Spatial Boundaries of Knowledge Sourcing in Case Of Knowledge-Intensive Industries in Hungary

ZSOFIA VAS
University of Szeged, Faculty of Economics and Business Administration
H-6722, Szeged Kalvaria sgt. 1.
Hungary
vas.zsofia@eco.u-szeged.hu

Abstract

Innovation is a creative and collective process, in which a variety of actors interact with each other, have knowledge–based communication, and create, distribute and use economically useful knowledge. In most of the cases these interactions take place within certain geographical barriers due to the location of the actors. For this reason the process of innovation is characterized by spatial boundaries of knowledge. This phenomenon was highlighted by the literature of sectoral innovation systems.

Among sectors, knowledge-intensive ones have attracted much attention in recent years in economic analysis, due to their driving role in the development of the knowledge-driven economy. Knowledge-intensive sectors differ from traditional ones not only in the nature of products, quality and quantity of human resource, but in the intensity and characteristics of knowledge sourcing, R&D activities, type of sectoral knowledge base and the nature of innovative cooperation.

The aim this paper is to provide a better insight to how firms in knowledge-intensive sectors exploit knowledge in Hungary, in the special case of the less developed Southern Great Plain NUTS2 region. The study reveals how knowledge-intensive firms combine different knowledge sources accessed at different geographical level. The research highlights significant differences among knowledge-intensive manufacturing and service companies and uncovers the differentiating role of sectoral knowledge base. Findings show that firms build on a complex system of interactions.

Keywords: knowledge sourcing, knowledge base, knowledge-intensive sectors, less developed regions, Hungary

JEL Classification: C12, O14, O30

1 Introduction

Looking back over centuries it can be seen that substantial source of increasing productivity and enhancing the realized financial welfare is represented by technological change and different forms of innovation (Edquist 2005). However, in order to describe, understand and evaluate the process of innovation it is essential to take account of all factors affecting the process. It is provided by the concept of innovation systems, which meant a turning point in innovation research. For over two decades large number of publications having been published in this topic (Lundvall 1992, Edquist 2005a, Fagerberg and Sapprasert 2011, Vas and Bajmócy 2012).

The concept of innovation systems emphasizes the interactive and collective nature of innovation, the wide range and complementary role of actors involved in the process of innovation, and it calls

attention to the importance of information, knowledge and learning. The systematic analysis of innovation began with the emergence of national innovation systems (Freeman 1995, Lundvall1992, Nelson 1993). Following this, the concept of innovation systems expanded with the theory of regional (Cooke et al. 1997), technological (Carlsson and Stankiewitz 1991) and sectoral (Malerba 2002, Breschi and Malerba 2005) innovation systems.

The literature of sectoral innovation systems (SISs) highlights that the innovation activity and performance of firms depends primarily on the nature of sectors, in particular on the specificities of the knowledge and knowledge base characterizing the sectors. But as Malerba − who elaborated the conceptual framework of SISs − describes in many of his studies, SISs are often localized. The operation of sectors is highly influenced by their geographical location, due to which the actors have to face so-called spatial boundaries of knowledge (Malerba 2002, Breschi and Malerba 2005). Today special attention is paid to the identification of factors affecting knowledge creation, distribution and use in the scope of knowledge-intensive economic activities. Knowledge-intensive sectors have quite different characteristics compared to traditional industries. Knowledge-based activities have gained a dominant role in production and service, and also excel in terms of their innovation activity and performance (Tödtling et al. 2006, Isaksen 2006, Vas 2013). Knowledge-intensive industries form specific SISs considering the industrial actors, their knowledge base, the standard of applied technologies, the cooperations for development and the rate of innovation results. Their examination is the subject of increased practical research, since due to their higher value-added activities they may become the catalysts of the economic growth and development of regions. This is why I have chosen knowledge-intensive sectors as the subject of my research.

Knowledge-intensive SISs cannot be studied separately from other types of innovation systems. The literature highlights that the different innovation system concepts complement each other and interact with each other. It has been pointed out (Lundvall et al. 2002) and detailed (Casper and Soskice 2004, Lee and Tunzelmann 2005) how interdependent relationship of sectors and national system exist. It is often examined how sectors explore clustering from the viewpoint of regional innovation systems (Cooke 1997, Asheim and Coenen 2005) or how firms in regional clusters show better innovation performance (Sölvell 2009, Beaudry and Breschi 2003). But it is less discussed how the mutual impact of sectors and regional economy emerge. There are even less attempts to reveal how the innovation pattern develops if the sector is located in a less developed region.

The problem outlined above determines the direction of the research. A broader research has begun to answer the question what specificities the knowledge creating, distributing and exploiting activities of knowledge-intensive SISs have, and to what extent they depend on the nature of the sector and the region. In order to answer this question I examine the less developed Southern Great Plain NUTS2 region of Hungary. Owing to the complexity of the topic, the present paper is aimed at answering a narrower question that how knowledge-intensive firms in the Southern Great Plain combine different knowledge sources accessed at different geographical level. Do knowledge-intensive sectors located in the Southern Great Plain have spatial boundaries of knowledge sourcing? The questionnaire-based research highlights significant differences among knowledge-intensive manufacturing and service companies and reveals the differentiating role of sectoral knowledge base. My findings indicate that the main knowledge source is the combination of customer, supplier and competitors, and interactions are rather national and not regional oriented.

2 Spatial Boundaries of Knowledge

The notion of spatial knowledge boundaries appears in the conceptual framework of SISs. The concept of SISs has emerged as a new approach in innovation studies in the last decades, and it has been less applied in the Hungarian literature.

The theoretical basis of innovation system related to sectors originates from Franco Malerba. Malerba provides a concept of SIS, which gives a dynamic view of innovation in sectors in several dimensions. He defines SIS as "a set of new and established products for specific uses and the set of agents carrying out market and non-market interactions for the creation, production and sale of those products" (Malerba 2002, 250, Malerba 2004, 10, 2005, 65). Malerba concludes the main characteristics of innovation and evolution processes of sectors in the article of 'Innovation and evolution of the industries'. He explains that it is (i) an outcome of the learning process by firms and individuals, (ii) based on the interactions of actors with different knowledge and competences, where the interactions can be competitive or cooperative, market or non-market, formal and informal ones, (iii) influenced by a specific institutional setting (nation or sector-specific institutions), and (iv) generating change and transformation in products, processes, actors, link, institutions and knowledge. In other works Malerba (2004, 2005) defines basically three dimensions through which a sector can be defined, and these factors are the building blocks of SISs. These are 1) knowledge and technologies, 2) actors and their networks and finally 3) institutions. Due to the focus of the recent paper, I detail the characteristics of SISs with regard to knowledge and interactions.

Evolutionary literature on innovation systems has proposed that sectors greatly differ from each other in terms of knowledge and learning related to innovation. The approach has a strong focus on knowledge; hence the characteristics of knowledge not only define the pattern of innovation activities, but shape the spatial distribution of the actors of SISs.

The operation of SISs depends on different conditions of knowledge. These are the opportunity of knowledge, the cumulativeness of knowledge and the appropriability of knowledge (see more in Breschi and Malerba 2005, Malerba and Orsenigo 2000). If there are conditions for high opportunity, high appropriability and high cumulativeness, actors tend to spatially concentrate. If there are low conditions, the actors are in sparse. Besides these conditions, the nature of the dominant knowledge base also defines the innovation and spatial pattern of sectors.

Depending on the character of the knowledge base, the dependence of the spatiality of SISs on the nature of knowledge is also demonstrated by the existence of the spatial knowledge boundaries of firms (Breschi and Malerba 2005). As the cooperation are geographically limited because of the spatial location of actors involved, the knowledge-based communication of actors is also "limited". Thus firms face certain proportion of spatial knowledge boundaries. Typically, if the knowledge base consists of knowledge elements which are tacit, complex and embedded in system, and innovation requires sophisticated supplier and customer relationships, firms have to face local knowledge boundaries. If the knowledge base comprises simple and separated knowledge elements, the spatial concentration of knowledge is not necessary. In this case knowledge boundaries are global, and the knowledge transfer can take place at national, international and global level as well (Breschi and Malerba 2005). In other words, it means that the more important it is for firms (such as knowledge-intensive firms) to build face-to-face relationships and to transfer tacit and complex

knowledge and the more significant the geographical proximity is to special suppliers and customers, the more they are concentrated geographically. On the contrary, in case of those firms (generally in traditional industries) which transfer mainly simple codified knowledge in their innovation activities and are more dispersed spatially, there are no geographical boundaries of knowledge.

3 Research Methodology

In order to answer the research question I conduct deductive research and I explore the specificities of the knowledge-intensive sectors of the Southern Great Plain region by testing a hypothesis. In case of the knowledge-intensive economic activities the extent of knowledge-based interactions is higher as a consequence of more intensive innovation activities. The interactions in the innovation system are aimed at creating, distributing and using knowledge, and can be established with customers, suppliers, universities and bridging institutions; they can be embedded in diverse territorial dimensions, and market and non-market based, as well as formal or informal relationships (Malerba 2002, Tödtling et al. 2011). It depends on the nature of the sector which actors interact through what type of relationships. I examine my hypothesis regarding interactions based on the nature of economic activities (the manufacturing and service sector nature of enterprises) and the type of knowledge base, and I analyze the type of actors involved in the innovation activity, the extent of relationships, and their emergence as knowledge sources and their geographical dimensions. I suppose that the knowledge-intensive enterprises in the Southern Great Plain region cooperate with several other actors of the innovation system of the Southern Great Plain region, and even if in many cases the relationships established with the subsystem of knowledge creation and distribution (see the literature of regional innovation systems) are weak or lacking in less developed regions, interactions are created at least with the actors in the subsystems of knowledge exploration and exploitation, thus with customers, suppliers and other enterprises.

The hypothesis: The knowledge-intensive enterprises of the Southern Great Plain build on a complex system of knowledge- and learning-based partnerships in their innovative cooperations; they typically interact with at least three, different types of actors of the regional innovation system. In case my expectation is fulfilled it would be proved that the nature of the economic activity and the knowledge base characterizing the sectors have a different effect on the process of knowledge creation, distribution and use, even on the process of knowledge sourcing.

The hypothesis is tested by a questionnaire-based research, which − as it was mentioned earlier − highlights the specificity of knowledge-intensive innovation activities from two perspectives. The research is looking for evidence on the process of knowledge sourcing taking the nature of the economic activity (companies are from manufacturing or service industries) into account on the one hand, and the dominant sectoral knowledge base on the other. The questionnaire is based on the Community Innovation Survey, and completed with questions from the innovation system literature and with general information on companies.

I follow the OECD classification for sectors (OECD 2001, Eurostat 2009). Based on the technological standard of sectors, there are high-technology manufacturing, medium-high-technology manufacturing sectors and knowledge-intensive services (KIS) (Eurostat 2009). The circle of KIS is divided to knowledge-intensive market services and knowledge-intensive financial services. The

classification also makes distinction between high-tech KISs and other KISs. The latter refers to less knowledge-intensive industries, only exploiting the knowledge of other economic activities and qualified labour force. That is why this group of economic activities is excluded from the research.
According to the literature on sectoral knowledge base, we can distinguish three main types of knowledge bases: the analytical, synthetic and symbolic knowledge base (Asheim and Coenen 2005, Tödtling et al. 2006). The analytical knowledge base is typical to knowledge-intensive industries such as biotechnology, pharmaceutical and chemical industry. Beside the relevance of tacit knowledge, firms focus on the codification of knowledge in the form of different studies, patent descriptions etc. The distribution and exchange of knowledge is not hindered by geographical distance, global networks of the actors are developed. The synthetic knowledge base is more likely confined to the traditional industries (such as machinery, food industry) with low level of R&D, application of existing knowledge and dominancy of practical skills and tacit knowledge. In these sectors the knowledge is rather embedded in experiences, and used to solve specific problem of the customers. In the industries building on symbolic knowledge base (e.g. advertising, film industry) it is typical to combine existing knowledge in a new way and to elaborate new images and ideas. The actors of the sectors with symbolic knowledge bases usually form local networks and are in quite a different spatial location.

Most of the sectors build on all three types of knowledge bases, but usually there is one that is dominant, and which greatly affects the competitiveness of the sector (Asheim et al. 2005). The problem is that the literature does not provide which knowledge base is the dominant one with regard to all the various industrial activities, services in particular. Abroad it is still the subject of many discourses among researchers on what basis and how the dominant sectoral knowledge base can be determined. Nevertheless, I attempt to determine the dominant sectoral knowledge base on the basis of the characteristics of sectors, including the radical or continuous type of innovation, the demand for creating new knowledge, the significance of customer or supplier interactions or the role of university, and with the help of content definition of the NACE Rev.2 codes. Thus in particular cases I make the categorization based on literature examples, while in other cases I define it with consideration of the characteristics of the sector. As it can be seen in Table 1, most of the industries have synthetic dominant knowledge base, and out of all knowledge-intensive firms, only 3-3 seems to have analytic and symbolic knowledge base as the dominant one. This affects the outcome of the research, and may cause distortion in the results, but can point out interesting findings as well.

Tab. 1 Knowledge-intensive industries and dominant knowledge bases

	Sectors (NACE Rev. 2. codes 2 digit level)	**Dominant knowledge base**
High-technology manufacturing industries	**21** Manufacture of basic pharmaceutical products and pharmaceutical preparations	Analytic
	26 Manufacture of computer, electronic and optical products	Synthetic
Medium-high-technology manufacturing industries	**20** Manufacture of chemicals and chemical products	Analytic
	27 Manufacture of electrical equipment	Synthetic
	28 Manufacture of machinery and equipment n.e.c.	Synthetic
	29 Manufacture of motor vehicles, trailers and semi-trailers	Synthetic
	30 Manufacture of other transport equipment	Synthetic

Knowledge-intensive services	Market services	**50** Water transport	Synthetic
		51 Air transport	Synthetic
		69 Legal and accounting activities	Synthetic
		70 Activities of head offices; management consultancy activities	Synthetic
		71 Architectural and engineering activities; technical testing and analysis	Synthetic
		73 Advertising and market research	Symbolic
		74 Other professional, scientific and technical activities	Synthetic
		78 Employment activities	Synthetic
		80 Security and investigation activities	Synthetic
	Financial services	**64** Financial service activities, except insurance and pension funding	Synthetic
		65 Insurance, reinsurance and pension funding, except compulsory social security	Synthetic
		66 Activities auxiliary to financial services and insurance activities	Synthetic
	High-tech services	**59** Motion picture, video and television programme production, sound recording and music publishing activities	Symbolic
		60 Programming and broadcasting activities	Symbolic
		61 Telecommunications	Synthetic
		62 Computer programming, consultancy and related activities	Synthetic
		63 Information service activities	Synthetic
		72 Scientific research and development	Analytic

Source: own construction based on Eurostat (2009), (Asheim and Gertler 2005, Asheim et al. 2007)

The sample size of the questionnaire is 400. However, out of the surveyed 400 knowledge-intensive enterprises in the Southern Great Plain region only 127 enterprises are innovative, examining the period of 2009-2011. Thus I test my hypothesis based on the sample size of 127.

Before presenting the result, I have to note that the regional conditions in less developed regions explicitly affect the fundamental innovation activities and the networking of the primary actors, the firms in sectors. In the Southern Great Plain, even if there is strong geographical proximity among actors, relational proximity is weak. There is a lack of sources of qualified human capital, lack of knowledge and financial sources, and there is a low number of knowledge providers (university, research centre, technology transfer institutions etc.). All the institutional and other regional factors have to be taken into consideration when we look at the knowledge sourcing.

4 Results - Role of the Nature of Economic Activities in Knowledge Sourcing

One dimension to look at the relevant knowledge sources is the nature of economic activities. It has been revealed that independently from the nature of the economic activity, the most important knowledge sources are the suppliers, customers and competitors (mainly SMEs and not large companies) (Table 2). It also can be seen that there is correlation between the type of economic activity and the type of relevant knowledge source in case of customers and competitors (even if this link is weak). Most of the knowledge-intensive enterprises do not turn to public research institutes, innovation and technology centers or development agencies to gain knowledge. Even the number of those who have university relations is relatively low. It is also found that there is a significant difference between the manufacturing industry and services in terms of the customers in the region and abroad, emerging as an important partnership in their innovation activities, and in terms of the SMEs as a circle of competitors in the region.

Tab. 2 Differences among knowledge-intensive manufacturing and service companies

		In the region		In the country		Abroad		Sig	Cramer V
		M	S	M	S	M	S		
Suppliers of equipment. materials. services. or software (n=102)	No.	3	25	13	45	6	10	*0.112	0.207
	%	10.7	89.3	22.4	77.6	37.5	62.5		
Clients and customers (n=97)	No.	**2**	**22**	16	48	**6**	**3**	***0.003**	**0.351**
	%	8.3	91.7	25.0	75.0	66.7	33.3		
Competitors – SMEs (n=70)	No.	**1**	**21**	13	30	3	2	****0.007**	**0.358**
	%	4.5	95.5	30.2	69.8	60.0	40.0		
Competitors – Large companies (n=42)	No.	1	8	12	17	3	1	**0.058	0.353
	%	11.1	88.9	41.4	58.6	75.0	25.0		
Consultants. commercial labs. or private R&D institutes (n=34)	No.	0	7	5	22	5	29	**0.112	0.211
	%	0.0	100	18.5	81.5	14.7	85.3		
Universities or other higher education institutes (n=38)	No.	2	7	9	19	0	1	**0.598	0.140
	%	22.2	77.8	32.1	67.9	0.0	100.0		
Government or public research institutes (n=19)	No.	1	3	2	12	1	0	**0.167	0.469
	%	25	75	14.3	85.7	100	0		
Innovation and technology centers. development agencies (n=22)	No.	2	5	0	14	0	1	**0.081	0.463
	%	28.6	71.4	0.0	100.0	0.0	100.0		

Notes:* Pearson χ^2, ** Likelihood ratio M – manufacturing, S – service companies

Source: own construction

It also can be seen how knowledge-intensive manufacturing enterprises and service providers combine the most relevant knowledge sources in terms of partnerships (Table 3). It is clear that only a small proportion of enterprises turn to only one innovative partner. Most of the enterprises (and higher number of service providers) are related to suppliers, customers and competitors, but there is a significant number of those who use the combination of supplier, customer, competitor and university relations. Those who have university relations are rather from the manufacturing.

Tab. 3 Innovation-relevant knowledge sources - partnerships

Combination of knowledge sources	Manufacturing companies		Services		All innovative knowledge-intensive company	
	No.	%	No.	%	No.	%
Only suppliers	1	3.3	8	8.2	9	7.1
Only customers	2	6.7	6	6.2	8	6.3
Only competitors	0	0.0	1	1.0	1	0.8
Only university	0	0.0	1	1.0	1	0.8
Supplier - customers	1	3.3	12	12.4	13	10.2
Supplier - competitors	1	3.3	4	4.1	5	3.9
Supplier - university	1	3.3	2	2.1	3	2.4
Customers - competitors	2	6.7	4	4.1	6	4.7
Customers - university	1	3.3	0	0.0	1	0.8
Competitors - university	1	3.3	0	0.0	1	0.8
Supplier - customers - competitors	11	36.7	31	32.0	42	33.1
Supplier - customers - university	1	3.3	9	9.3	10	7.9
Supplier - competitors - university	0	0.0	2	2.1	2	1.6
Customers- competitors - university	1	3.3	2	2.1	3	2.4

Supplier - customers - competitors - university	6	20.0	11	11.3	17	13.4
No relationship	1	3.3	4	4.1	5	3.9
All:	**30**	**100.0**	**97**	**100.0**	**127**	**100.0**

Note: % within the category (manufacturing or service companies)
Source: own construction

It also turns out that relationships are basically not regional, but national oriented (Table 4). In many cases national relations are coupled with regional and international relations, but it is proved that the most relevant spatial dimension is the nation. The spatial boundary of knowledge sourcing is national. It is noteworthy that higher proportion of manufacturing industries has foreign knowledge sources.

Tab. 4 Geography of knowledge sources - partnerships

Geography of partnership	**Manufacturing companies**		**Services**		**All innovative knowledge-intensive company**	
	No.	%	No.	%	No.	%
Only regional	1	3.3	19	19.6	20	15.7
Only national	13	43.3	35	36.1	48	37.8
Only international	3	10.0	2	2.1	5	3.9
Regional + national	6	20.0	26	26.8	32	25.2
Regional + international	1	3.3	3	3.1	4	3.1
National + international	4	13.3	6	6.2	10	7.9
Regional + national + international	1	3.3	3	3.1	4	3.1
No relationship	1	3.3	3	3.1	4	3.1
All:	**30**	**100.0**	**97**	**100.0**	**127**	**100.0**

Note: % within all (manufacturing and service companies)
Source: own construction

The nature of relationships is further analyzed by two-step cluster analysis, where I create homogeneous groups of enterprises depending on the most relevant knowledge sources and their geography (Table 5). Results show that partnerships are regional, regional-national, only national and global oriented. There is no group of firms which has only regional oriented relations.

Table 5 Clusters based on the most relevant partnership

Input	**Clusters**			
	Regional orientation (n=11)	**Regional national** (n=16)	**National orientation** (n=19)	**Global** (n=5)
Competitors (SMEs)	Regional (100%)	National (100%)	National (100%)	International (100%)
Customers	Regional (100%)	National (100%)	National (100%)	International (100%)
Suppliers	National (100%)	Regional (100%)	National (100%)	International (60%)

Source: own construction

The cluster analysis reveals that slightly more that 30% of the enterprises are national and regional oriented, and more than one third clearly national oriented. Even if only 10% of firms are global oriented, they form a clear, separate group.

5 Results - Role of Dominant Knowledge Base in Knowledge Sourcing

Another dimension to look at the relevant knowledge sources is the dominant sectoral knowledge base. It should be noted that in my sample there is no significant difference between the groups of firms with different dominant knowledge base. But some differentiating characteristics can be outlined. In line with the literature, industries with synthetic knowledge base have a high number of supplier and customer relations (Table 6). But it is not only the characteristic of sectors with synthetic, but also with analytic knowledge base. Even in the combination with other types of partnerships, about 80% of enterprises in sectors with analytic and synthetic knowledge base have supplier relations. 70-90% of enterprises have customer relation.

Tab. 6 Partnership and knowledge bases

	Analytical		Synthetic		Symbolic	
	No.	%	No.	%	No.	%
Only suppliers	0	0.0	10	10	0	0.0
Only customers	2	11.1	6	6	1	11.1
Only competitors	0	0.0	2	2	0	0.0
Only university	0	0.0	1	1	0	0.0
Supplier - customers	5	27.8	12	12	2	22.2
Supplier - competitors	0	0.0	4	4	0	0.0
Supplier - university	1	5.6	3	3	0	0.0
Customers - competitors	0	0.0	4	4	0	0.0
Customers - university	0	0.0	1	1	0	0.0
Competitors - university	0	0.0	0	0	0	0.0
Supplier - customers - competitors	2	11.1	35	35	2	22.2
Supplier - customers - university	4	22.2	3	3	0	0.0
Supplier - competitors - university	1	5.6	3	3	0	0.0
Customers- competitors - university	1	5.6	1	1	0	0.0
Supplier - customers - competitors - university	2	11.1	10	10	4	44.4
No relationship	0	0.0	5	5	0	0.0
All:	18	100.0	100	100.0	9	100.0

Source: own construction

Firms with synthetic industrial knowledge base cooperate with more competitors, but what is more important (and also written in the literature) enterprises with analytic industrial knowledge base have higher number of relations with universities. Twice as many firms have university relation (in combination with other types of relationships) from industries with analytic knowledge base.
In connection with the geography of most relevant knowledge sources, it can be seen that only regional relations are more relevant in case of sectors with synthetic or symbolic knowledge base (however, the sample of enterprises with symbolic knowledge base is very small) (Table 7.).

Tab. 7 Knowledge sources and knowledge bases

	Analytical		Synthetic		Symbolic	
	No.	%	No.	%	No.	%
Only regional	2	11.1	20	20.0	2	22.2
Regional + national		0.0	17	17.0	2	22.2
Regional + international	4	22.2	2	2.0		0.0
Regional + national + international	1	5.6	2	2.0	1	11.1

Only national	9	50.0	39	39.0	4	44.4
National + international	2	11.1	6	6.0		0.0
Only international		0.0	4	4.0		0.0
No relationship		0.0	10	10.0		0.0
All:	18	100.0	99	100.0	9	100.0

Source: own construction

National oriented relationships are relevant independently from the type of knowledge base. But international relations are much more relevant in case of sectors with analytics knowledge base.

4 Conclusions

Results show that knowledge-intensive firms in the Southern Great Plain Region use the combinations of knowledge sources from different partners located at different spatial levels. Sectoral knowledge base and manufacturing or service nature of activities describes the significant differences in the existence of spatial boundaries of knowledge sourcing. The main knowledge sources of firms independently of the nature of the economic activity or knowledge base are the customer, supplier, competitors and the university partners. However, sectoral knowledge base has a differentiating role, and it leads to a higher number of university interactions in case of sectors with analytical knowledge base. It also can be seen that the nature of economic activity influences the type of innovation-relevant partnership, and there are significant differences between manufacturing and service industries in case of the most relevant partnerships.

Interactions seem to be rather national and not regional oriented. Knowledge sources are rather over the regional border, interactions are created with partners nationwide. In order to reveal that it is due to the innovativeness and knowledge-intensity of firms or due to the level of development of the region, we need further analysis. But there are evidence on manufacturing industries and industries with analytic knowledge base to have more national or even international partnership.
Based on the obtained results I have proved my hypotheses. It can be seen that the innovative knowledge-intensive enterprises of the Southern Great Plain build on a complex system of knowledge- and learning-based partnerships in their innovative cooperations; they cooperate with several, at least three, different types of actors of the regional innovation systems outside the Southern Great Plain region.

Acknowledgements

Present paper is supported by the European Union and co-funded by the European Social Fund. Project title: "Preparation of the concerned sectors for educational and R&D activities related to the Hungarian ELI project." Project number: TÁMOP-4.1.1.C-12/1/KONV-2012-0005

References

ASHEIM, B. T., COENEN, L. 2005. Knowledge bases and regional innovation systems: Comparing Nordic clusters. In: *Research Policy*. 34, pp. 1173 – 1190.

ASHEIM, B., COENEN L., MOODYSSON, J. 2005. *Regional Innovation System Policy: a Knowledge-based Approach.* Lund, Lund University, Centre for Innovation, Research and Competence in the Learning Economy.

ASHEIM, B. T., COENEN, L., VANG, J. 2007. Face-to-face, buzz and knowledge bases: Sociospatial implications for learning, innovation and innovation policy. In: *Environment and Planning C: Government and Policy*. 25, 5, pp. 655 – 670.

ASHEIM, B. T., GERTLER, M. C. 2005. The Geography of Innovation: Regional Innovation Systems. In: Fagerberg, J., Mowery, D.C., Nelson, R.R. (eds) *The Oxford Handbook of Innovation*. Oxford University Press, Oxford – New York, pp. 291 – 317.

BEAUDRY, C., BRESCHI, S. 2003. Are firms in clusters really more innovative? In: *Economics of Innovation and New Technology*. 12, 4, pp. 325 – 342.

BRESCHI, S., MALERBA, F. 2005. Sectoral innovation systems: technological regimes, Schumpeterian dynamics, and spatial boundaries. In: Edquist, C. (ed.) *Systems of innovation. Technologies, institutions and organizations*. London – New York: Routledge, pp. 131 – 156.

CARLSSON, B., STANKIEWITZ, R. 1991. On the nature, function and composition of technological systems. In: *Journal of Evolutionary Economics*. 1, pp. 93 – 118.

CASPER, S., SOSKICE, D. 2004. Sectoral systems of innovation and varieties of capitalism: explaining the development of high-technology entrepreneurship in Europe. In: Malerba, F. (ed) *Sectoral systems of innovation: concepts, issues and analyses of six major sectors in Europe*. Cambridge: Cambridge University Press. pp. 348 – 387.

COOKE, P. 1997. Regional innovation systems: Institutional and organizational dimensions. In: *Research Policy.* 26, 4-5, pp. 475 – 491.

COOKE, P., URANGA M. J., ETXEBARRIA, G. 1997. Regional Innovation System: Institutional and Organizational Dimensions. In: *Research Policy*. 26, pp. 475 – 491.

EDQUIST, C. 2005. Systems of innovation approaches. Their emergence and characteristics. In: Edquist, C. (ed) *Systems of innovation. Technologies, institutions and organizations*. Routledge, London – New York, pp. 1–35.

EUROSTAT 2009. *High-tech industry and knowledge-intensive services*. Metadata. http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/htec_esms.htm

FAGERBERG, J., SAPPRASERT, K. 2011. National Innovation Systems: The Emergence of a New Approach. In: *Science and Public Policy*, 38, 9, pp. 669–679.

FREEMAN, C. 1995. The „national systems of innovation" in a historical perspective. In: *Cambridge Journal of Economics*. 19, pp. 5 – 24.

ISAKSEN, A. 2006. Knowledge-intensive industries and regional development. The case of the software industry in Norway. In: Cooke, P., Piccaluga, A. (eds) *Regional Development in the Knowledge Economy.* New York: Routledge. pp. 43 – 62.

LEE, T-L., TUNZELMANN, N. 2005. A dynamic analytic approach to national innovation systems: The IC industry in Taiwan. In: Research Policy. 34, pp. 425 – 440.

LUNDVALL, B-A. 1992 (ed). *National System of Innovation. Towards a Theory of Innovation and Interactive Learning.* London: Pinter Publisher.

LUNDVALL, B-A., JOHNSON, B., ANDERSEN E. S., DALUM, B. 2002. National systems of production, innovation and competence building. In: *Research Policy*. 31, pp. 213 – 231.

MALERBA, F. 2002. Sectoral systems of innovation and production. In: *Research Policy*. 31, pp. 247 – 264.

MALERBA, F. 2004. Sectoral systems of innovation: basic concepts. In: Malerba, F. (ed) *Sectoral System of Innovation. Concept, issues and analysis of six major sectors in Europe*. Cambridge: Cambridge University Press. pp. 9 – 41.

MALERBA, F. 2005. Sectoral Systems: How and why innovation differs across sectors. In: Fagerberg, J., Mowery, D.C., Nelson, R.R. (ed) *The Oxford Handbook of Innovation*. Oxford – New York: Oxford University Press. pp. 291 – 317.

MALERBA, F., ORSENIGO, L. 2000. Knowledge, Innovative Activities and Industrial Evolution. In: *Industrial and Corporate Change*. 9, 2, pp. 289 – 314.

NELSON, R. R. 1993 (ed). *National Innovation System*. *A comparative analysis*. Oxford – New York Oxford, University Press.

OECD 2001. *Science, Technology and Industry Scoreboard: Towards a Knowledge-based Economy*. Organization for Economic Co-operation and Development, Paris.

TÖDTLING, F., LEHNER, P., TRIPPL, M. 2006. Innovation in Knowledge Intensive Industries: The Nature and Geography of Knowledge Links. In: *European Planning Studies*. 8, pp. 1035 – 1058.

TÖDTLING, F., LENGAUER, L., HÖGLINGER, C. 2011. Knowledge Sourcing and Innovation on "Thick" and "Thin" Regional Innovation Systems - Comparing ICT Firms in Two Austrian Regions. In: *European Planning Studies*, 19, 7, pp. 1245–1276.

SÖLVELL, Ö. 2009. *Clusters and Balancing Evolutionary and Constructive Forces*. Stockholm: Ivory Tower Publishers.

VAS ZS. 2013. Evidence on Knowledge-intensive Industries in the Regional Innovation System of Southern Great Plain. In: Lengyel I., Vas Zs. (eds) *Regional Growth, Development and Competitiveness.* University of Szeged, Doctoral School in Economics, Szeged, pp. 215 – 231.

VAS ZS., BAJMÓCY Z. 2012. Az innovációs rendszerek 25 éve. Szakirodalmi áttekintés evolúciós közgazdaságtani megközelítésben. In: *Közgazdasági Szemle*, 59, 11, pp. 1233 – 1256.