Determinants of Collaboration and Innovation in Creative Industries A Case of the Czech Republic

Jan Stejskal, and Petr Hajek

University of Pardubice, Czech Republic, Europe,{ jan.stejskal; petr.hajek}@upce.cz

ABSTRACT

The process of knowledge acquisition, creation and effective utilization is considered a key determinant of innovation activity. Thus, this process becomes a strong source of competitiveness. Knowledge is best transferred in a collaborative environment with strong links between actors. Here we focus on creative industries which can be characterized by a high importance of individuals and their social networks in the local and regional development. The paper deals with the determinants of cooperation and innovation in the creative industries, including knowledge acquisition from various sources, R&D activity and support, and creative individuals. We empirically show that firms from creative industries create innovation mainly through knowledge acquisition from clients and competition. The industry effect was also a significant determinant of innovation activity.

Keywords: Creative industry; knowledge acquisition; collaboration; innovation

I INTRODUCTION

Traditional production sources such as the amount of manpower, natural resources and available capital are necessary for production and economic development (Porter & Van der Linde, 1995). However, at present, these production factors are not sufficient to maintain the market position and mostly not to gain competitiveness in all industries in the globalized world economy (Carney, 1998). During the second half of the 20th century, the significance of the original production factors has decreased and, on the other hand, the importance of knowledge and ability to learn has substantially increased.

Using the knowledge for generating innovations provides a critical source competitiveness too. The concept of competitiveness can be viewed from different perspectives, namely from microeconomic, mezzoeconomic and macro-economic level (Krugman, 1994). In terms of the microeconomic level, competitiveness refers to the ability of the entity to compete, be profitable, develop and grow (Porter, 2004). The competitiveness of firms is derived from the competitive advantages that the firms create through its strategy and actions in the markets (Prokop & Stejskal, 2015). In contrast, the competitiveness of a region at the mezzoeconomic level cannot be expressed simply as the sum of the efforts and achievements of the firms in the region (Balkyte & Tvaronavičiene, 2010). Regional competitiveness is a result of the activities of various institutions and organizations working in the same environment, including knowledge-intensive organizations such as universities and research organizations (Kitson, Martin & Tyler, 2004).

Innovative processes are considered the key factors of both firm competitiveness and the performance of the whole national economy. They should be therefore supported by public policies (Merickova & Stejskal 2014). Innovations are closely associated with research, development and new technologies. Due to cost-cuts and time-cuts for acquiring new knowledge, firms and other institutions are using collaboration (also in creativity) as a production factor (Laperche, Lefebvre & Langlet, 2011). It is mainly a collaboration of universities and private firms that leads to innovation networks and to the transfer of knowledge (Siegel et al., 2003). Innovations are currently not generated in one firm in isolation, but mostly in the cooperative based networks. Moreover, innovations are relevant to a particular region which provides essential production factors. Thus, there exists a natural connection between these concepts and many studies have analysed firm competitiveness in specific regional and industrial settings.

Recent studies for manufacturing industries have shown that collaboration with other entities allows the effective use of the acquired knowledge, resulting into increased innovation activity (Belderbos et al., 2004). However, little attention has been given to creative industries that have increasing potential to create wealth. This paper aims to fill this gap and analyse the innovation determinants of creative industries in the Czech Republic. Specifically, we use logistic regression to develop two models, one for innovation and the other one for collaboration activity in creative industries.

The remainder of this paper is structured as follows. In the next section, we present a theoretical background for the innovation determinants in creative industries. Section 3 provides the characteristics of the dataset and the research methodology. Section 4 provides the experimental results. In Section 5, we discuss the obtained results and conclude the paper with suggestions for future research.

II THEORETICAL BACKGROUND

In the context of firm innovation activity, regional level is emphasized for several reasons: (a) the regions are increasingly becoming the drivers of development; (b) there is a considerable allocation of production factors, which are moved to places with better (cost) conditions for production; (c) there are no macroeconomic stabilizers at the regional level (such as devaluation of the exchange rates and the flexibility of wages and prices, migration of mobile factors), i.e. capital and labour can become a threat for the region; (d) regional competitiveness is also influenced by the decentralization of public innovation policies, often there is a shift of decision-making and coordination of activities towards the regional level (Porter, 2003; Skokan, 2004; Chapain & De Propris, 2009; Blažek et al., 2011).

Innovative regions have a high level of productivity and labour forces. Regions with a higher productivity usually achieve a higher economic growth. They create and attract investments (especially FDI) and associated jobs. Productivity is defined through the value of goods and services produced per unit of labour and capital and the development in recent years has demonstrated that competitiveness is based on productivity level (Porter, 2004). To maintain competitiveness, firms have fundamentally changed the attitude to production factors in the last decade. Whereas the old approach was based on optimal cost and efficiency, the new one is based on knowledge, innovation and creativity. Productivity is affected not only by policy, law and macro-economic framework but also by innovation milieu and the firm performance and sophistication of firm strategies (Karaev et al., 2007).

With the development of the knowledge economy, the characteristics of competitive advantage have dynamically changed (i.e., the ways of competition, the sources of competitiveness, etc.). Porter et al. (1998) analysed the various stages of competitive development. In the long term, the successful economic development is the process of gradual recovery, when the national innovation environment evolves and promotes the growth and productive ways of competing firms that operate in the same region (Lucas, 1988). The development of the country can be divided into four stages. The first three stages are called economy driven by (a) production factors, (b) efficiency and (c) innovations. These three stages reflect improving national prosperity. The fourth stage is called economy driven by prosperity. When the region gets to this stage, there is a lock-in problem, the dynamics of innovation is reduced and competitiveness can be decreased (Skokan, 2004).

In each of these stages, the economy is stimulated by various determinants; there is another innovative environment (milieu) where the innovation processes are taking place. The innovation process of enterprises differs substantially between various industries whose innovation activities require specific knowledge bases (Asheim & Gertler, 2005; Hajkova & Hajek, 2014). Asheim et al. (2007) highlight the need for specific knowledge in creative industries. They introduced symbolic knowledge, which is characterized by a distinctive tacit component and high context-specificity. Although creative industries also draw on an analytical knowledge base, which relies on codified knowledge and university-industry links, symbolic knowledge is essential in the creative process. The knowledge required by creative industries is often narrowly tied to a deep understanding of the habits and culture of specific social groups (Asheim & Hansen, 2009). Therefore, this type of knowledge tends to be generated in interpersonal (face-to-face) interactions, this is via socialization. In this process, "know-who" knowledge (of potential collaborators) is acquired.

Contrary to synthetic knowledge, which is typical for engineering industries, symbolic knowledge is less sensitive to regional economic and institutional structures. Another distinction lies in the knowledge creation process. Synthetic knowledge is usually created via interactive learning with customers and suppliers, whereas symbolic knowledge is gained through learning by working in project teams (Asheim & Hansen, 2009). Camelo-Ordaz et al. (2012) included additional determinants of innovation activity for enterprises in creative industries and demonstrated that the entrepreneurial characteristics (previous experience and value system) positively affect the innovation performance of small enterprises in creative industries.

III DATA AND RESEARCH METHODOLOGY

For the data collection we used a harmonized questionnaire of EU Member States from the Community Innovation Survey (CIS). The survey was carried out in the Czech Republic for the period 2008-2010 by combining sample (stratified random sampling) and exhaustive surveys taking into account the regional dimension of NUTS3. In total, data on 5,151 Czech enterprises with at least 10 employees was obtained. Enterprises in selected sectors of creative industries were then incorporated in our sample: Publishing activities (J58.1 - Publishing of books, periodicals and other publishing activities; J58.2 - Software publishing), Computer programming, consultancy and related activities (J62) and Architectural and engineering activities (M71). This list is based on recent literature (Bakhsi et al., 2013; Boix et al., 2013); however, some of the creative industries were not present in the dataset (J59 - Motion picture, video and television programme

production; J60 - Programming and broadcasting activities ; M72 - Scientific research and development; M73 - Advertising and market research; and M74 - Other professional, scientific and technical activities). The basic characteristics of the dataset are given in Table 1. The innovation activity of creative industries was estimated by calculating the number of enterprises that introduced a new product or process to the market. We are aware that this approach may fail to capture all forms of innovation in this sector due to less formalized innovation processes, strong structural dynamics and difficulties in measuring outputs of creative industries (Miles & Green 2008; Kimpeler & Georgieff, 2009). On the other hand, this approach enables comparative analyses in innovation performance across sectors (Müller et al., 2008).

Table 1. Average values of numerical determiants for creative industries.

NACE	**J58**		**J62**	
Innovative	NO	YES	NO	YES
TURN10	214,163.4	152,374.7	164,882.3	332,779.0
EMP10	99.1	66.9	50.0	125.8
EMPUD	2.9	4.0	4.4	5.0
RRDIN10	522.0	3,077.0	5,280.4	8,496.5
RRDE10	513.6	660.1	973.5	1,729.6
RMAC10	5,781.9	891.6	573.0	4,300.2
ROEK10	1,388.9	272.5	31.4	322.0
RTOT10	8,206.3	4,649.9	6,858.4	14,848.3
N	56	41	122	140
NACE	**M71**		**total**	
Innovative	NO	YES	NO	YES
TURN10	290,162.8	391,612.7	225,028.9	300,931.9
EMP10	46.1	103.7	57.6	111.6
EMPUD	4.2	4.4	4.0	4.8
RRDIN10	489.7	7,905.1	2,591.7	7,355.1
RRDE10	23.3	143.7	531.0	1,361.4
RMAC10	339.6	1,639.3	1,462.1	3,359.6
ROEK10	63.9	72.2	298.1	287.8
RTOT10	916.6	9,760.3	4,882.9	12,231.6
N	122	18	300	199

Legend: TURN10 – total turnover in 2010, EMP10 – average number of employees in 2010, EMPUD – employees with a university degree, RRDIN10 – in-house R&D expenditure, RRDE10 – external R&D expenditure, RMAC10 – acquisition of equipment, ROEK10 – acquisition of external knowledge, RTOT10 – total innovation expenditure.

Table 1 shows that there are significant differences between sectors. While in the sectors publishing activities (J58) and computer programming (J62) there was a relatively high proportion of innovative enterprises, i.e. 42.3% and 53.4%, respectively, in the sector architectural engineering activities (M71) this proportion was only 12.9%. On the other hand, sector J58 is specific in that the size of innovative enterprises (measured TURN10 and EMP10) was relatively small, even smaller than the size of non-innovative enterprises in this sector. Innovative enterprises in sector J62 have the highest proportion of employees with a university education. Expenditure on R&D is dominated by in-house R&D expenditure in all sectors. Acquisition of equipment due to innovative activity was the least effective in sector J58.

The determinants of innovation activity in Table 1 estimate: (1) size of enterprise (larger enterprises are generally expected to be more innovative owing to higher resources for innovation projects (Tang, 2006)); (2) human resource competences (the presence of a university-trained workforce can contribute to an enterprise's innovative capabilities (Romijn & Albaladejo, 2002); and (3) technological competences (intensity of R&D usually approximates to R&D expenditure (Souitaris, 2002)).

We further considered the markets in which enterprises sold goods and services, distinguishing local (51.1 % of all enterprises in the dataset), regional (54.1 %), national (85.6 %), EU (49.7 %) and other countries' markets (20.8 %). In total, 37.8 % of the enterprises were part of an enterprise group. International market competition is assumed to require higher innovation activity (Roper & Love, 2002).

Undoubtedly, organisational competencies are another important determinant of innovation activities. These are mainly communications (internal and external) and cooperation (Mention, 2001). Several studies have demonstrated that the new information obtained from other firms and customers (occurring in the innovation environment) is more important than the information obtained from journals, conferences, public agents, private consultants, etc. Firms use the information from suppliers and customers as a stimulus for their innovation.

Cooperation with other companies is a specific source of innovation incentives. It is more important than the collaboration with universities and research institutions (Souitaris, 2002). Based on the analysis of our sample we can state that innovative firms in creative sectors collaborate closely on innovation activity with other enterprises or institutions. Sector J62 shows the most frequent collaboration with other enterprise and sector M71 collaboration with universities or other research institutions.

An important group of determinants supporting innovative firm activity further includes the creativity and creative skilled labour forces. Firms can gain from both internal (own employees) and external sources (bought on the market - including freelancers, consultants, other independent enterprises, other parts of the enterprise group). The largest proportion of the analysed firms used the creative occupation in web design (39.2%), creative occupation in graphic arts (31.7%) and creative occupation in multimedia

(28.1%) as innovation determinants. Individual industries have a similar composition:

- J58 - creative occupation in web design (48.8 %), creative occupation in software development (36.6. %),
- J62 - creative occupation in graphic arts (35.7 %), creative occupation in web design (33.6 %),
- M71 - creative occupation in web design (61.0 %), creative occupation in software development (50. 0 %).

The variety of the above-mentioned determinants makes it possible to examine numerous effects on both collaboration and innovation activity in creative industries.

IV EXPERIMENTAL RESULTS

Firstly, a principal component analysis was conducted in order to obtain a set of uncorrelated variables. Sixteen components (factors F_1 to F_{16}) were detected which had eigenvalues greater than one. The components explained 68.7 % of the total variance in the data (Figure 1). The components were further labelled based on the component loadings, see Table 2 for the labels. We used the components as input variables in the logistic regression models. In the collaboration model, the output variable was represented by 0 for no collaboration and 1 for collaboration activity. Similarly, non-innovative and innovative firms were distinguished in the innovation model.

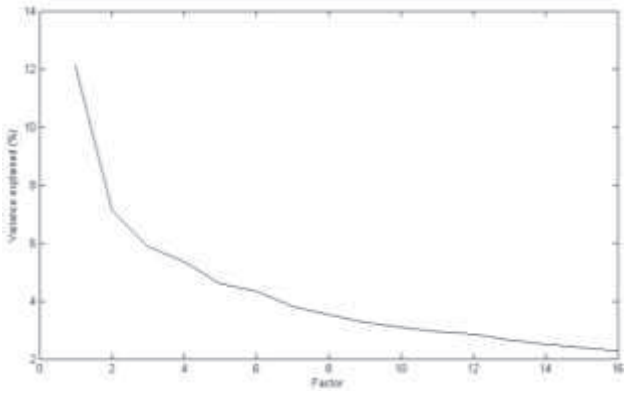

Figure 1. Variance explained by factors with eigenvalues greater than one.

To estimate the quality of the logistic regression models we used approximations of the coefficient of determination, namely Cox and Snell's R^2 which is based on the log likelihoods for the model and baseline model, and Nagelkerke's R^2 which is an adjusted version of the Cox & Snell R^2. For the collaboration model, information sources were the only significantly positive determinant of collaboration activity (Table 2).

Table 2. Collaboration and Innovation Logistic Regression Models.

Factor	Collaboration model		Innovation model	
F_1 knowledge acquisition	.541	.000***	.157	.053*
F_2 firm size and expenditure on R&D	.129	.358	.054	.702
F_3 creative individuals	-.151	.146	-.094	.408
F_4 European financial support	.096	.371	.042	.735
F_5 regional market	.037	.734	.105	.378
F_6 university education	-.001	.994	-.011	.935
F_7 group of enterprises	.030	.813	.041	.770
F_8 knowledge acquisition from clients and competition	-.043	.737	.265	.067*
F_9 nat. market and knowledge acquisition from clients	.051	.694	.132	.356
F_{10} nat. market and acquisition of equipment	.181	.264	.042	.794
F_{11} local and regional support	.001	.992	.233	.139
F_{12} knowledge acquisition from suppliers	-.106	.438	-.205	.178
F_{13} Europ.market	.020	.903	-.001	.995
F_{14} multimedia individuals	-.275	.092*	.072	.676
F_{15} other markets	-.110	.476	.275	.099*
F_{16} acquisition of exter. knowledge	-.172	.296	-.037	.837
Industry J58		.346		.088*
Industry J62		.916		.000***
Constant	-.566	.001***	1.496	.000***
Cox & Snell R^2	.251		.227	
Nagelkerke R^2	.339		.267	

Legend: * significant at $P<0.10$, ** significant at $P<0.05$, *** significant at $P<0.01$.

Similarly, information sources were also important for the innovation model, particularly information from clients and competition. In addition, a focus on markets other than those in the EU was a positive determinant of innovation activity in creative industries. The industry effect was significant only in the innovation model. The values of the coefficients showed that while the collaboration activity was partly

explained using the chosen determinants; this was not possible for the innovation activity model, which is strongly dependent on the creative industries in the dataset. Thus, the results supported our primary assumption on knowledge spill-overs and provided a rationale for consequent structural equation models.

V CONCLUSION

Our research contributes to the literature in several ways. Firstly, we have empirically shown that enterprises from creative industries can create spill-overs through innovation collaboration. Secondly, we confirmed that both internal and external collaboration significantly contribute to the creation of innovation. Internal collaboration contributes to a lesser extent than external or their mutual combination. Enterprises can create innovation most effectively by collaborating with other creative enterprises.

In contrast to previous studies on knowledge-based determinants of collaboration and innovation activity (Liao & Wu, 2010), we focused on creative industries. In these creative industries, where a new idea or thought constitutes a new result (typically design, graphic, multimedia), we have shown the greater effect of collaboration and the use of external collaboration or spill-over effects from external collaboration. In contrast, in sectors that use knowledge and information, along with other factors of production only as a means of production, a higher importance of internal collaboration was shown.

The results of our research have other policy implications. These relate mainly to two areas of support. The first is strategic support, which includes support for activities utilizing the collaboration between enterprises or the knowledge-based sector. Here we can see the role of public sector organizations, which can become mediators or institutions for collaboration (as is often the case in industrial clusters for example). The practical implication is support for the establishment of regional innovation systems, which can create a favourable environment for the transfer of tacit knowledge, spill-over effects and their use to create commercial sable results (Matatkova & Stejskal, 2013; Hajek et al., 2014, Stejskal et al. 2015).

The second implication relates to financial support. The research has shown that innovative enterprises in creative industries received more public financial support for innovation activities from all levels of government. Public administration should continue to support innovative enterprises in areas that create commercial sable innovation. However, we should point out a frequently occurring phenomenon called the innovation paradox, which describes the danger of investing public funds into industries and enterprises that fail to transform this support into innovation.

Examination of the individual determinants affecting innovation in creative industries of the Czech economy reveals the following conclusions. The monitored creative industries are specific in terms of the determinants. A key role is played by the acquisition of knowledge, particularly from clients and competitors.

Unlike the manufacturing sector (Belderbos et al. 2004; Murovec & Prodan, 2009) no significant effect was determined based on the size of the enterprise and the amount of expenditure on research and development or on the innovation or collaboration of enterprises. On the other hand, determinants of collaboration between enterprises were common for all of the creative industries examined. Knowledge acquisition and employment of creative individuals (especially from multimedia) leads to greater collaboration in the creative industries.

Surprisingly, we did not observe a direct effect of communication and creative skills on the ability to innovate. This may be explained by the fact that this effect is mainly indirect, requiring collaboration of the enterprise either with other enterprises or with universities and other research institutions. In other words, enterprises alone are not able to transform the communication with their surroundings and their creative staff into innovation. This may be due to the small size of enterprises in the dataset and the nature of the Czech economy, which is a typical export economy dependent on the economies of other countries (especially Germany). Economically significant enterprises are from the manufacturing industry, especially automotive and electrical production. They are more processors than creators. In the context of global production chains (networks) they belong to the so-called third group of suppliers, from which no distinct creativity or ability to create innovation is expected. Other reasons may be the Czech environment, the high level of bureaucracy, complex law enforcement and a high degree of ineffectiveness of both investment and collaboration with scientific research organizations. The latter reason was also demonstrated by our research. In similar economies with comparable characteristics, it is possible to expect completely different determinants which affect collaboration, creativity and innovation. It is necessary, therefore, to subject them to further detailed examination.

ACKNOWLEDGMENT

This work was supported by a grant provided by the scientific research project of the Czech Sciences Foundation Grant No: 14-02836S.

REFERENCES

Asheim, B. T., & Hansen, H. K. (2009). Knowledge bases, talents, and contexts: On the usefulness of the creative class approach in Sweden. *Economic Geography*, 85(4), 425–442.

Asheim, B. T., Coenen, L., Moodysson, J., & Vang, J. (2007). Constructing knowledge-based regional advantage: implications for regional innovation policy. *International Journal of Entrepreneurship and Innovation Management*, 7(2), 140–155.

Asheim, B., & Gertler, M. 2005. *The geography of innovation: Regional innovation systems*. In J. Fagerberg, D.C. Mowery, & R. R. Nelson, The Oxford handbook of innovation (pp. 291–317), Oxford, U.K.: Oxford University Press.

Bakhshi, H., Freeman, A., & Higgs, P. L. (2013). *A dynamic mapping of the UK's creative industries*. London: CCI.

Balkyte, A., & Tvaronavičiene, M. (2010). Perception of competitiveness in the context of sustainable development: facets of "sustainable competitiveness". *Journal of Business Economics and Management*, 11(2), 341-365.

Belderbos, R., Carree, M., Diederen, B., Lokshin, B., & Veugelers, R. (2004). Heterogeneity in R&D cooperation strategies. *International Journal of Industrial Organization*, 22(8), 1237–1263.

Blažek, J., Zizalová, P., Rumpel, P., & Skokan, K. (2011). Where does the knowledge for knowledge-intensive industries come from? The case of biotech in Prague and ICT in Ostrava. *European Planning Studies*, 19(7), 1277-1303.

Boix, R., De-Miguel-Molina, B., & Hervas-Oliver, J. L. (2013). Creative service business and regional performance: evidence for the European regions. *Service Business*, 7(3), 381–398.

Camelo-Ordaz, C., Fernández-Alles, M., Ruiz-Navarro, J., & Sousa-Ginel, E. (2012). The intrapreneur and innovation in creative firms. *International Small Business Journal*, 30(5), 513–535.

Carney, M. (1998). The competitiveness of networked production: the role of trust and asset specificity. *Journal of Management Studies*, 35(4), 457-479.

Hajek, P., Henriques, R., & Hajkova, V. (2014). Visualising components of regional innovation systems using self-organizing maps – Evidence from European regions. *Technological Forecasting and Social Change*, 84, 197–214.

Hajkova, V., & Hajek, P. (2014). Efficiency of knowledge bases in urban population and economic growth – Evidence from European cities. *Cities*, 40, 11–22.

Chapain, C., & De Propris, L. (2009). Drivers and processes of creative industries in cities and regions. *Creative Industries Journal*, 2(1), 9.

Karaev, A., Lenny Koh, S. C., & Szamosi, L. T. (2007). The cluster approach and SME competitiveness: a review. *Journal of Manufacturing Technology Management*, 18(7), 818-835.

Kimpeler, S., & Georgieff, P. (2009). *The roles of creative industries in regional innovation and knowledge transfer - The case of Austria*. In E. Villalba (Ed.), Measuring creativity (pp. 207-221). Luxembourg: OPOCE.

Kitson, M., Martin, R., & Tyler, P. (2004). Regional competitiveness: an elusive yet key concept?. *Regional studies*, 38(9), 991-999.

Krugman, P. (1994). Competitiveness: a dangerous obsession. *Foreign Affairs – New York*, 73, 28-28.

Laperche, B., Lefebvre, G., & Langlet, D. (2011). Innovation strategies of industrial groups in the global crisis: Rationalization and new paths.*Technological forecasting and social change*, 78(8), 1319-1331.

Liao, S. H., & Wu, C. C. (2010). System perspective of knowledge management, organizational learning, and organizational innovation. *Expert Systems with Applications*, 37(2), 1096–1103.

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of monetary economics*, 22(1), 3-42.

Matatkova, K., & Stejskal, J. (2013). Descriptive analysis of the regional innovation system – Novel method for public administration. *Transylvanian Review of Administrative Sciences*, 39, 91–107.

Mention, A. L. (2011). Co-operation and co-opetition as open innovation practices in the service sector: which influence on innovation novelty? *Technovation*, 31(1), 44–53.

Merickova Mikusova, B., & Stejskal, J. (2014). Value of Collective Consumption Goods. *Politicka ekonomie*, 62(2), 216-231.

Miles, I., & Green, L. (2008): *Hidden innovation in the creative industries.* London: NESTA Research Report.

Müller, K., Rammer, C., & Trüby, J. (2009). The role of creative industries in industrial innovation. *Innovation*, 11(2), 148-168.

Murovec, N., & Prodan, I. (2009). Absorptive capacity, its determinants, and influence on innovation output: Cross-cultural validation of the structural model. *Technovation*, 29(12), 859-872.

Porter, M. (2003). The economic performance of regions. *Regional studies*, 37(6-7), 545-546.

Porter, M. E. (2004). *Building the microeconomic foundations of prosperity: Findings from the business competitiveness index*. World Competitiveness Report, 2005.

Porter, M. E., & Porter, M. P. (1998). Location, Clusters, and the" New" Microeconomics of Competition. *Business Economics*, 33(1), 7-13.

Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *The Journal of Economic Perspectives*, 9(4), 97-118.

Prokop, V., Stejskal, J. (2015). Impacts of local planning to competitiveness index change – using approximate initial analysis to the Czech regions. *WSEAS Transactions on Business and Economics*, 12(1), 279-288.

Romijn, H., & Albaladejo, M. (2002). Determinants of innovation capability in small electronics and software firms in southeast England. *Research Policy*, 31(7), 1053–1067

Roper, S. & Love, J. H. (2002). Innovation and Export Performance: evidence form UK and German Manufacturing Plants. *Research Policy*, 31(7), 1087–1102.

Siegel, D. S., Waldman, D. A., Atwater, L. E., & Link, A. N. (2003). Commercial knowledge transfers from universities to firms: improving the effectiveness of university–industry collaboration. The *Journal of High Technology Management Research*, 14(1), 111-133.

Skokan, K. (2004). Competitiveness, innovation and clusters in regional development. 1st ed. Ostrava: Repronis.

Souitaris, V. (2002). Firm–specific competencies determining technological innovation: A survey in Greece. *R&D Management*, 32(1), 61–77.

Stejskal, J., Nekolova, K., & Rouag, A. The Use of the Weighted Sum Method to Determine the Level of Development in Regional Innovation Systems – Using Czech Regions as Example. *Ekonomicky casopis*, 63(3), 239-258.

Tang, J. (2006). Competition and innovation behaviour. *Research Policy*, 35(1), 68–82.

Knowledge Spillover Effects in German Knowledge-Intensive Industries

Petr Hájek, and Jan Stejskal

University of Pardubice, Czech Republic, Europe, {petr.hajek; jan.stejskal}@upce.cz

ABSTRACT

It is widely assumed that firms collaborating in Research and Development (R&D) activities benefit from knowledge spillovers. However, there has been little discussion about the synergistic effects of knowledge spillovers and R&D collaboration. This paper examines the role of three types of knowledge spillovers, namely internal, market and institutional. R&D collaboration mediates the knowledge spillovers effects in the proposed structural equation models. This study demonstrates that German knowledge-intensive firms prefer internal knowledge transfer and market R&D collaboration, respectively. The empirical evidence shows that these tools promote innovation performance. The highest effects are obtained for the combination of market knowledge spillovers (.043***) and market R&D collaboration (.066***). This research thus provides justification for this strategy. It also shows that public financial support represents an effective measure for establishing R&D collaboration based on knowledge spillovers generated in the communication within the firm, in the market and with public institutions. The support of market and institutional R&D collaboration seems to be particularly important.

Keywords: Knowledge spillover, knowledge-intensive industries, innovation, collaboration, Germany

I INTRODUCTION

The great advance in new technologies in the last years has become the driver of the world economy in all industrial sectors (Chesbrough, 2006). Many theoretical and empirical studies have analysed the relationship between innovation capacity and technology-orientation of the firm (Hakala & Kohtamäki, 2011). They confirmed that the use of high-technologies has a positive effect on firm's product and process innovation success. The globalisation leads to higher dynamics of the use of high-technologies. This is associated with the price reduction of the available technologies, increasing scope of their use in "common practice". The rapid tempo of new knowledge application paradoxically requires a high initial investment in science and research (Carpenter & Petersen, 2002).

The firms and organizations that do not have investment necessary for a continuous stream of new technologies, must find new ways to provide them. More intensive cooperation in innovation processes seems to be a solution; the firms have to cooperate with the specific type of partners (customers, suppliers, competitors, etc.) on innovation processes. The cooperation with a large number of partners forms a cooperative network where every subject involved contributes with specific assets (from common production factors to patents, technology, knowledge or know-how) (Tsai, 2001; Matatkova & Stejskal, 2013; Hajek et al., 2014). These assets form the comparative competitive advantage of the firm. However, the firms have to be willing to share these sources of the advantage in the knowledge network (Meihami & Meihami, 2014).

It should be noted that companies build up and maintain only those relationships which are particularly valuable for them. As companies differ in respect of their needs for networking, it is plausible to assume that companies also differ in respect of the types of external partners they collaborate with (Gemünden, Ritter & Heydebreck, 1996).

The cooperating subjects are forming the networks, which are sometimes based solely on co-operation ties, but the networks based on knowledge usually achieve a greater efficiency. Some authors agree that the network configuration is shaped by both the importance of cooperation (perceived by the members of the network) and the intensity of cooperation. In knowledge networks, the synergistic and knowledge spillover effects occur. These effects significantly increase the efficiency of knowledge and innovation processes (Alegre, Sengupta & Lapiedra, 2013; Puškárová & Piribauer, 2016; Wang et al., 2016).

So far, however, there has been little discussion about the synergistic effects of knowledge spillovers and Research and Development (R&D) collaboration. This paper aims to shed some new light on the role of various types of knowledge spillovers on R&D collaboration and innovation performance, respectively. Specifically, it is hypothesized that firm innovation performance is significantly affected by the synergistic effects of knowledge spillovers and R&D collaboration.

The remainder of this paper is structured as follows. In the next section, a theoretical background is presented on knowledge spillover effects. Section 3 provides the research methodology and the characteristics of the data. Section 4 provides the empirical results. In Section 5, the paper is concluded, some political