Does co-operation affect positively innovative performance? Case study of Estonia and Romania

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AIMS OF THE PAPER

SMEs support their innovative processes with connecting to networks (corporate or business or knowledge--based or cooperative). Many international studies show that participation in the cooperative network can help to improve the innovation performance of small or medium sized enterprises. It has been proved that various types of cooperative linkages (e. g. inter-firm cooperation and cooperation with the intermediaries, cooperation with research organizations or cooperation in the holding group) has a positive impact on the firm's ability to innovate. An interesting question is the involvement of government or public institution in these cooperative networks. Mostly the world wide studies show that their involvement does not bring significant positive benefits. But the new forms of cooperation, such as vertical or horizontal cooperation with customers and suppliers or competing companies also play a significant role in the innovation processes. Even some studies show that the cooperation among the industrial enterprises and customers is more important than cooperation in the knowledge-based network. The question remains whether the results of various international studies are also valid in the CEE regions.

THE METHODOLOGY

Therefore, to fill the gap, we analyse the influence of cooperation with different partners (e. g. customers, competitors, universities) on the growth of firms' turnover from innovated products in manufacturing industries (in total, 4903 firms) in Estonia and Romania between the years 2010-2012 by using own multiple linear regression models. For data collection, we use CIS, which is a harmonised questionnaire.

THE MOST IMPORTANT RESULTS

Results show, that proper selection of cooperation partners (especially in Estonia) in combination with other determinants of innovative activities (e. g. participation in the group of companies, public financing) lead to creation of synergies and spillover effects, that significantly influence innovative activities.

RECOMMENDATION

We recommend countries to thoroughly define their innovation policy goals and system of support to analyse them before their wide application.

Keywords: innovation, cooperation, spill-over effects, Estonia, Romania

INTRODUCTION

Even today, traditional production factors – considered to be work, land, and various forms of capital – can still be perceived as one of the basic determinants of economic development (Porter & Van der Linde 1995). Nonetheless, other kinds of production resources, which help strengthen or maintain a company's position on the international and domestic markets or help increase company competitiveness, began to increase in importance during the second half of the 20th century (Carney 1998).

In the last few decades of the 20th century, there was a reduction in industrial production in many countries, which has tended to be replaced in modern Western economies more frequently by the production of services. It is possible to explain this by using technological and demographic changes, people's changing preferences, or a change in the maturity of individual economies, for example. These factors gradually and noticeably change the ways of looking at the role of production factors and logically result in a changeover from material production to production based primarily on the use of information, i.e., knowledge. On the basis of scientific research, it was already possible to state in the 1990s that economies based on knowledge achieve a higher gross domestic product (Abramovitz & David 1996).

The use of various types of knowledge is a driver for company growth in the 21st century. Knowledge is a source of innovation; moreover, in contemporary economies, the competitive advantage of companies, regions as well as countries is dependent on it. Alois Schumpeter, who considered innovation originating with entrepreneurs to be the source of technological change for nations, came up with these conclusions (Peters et al. 2009).

Nonetheless, thanks to globalization, market competition is increasing – even in relation to the use of the aforementioned information and knowledge and the subsequent creation of innovation. It is possible to discover the fundamental differences that distinguish one company from the rest within the innovation process itself. Primarily groups of small and medium-sized companies are more frequently engaging in networks that operate on the basis of cooperation and knowledge in the attempt to hasten the overall innovation process and make it less expensive. Representatives of institutions from the public sector (of regional or national governments) also tend to be included in the cooperative chains or forms of cooperation. Another interesting fact from recent years is the finding that a direct relationship between industrial companies and customers is also fundamental for the development of the innovation process. Many mentioned scholars even point to the fact that this relationship is more important than cooperation in networks based on pure knowledge.

The goal of this paper is thus to analyze how individual partners influence companies' innovation performance. For example, this is understood to be the possible increase in innovation outputs resulting from cooperation with local, regional, government, or European public financing; from cooperation with suppliers of equipment, materials, components, or software; and from cooperation with clients and customers as well as universities or other government or public research institutions. The overall 26 variables that were selected were analyzed in addition to their individual combinations. Regarding a gap stemming from research on existing studies in this area, attention has been focused on Estonia and Romania. In addition, the comparison of the innovation leader and the innovation backbone can bring interesting results to other CEE countries that are moving between these extremes.

THEORETICAL BACKGROUND

It was first possible to observe massive cooperation between companies for the purpose of increasing productivity in the 1980s (Negassi 2004). In the studies of this period, it was initially proven that knowledge spillover (as one of the unintentional outputs of cooperation) is able to reinforce a company's innovation capacity and increase its competitiveness. Miotti and Sachwald (2003) observed the influence of cooperation and spillover effects in the area of research and development (as well as the creation of global research and development networks) over the course of the 1990s in various European countries.

Germany is one important European economy where it is possible to observe how cooperation's positive influence on competitiveness and the capacity to innovate evolves. As Stejskal and Prokop (2016) have stated, this country has one of the most productive economies in the world; additionally, it is also primarily one of the countries that are most competitive internationally (for 2015–2016, Germany came in fourth place in the Global Competitiveness Index composed by the World Economic Forum). However, the situation was the reverse even into the 1990's. As Audretsch

(1995) states, this county struggled with both high unemployment as well as a loss of international competitiveness at the beginning of the 1990s. The scope of this problem can be seen in the fact that a solution for the innovation crisis was eventually adopted as one of the German government's three main objectives for the 1990s.

In general, however, the importance of innovation, competitiveness, and cooperation can also be explained using economic theory. For example, from the microeconomic perspective, it is possible to start with the knowledge spillover theory, which explains the p sitive recognition and use of companies' opportunities. This fact was confirmed by Acs et al. (2009), among others. In their research, Alfaro and Chen (2013) explained that cooperation also contributes to the growth of productivity. They demonstrated that it is also possible to observe this positive effect on a sample of 60 of the world's countries for knowledge that has spilled over from transnational companies to domestic companies. The significance of cooperation and knowledge spillovers was also documented by Prokop and Stejskal (2016) – on data originating in the Czech Republic confirming that innovation does not emerge in isolation, but rather is created and disseminated effectively via cooperation. For example, Fritsch and Franke (2004) have actually already confirmed a similar fact for a number of German regions for the beginning of the 21st century itself.

As can be seen from the above, primarily in recent years, knowledge has played an important role in theoretical concepts of innovation – not only for companies but also for national economies. Nonetheless, the general discovery of the positive benefits of spillover effects and cooperation can be considered merely a first step on the road to prosperity. In order to be able to cooperate and derive benefits, it is necessary to find an appropriate partner for cooperation. From a closer analytical perspective, this fact naturally appears to be a distinctly complicated process. It is necessary to start with the fact that potential partners are significantly different depending on industrial focus or affiliation to an industrial sector. Different rules apply to each case, and ties emerge that vary in strength and effectiveness.

At the start of the 21st century, this problem was also analyzed for Germany; Fritsch and Lukas (2001), for example, analyzed the tendency to maintain various forms of cooperation in the area of research and development with customers, suppliers, competitors, and public research institutes on a sample of 1800 manufacturing companies from the processing industry. On the basis of this research, it was demonstrated that a propensity for maintaining ties tended to be shown by larger companies with a higher participation in research and development. Moreover, using data for Belgium, Veugelers and Cassiman (2005) determined that it is primarily large firms engaging in the chemical and pharmaceutical industry (a so-called vertical network) that have distinct interest in maintaining mutual ties, i.e., actively engaging in cooperation in the area of industry and science. This fact was also verified in research by Tomlinson (2010), who confirmed a hypothesis using data from Great Britain that ties in vertical networks are able to explain the innovation level of individual companies. This study also drew attention to the fact that it is not only the existence of these mutual ties that is fundamental, but also, particularly, their strength. Nonetheless, the results also concede that horizontal network ties are also important in certain sectors (even though this is to a lesser degree). On the basis of the study results listed here, it is possible to postulate the conclusion that companies cooperate on R&D in order to supplement internal resources for their private innovation process (Becker and Dietz, 2004).

Even despite the above, it is also necessary to accept the fact that mutual cooperation by companies from the private sector is not the only driver of innovative development. Today, positive participation on behalf of the public sector in creating innovation is overall a common phenomenon, which has been demonstrated by David et al. (2000), among others. German experience can be utilized for this as well, because Germany has been pursuing extensive expansionary fiscal policy in the area of industry, primarily using the system of providing grants. This fact has been confirmed by Beise and Stahl (1999), among others. Using a sample of 2300 German companies, they determined that less than one tenth of new innovative products (or innovative production methods) were developed without the participation of research derived from public resources. It is thus a logical connection that universities began to be perceived by companies as an important source of findings for their innovation activities. Nonetheless, it is necessary to point out that massive private investment is the primary reason behind the German companies' success (Prokop and Stejskal 2016). McMillan et al. (2000) also came to the same conclusions concerning the significance of government grants. They investigated the effects of supporting research and development in the USA. They determined that American companies' industrial base relies

on public research to a large degree; this implies that knowledge is derived from universities, research institutions, and government laboratories (the results confirmed the fluctuating dependency of various sectors of industry).

However, individual companies' capacity for innovation is also dependent on other variables – primarily, on the quality of the innovation environment, the condition of the global economy, and the public policies that have been adopted (mainly industrial and tax policies). Cooke (2001) points to the gap in the innovation capabilities of European and American companies. European companies lose their ability to be successful in competitive markets precisely because they rely too much on public "pro-innovation" government intervention. Naturally, this can cause market failure and a crowding out effect on private investment (as can all government interventions). Almus and Czarnitzki (2003) have dealt with this subject on the European continent. They analyzed the effect government expenditure programs supporting R&D had on the innovation activity of German enterprises (whether they stimulate research activities or whether they crowd out private investment in research and development). The results show that if companies use both private and public funding to finance their research, this increased their innovation activity by 4% (this did not lead to the crowding out effect in the given empirical sample). Czarnitzki and Fier (2002) also came to the same conclusion.

The studies presented here primarily deal with the influence of cooperation and public support for research and development in the most advanced countries. However, the question remains as to whether these two factors of a pro-innovation environment also have a positive effect on economies that are not as advanced, whose public and private business sectors suffer various deficiencies. The goal of this paper is thus to analyze whether the analyzed companies' ability to innovate their production increases with the influence of cooperation in the selected sectors. Two countries that appear to be undergoing development in the area of innovation, Estonia and Romania, were chosen for analysis.

DATA AND METHODOLOGY

For our analyses, we obtained data from the Community Innovation Survey 2010–2012. The Community Innovation Survey is a harmonized questionnaire, which is part of the EU's science and technology statistics and it is carried out every two years by the EU member states and a number of ESS member countries. Continuously, we created original multiple linear regression models to investigate the relationship between one dependent variable – *innovation performance* – represented by the % of turnover in new or improved products introduced during 2010–2012 (new to the market), and a number of selected independent variables (innovation activities determinants). In total, we analysed 4 903 enterprises from the manufacturing industries (NACE Categories 10-33) in Estonia and Romania. We don't consider data from Eurostat as censored or truncated. All independent variables are shown in Table 1. Regression models are commonly used for this kind of analysis (e.g., Nieto and Quevedo 2005, Chen and Huang 2009, Schneider and Spieth 2013) and take the general form as follows (Chatterjee and Hadi 2013):

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

where

y is a dependent variable;

$x_1, x_2 \ldots x_n$ are independent variables;

ε is an error term that accounts for the variability in y that cannot be explained by the linear effect of the n independent variables;

$\beta_1, \beta_2 \ldots \beta_n$, called the regression parameters or coefficients, are unknown constants to be determined (estimated) from the data.

To verify whether the data from the Community Innovation Survey were correlated, Spearman's test was used. 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 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 di. The general formula for Spearman's rank correlation coefficient takes the general form as follows (Weinberg and Abramowitz 2002, Borradaile 2013):

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

All calculations were made using the statistical software STATISTICA (StatSoft Inc., 2011). The values of Spearman's test rejected the hypothesis that the data are correlated with a level of significance at $p<0.05$. After fulfilling the first prerequisite (uncorrelated data) and the rejection of multicollinearity in the model, the analysis itself was conducted.

Table 1: Independent variables

Financing	Cooperation	Innovation	Expenditures	Firm Activities	Other
Public funding from local or regional authorities (FUNLOC)	Cooperation arrangements on innovation activities (CO)	Introduced a new or significantly improved product into the market (INN_G)	Intramural R&D (RRDIN)	Merge with or take over another enterprise (ENMRG)	The largest market in terms of turnover between 2010-2012 (LARMAR)
Public funding from the central government (FUNGMT)	Other enterprises within an enterprise group (COGP)	Introduced a new or significantly improved service into the market (INN_S)	Extramural R&D (RRDEX)	Sell, close, or outsource some of the company's tasks or functions (ENOUT)	Participation in a group of enterprises (GP)
Public financial support from the EU (FUNEU)	Suppliers of equipment, materials, components, or software (COSUP)	Introduced a new or significantly improved process into the market: method of production; logistic, delivery, or distribution system; supporting activities (INN_P)	Acquisition of machinery (RMAC)	Establish new subsidiaries in [home country] or in other European countries (ENNWEUR)	
	Clients or customers (COCUS)		Acquisition of external knowledge (ROEK)	Establish new subsidiaries outside Europe (ENNWOTH)	
	Consultants and commercial labs (COCONS)		All other activities (ROTR)		
	Competitors or other enterprises in the sector (COCOMP)		Total expenditures on innovation activities (RALL)		
	Universities or other higher education institutions (COUNI)				
	Government or public research institutes (COGOV)				

RESULTS OF REGRESSION ANALYSES IN ESTONIA AND ROMANIA

Firstly, we analyzed the relationship between each of the independent variables (the determinants of innovative activities) and the target variable - *innovation performance* - by using original multiple regression models. Table 2 shows the results of the individual models for the manufacturing industries of each country.

Table 2:Comparison of determinants of innovation activities between the countries

	Romania R=0.983; R^2=0.967; p=0.045	**Estonia** R=0.706; R^2=0.498; p=1 E-04
FUNGMT	-	0.014**
FUNEU	0.059*	-
COGP	0.065*	0.000***
COSUP	-	0.643
COCUS	-	0.047**
COUNI	0.055*	-
COGOV	0.070*	-
INN_G	-	-
INN_S	0.076*	0.402
INN_P	0.104	0.133
RRDIN	-	0.000***
RRDEX	0.034*	0.630
RALL	0.054*	-
ENOUT	0.082*	-
ENNWOTH	-	0.007***
GP	-	0.037**

Legend: significant at P<0.1; ** significant at P<0.05; *** significant at P<0.01
Source: Authors' own research.

Determinants of innovation performance are different in each country because of number of different internal and external factors (e. g. initial conditions, background for innovation activities, infrastructure, and absorptive capacity). In Romania, a background in innovation is missing and therefore determinants of innovative activities are not able to influence firms' innovation performance. This is one of the signs of the innovation paradox, which countries like Romania may suffer. Innovation paradox refers to the apparent contradiction between the comparatively greater need to spend on innovation in lagging regions and their relatively lower capacity to both absorb public funds earmarked for the promotion of innovation and invest in innovation related activities (as we can see in Table 2 – FUNGMT, FUNEU do not effectively influence innovation performance) as compared to more advanced regions or countries (Oughton et al. 2002). Therefore, innovation performance cannot increase with the cooperation as well as it could.

The situation in Estonia is different from Romania and number of factors (determinants of innovation activities) influence firms' innovation performance independently. Financial sources are the most important determinants (businesses intramural expenditures in R&D, establishment of new subsidiaries outside Europe and self-financing from their national resources). The new product – innovated process or service (INN_P and INN_S) – is not a significant determinant of innovative activities in Estonia (their role increases, combined with other changes – see below). Estonian firms,

in comparison with firms from Romania, can use the cooperation as the source of cost-cuts and new knowledge. We show that cooperation with other enterprises within the enterprise group (COGP: 0.000***), participation in the group of firms (GP: 0.037**) and cooperation with clients and customers (COCUS: 0.047**) significantly influence firms' innovation performance in Estonia.

Because of weak effects, especially in Romania, we consequently analysed the effects of mutual combinations between determinants that allow the creation of synergies and spillover effects and can significantly influence firms' innovation performance. It is clear because innovation is not created in isolation (Hajek and Stejskal 2015, Mikušová Meričková et al. 2016, Prokop and Stejskal 2016).

Romania is a typical example of a country where there is an innovation paradox. In this country, a background for innovation is missing, and the country faces obstacles in elements of its environment. Therefore, determinants of innovative activities are not able to influence firms' innovation performance even if they were provided with sufficient public funds. The country struggles with a lack of absorption capacity but may also be hampered by a lack of demand for innovation outputs (from both enterprises and research organizations). On the other hand, results in Table 3 show that finding of proper collaboration partners (universities and public research institutes) has impact on firms' innovation performance. For example, if a company simultaneously introduced process innovations and cooperated with universities, this causes effects influencing the growth of turnover from innovations (0.046**). Also, the provision of EU funds led to the creation of significant effects in some cases – in cooperation with universities (0.045**) and in cooperation with public research institutes (0.042**).

Table 3. Influence of Cooperation on Innovative Activities in Romania

	Universities (or Other Higher Education Institutions)	Public Research Institutes (or the Government)
FUNEU	0.045**	0.042**
INN_S	-	0.048**
INN_P	0.046**	0.065*
COGP	0.055*	0.052*

*Legend: significant at P<0.1; ** significant at P<0.05; *** significant at P<0.01*
Source: Authors' own research.

The results in Table 4 confirmed that cooperation (with various subjects) brings positive effects on firms' innovation performance (the rate of signification was increased). We can see the improved results in INN_S (improved service onto the market). INN_S in combination with all types of cooperation increase the level of determination (compare result: Tab.4: INN_S*COCUS: 0.006*** in opposite itself Tab.2: INN_S: 0.402 - without influence). Cooperation with competitors or other enterprises in sector (COCOMP) has no significant influence 0.249 (see table 2); now if we analyse the combination with INN_S we obtain significant value 0.009***. In our analyses, we also confirmed the negative role of national financial sources in combination with other variables. If we analyse these combinations, the results are lower (for example FUNGMT*COCUS*INN_S: 0.087**) or the level of significance is lower. We can conclude that public support does not always bring positive effects, especially if subsidies are not carefully targeted to the appropriate industry and to the target activity (totally clear type of innovation; the same results as in Franco and Gussoni 2014). It was confirmed also with results from INN_P analysis. If we analyse the combinations concerned INN_P, we obtain higher significance levels and better results also in combination with public funds (example: FUNGMT*COSUP*INN_P: 0.009*** means that public sector brings positive effects if support the process innovation in firm who cooperate with its suppliers). A number of other studies have also produced unequal results (for example Gallego et al. 2013 or Gołębiowski and Lewandowska, 2015).

Table 4. Combinations of Variables in Estonia - Importance of Innovation and Cooperation

	INN_S	INN_P
GP	0.004***	0.662
COGP	0.004***	0.430
COCUS	0.006***	0.210
COCOMP	0.009***	0.099*
COSUP	0.461	0.034**
COCOMP*FUNGMT	0.046**	-
GP*COCUS	0.007***	0.018**
COGP*COCUS	0.006***	0.019**
FUNGMT*COCUS	0.087**	0.506
FUNGMT*COSUP	0.289	0.009***

*Legend: significant at P<0.1; ** significant at P<0.05; *** significant at P<0.01*
Source: Authors' own research.

The results of our study confirm the results of previous studies – for example, Srholec (2015) in his study states that results indicate strong differences across countries in the latter. But characteristics of firms that explain cooperation have not been found to differ much by country. Rõigas et al. (2014) analysed three groups of variables which could be related to the probability to cooperate with universities (size of a firm, the second group measures different innovation activities and the third group describes the internationalisation of firms) and stated that conducting internal or external R&D is a significant factor characterising the cooperation with universities (home and also the foreign).

CONCLUSION AND PRACTICAL IMPLICATIONS

Based on the results of this research we can state that complete innovation ecosystem lacks in Romania. The Romanian environment is not able to absorb the incoming innovation impulses – all innovation are crowded out. The Romanian public authorities try to block the crowding out effect with the public investments, but the innovation paradox is observed. Also, the other public funds from EU budget are used. The results show that variables FUNGMT or FUNEU are not able to change the situation and influence the output of the innovation processes (innovation performance of the firms). Conversely we have shown that cooperation among universities (other higher educational institutions) as well as cooperation with public research institutions improved firms innovativeness (INN_P 0.046**, 0.065* respectively), but this didn't lead to their ability to introduce a new or improved service into the market. Funding from the EU (FUNEU) influenced firm's collaboration with universities and public research institutions.

In contrast, the same models were used also in Estonian CIS data. The results showed that the innovation paradox is not observed in this country. Public support (from EU budget – FUNEU 0.014**) affects the innovation activities in Estonian firms. But firm's collaborations with universities and other public research entities didn't demonstrate any influence on their innovation activities. Lastly their general cooperation influenced their propensity to introduce a new or improved service into the market than their ability to introduce a new product to the market.

Not only does this result confirms that EU subsidy policy affect differently the innovation activities in various countries. Therefore, it is necessary to more thoroughly define the goals of public innovation policies, planned tools and system of support analyse before their wide application (ex-ante). When this is done then the greater efficiency can be achieved.

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