses and drawing the right conclusions are greatly dependent on the quality of the basic database, prior to the indicators and the multi-variable data analysis **firstly** we have to **create a proper basic database**, which is suitable for characterizing the competitiveness and innovation performance. The experience of the reviewed sets of indicators gives an appropriate help with this (chart).

From the basic database given by the study of literature, **secondly** we have to select the indicators which indeed have a **relevant impact** on competitiveness and innovation performance. For this we will characterize the categories of the applicable models with maximum two or three indicators artificially created by principal components analysis in a way that the principal components convey the 75-80% of the information content of the original variables. We will not include in the model the original variables the communality of which will be low and their omission would not mean a distorted model in terms of the examination.

After forming the circle of relevant variables, the **clustering** of small regions comes next. We plan to conduct it on two lines. We complete the clustering, on the one hand, based on the whole pyramid model, on the other hand, based on only the innovation indicators. From the received results and their comparison we try to type the small regions based on their competitiveness and innovation performance, furthermore we check that in what kind of pattern and combination the type categories according to the competitiveness and innovation performance occur.

Finally, we establish a **ranking** of the small regions **based on their competitiveness and innovation performance**. The multi-dimensional procedure is a suitable procedure for this. From the results and their comparison we try to conclude the character of relationship that may be between the level of competitiveness and the innovation performance in the case of small regions. We also examine whether the existing relationship is the same character as if we examined country or regional data.

This study aimed at reviewing the set of indicators and methodology of competitiveness reports and researches from two aspects: on the one hand, we examined the weight and role of innovation in the 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 small regions. The study reviewed the set of indicators of **17 international competitiveness reports and competitiveness researches** (table 1).

Table 1. The occurrence of certain indicators in the reviewed sets of indicators

Name of indicator	WEF GCR 2009-2010	IMD WCY 2009-2010	ECI 2006-2007	BERR 2008 PCI	Forfás ACR 2009	WB KEI 2008	European Inn. Sc.	BERR REPI 2009	BHI 2008	ACR Croatia 2008	Estonian Comp. R.	Puget Sound 2008	Lithuanian RCI 2009	German regions 2003	Portugal regions 2004	Poland	World Bank 2008
1. Innovation capacity for enterprises	X									X							
2. The quality of scientific research institutes	X									X							
3. University-industry research cooperations	X									X			X				
4. The public purchase of advanced technology products	X																
5. Availability of researchers, engineers	X								X								
6. The number of patents per unit	X	X		X	X	X	X		X	X	X	X	X			X	X
7. Intellectual property	X																
8. The number of technological cooperations between enterprises		X								X						X	
9. Supporting technological development		X								X							
10. Technological regulation, legal background		X								X							
11. High-tech export		X															
12. Total R&D expenditure in all (million US $)		X	X														
13. Total R&D expenditure in all (per unit)		X															
14. Total R&D expenditure in GDP %		X		X	X		X			X	X	X			X	X	
15. R&D expenditure of business sector in total (million US $)	X	X	X											X	X	X	
16. R&D expenditure of business sector in GDP %	X	X		X	X	X					X	X					
17. The number of R&D employees		X									X					X	
18. The number of R&D employees per inhabitant		X	X				X			X	X						
19. The number of R&D employees in enterprises		X															
20. The number of R&D employees in enterprises per inhabitant		X	X														
21. The number of basic researches		X								X							
22. Science and engineering degrees in proportion to the first university degrees		X															
23. The number of published scientific articles		X				X	X				X						X
24. The focus of sciences in schools		X															
25. The number of Nobel Prizes in total (chemistry, physics, economics, life science)		X															
26. The number of Nobel Prizes in total per unit (chemistry, physics, economics, life science)		X															
27. The number of patent applications		X	X									X		X		X	
28. Intellectual property rights		X															
29. Patent productivity (patent number/the number of R&D persons working in the business sector (1000)		X															
30. Scientific research		X															
31. The rate of innovative enterprises within all the enterprises				X													
32. The number of trademarks and designs per unit				X	X												
33. The income from research of higher education institutes and publicly financed research institutes				X													
34. The rate of turnover form innovation activity in turnover				X													

Name of indicator	WEF GCR 2009-2010	IMD WCY 2009-2010	ECI 2006-2007	BERR 2008 PCI	Forfás ACR 2009	WB KEI 2008	European Inn. Sc.	BERR REPI 2009	BHI 2008	ACR Croatia 2008	Estonian Comp. R.	Puget Sound 2008	Lithuanian RCI 2009	German regions 2003	Portugal regions 2004	Poland	World Bank 2008
35. The supply and demand side of innovation				X													
36. Employment in R&D and high-technology, in addition, in technology demanding industries.								X									
37. Innovation index of European Innovation Scoreboard					X												
38. The rate of firms doing innovation activity within all the enterprises					X												
39. The part of income that the enterprises spend on innovation activity					X											X	
40. R&D expenditure of higher education institutes in GDP %					X		X										
41. The number of researchers in proportion to employees (1000)					X												
42. BERD by enterprise type (with foreign or domestic ownership)					X												
43. The rate of people having PhD degree in relation to the population (1000)					X						X						
44. Amount of royalties per capita						X											X
45. The rate of labour force with higher education degree in relation to the total workforce							X										
46. The number of participants in scientific training, the number of PhD students							X									X	
47. ICT expenditure per capita							X										
48. Broadband access in proportion to the population							X										
49. HERD (R&D expenditure of higher education) in proportion of GDP (%)			X				X		X		X						
50. Knowledge transfer between universities and enterprises										X							
51. The size of venture capital per capita									X	X		X					
52. The number of university students per 1000 inhabitants													X				
53. The number of college students per 1000 inhabitants													X				
54. The number of technologies produced by universities													X				
55. The cooperations of universities of different regions													X				
56. The participation of universities in international research													X				
57. The rate of R&D financed by foreign countries within GERD																X	
58. The number of high-tech patents per unit																X	
59. The rate of medium-high-tech and high-tech researches in the total number of researches																X	
60. The number of employees in ICT sector			X														
61. The R&D expenditures of higher education per capita			X														

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