Determinants of Innovation Activities: Public Financing and Cooperation: Case Study of Czech Republic and Hungary

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Abstract Innovation represents one of the key factors in achieving competitive advantage of companies, hence the whole economies. Therefore, managers aim to acquire knowledge. Likewise public policy makers understand an importance of creating innovations and thus promote the generation and spread of positive effects through knowledge diffusion. In the context of modern innovation, the science-industry collaboration comes into its importance. Many foreign studies pointing to the fact, that this cooperation cannot be successful in each sector and that not every kind of innovation depends on the same knowledge flows. Therefore, we can notice inefficient attempts to cooperate in a number of cases, which are frequently accompanied by excessive use of national and European funds. The article aims to compare situation of companies in manufacturing industry in the Czech Republic and Hungary to analyze how is their growth of total turnover affected by (i) implementation of innovation (product and process); (ii) university-industry and government-industry collaboration; (iii) provision of public subsidies (national and European). We show, by using the multiple linear regression models, that cooperation with universities and with other enterprises within enterprise groups positively influences innovation activities. The results also show that public funds are more effectively provided in Hungary, more specifically the European funds. We provide comparison between Czech and Hungarian manufacturing industries and proposals how to improve the efficiency of national funds provision, which is not sufficient in these countries.

Keywords Cooperation • Knowledge acquisition • Modern innovation • Public funding

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1 Introduction

Since the 1970s of the twentieth century there is a gradual change in the economies of countries. It spontaneously leads to decreased in industrial production (in - manufacturing-based economy) and shifted attention to the services production (service-driven economy). It is due to many factors, particularly to developments in countries, but also to technology boom, and its speed.

It fundamentally changed the producers' requirements for production factors, which they are demanding. There is a shift from material and capital inputs to the input information, respectively knowledge. Many authors and studies have begun to analyse the influence of knowledge, respectively their research was focused on the ability to produce knowledge and ability to gain competitive advantage in various markets. Studies suggest that the impact of knowledge is essential, but quite distinct from the type of industry where rise. Scholars suggest that for economic growth promotion it is necessary to take actions to support the creation and dissemination of knowledge, to support research and development activities, investment in appropriate infrastructure and communication technology. There has also been a significant shift in the use of intellectual capital, patents and licenses. An economy that based on knowledge-intensive activities is described as a knowledge-based economy (Powell and Snellman 2004). Already in the 1990s of the twentieth century studies have been published and they provide the evidences that the knowledge economy increases gross domestic product (Abramovitz and David 1996).

However, some authors point out the attention to divide knowledge flows (as determinants) from effects (result or outputs) that they cause (Peri 2005). The flows represent a situation where information and knowledge passes through "learning" to another entity (institution). The effects are the result of the application realized (mostly) in commercial sector. They lead to commercialization and thus to achieve business goals. The scholars still warn that it is necessary to analyse knowledge flows separately and then evaluate the effects of knowledge flows (processes).

The remainder of this paper has been divided into four sections. The paper first gives a brief overview of the evidence for cooperation and knowledge as the most important production factors nowadays. The next section lays out the theoretical foundations of structural equation modelling, and analysis of the research data. Section 4 provides the results of analysis, conclusion and discusses its implications.

2 Selected Determinants for Innovation Activities

Many studies have focused on analysing the determinants of the knowledge economy in order to better control the amount of the increase in GDP due to the knowledge economy. Absolutely fundamental determinants are as follows: (1) knowledge (mostly codified knowledge) and information; (2) infrastructure, particularly technical, to ensure the transfer of information and technology; (3) educated and skilled workers with responsibilities such as creativity and innovation; (4) the scientific and technical institutions and other helpful organizations willing to cooperate. It turns out that the mentioned determinants are the pre-conditions; respectively they help to create an environment for knowledge transfer and creation of innovations (milieu). However, this innovative milieu requires further factors which are the common denominator in all the previously mentioned "secondary" determinants. Especially in Europe, it is possible to "secondary" or supporting determinants include: (i) cooperation and (ii) public financial support, which aims to support some of the primary determinants, in particular to ensure knowledge acquisition and transfer service, respectively willingness to cooperate. Completely separate pre-condition form, for example, public policy and management strategy.

Cooperation is more a prerequisite for the realization of knowledge flows and processes. Prerequisite for cooperation is a group of companies and scientific research institutes, applying a model of open innovation. The role of universities and R&D organizations is far more important than it was 20 years ago (Etzkowitz and Leydesdorff 2000). The universities and public research institutes have emerged as key components of the national innovation system (Eom and Lee 2010), which were gradually transformed into regional innovation systems (Cooke et al. 1997; Matatkova and Stejskal 2013). Any form of system or network of relationships is beneficial to knowledge transfer, but not same weight (equally). It turns out that in some sectors (and some states); the cooperation between firms has higher efficiency than cooperation between firms and knowledge-based organizations (Prokop and Stejskal 2015). The innovation systems are operational structure of cooperating entities from the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies. And there are the relationships that lead to the production, diffusion and economic application of new ideas and knowledge (Lundvall 1992).

R&D and university—knowledge-based organizations—play the important role in knowledge and innovation systems. Eom and Lee (2010) suggest that there are two contrasting views on the role of universities in these chains. The first view regards the universities involvement to triple helix system, later also quadruple-helix system. Triple-helix model presents the connection among industry and university and government, where the university plays social and knowledge role. Individual interaction and knowledge transfer in this simple system makes innovations creation easier, faster and cheaper. This emphasizes the "third mission" of the university, that is, serving for economic development aside from teaching and research (Etzkowitz and Leydesdorff 1997). Moreover, this model emphasizes the cooperation between research and application sphere in order to use the most of new knowledge. It should be added that spill-over effects are formed in this form of collaboration (Stejskal and Hajek 2015).

The second view is associated with the definition of the New Economics of Science (Partha and David 1994). It is a narrow view of the university, which, according to these authors, especially educational institution, and research leading to the industrialization of knowledge is perceived as harmful. It should be noted that the assessment of the impact and contribution of universities to industry is to be done individually, in different regions separately (the same conclusion is also in Eun et al. 2006). However, there are a number of studies that deals precisely analysing the contribution of university-industry cooperation in various sectors of industry. Some scholars argued that learning from advancements in technology is crucial for science-based industries, such as electronics, biotechnology and chemicals, for which industry-university should be more important (findings are confirmed by the results of studies (Pavitt 1984; Blumenthal et al. 1986; Feng et al. 2015; Althoff Philippi et al. 2015).

The financing is a specific secondary determinant of innovation activity. This money is inserted by co-actors into the realization of interaction and application of knowledge. In this study, it is not private investment, but of *public financing* (sometimes government-sponsored R&D or cooperation). The theory of public economics shows that public funding may be used for market failure preventing to new knowledge provision. The question for future research is whether in this case there is indeed a market failure when demand for new knowledge is increasing now. The first justification of public funding can be this: knowledge spill-overs lead to incomplete appropriability of the R&D results, which gives rise to market failure (Griliches 1992). The second justification is that R&D involves three types of uncertainties with regard to technological success, commercial success, and competitor behaviour (Malmberg et al. 1996; Nishimura and Okamuro 2011). However, the research results show it is strongly required that public support for innovation activities should be targeted. And the achieving of the targets must be carefully checked (also ex ante checks). Acceptable objectives of public support can be for example these: R&D cooperation and generate learning effects to Increase the absorptive capacity of supported subjects; public money to enable the use experimental research activities with the high initiative costs; innovation creation for public or private sector, which in future will generate societal benefits. The public support for the cooperating chains is justifiable even if public money is to remove obstacles that hamper knowledge transfer and reduced ability to generate innovation.

In practice, however, the public support is provided to research and promote collaboration without proof of the market failure. The reason is that public support is provided (typically in Europe) very heavily in member states and not-providing this support would reduce the competitiveness of individual beneficent. When public support was provided, the crowding-out effects of private investments were recorded. If authorities select high-quality projects and low-risk objectives, they can avoid the inefficient allocation of a harmful crowding-out effect (Nishimura and Okamuro 2011). Likewise, there are studies that show a high degree of public support inefficiency (Cowling et al. 1999; Hospers et al. 2009). Scholars argue that decisions on public subsidies are made by public choice under information asymmetry conditions (politicians have less information than the managers of companies; Wolf 1993).

The aim of the paper is to make an initial comparison of firms situation in manufacturing industry in the Czech Republic and Hungary with an emphasis on the determinants of innovative activities: public financing and cooperation. We aim to analyze how is the growth of total turnover affected by (i) implementation of innovation (product and process); (ii) university-industry and government-industry collaboration; (iii) provision of public subsidies (national and European); in these countries. For the purpose of this study and with following previous arguments, we hypothesize that:

H_1 *Implementation of product and process innovation in manufacturing industries in the Czech Republic and Hungary positively influence firms' growth of performance.*

Prior studies stated that innovation represent an essential component of competitiveness and analyzed relationship between innovation and firms' performance (Yam et al. 2011) in manufacturing industry (Gunday et al. 2011; Hashi and Stojčić 2013), specifically in chemical industry e.g. García-Morales et al. (2012). There are no studies analyzing impact of innovation implementation on firms' performance in chemical industry in the Czech Republic and Hungary. Halpern and Muraközy (2012) showed positive relation between innovation and firm performance in Hungary. Therefore we want to fill the gap and make comparison between the Czech Republic and Hungary by using multiple linear models including the same variables for both countries.

Importance of this research is emphasized by the fact that we are following results provided by the World Economic Forum (WEF), which annually publishes The Global Competitiveness Report and assesses the competitiveness landscape of 144 world economies. Results show that both Czech Republic and Hungary have failed in the scale of the competitiveness. However, determinants of competitiveness are many and complex (WEF is currently monitors 12 pillars of competitiveness), therefore we compare the evolution of the pillar Innovations (see Table 1) and hypothesize that:

H_2 *Implementation of innovation in manufacturing industry in the Czech Republic lead to more significant results than the implementation of innovation in manufacturing industry in Hungary.*

Results in Table 1 show that both countries decreased in the overall competitive index. However, we can see that Czech Republic has improved in the individual index/pillar Innovation, while Hungary has decreased significantly.

Moreover, Srholec (2014) analyzed effects of cooperation on innovative performance in the Czech Republic however we see the lack of studies analyzing the impacts of cooperation with universities (and/or government or public research

Table 1 Evolution of competitiveness and innovation in the Czech Republic and Hungary

	Czech Republic		Hungary	
Year	Competitiveness	Innovation	Competitiveness	Innovation
2006–2007	29	28	41	31
2008–2009	33	25	62	45

Source: Own processing according to World Economic Forum (2015)

Table 2 Evolution of individual competitiveness pillar—institutions

Year	Czech Republic	Hungary
2006–2007	60	46
2008–2009	72	64

Source: Own processing according to World Economic Forum dataset

institutes) on innovative activities and firms' performance in the Czech Republic and also in Hungary, specifically in manufacturing industry. Again, we compare the evolution of individual pillars of competitiveness between countries—Higher education and training; between the years 2006–2007 and 2008–2009. Czech Republic has improved from 27 to 25 places; conversely, Hungary has decreased from 30 to 40 places. This assumption leads us to the next hypothesis:

H_3 *Cooperation with universities and public research centers influences the overall performance of companies in manufacturing industry in the Czech Republic more significantly than cooperation with universities and public research centers in manufacturing industry in Hungary.*

As we argued above, there is a growing importance of universities and R&D organizations within cooperation process. This kind of collaboration is also analysed and supported by number of foreign studies, e.g. Okamuro and Nishimura (2013), López et al. (2014).

Rodríguez-Pose and Di Cataldo (2014) show, that (i) there are a relationship between quality of government and innovative performance in the regions of Europe; (ii) ineffective and corrupt governments represent a fundamental barrier for the innovative capacity of the periphery of the EU. To support this study, we also analyzed another individual pillar that WEF provides—Institutions. Both countries have significantly fallen in the ratings of this pillar (See Table 2).

Moreover, we compared results of Corruption Perceptions Index (Transparency International 2016). The results showed that the Czech Republic has improved by one place (from 46 to 45), while Hungary fell by six places (from 41 to 47). Therefore, we follow these findings and hypothesize that:

H_4 *In the manufacturing industry in the Czech Republic and Hungary, there is the same inefficient spending of public funds (national and European) that are targeted to support innovative activities of companies.*

3 Data, Methodology, Results and Analysis

For data collection, Community Innovation Survey (CIS) were used. CIS are part of the EU science and technology statistics and provide a harmonised questionnaire of EU Member States. CIS (Eurostat 2015) is a survey of innovation activities of enterprises and is designed to provide information on the innovativeness of sectors by type of enterprises, on the different types of innovation and on various aspects of the development of an innovation (e.g. the objectives, the sources of information, the public funding, the innovation expenditures etc.).

Community Innovation Survey carried out in the Czech Republic and in the Hungary for the period 2006–2008 by combining sample (stratified random sampling) and exhaustive surveys was used for our analysis. The target population of the CIS 2008 is the total population of enterprises in NACE Rev. 2 sections A to M. Data on 6804 Czech and 5390 Hungarian companies with at least 10 employees was obtained in total. For the purpose of this study, we filtered 547 Czech and 417 Hungarian companies from the manufacturing industry into our data groups—specifically, companies covering countries NACE categories 19–23 (Manufacture of coke and refined petroleum products; Manufacture of chemicals and chemical products; Manufacture of basic pharmaceutical products and pharmaceutical preparations; Manufacture of rubber and plastic products; Manufacture of other non-metallic mineral products).

Multiple linear regression models were used to analyse relationships between variables. We analysed the relationship between the growths of total turnover (between the years 2006 and 2008), as a dependent variable representing companies' performance, and selected independent variables (all the variables are listed in the Table 3). Multiple linear regression models have the following general form (Jann 2008; Vlachogianni et al. 2011):

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + \varepsilon \tag{1}$$

where

y is dependent variable;
x_1, x_2 . . . x_n are independent variables;
β_1, β_2, . . ., β_n called the regression parameters or coefficients, are unknown constants to be determined (estimated) from the data;
ε . . . the residual error = difference between observations and predicted values.

At the beginning, 20 identical variables have been selected (see Table 3). These variables were tested for each country by using regression models. Results allowed us to (i) carry out an initial comparison of situation in manufacturing industries in the Czech Republic and Hungary; (ii) answer defined hypotheses. Initially, we conducted Spearman test to verify that the data are not correlated.

Before we answer defined hypotheses, we analyzed which variables (listed in Table 3) directly influence the growth of firms' total turnover. Table 4 shows the results of two mutually independent regression models. The first was assembled to analyze the situation of companies in manufacturing industry in the Czech Republic and the correlation coefficient of this model reached the value of 0.545. The coefficient of determination reached 0.297. P-value of the model was measured at 0.001. There was thus a rejection of the null hypothesis. The model could be regarded as significant. In this model, seven independent variables were used. The second model analyzed situation of companies in manufacturing industry in

Table 3 Variables used in the model

Dependent variable	Independent variables—categorical	Independent variables—continuous
TURN	LARMAR	RRDIN/TURN
	GP	RRDEX/TURN
	PROD_IN PROC_IN FUNGMT FUNEU CO CO_GP CO_SUP CO_CUSTOM CO_COMPET CO_UNI CO_GOV CO_CONSULT	ROEK/TURN RMAC/TURN RTOT/TURN

TURN the growth of total turnover between the years 2006–2008, *LARMAR* Largest market in terms of turnover between 2006–2008 (1—local or national, 0—other), *GP* part of the group of enterprises, *PROD_IN* introduced onto the market a new or significantly improved product (good or service), *PROC_IN* introduced onto the market a new or significantly improved process (method of production; logistic, delivery or distribution system; supporting activities), *FUNGMT* public funding from central government, *FUNEU* public financial support from the EU, *CO* cooperation arrangements on innovation activities, *CO_GP* co-operation partner: other enterprises within enterprise group, *CO_SUP* co-operation partner: Suppliers of equipment, materials, components, or software, *CO_CUSTOM* co-operation partner: clients or customers, *CO_COMPET* co-operation partner: competitors or other enterprises in sector, *CO_UNI* co-operation partner: universities or other higher education institutions, *CO_GOV* co-operation partner: government or public research institutes, *CO_CONSULT* co-operation partner: consultants, commercial labs, or private R&D institutes, *TURN* total turnover, *RRDIN* Expenditure in intramural R&D, *RRDEX* Expenditure in extramural R&D, *RMAC* Expenditure in acquisition of machinery, *ROEK* Expenditure in other external knowledge, *RTOT* Total innovation expenditure

Hungary. The correlation coefficient of this model reached the value of 0.718. The coefficient of determination reached 0.515. P-value of the model was measured at 0.037. There was thus a rejection of the null hypothesis. The model could be regarded as significant. In this model, nine independent variables were used. Results show, that only two variables (PROD_IN, GP) were same for both countries and influence dependent variable. We can also see, that in the case of the Czech manufacturing firms, there were other variable LARMAR. On the other hand, in Hungary, there were more variables, especially PROC_IN, FUNEU, CO_UNI, CO_GOV.

Regarding to the results listed in Table 4, we can answer hypothesis H_1. We can see that implementation of product innovation (PROD_IN) influence dependent variable (more significantly in Hungary; $0.01013 < 0.03044$). Implementation of process innovation (PROC_IN) is significant and influences the growth of total turnover only in Hungary. According to these results, we can accept hypothesis H_1 and state that implementation of innovation in manufacturing industry in the Czech Republic and Hungary positively influence firms' performance.

Table 4 Variables used in model in the Czech Republic and Hungary

Variables	Czech Republic		Hungary	
	p-value	sd	p-value	sd
RTOT/TURN	–	–	0.16455	0.12411
RRDIN/TURN	0.20498	0.41436	–	–
PROD_IN	0.03044**	0.12396	0.01013**	0.20930
PROC_IN	–	–	0.00033***	0.71022
CO_COMPET	0.57222	0.05612	–	–
FUNGMT	0.61628	0.13439	0.34529	0.21542
FUNEU	–	–	0.00214***	0.55331
LARMAR	0.02090**	0.14392	–	–
GP	0.01083**	0.18598	0.01527**	0.54623
CO_UNI	0.36056	0.13386	0.00199***	0.39990
CO_GP	–	–	0.89682	0.31773
CO_GOV	–	–	0.00074***	0.46732

Source: Own research
sd standard deviation
**Significant at $P < 0.05$; ***Significant at $P < 0.01$

To answer next hypothesis H_2, we compared another interactions that were created during analysis. Results show that in Hungary were created more significant interactions between implementation of innovation (product, process) and other variables (see Tables 5 and 6). For example, implementation of innovation (only product innovation) in the manufacturing industry in the Czech Republic significantly influenced the growth of total turnover in combination with cooperation with universities (PROD_IN*CO_UNI = 0.03917). This implementation was more significant when companies participated in the group of companies (PROD_IN*GP = 0.00178). Implementation of innovation in group of companies also showed more significant results than the implementation of innovation within company by itself (we compare results in Tables 4 and 5).

On the other hand, combination of implementation of innovation (product and process) with other variable in the manufacturing industry in Hungary caused creation of other significant results (see Table 6). For example, firms implementation of product innovation in collaboration with universities (CO_UNI*PROD_IN = 0.00222) causes more significant effect on the growth of total turnover than the situation without collaboration (we compare result in Tables 4 and 6; 0.00222*** is more significant than 0.01013**). For these reasons, we reject the hypothesis H_2. In the manufacturing industry in Hungary, implementation of innovation leads to more significant results.

Results in Table 4 also allowed us to answer hypotheses H_3. We claimed that cooperation with universities and public research centers influences the overall performance of companies in manufacturing industry in the Czech Republic more significantly than cooperation with universities and public research centers in manufacturing industry in Hungary. However, as we can see, this kind of cooperation influences firms' growth of total turnover only in manufacturing industry in

Table 5 Cooperation with universities and influence of participation in the groups of companies on firms' performance in the Czech Republic

Variables	CO_UNI	GP
PROD_IN	0.03917 (0.10472)**	0.00178 (0.17168)***
CO_COMPET	0.17715 (0.07578)	0.04583 (0.05626)**
FUNGMT	0.00392 (0.11177)***	0.03125 (0.16959)**
LARMAR	0.00000 (0.11907)***	0.16172 (0.10054)
GP	0.01114 (0.08331)**	–
CO_UNI	–	0.01114 (0.08331)**
PROD_IN*FUNGMT	0.00181 (0.10630)***	0.00287 (0.15041)***
CO_COMPET*LARMAR	0.00240 (0.06392)***	0.00676 (0.05595)***
PROD_IN*LARMAR	0.00009 (0.09400)***	0.93162 (0.07595)

Source: Own research

Table shows p-values; values of standard deviations are shown in brackets

**Significant at $P < 0.05$; ***Significant at $P < 0.01$

Table 6 Efficiency of public funding and innovation implementations in Hungary

Variables	FUNGMT	FUNEU	PROD_IN	PROC_IN
CO_UNI	0.31551 (0.222)	0.00446 (0.348)***	0.00222 (0.416)***	0.04754 (0.458)**
CO_GP	0.76553 (0.217)	0.00219 (0.352)***	0.00079 (0.321)***	0.06521 (0.157)*
GP	0.06431 (0.411)*	0.00374 (0.289)***	0.34640 (0.105)	0.13905 (0.396)
CO_GOV	0.79881 (0.165)	0.60756 (0.167)	0.00056 (0.449)***	0.00003 (0.347)***
FUNGMT	–	0.00016 (0.322)***	0.00603 (0.286)***	0.00885 (0.327)***
FUNEU	0.00016 (0.322)***	–	0.43722 (0.171)	0.00347 (0.503)***
PROC_IN	0.00885 (0.327)***	0.00347 (0.503)***	0.00024 (0.193)***	–
PROD_IN	0.00603 (0.286)***	0.43722 (0.171)	–	0.00024 (0.193)***
CO_UNI*CO_GP	0.00448 (0.123)***	0.00040 (0.318)***	0.00075 (0.304)***	0.04151 (0.154)**

Source: Own research

Table shows p-values; values of standard deviations are shown in brackets

*Significant at $P < 0.1$; **Significant at $P < 0.05$; ***Significant at $P < 0.01$

Hungary. In the manufacturing industry in the Czech Republic, there are not efficient cooperation between firms and universities or public research institutions (or/and government) that will significantly influence dependent variable. Therefore we have to reject hypothesis H_3. On the other hand, results in Table 5 show, that proper collaboration with universities in the manufacturing industry in the Czech Republic significantly influences firms overall performance (e.g. PROD_IN* CO_UNI = 0.039; LARMAR*CO_UNI = 0.000).

To answer hypothesis H_4, firstly, we use results in the Table 4. We can see that financial support from national funds is totally inefficient in both cases. Public subsidies from European funds are insignificant in the manufacturing industry in the Czech Republic, not in Hungary (0.00214). Results also showed us, that proper targeting of public subsidies (national and European) leads to creation of further significant interactions that influence firms' growth of total turnover. For example, we can see that in Hungary there are created a number of other significant interactions with variables FUNGMT and FUNEU (see Table 6).

For example, we can see that collaboration with universities, that is supported from European funds, significantly influences growth of firms' performance (CO_UNI*FUNEU = 0.00446). On the other hand, the same collaboration supported from the national funds becomes insignificant (CO_UNI* FUNGMT = 0.31551). Conversely, in the manufacturing industry in the Czech Republic, there are not created the same number of further significant interactions.

We analyzed only a negligible amount of significant interactions (see Table 5). For example, FUNGMT*CO_UNI = 0.00392; PROD_IN*FUNGMT*CO_UNI = 0.00181. Therefore, we reject hypothesis H_4 because in manufacturing industries in the Czech Republic and Hungary, there are not the same inefficient spending of public funds (that are targeted to support innovative activities of companies).

4 Conclusions

Results allowed us to confirm only hypothesis H_1 that showed the growing importance of implementation of innovation (product and process) in both countries. These results contribute to the literature (e.g. Ulku 2007; Brown et al. 2009) and highlight the importance of innovation. Rejection of hypothesis H_2 showed to us that implementation of innovation leads to more significant results in manufacturing industry in Hungary, even though that the Czech Republic has improved in the individual pillar Innovation and Hungary decreased. The hypothesis H_3 was aimed to confirm the importance of collaboration with universities and public research centers and compare situation between selected countries. We claimed that cooperation with universities and public research centers in manufacturing industry is more significant in the manufacturing industry in the Czech Republic. However direct impact of this cooperation on firms' performance was shown only in manufacturing industry in Hungary, therefore we reject hypothesis H_3. On the other hand, further results showed that cooperation with universities could lead to creation of significant effects on firms' growth of total turnover in manufacturing industry in the Czech Republic. These collaborations are often accompanied by firms' participating in the groups of companies that lead to creation of strong ties and positively affect university-industry collaborations because there are a prerequisite for more effective dissemination of knowledge (Capello and Faggian 2005; Laperche et al. 2011). Hypothesis H_4 showed that in manufacturing industries there is the same inefficient spending of public funds (national and European) in both countries. However, in Hungary there were found further significant links between financial support (especially from the European Union) and firms' overall performance through combinations with other variables. Therefore, hypothesis H_4 was rejected.

Our findings provide practical implications for policy makers. The innovation implementation and knowledge diffusion represent a complex process that involves number of factors. As results shown, both determinants of innovative activities (Public Financing and Cooperation) significantly influence the overall performance of firms in manufacturing industries in selected countries. However, there is a need for proper targeting of these determinants. In the manufacturing industry in the Czech Republic, companies should not cooperate with universities by themselves because this kind of cooperation (university-industry) brings with it certain disadvantages or drawbacks (Siegel et al. 2003; Bruneel et al. 2010). For example, each collaborating partner has different interests and different expectations of the results. Therefore, cooperation with universities should include other specific determinants that were shown in this analysis. Other implication that we suggest is implementation of dual system vocational education and training (VET) that could support practical skills that are necessary for researchers and that could support collaborating activities between firms and universities and public research centres in manufacturing industries in the Czech Republic and Hungary. VET system is for example deeply embedded and widely respected in Germany and offers qualifications in a broad spectrum of professions and flexibly adapts to the changing needs of the labour market. Next implication is aimed on the issue of financial support (national and European) on innovative activities in manufacturing industry in the Czech Republic and Hungary. Following the results, we recommend continuing with financial supporting innovation activities of firms in manufacturing industry in Hungary, especially from European Union. However, we showed that there is a need for proper targeting of public financial support on innovative activities in both countries. In Hungary, public funds are provided more effectively in the manufacturing industry than in the Czech Republic. Policy makers should also decide which kinds of cooperation they will financially support (particularly from the national funds) because we can see inefficiency in the Czech Republic and also in Hungary. In this case, there are not direct effects of national subsidies on the growth of total turnover. Therefore, we propose the use of non-financial types of support for innovative activities because it is clear that there is no clearly demonstrable relationship between growth of financial subsidies provided from national or European funds and increase of firms' performance. The issue of non-financial support was also analysed by number of researchers (e.g. Mole and Bramley 2006; Sonne 2012). Finding appropriate determinants of innovation activities is a complex process that is influenced by number of factors. Therefore, further research is aimed to follow significant results of this analysis and their conditions, and to analyse the situation of other industries in selected countries to make further comparison and bring appropriate practical implications for policy makers.

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