

THE COOPERATION BETWEEN ENTERPRISES: SIGNIFICANT PART OF THE INNOVATION PROCESS – A CASE STUDY OF THE CZECH MACHINERY INDUSTRY

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Introduction

In recent years we have been able to see the growing importance of knowledge in the context of the emerging knowledge-based global economy (Miotti & Sachwald, 2003; Carmeli, Gelbard, & Reiter-Palmon, 2013; Prokop & Stejskal, 2015). Tödting and Tripl (2005) suggest that there is widespread agreement in academic literature that knowledge, learning, and innovation are key to economic development and the competitiveness of enterprises or regions (and nations). Generating innovation has come to be seen as a productive topic in economics and has also been becoming increasingly related to enterprise's ability to absorb external information, knowledge, and technologies (Negassi, 2004; Lichtenthaler, 2011). It is commonly accepted that (i) innovations are brought forward through an interactive process of knowledge generation, diffusion, and application; (ii) innovations are increasingly seen as fundamental to the competitiveness of enterprises and economies; and (iii) knowledge is critical to the process of innovation (Tether & Tajar, 2008; Tödting, Lehner, & Kaufmann, 2009). Tomlinson (2010) states that knowledge transfer definitively leads to greater levels of both product and process innovation. Knowledge can be generated internally or acquired externally (what an organization knows determines what it can do) and R&D cooperation is a fundamental ingredient for the division of innovative labor (Fritsch & Lukas, 2001; Stejskal & Hájek, 2015). We can state that entrepreneurship and innovation are fundamental drivers of economic growth, the creation of wealth in an

economy, and enterprise's long-term survival, profitability, and sustainable growth (Myšková, 2010; Classen et al., 2012; Acemoglu, Gancia, & Zilibotti, 2012; Kim et al., 2012).

Therefore, enterprises that want to succeed in the market are increasingly looking for partners with whom they can collaborate effectively and gain a competitive advantage (Stejskal & Hájek, 2012). It is clear that the role of R&D cooperation within the innovation process has recently increased (Xia, Danping, & Yue, 2012). This fact is supported by several studies that confirm the importance of cooperation – e.g. De Faria, Lima and Santos (2010); Tomlinson (2010) and Beers and Zand (2014). Collaboration with other enterprises and institutions in R&D is a decisive way to make external resources usable (Becker & Dietz, 2004). Enterprises and countries use the experience acquired (knowledge developed) by other enterprises (or countries) to build their own knowledge capital (Negassi, 2004). Becker and Dietz (2004) also suggest that the importance of R&D cooperation has risen steadily as a consequence of the growing complexity, risks, and costs of innovation and that enterprises engaged in the innovation process are aware of the necessity of establishing R&D cooperation to obtain expertise that cannot be generated in-house. But the question is which partner is the most suitable for innovative industrial enterprises. Enterprise cooperates with various partners for various reasons. Therefore, it is not possible to specify a universal partner that would be suitable for all enterprises in all sectors. De Faria, Lima, and Santos (2010) state that the factors influencing the importance

attributed to cooperation activities are different from the ones behind the decision to cooperate. Enterprises are able to cooperate with four different types of R&D partners: (i) competitors, (ii) suppliers, (iii) customers, and (iv) universities and research institutes (Belderbos, Carree, & Lokshin, 2004).

Finding a suitable partner for cooperation is a complicated process, because these partners are different for each sector. A number of studies have addressed the issue of collaboration in the manufacturing industry – e.g. Fritsch and Lukas (2001); Becker and Dietz (2004); Veugelers and Cassiman (2005); Tomlinson (2010). However, none of these studies examine the effectiveness of cooperative chains or compare the results for the industry. Such information could help managers appropriately target efforts to find suitable partners for cooperation.

The research presented in this article examines the impact of important partners in one of the sectors of manufacturing industry – the machinery industry (engineering). The paper intends to analyze the issues of (i) the importance of collaboration between enterprises and other partners through enterprises' innovative behavior and the overall growth of their performance and (ii) the efficiency of public subsidies from national and European funds. The paper will analyze both of these for the Czech Republic's machinery industry by using original multiple linear regression models based on the data from the Community Innovation Survey carried out in the Czech Republic for the period of 2010-2012. The remainder of the paper is structured as follows. The second section discusses the theoretical background and hypotheses. The data methodology, results, and their analysis are presented in the third section. The final section consists of conclusions and recommendations.

1. Theory and Hypotheses

Since the late 1980s, it has become increasingly acknowledged that spillovers of knowledge from external sources have an important impact on innovation processes and economic development and that the role of innovation as a factor of competitiveness and technological progress have combined to make enterprises intensify and expand their innovative capabilities (Miotti & Sachwald, 2003; Fritsch & Franke, 2004; Acs, Audretsch, & Lehmann, 2013; Alfaro & Chen, 2013). Negassi (2004) suggests that

the rise of inter-enterprise cooperation did not begin until the beginning of the 1980s.

A number of studies and researchers suggest that human capital factors play an important role in spurring regional growth and that regions (or enterprises) function as incubators of creativity and innovation (Lee, Florida, & Acs, 2004; Bartelsman, Dobbelaere, & Peters, 2014; Uramová & Koziak, 2008). The growing importance of knowledge processes is supported by Florida, who defined the new concept of learning regions, which are becoming focal points for knowledge creation and learning in the new age of global, knowledge-intensive capitalism (Florida, 1995). Institutional economics is another theoretical concept that supported the role of knowledge and innovation. Richard Nelson – one of the main proponents of this theory – described the three main issues of institutional economics: (i) technology and technological innovation; (ii) concepts of enterprises, their principles of operation, and their relation to competitors or subcontractors; and (iii) institutions (Blažek & Uhlíř, 2011). The endogenous growth theory, in which knowledge represents an input into the process of generating innovative activity in the economy, gives new insights into the role of knowledge in economic growth (Acs, de Groot, & Nijkamp, 2002).

As we can see, knowledge has been playing an important role in theoretical concepts in recent years. However, in-house production of innovation is no longer sufficient. Therefore, enterprises use R&D partnerships to access knowledge and build global R&D networks (Miotti & Sachwald, 2003; Beers & Zand, 2014; Hájková & Hájek, 2014), and adopt open innovation approach to use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation (Chesbrough, 2006; Chesbrough & Crowther, 2006). Tether (2002) states that the relationship between innovation and cooperation is not straightforward and that most enterprises still develop their new products, processes, and services without forming cooperative arrangements for innovation with other organizations. However, enterprises that engage in R&D and are attempting to introduce innovations at a higher level (i.e. innovations that are new to the market rather than new to the enterprise) are much more likely to engage in cooperative arrangements for innovation and

are able to access and leverage strategically critical resources to support the enterprise's innovation process (Tether, 2002; Classen et al., 2012). In fact, enterprises looking to improve their competitiveness need to develop two kinds of competences: (i) technological, which allows enterprises to add value to products and processes, and (ii) network, by which enterprises are able to link their organization to other players in the market to allow interactions beyond organizational boundaries (Ritter & Gemünden, 2004).

The relative importance of cooperation on innovative activity varies and depends upon a number of factors, i.e. the number of cooperative ties and the context in which network relations exist (Tomlinson, 2010). Belderbos et al. (2004) explored heterogeneities in the determinants of innovating enterprises' decisions to engage in R&D cooperation, differentiating between four types of cooperation partners (competitors, suppliers, customers, and universities and research institutes – representing institutional cooperation). The determinants of R&D cooperation differ depending on the types of cooperation: (i) the positive impact of enterprise size, R&D intensity, and incoming source-specific spillovers is weaker for competitor cooperation, reflecting greater concerns about appropriability and (ii) institutional spillovers are more generic in nature and positively impact all types of cooperation (Belderbos et al., 2004). Negassi (2004) analyzed the situation among French enterprises and suggested that the crucial determinants for the commercial success of innovations are enterprise size, market share, R&D intensity, and human capital. This study also pinpointed that spillover measurements (the acquisition of machine tools, foreign patents, licenses) and technological opportunities have a positive impact on innovation. Segarra-Blasco & Arauzo-Carod (2008) divided a propensity for R&D cooperation with other enterprises and institutions into three approaches: (i) the transaction cost approach (cooperative R&D projects enable the costs and risks of R&D activities to be shared and the dissemination of the results to be protected); (ii) the strategic management approach (cooperative behavior is a way of accessing additional resources and this leads to competitive advantages, see more Gavurova (2012); and (iii) the industrial

organization approach (which focuses on knowledge spillovers between partners).

Universities constitute one of the cooperation partners; however, enterprises do not cooperate with them very often. Veugelers and Cassiman (2005) used Community Innovation Survey data to analyze Belgian manufacturing enterprises and showed that (i) only a small fraction of innovative enterprises use science (i.e. universities and public research laboratories) as an important information source in their innovation process and (ii) cooperating with universities cannot be analyzed in isolation from the overall innovation strategy of the enterprise, because cooperating with universities is complementary to other innovation activities such as providing their own R&D, sourcing public information, and cooperating with other partners. Decision-making concerning suitable cooperative partners that will produce commercial results is missing from this study. Further studies (Belderbos, Carree, & Lokshin, 2004) argued that cooperation with competitors and universities impacted innovation output levels positively but cooperation with customers negatively – these findings are in contrast with lead-users concept (Von Hippel, 1986; 2005). This concept defines lead users as users whose present strong needs will become general in a marketplace months or years in the future and states that user-centered innovation is a very powerful and general phenomenon supporting innovative activities, therefore there is a need for further investigation of the relationship between enterprises and customers. Cooperation on innovation with domestic universities causes the growth of knowledge capital. In fact, universities are able to significantly influence the regional economy, play an important role in innovation performance, and are also linked to social effects (Mohammadi & Karami, 2014). The obvious implications of applying an increase in social capital (typically on the market) is also missing from this study. Universities are regarded as a key factor in national innovation plans and strategies by many authors (e.g. Goddard, Robertson, & Vallance, 2012; Watkins et al., 2015). Diez-Vial & Montoro-Sanchez (2014) show a positive relationship between the technological knowledge obtained from universities and the innovation carried out by enterprises. We can conclude that universities play an important role in the global knowledge economy and represent key points

of international contact, which is complicated for many reasons – such as mobility issues, the use of technology, or collaboration (Deiaco, Hughes, & McKelvey, 2012; Altbach, 2013). Therefore, we proceed from the arguments mentioned above and hypothesize that:

H₁: Enterprises that cooperate on innovative activities in the machinery industry in the Czech Republic demonstrate a greater growth of their performance than the ones that do not cooperate. In most cases, these enterprises participate in groups of enterprises that positively influence innovative creation within the group.

This assumption is based on a series of analyses. De Faria, Lima and Santos (2010) analyzed the effects of cooperation on the overall performance of enterprises and on innovation and R&D performance. They state that (i) enterprise's decision to cooperate on innovation is driven by the fact that cooperation is an efficient way to improve the probability of the success of innovation projects and (ii) cooperative enterprises have, on average, higher overall performance levels and higher R&D intensity than non-cooperative enterprises. Belderbos, Carree and Lokshin (2004) also suggested that cooperating enterprises are generally engaged in innovative activities to a greater degree and demonstrated the impact of cooperation on productivity growth. Cooperation with different partners leads to learning opportunities with regard to both cooperation and innovation skills and hence is expected to enhance enterprise's innovation performance (Beers & Zand, 2014). Chesbrough & Appleyard (2007) also suggested that to make strategic sense of innovation networks, collaborations, ecosystems, communities, and their implications for competitive advantage, open innovation concept and strategy are needed.

Participation in a group of enterprises presents another opportunity for cooperation, and it also supports the contention that innovations do not arise independently. This issue was also analyzed by a number of authors (e.g. Lodefalk, 2010; Hashi & Stojčić, 2013; Dachs & Peters, 2014).

As we demonstrated previously, innovation creation can be supported by cooperation with universities, because they positively impact innovation output levels. University-industry collaboration can be regarded as a determinant

of innovation, because more innovative enterprises tend to be more interested in collaborating with universities (Oyelaran-Oyeyinka & Abiola Adebowale, 2012; López et al., 2014). This assumption leads us to the next hypothesis:

H₂: Enterprises in the machinery industry in the Czech Republic that cooperate with universities and public research centers demonstrate a greater growth of their overall performance.

The previous hypotheses focus only on the importance of cooperation. However, many collaborations are often supported by public funds (Matt, Robin, & Wolff, 2012; Hottenrott & Lopes-Bento, 2014). In recent years, increasingly inefficient spending of public funds and subsidies has been resulting in additional spending on innovation by enterprises but has not lead to additional innovation output (Hashi & Stojčić, 2013). Therefore, let us define further hypothesis:

H₃: In the Czech Republic, public funding in the machinery industry is being provided in an inefficient way.

2. Data Methodology and Analysis of Research Results

A harmonized questionnaire of EU Member States from the Community Innovation Survey (CIS) carried out in the Czech Republic for the period of 2010-2012 by combining sample (stratified random sampling) and exhaustive surveys was used for the data collection. The CIS is a survey of innovation activity in enterprises that is designed to provide information on the innovativeness of sectors by enterprise type, the different types of innovation, and various aspects of innovation development, e.g. objectives, sources of information, public funding, and innovation expenditures (Eurostat, 2015). The CIS questionnaire was used to examine the impacts of cooperation by many other authors (e.g. Miotti and Sachwald (2003); Belderos, Carree and Lokshin (2004); Veugelers and Cassiman (2005); Tether and Tajar (2008); De Faria, Lima and Santos (2010). In total, data on 5,151 Czech enterprises with at least 10 employees were obtained (with a response rate greater than 60%). For the purpose of this study, we filtered 284 enterprises, i.e. only enterprises from the machinery industry, into our data group – specifically, enterprises covering NACE categories 29-30.

For analyzing the relationship between variables, a multiple linear regression model was used (regression models are commonly used for this kind of research, e.g. Schneider and Spieth (2013); Laeven, Levine and Michalopoulos (2015)). This model was adapted to investigate the relationship between one dependent variable, represented by the growth of total turnover between the years 2010-2012, and independent variables (see Tab. 1). Eurostat does not provide number of variables suitable for analyzing, input data from other source will not ensure the causality, therefore, for further research we investigate to analyze the growth of total turnover. Multiple linear regression models take the general form shown below (Chatterjee & Hadi, 2013; Wu et al., 2013):

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \varepsilon \quad (1)$$

where y is the dependent variable;
 $x_1, x_2 \dots x_n$ are independent variables;
 ε is an error term accounting for the variability in y that cannot be explained by the linear effect of the n independent variables;
 $\beta_1, \beta_2 \dots \beta_n$, called the regression parameters or coefficients, are unknown constants to be determined (estimated) from the data.

Firstly, before we composed the models, verification whether the data from CIS were correlated was conducted by using Spearman's test. Spearman's coefficient (r_s) measures the strength of the linear relationship between each two variables when the values of each variable are rank-ordered from 1 to N, where N represents the number of pairs of values (the N cases of each variable are assigned the integer values from 1 to N inclusive and no two cases share the same value). The difference between ranks for each case is represented by d_i . The general formula for Spearman's rank correlation coefficient takes the general form as follows (Weinberg & Abramowitz, 2002; Borradaile, 2013):

$$r_s = 1 - \frac{6 \sum d_i^2}{N^3 - N} \quad (2)$$

All calculations were made in statistical software STATISTICA (StatSoft Inc., 2011). Values of Spearman's test rejected the hypothesis that the data are correlated at the level of significance $p < 0.05$. After fulfilling

the first prerequisite (uncorrelated data) and refusal to multicollinearity in the model, the analysis itself was conducted. Subsequently, several multiple linear regression models were created to analyze the hypotheses. In total, the final model (Model 1) describing the situation in the Czech Republic's machinery industry used 17 variables (1 dependent, 10 independent categorical, and 6 independent continuous). All variables are listed in Tab. 1. The correlation coefficient R of Model 1 had a value of 0.979 and the coefficient of determination R^2 was 0.958. It means that regression line nearly perfectly fits the data. The P-value for this model was calculated at 0.000 (the value is rounded to three decimal places). The P-value showed that this model was significant at $p < 0.01$; therefore, the null hypothesis, that the model is not significant, was rejected. Therefore, Model 1 can be regarded as significant.

Before we test the hypothesis, it is necessary to describe the results provided by Model 1 (see Tab. 2). The results in Tab. 2 show that seven variables positively influence the dependent variable. We can see that the introduction of product innovation affects the growth of performance in all cases (independently, with other enterprises, and with universities and research institutes). When the enterprise introduced product innovations separately without cooperation, this variable is significant at $p < 0.05$ (0.047). Conversely, if enterprise collaborates in the development of product innovations, it is possible to observe that this cooperation has a greater impact on the creation of innovations. When enterprises use other enterprises to cooperate, the value was measured at 0.002 (0.004 for cooperation with universities). Both values are significant at the higher level of significance ($p < 0.01$). When process innovation was implemented, we can see that the enterprise's performance is most affected when enterprises introduce innovations alone or with universities and research institutions. In both cases, the p-value is measured at 0.000, which is significant at a significance level of $p < 0.01$. On the other hand, the introduction of process innovations in collaboration with other enterprises proved to be insignificant. Participation in group of enterprises (GP) and cooperation on technical innovation activities (CO) are among the other significant variables that affect the growth of total turnover.

Tab. 1: Input variables

Dependent variable	Independent variables (categorical)	Independent variables (continuous)
Growth of total turnover	Part of a group of enterprises (GP)	Total innovation expenditure/ total turnover (RTOT/TOT)
	Introduction of product innovation: a) innovation was developed independently by the enterprise (INPRI); b) innovation was developed in collaboration with other enterprises (INPRE); c) innovation was developed in collaboration with universities and research institutes (INPRU)	In-house R&D expenditure/ total turnover (RRDIN/RTOT)
	Introduction of process innovations: a) innovation was developed independently by the enterprise (INPSI); b) innovation was developed in collaboration with other enterprises (INPSE); c) innovation was developed in collaboration with universities and research institutes (INPSU)	External R&D expenditure/total turnover (RRDEX/RTOT)
	Public financial support from the EU (FUNEU)	Acquisition of equipment/total turnover (RMAC/RTOT)
	Regional and/or national public financial support (FUNGMT)	Acquisition of external knowledge/total turnover (ROEK/RTOT)
	Cooperation on technical innovation activities (CO)	Acquisition of other innovation activities/total turnover (ROTH/RTOT)

Source: own

Legend: introduction of product innovation = introduction of a new or improved product/service; introduction of process innovations = new or improved method of production or provision of services, also including distribution and storage, providing business support activities, or significant changes in technology, equipment, or software)

Tab. 2: Variables used in Model 1

Variables	p	sd
RTOT/TOT	0.689	1.739
IN/RTOT	0.694	0.011
RMAC/RTOT	0.610	0.009
GP	0.037**	1.342
INPRI	0.047**	1.479
INPRE	0.002***	1.511
INPRU	0.004***	1.312
INPSI	0.000***	1.082
INPSE	0.359	0.684
INPSU	0.000***	1.007
FUNEU	0.755	0.768
CO	0.000***	0.706

Source: own

Legend: p = p-value; sd = standard deviation; ***significant at $p < 0.01$; **significant at $p < 0.05$

The results in Tab. 2 allow us to confirm hypothesis H_1 and show that innovation does not arise in isolation, respectively of course innovations can occur in isolation, however cooperation could be positively affected by innovation creation. The variable CO was analyzed as one of the most significant variables with greater influence on the enterprises' performance (0.000***). Moreover, participation in a group of enterprises that showed strong chains was measured as significant. We can say that external sources of knowledge gained from innovative collaboration currently represent an important competitive element; therefore, enterprises often opt for external cooperative partners that have a significant impact on their overall performance in creating innovation (e.g. INPRE, INPRU, INPSU – see Tab. 2). A number of foreign studies confirm this fact: Clausen (2013); Gallego, Rubalcaba, and Suárez (2013); and Stock, Totzauer, and Zacharias (2014).

The results in Tab. 2 also allow us to test hypothesis H_2 . Collaboration with universities and research institutes plays an important role in the machinery industry in the Czech Republic. In both cases (product and process innovation), there are significant interactions between variables. For product innovation, the importance of cooperation with these institutions and with other enterprises outweighed the creation of innovation independently. For process innovation, creating innovation with universities and research institutes and creating these innovations independently is

gaining in importance (creating innovations in collaboration with other enterprises is insignificant in this case). Robin and Schubert (2013) also analyzed the impact of cooperation with public research on enterprises' product and process innovations by using the CIS. They examined that cooperating with public research increases product innovation but has no effect on process innovation, which depends more on the enterprises' openness. In our analysis, cooperation with public research increases enterprises' performance for both product and process innovation; therefore, we can confirm hypothesis H_2 . Model 1 also provided a number of additional higher order interactions that support our hypothesis H_2 . Tab. 3 shows that cooperation with the public sector can contribute to significant ties in some cases (more than when this type of cooperation is not used). The results in Tab. 2 show that if the enterprise performs product innovation independently (INPRI), the influence on the measured value of the enterprises' performance was 0.047 (significant at $p < 0.05$). If there is a subsequent interaction with INPRU or INPSU, the resulting value was 0.001 (significant at $p < 0.01$). Cooperation in the creation of product innovations has proven to be more significant in both cases – cooperation on product and process innovation. For process innovation, it was revealed that only INPRU cooperation leads to positive effects (leading to the same value of 0.000). The combination of INPSI*INPSU was analyzed to be insignificant in this case.

Tab. 3: The Influence of Public Cooperation on Enterprises' Innovative Activity

	INPRU	INPSU
INPRI	0.001*** (1.323)	0.001*** (1.303)
INPSI	0.000*** (0.691)	0.807 (1.175)

Source: own

Legend: ***significant at $p < 0.01$; the values of standard deviations are in brackets

Even though INPSU proved to be insignificant, further analysis revealed a combination of variables with INPSU that led to important results (e.g. the combination with the INPSI variable). The combination of variables INPSU*INPRU or INPSU*INPRE showed a positive interaction that influenced the enterprises' overall performance. The value

of these impacts were measured identically at 0.001 (significant at $p < 0.01$).

To test hypothesis H_3 , we analyzed the impact of public subsidies on enterprises' performance. Tab. 2 shows that the provision of public subsidies from EU funds (FUNEU) was insignificant (0.755). Therefore, we included the variable FUNGMT and created Model 2

to analyze whether public funds increase the enterprises' performance. The correlation coefficient R from the second regression model showed a value of 0.979. The coefficient of determination R² was 0.959. The p-value of this model was measured at 0.000. The p-value showed that this model was significant at p < 0.01. Therefore, the null hypothesis was rejected. Model 2 is regarded as significant. However, the results showed that there are

no significant interactions influencing the enterprises' performance. This result allows us to confirm hypothesis H₃, in which we argued that there is inefficiency in providing public subsidies. The results in Tab. 2 also confirm this claim (FUNEU is insignificant in Model 1).

However, we also found positive combinations of variables that confirm the significant influence of European public funds in Model 1.

Tab. 4: Variables with a positive impact on public subsidies

	FUNEU
CO	0.000*** (0.392)
GP	0.000*** (0.965)
GP*INPSI	0.000*** (0.464)
CO*INPSI	0.000*** (0.403)

Source: own

Legend: ***significant at p < 0.01; the values of standard deviations are in brackets

The results in Tab. 4 not only show that the importance of cooperation and participation in a group of enterprises positively influences the spending of public funds but also confirm that it is possible for well targeted public spending to lead to effective results. When public funds are provided to enterprises individually, no significant interactions were found and the p value was measured at 0.755 (see Tab. 2). Conversely, strong ties influencing enterprises' performance emerge when public support is targeted correctly and the combination of FUNEU*CO or FUNEU*GP exists. These values are 0.000 (significant at p < 0.01). Other strong ties occurred at the higher order interactions. The combination of GP*INPSI*FUNEU or INPSI*CO*FUNEU showed significant interactions with a value of 0.000, which are also significant at p < 0.01. Even though an inefficient use of public resources occurs in most cases, it is possible to find cases where they are used effectively. Czarnitzki and Lopes-Bento (2014) came to a similar conclusion. They suggested that public funding triggers socially beneficial research projects (but they don't talk about economic efficiency, which is often missing in these projects) and that the co-existence of national and European policies does not lead to crowding-out effects when compared to

a hypothetical world with a closed economy and no supplemental European policies.

Discussion and Conclusions

The intent of this paper was to analyze whether enterprises' collaboration on innovative activities in the Czech Republic's machinery industry has a positive impact on their overall performance by examining three research hypotheses. The results of the regression models that were composed allowed us to confirm individual hypotheses. Hypothesis H₁ indicates the need to systematically promote cooperation between enterprises and other partners and create groups of enterprises that have an impact on the growth of enterprises' overall performance. This finding confirm the concept of open innovation that is based on different research streams and suggest that valuable ideas can come from inside or outside the enterprise and can go to market from inside or outside the enterprise as well (Chesbrough, 2006; Chesbrough & Appleyard, 2007), therefore, cooperation is seen as a crucial way to increase enterprises' growth of turnover. The results of hypothesis H₂ allow us to state that enterprises in the Czech Republic's machinery industry that cooperate with universities and public research centers demonstrate

a greater positive influence on their overall performance. Universities represent important collaborative partners in the Czech Republic's machinery industry. These collaborations between enterprises and universities positively affect enterprises' creation of innovation – both product and process. Therefore, we recommend continuing to support these types of cooperation in the machinery industry in the Czech Republic and creating links between enterprises and universities. This remains true in the case that enterprises do not receive support from public budgets. We argue that there is inefficient provision of public aid in the machinery industry in the Czech Republic, which is possibly caused by excessively granting public funding without directly monitoring its impact; this was subsequently confirmed by hypothesis H3. A number of projects financed by the European Union arise only in order to exploit these funds, without anyone to oversee the effectiveness of these projects. Excessive bureaucracy is another reason that leads to inefficiency when providing public aid. On the other hand, advanced analysis showed that, if public funding is properly targeted, it may be effective and powerfully influence enterprises' collaboration activities and overall performance. Therefore, it is necessary to adopt an appropriate way to provide public support to the machinery industry in the Czech Republic. It should be noted that innovative activities are essential parameter strategic (i.e. long-term) performance. Relevant data in an appropriate time range are critical to the explanatory power of every similar research. The limitation of this research is a smaller range of the analyzed sample. For this reason, the generalizability of result is limited.

We recommend that governments put more emphasis on adapting subsidies to specific entrepreneurial activities and promoting the emergence of common linkages between enterprises and universities. In future research, we plan to analyze the issue of collaboration partners and providing public subsidies to other industries in the Czech Republic and subsequently compare the results with those of other European countries.

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References

Acemoglu, D., Gancia, G., & Zilibotti, F. (2012). Competing engines of growth: Innovation and standardization. *Journal of Economic Theory*, 147(2), 570-601. doi:10.1016/j.jet.2010.09.001.

Acs, Z. J., Audretsch, D. B., & Lehmann, E. E. (2013). The knowledge spillover theory of entrepreneurship. *Small Business Economics*, 32(15), 757-774. doi:10.1007/s11187-008-9157-3.

Acs, Z. J., de Groot, H. L., & Nijkamp, P. (Eds.). (2013). *The emergence of the knowledge economy: A regional perspective*. Springer Science & Business Media. doi:10.1007/978-3-540-24823-1.

Alfaro, L., & Chen, M. X. (2013). *Market reallocation and knowledge spillover: The gains from multinational production* (BGIE Unit Working Paper). p. 12-111. Harvard Business School.

Altbach, P. G. (2013). Advancing the national and global knowledge economy: the role of research universities in developing countries. *Studies in higher education*, 38(3), 316-330. doi:10.1080/03075079.2013.773222.

Bartelsman, E., Dobbelaere, S., & Peters, B. (2015). Allocation of human capital and innovation at the frontier: firm-level evidence on Germany and the Netherlands. *Industrial and Corporate Change*, 24(5), 875-949. doi:10.1093/icc/dtu038.

Becker, W., & Dietz, J. (2004). R&D cooperation and innovation activities of firms – evidence for the German manufacturing industry. *Research policy*, 33(2), 209-223. doi:10.1016/j.respol.2003.07.003.

Beers, C., & Zand, F. (2014). R&D cooperation, partner diversity, and innovation performance: an empirical analysis. *Journal of Product Innovation Management*, 31(2), 292-312. doi:10.1111/jpim.12096.

Belderbos, R., Carree, M., & Lokshin, B. (2004). Cooperative R&D and firm performance. *Research policy*, 33(10), 1477-1492. doi:10.1016/j.respol.2004.07.003.

Belderbos, R., Carree, M., Diederer, B., Lokshin, B., & Veugelers, R. (2004).

- Heterogeneity in R&D cooperation strategies. *International journal of industrial organization*, 22(8), 1237-1263. doi:10.1016/j.ijindorg.2004.08.001.
- Blažek, J., & Uhlíř, D. (2011). *Teorie regionálního rozvoje: nástin, kritika, implikace*. Praha: Karolinum.
- Borradaile, G. J. (2013). *Statistics of earth science data: their distribution in time, space and orientation*. Springer Science & Business Media. doi:10.1007/978-3-662-05223-5.
- Carmeli, A., Gelbard, R., & Reiter-Palmon, R. (2013). Leadership, Creative Problem-Solving Capacity, and Creative Performance: The Importance of Knowledge Sharing. *Human Resource Management*, 52(1), 95-121. doi:10.1002/hrm.21514.
- Chatterjee, S., Hadi, A. S. (2013). *Regression analysis by example*. John Wiley & Sons.
- Chesbrough, H. (2006). Open innovation: a new paradigm for understanding industrial innovation. In H. Chesbrough, W. Haverbeke, & J. West (Eds.), *Open innovation: Researching a new paradigm* (pp. 1-12). Oxford: Oxford University Press.
- Chesbrough, H. W., & Appleyard, M. M. (2007). Open innovation and strategy. *California management review*, 50(1), 57-76. doi:10.2307/41166416.
- Chesbrough, H., & Crowther, A. K. (2006). Beyond high tech: early adopters of open innovation in other industries. *R&D Management*, 36(3), 229-236. doi:10.1111/j.1467-9310.2006.00428.x.
- Classen, N., Van Gils, A., Bammens, Y., & Carree, M. (2012). Accessing resources from innovation partners: The search breadth of family SMEs. *Journal of Small Business Management*, 50(2), 191-215. doi:10.1111/j.1540-627X.2012.00350.x.
- Clausen, T. H. (2013). External knowledge sourcing from innovation cooperation and the role of absorptive capacity: empirical evidence from Norway and Sweden. *Technology Analysis & Strategic Management*, 25(1), 57-70. doi:10.1080/09537325.2012.751009.
- Czarnitzki, D., & Lopes-Bento, C. (2014). Innovation subsidies: Does the funding source matter for innovation intensity and performance? Empirical evidence from Germany. *Industry and Innovation*, 21(5), 380-409. doi:10.1080/13662716.2014.973246.
- Dachs, B., & Peters, B. (2014). Innovation, employment growth, and foreign ownership of firms: A European perspective. *Research Policy*, 43(1), 214-232. doi:10.1016/j.respol.2013.08.001.
- De Faria, P., Lima, F., & Santos, R. (2010). Cooperation in innovation activities: The importance of partners. *Research Policy*, 39(8), 1082-1092. doi:10.1016/j.respol.2010.05.003.
- Deiaco, E., Hughes, A., & McKelvey, M. (2012). Universities as strategic actors in the knowledge economy. *Cambridge Journal of Economics*, 36(3), 525-541. doi:10.1093/cje/bes024.
- Diez-Vial, I., & Montoro-Sanchez, A. (2014). Linkages with universities and innovation: an application in a science park. *Academy of Management Proceedings*, 1. doi:10.5465/AMBPP.2014.13856.
- Eurostat. (2015). *Community Innovation Survey (CIS)*. Retrieved July 23, 2015, from http://ec.europa.eu/eurostat/web/microdata/community_innovation_survey.
- Florida, R. (1995). Toward the learning region. *Futures*, 27(5), 527-536. doi:10.1016/0016-3287(95)00021-N.
- Fritsch, M., & Franke, G. (2004). Innovation, regional knowledge spillovers and R&D cooperation. *Research policy*, 33(2), 245-255. doi:10.1016/S0048-7333(03)00123-9.
- Fritsch, M., & Lukas, R. (2001). Who cooperates on R&D? *Research policy*, 30(2), 297-312. doi:10.1016/S0048-7333(99)00115-8.
- Gallego, J., Rubalcaba, L., & Suárez, C. (2013). Knowledge for innovation in Europe: The role of external knowledge on firms' cooperation strategies. *Journal of Business Research*, 66(10), 2034-2041. doi:10.1016/j.jbusres.2013.02.029.
- Gavurova, B. (2012). Source Identification of Potential Malfunction of Balanced Scorecard System and Its Influence on System Function. *E&M Ekonomie a Management*, 15(3), 76-90.
- Goddard, J., Robertson, D., & Vallance, P. (2012). Universities, Technology and Innovation Centres and regional development: the case of the North-East of England. *Cambridge Journal of Economics*, 36(3), 609-627. doi:10.1093/cje/bes005.
- Hájková, V., & Hájek, P. (2014). Efficiency of knowledge bases in urban population and economic growth – Evidence from European cities. *Cities*, 40, 11-22. doi:10.1016/j.cities.2014.04.001.
- Hashi, I., & Stojčić, N. (2013). The impact of innovation activities on firm performance using a multi-stage model: Evidence from the

Community Innovation Survey 4. *Research Policy*, 42(2), 353-366. doi:10.1016/j.respol.2012.09.011.

Hottenrott, H., & Lopes-Bento, C. (2014). (International) R&D collaboration and SMEs: The effectiveness of targeted public R&D support schemes. *Research Policy*, 43(6), 1055-1066. doi:10.1016/j.respol.2014.01.004.

Kim, Y. K., Lee, K., Park, W. G., & Choo, K. (2012). Appropriate intellectual property protection and economic growth in countries at different levels of development. *Research policy*, 41(2), 358-375. doi:10.1016/j.respol.2011.09.003.

Laeven, L., Levine, R., & Michalopoulos, S. (2015). Financial innovation and endogenous growth. *Journal of Financial Intermediation*, 24(1), 1-24. doi:10.1016/j.jfi.2014.04.001.

Lee, S. Y., Florida, R., & Acs, Z. (2004). Creativity and entrepreneurship: a regional analysis of new firm formation. *Regional studies*, 38(8), 879-891. doi:10.1080/0034340042000280910.

Lichtenthaler, U. (2011). Open innovation: Past research, current debates, and future directions. *The Academy of Management Perspectives*, 25(1), 75-93. doi:10.5465/AMP.2011.59198451.

Lodefalk, M. (2010). *Servicification of Manufacturing: Evidence from Swedish Firm and Enterprise Group Level Data* (Working paper 3/2010). Örebro: School of Business, Örebro University.

López, S. F., Astray, B. P., Pazos, D. R., & Calvo, N. (2014). Are firms interested in collaborating with universities? An open-innovation perspective in countries of the South West European Space. *Service Business*, 9(4), 637-662. doi:10.1007/s11628-014-0243-0.

Matt, M., Robin, S., & Wolff, S. (2012). The influence of public programs on inter-firm R&D collaboration strategies: project-level evidence from EU FP5 and FP6. *The Journal of Technology Transfer*, 37(6), 885-916. doi:10.1007/s10961-011-9232-9.

Miotti, L., & Sachwald, F. (2003). Co-operative R&D: why and with whom?: An integrated framework of analysis. *Research Policy*, 32(8), 1481-1499. doi:10.1016/S0048-7333(02)00159-2.

Mohammadi, A., & Karami, H. (2014). The Role of Universities in Innovation Development as Trainer and Innovator. *International Journal of Management Sciences*, 3(7), 471-486.

Myšková, R. (2010). The development and use supporting of renewable energy sources in terms of Czech enterprises. *WSEAS Transactions on Environment and Development*, 6(3), 188-197.

Negassi, S. (2004). R&D co-operation and innovation a microeconomic study on French firms. *Research policy*, 33(3), 365-384. doi:10.1016/j.respol.2003.09.010.

Oyelaran-Oyeyinka, B., & Abiola Adebowale, B. (2012). University-Industry Collaboration as a Determinant of Innovation in Nigeria. *Institutions and Economies*, 4(1), 21-46.

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.

Ritter, T., & Gemünden, H. G. (2004). The impact of a company's business strategy on its technological competence, network competence and innovation success. *Journal of business research*, 57(5), 548-556. doi:10.1016/S0148-2963(02)00320-X.

Robin, S., & Schubert, T. (2013). Cooperation with public research institutions and success in innovation: Evidence from France and Germany. *Research Policy*, 42(1), 149-166. doi:10.1016/j.respol.2012.06.002.

Schneider, S., & Spieth, P. (2013). Business model innovation: towards an integrated future research agenda. *International Journal of Innovation Management*, 17(1), 1-34. doi:10.1142/S136391961340001X.

Segarra-Blasco, A., & Arauzo-Carod, J. M. (2008). Sources of innovation and industry–university interaction: Evidence from Spanish firms. *Research Policy*, 37(8), 1283-1295. doi:10.1016/j.respol.2008.05.003.

StatSoft, Inc. (2011). STATISTICA (data analysis software system) (version 10) [software]. Available from: www.statsoft.com.

Stejskal, J., & Hájek, P. (2012). Competitive advantage analysis: A novel method for industrial clusters identification. *Journal of Business Economics and Management*, 13(2), 344-365. doi:10.3846/16111699.2011.620154.

Stejskal, J., & Hájek, P. (2015). Modelling knowledge spillover effects using moderated and mediation analysis – The case of Czech high-tech industries. *Lecture Notes in Business Information Processing*, 224, 329-341. doi:10.1007/978-3-319-21009-4_25.

- Stock, R. M., Totzauer, F., & Zacharias, N. A. (2014). A Closer Look at Cross-functional R&D Cooperation for Innovativeness: Innovation-oriented Leadership and Human Resource Practices as Driving Forces. *Journal of Product Innovation Management*, 31(5), 924-938. doi:10.1111/jpim.12132.
- Tether, B. S. (2002). Who co-operates for innovation, and why: an empirical analysis. *Research policy*, 31(6), 947-967. doi:10.1016/S0048-7333(01)00172-X.
- Tether, B. S., & Tajar, A. (2008). Beyond industry–university links: Sourcing knowledge for innovation from consultants, private research organizations and the public science-base. *Research Policy*, 37(6), 1079-1095. doi:10.1016/j.respol.2008.04.003.
- Tether, B. S., & Tajar, A. (2008). The organisational-cooperation mode of innovation and its prominence amongst European service firms. *Research policy*, 37(4), 720-739. doi:10.1016/j.respol.2008.01.005.
- Tödtling, F., & Tripl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research policy*, 34(8), 1203-1219. doi:10.1016/j.respol.2005.01.018.
- Tödtling, F., Lehner, P., & Kaufmann, A. (2009). Do different types of innovation rely on specific kinds of knowledge interactions? *Technovation*, 29(1), 59-71. doi:10.1016/j.technovation.2008.05.002.
- Tomlinson, P. R. (2010). Co-operative ties and innovation: Some new evidence for UK manufacturing. *Research Policy*, 39(6), 762-775. doi:10.1016/j.respol.2010.02.010.
- Uramova, M., & Koziak, R. (2008). Regional disparities in Slovakia from the Aspect of Average Nominal Wage. *E&M Ekonomie a Management*, 11(2), 6-17.
- Veugelers, R., & Cassiman, B. (2005). R&D cooperation between firms and universities. Some empirical evidence from Belgian manufacturing. *International Journal of Industrial Organization*, 23(5), 355-379. doi:10.1016/j.ijindorg.2005.01.008.
- Von Hippel, E. (1986). Lead users: a source of novel product concepts. *Management science*, 32(7), 791-805.
- Von Hippel, E. (2005). Democratizing innovation: The evolving phenomenon of user innovation. *Journal für Betriebswirtschaft*, 55(1), 63-78. doi:10.1007/s11301-004-0002-8.
- Watkins, A., Papaioannou, T., Mugwagwa, J., & Kale, D. (2015). National innovation systems and the intermediary role of industry associations in building institutional capacities for innovation in developing countries: A critical review of the literature. *Research Policy*, 44(8), 1407-1418. doi:10.1016/j.respol.2015.05.004.
- Weinberg, S. L., & Abramowitz, S. K. (2002). *Data analysis for the behavioral sciences using SPSS*. Cambridge University Press.
- Wu, C. H., Li, J. B., & Chang, T. Y. (2013). SLinRA2S: A Simple Linear Regression Analysis Assisting System. In *e-Business Engineering (ICEBE), 2013 IEEE 10th International Conference on* (pp. 219-223). IEEE. doi:10.1109/ICEBE.2013.33.
- Xia, F., Danping, Z., & Yue, H. (2012). Enterprise innovation efficiencies of university-industry cooperation and their influential factors. *Science Research Management*, 2, 33-36.

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THE COOPERATION BETWEEN ENTERPRISES: SIGNIFICANT PART OF THE INNOVATION PROCESS – A CASE STUDY OF THE CZECH MACHINERY INDUSTRY

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In recent years, we have been able to see the growing importance of knowledge in the context of the emerging knowledge-based global economy. It is commonly accepted that (i) innovations are brought forward through an interactive process of knowledge generation, diffusion, and application; (ii) innovations are increasingly seen as fundamental to the competitiveness of enterprises and economies; and (iii) knowledge is critical to the process of innovation. The relative importance of cooperation on innovative activity varies and depends upon a number of factors, i.e. the number of cooperative ties and the context in which network relations exist. The determinants of R&D cooperation differ depending on the types of cooperation: (i) the positive impact of enterprise size, R&D intensity, and incoming source-specific spillovers is weaker for competitor cooperation, reflecting greater concerns about appropriability and (ii) institutional spillovers are more generic in nature and positively impact all types of cooperation. The question is the effectiveness of different types and subjects of cooperation. This article aims to analyze the impact of (i) the cooperation and participation in the group of enterprises; (ii) cooperation with universities; (iii) the provision of state aid; on overall enterprises' performance. Analysis was performed on data from Community Innovation Survey (CIS) carried out in the Czech Republic between the period 2010-2012 by using own multiple linear regression models. The results confirm the importance of cooperation between enterprises and the positive impact of participation of enterprises in the enterprise groups. Cooperation with universities and research organizations also has a positive impact on the performance of enterprises in the machinery industry in the Czech Republic. We also show that there were inefficient provisions of public aid in machinery industry in the Czech Republic.

Key Words: Cooperation, innovation, knowledge transfer, machinery industry.

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