Networking theory of innovation in practice A Pan-European overview based on the Community Innovation Survey

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Abstract:

According to the European Innovation Scoreboard report, there is a big difference between the European Union (EU) member states' innovation performance. The majority of the Southern-European countries and Member States joined to the EU in 2004 are considered as moderate innovators. On the top of the list there are the Scandinavian and the Benelux countries, the UK and Germany, while Bulgaria and Romania are the modest innovators in Europe. From an innovation point of view food industry is seen as slow one, which is lagging behind the technology pushed possibilities, but sometimes behind the costumers' desires and requirements as well. In our research, we determine why the food companies in the examined European countries - do not engage in innovation activities and - if they do so, what are the main drivers of their innovation performance? We use the Community Innovation Survey (CIS) 2012 data and employ double hurdle estimation because of the nature of the innovation distribution. This method also helps in overcoming the selection bias problem, which necessarily occurs in this situation. Results prove that networking scope as well as networking intensity, play important role in explaining innovation performance. The size and market obstacles are also significant factors.

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In our research, we determine why the food companies in the examined European countries

a. do not engage in innovation activities and
b. if they do so, what are the main drivers of their innovation performance?

We use the Community Innovation Survey (CIS) 2012 data and employ double hurdle estimation because of the nature of the innovation distribution. This method also helps in overcoming the selection bias problem, which necessarily occurs in this situation.

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Keywords: Community Innovation Survey, networking, innovation activity, European food industry

Introduction

Understanding the relationship between **innovation and performance** in both large and small firms is relevant for researchers, policy-makers, and managers of large and small companies alike. Understanding **innovations and their relationship with firm performance become even more relevant since the EU stated, in March 2000 in Lisbon**. The underlying rationale is that encouraging firms to innovate will lead to a **better economic performance** (Sirelli, 2000, p. 61); higher growth, more jobs, and higher wages.

This paper provides an empirical test of hypotheses on the role of **networking scope and intensity** in explaining **innovation performance.** O*ur research question is why the food processing companies in the examined European countries do not engage in innovation activities, and if they do so, what are the main drivers of their innovation development*. How the networking activities affect innovation in the different food processing industry? More specifically, we analyse the scope- and intensity of the innovation network connections in food processing sector based on the EU's Community Innovation Survey (CIS)[1] data.

Literature

In this paper, we outline a conceptual framework for depicting **network theory of innovation**. **Innovation networks** are generally considered as a means to share R&D costs, gain access to rare resources, to manage complex innovation processes, cope with technological uncertainty and create learning opportunities (Pyka 2002, Buchmann and Pyka 2012). In general, there is an increasing trend in firms' practice that they carry out innovation with their network partners instead of in-house R&D. In addition, they are looking for partners beyond the boundaries of their organization, **mainly with other firms, universities, research organisations and government agencies** (Rampersad et al., 2010). Existing **literature on firms' networks** (Dyer and Singh, 1998; Dyer and Nobeoka, 2000; Levinson and Asahi, 1996) has widely discussed and accepted networks of firms as a crucial factor for innovation, knowledge creation and inter-organizational learning (Podolny and Page, 2000).

A **firms' innovation network** consists of a collection of autonomous actors that pursue repeated and enduring **reciprocal exchanges** aimed at **creating new or better products**, services for final markets or creating new or improving production and/or administrative processes (Möller and Rajala 2007). Furthermore, Möller and Rajala (2007) argued that in innovation networks, knowledge exploration through **weak ties**, i.e. sources external to well-established relationships, is needed, and flexibility of network is essential.

In the last few decades, **university-industry collaborations** have attracted considerable attention. A large body of literature has pointed to the importance of scientific research for the technological change, innovation, and economic performance. Aissaoui (2014) **identifies the effect of collaborations with public research organizations on firms' innovative performance**. Using the **French Community Innovation Survey**, he concludes that **collaborating with universities and other public research organizations increases firm's innovative performance**.

Various empirical studies find support for the idea that interactions with public research organizations positively influence firms' innovative performance (Aissaoui, 2014). For instance, cooperation with universities is shown to be positively associated with innovative sales in Netherlands, Germany, and Sweden (Mansfield 1996, Belberdos et al. 2004, Aschhloff and Schmidt, 2008). As a result, empirical evidence is to be found confirming whether collaborations with public research organizations could significantly improve firms' innovative performance.

[1] The Community Innovation Survey 2012 dataset is available for 13 European countries: Bulgaria, Czech Republic, Germany, Estonia, Spain, Croatia, Cyprus, Lithuania, Hungary, Portugal, Romania, Slovenia, Slovakia and Norway.

Colurcio and Russo-Spena (2013) concluded that f**ood SMEs are orientated to collaborate with partners for innovation**. **Cooperation in innovation networks** brings mutual benefits and partners cooperate at the same level. However, the innovation openness is **focused on some privileged relationships with few partners often belonged to the current network of SMEs** where long-lasting relationship alleviates trust concerns. Moreover, they highlight the **importance of trust in innovation relationships**. In addition, for the more knowledgeable **SMEs** the interaction for innovation allows the access in a w**ider network of connected relationships and to better position themselves in value networks**.
Chesbrough (2003) suggests that many innovative firms have shifted to an **'open innovation'** model, using a **wide range of external actors** and **sources** to help them achieve and sustain innovation. There are two factors influencing the success of the open innovation. First, the factor called **absorptive capacity** that depicts access to skills and external networks. Second, **complementary resources** that include proprietary R&D knowledge, distribution or service networks, and manufacturing capabilities (Fertő et al. 2016).
Gilsing and Nooteboom (2005) provide an empirical study on **density and strength of ties in innovation networks in the Dutch multimedia and pharmaceutical biotechnology industry**. They aimed to distinct between **exploration versus exploitation** and find a stronger sectoral effect in how exploration and exploitation settle in **network structural properties** than anticipated thus far.
Innovative companies **generally establish linkages with other actors and access external knowledge in order to benefit from the dynamic effects of interactive processes**. Indarti and Postma (2013) show that **the quality of interaction as indicated by the depth of knowledge absorbed from various external parties and intensity of interaction** (i.e., **tie intensity**) are better predictors of product innovation than the **diversity of interaction**. An understanding of the **contribution of external networks to innovation** is essential for the effective management and functioning of these networks. Buchmann, and Pyka (2012) outline a conceptual framework for depicting **network evolution patterns of interfirm innovation networks** and analysing the **dynamic evolution of an R&D network in the German automotive industry**. They suggest that structural positions, actor and dyadic covariates describing characteristics of the firms' knowledge bases are influential determinants of network development.

Laursen and Salter (2006) analysed links search strategy to innovative performance, finding that **searching widely and deeply is curvilineal related to performance using a large-scale sample of industrial firms.** They claimed that firms who are more open to external sources or search channels are more likely to have a higher level of innovative performance. They concluded that searching a variety of search channels can provide ideas and resources that help firms gain and exploit innovative opportunities.

Fertő (2016) tested that the **scope and depth of openness** to external organizations has a **curvilinear (inverted U-shape) effect** on innovative performance. He concluded that positive relationships exist between scope/depth of open innovation and firms' performance. Moreover, he found that a curvilinear (inverted U-shape) impacts of scope/depths of open innovation exist on firms' performance only at the phase of idea development. Chen et al. (2011) analysed how the innovative performance is affected by **the scope, depth, and orientation of firms' external search strategies** in China. They analysed the using science, technology, innovation, doing, using and interacting innovation modes. Their finding suggests that **greater scope and depth of openness for both innovation modes improves innovative performance** indicating that open innovation is also relevant beyond science and technology-based innovation.

There are three dimensions of external searching strategies. First, the scope of the external search focuses on the **diversity of the external sources of innovation** (Laursen and Salder, 2004). Second,

the depth of a firm's external search and is defined as the extent to which firms draw on different external sources (Laursen and Salder, 2004). Third, the orientation of a firm's external search refers to the role of different types of external actors in enhancing the innovative performance of firms (Chen et al. 2011)

Methodology

Theoretical considerations, empirical findings and preliminary analysis of our data suggest that the companies' innovation decisions consist of two stages: first they make a choice whether to deal with innovation issues at all. If they are not motivated and/or forced to do so, and if their market does not extort them into this direction, they probably wouldn't do it. The innovation activities and the innovative products and processes inherently encompass a certain amount of risk, which can be avoided if the company does not deal with it. Our data proves that the majority of European food processors doesn't carry out any innovation activity. Therefor we had to look after an appropriate method which takes into consideration the specific problem of selection bias: not all firms should be taken into consideration when we determine the factors influencing the innovation performance, just the ones, which really do it. The double hurdle estimation came handy for this purpose. The Cragg's (1971) hurdle model combines a selection model that determines the boundary points of the dependent variable with an outcome model that determines its nonbounded values. In this model, individual firms carry out zero or a positive amount of innovation, with (possibly) different factors determining each of these choices.

Hurdle models are characterized by the relationship $y_i = s_i h_i^*$, where y_i is the observed value of the dependent variable. The selection variable, s_i, is 1 if the dependent variable is not bounded and 0 otherwise. In the Cragg model, the lower limit that binds the dependent variable is 0 so the selection model is

$$s_i = \begin{cases} 1 & if \quad z_i\gamma + \epsilon_i > 0 \\ 0 & otherwise \end{cases} \qquad \text{Equation 1}$$

where z_i is a vector of explanatory variables, γ is a vector of coefficients, and ϵ_i is a standard normal error term (Stata User's Guide Release 14).

Hypotheses

According to the methodological approach, we make difference between the two sets of hypotheses: one refers to the selection, the other to the outcome parts of the model. In the selection phase, we postulate the probability whether a company deals with any kind of innovation, while in the outcome one we predict the quantity of total innovation activity of the companies. We also control for openness, market obstacles, and company size.

Selection hypotheses

Literature of innovation network suggests that innovative firms are using a **wide range of external skills, network relations**, **information sources** in order to achieve and improve innovation performance (Chesbrough 2003, Fertő et al. 2016, Chen et al. 2011). According to Postma (2013), we suppose that networking intensity is a good predictor of whether the firms are engaged in innovation at all. If the firm's network relations are more intensive, it provides companies more information on where to innovate. If network relationships are not significant (its intensity is close to zero), the information and new ideas are not important for them, consequently, they are not interested in carrying out innovation.

H1: The higher the intensity of cooperation with information sources are, the more the propensity to innovate is.

Firms innovate to meet the unsatisfied needs of consumers. In order to control for this feature, a binary variable is used describing if the firm aimed **to enter into new markets** and/or to increase its market share (Aissaoui, 2014). Therefore, the openness is a good indicator, whether the firm is forced to innovate by the global competition.

H2: The more the company is exposed to global competitiveness the higher the willingness to innovate is.

We also consider a binary variable which identifies firms who **faced obstacles linked to the market that has hampered their innovation activities** (Aissaoui, 2014**).** If they are not, probably they are less motivated for making any kind of inherently risky innovation activity.

H3: Market obstacles in Hungarian food processing enterprises force a company's innovation performance.

The very low (close to zero) values of variables representing H1-H3 suggest that food companies are not getting into innovation.

Outcome hypotheses
The scope and orientation of firms' external search strategies significantly affect innovative performance. Greater scope of openness for innovation modes improves innovative performance indicating that open innovation is also relevant beyond science (Chen et al. 2011). The scope of the external search focuses on the diversity of the external sources of innovation (Laursen and Salder, 2004).

H4: The wider the scope of firm's innovation networks is, the higher the innovation performance is.

Schumpeter (1942) argues that large firms have **the resources** that enable them to address the risks associated with innovation activities. In consequence, we control for firm's size measured as company's total turnover.

H5: Company's size provides a resource base for firm's innovation activity.

The open way of innovation articulates a certain behavioural aspect of activity: of those who communicate openly with business partners about new business ideas we can state that they **share their knowledge with these partners**. Naturally, they expect from these people the same behaviour. They do it because they perceive that the outcome from **performing that behaviour is positive, therefore they will have a positive attitude towards performing that behaviour** (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The aspiration of the strategic approach to innovation indicates a positive attitude for innovation performance.

H6: Strategic importance of introducing new or significantly improved goods or services positively related to innovation performance.

The dependent variable of the regression depicts whether the enterprise has performed product, process, organisation or market innovation during the past 3 years. More specifically, these activities encompass new or significantly improved goods, new or significantly improved services, new or significantly improved methods of manufacturing, new or significantly improved logistics, new or significantly improved supporting activities, new business practices for organising procedures, new methods of organising work responsibilities and decision making, new methods of organising external

relations with other firms, significant changes to the aesthetic design or packaging of a good or service, new media or techniques for product promotion, new methods for product placement or sales channels and new methods of pricing goods or services.
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Explanatory variables
Networking scope is representing how many kinds of external sources have been used for acquiring new ideas for the innovation. A total count of any kind of information sources has been counted.
Networking intensity was generated by summing the importance of all kind of information sources and cooperation for innovation activities (market sources, education and research institutes, other sources: e.g. conferences, trade fairs, exhibitions), except internal innovation.
We applied **total turnover in 2012** expressed in Euro as company size**.**
The **strategic behaviour**al variable captures the *importance of introducing new or significantly improved goods or services***.**
In addition, we used **market openness** variable for international markets depicting foreign geographic markets (other EU and all other countries) in which enterprise sell goods or services between 2010 and 2012.
Finally, **market obstacles** variable expresses in strong competing situation companies necessarily have to innovate otherwise they are lagging back (strong price competition, strong competition on product quality, reputation or brand, lack of demand, innovations by competitors, the dominant market share held by competitors).

Data

To explore the innovation networks in the selected[2] European food industries and to test the determinants of innovation performance, the dataset was collected from the 2012 Community Innovation Survey (CIS), by a harmonised survey questionnaire. Data were provided by the Eurostat after we have been accredited for handling individual (micro) data. We applied CIS Nace rev 2. statistical classification of economic activities (manufacture of food products, beverages, and tobacco products) in the European Community for our analysis (EUROSTAT, 2008, p. 65).

The descriptive statistics of the datasets included to our calculations are available in Appendix I. In general, the size of the samples varied between 92 (Slovakia) and 2146 (Spain) observations with an average of 519.

Innovation was defined as the introduction of a new or significantly improved **product, process, organisational-**, or **marketing** method by the enterprise. An innovation must have characteristics or intended uses that are new or which provide a significant improvement over what was previously used or sold by the enterprise. However, an innovation can fail or take time to prove itself. An innovation need only be **new or significantly improved for the enterprise**. It could have been originally developed or used by other enterprises (CIS 2012).

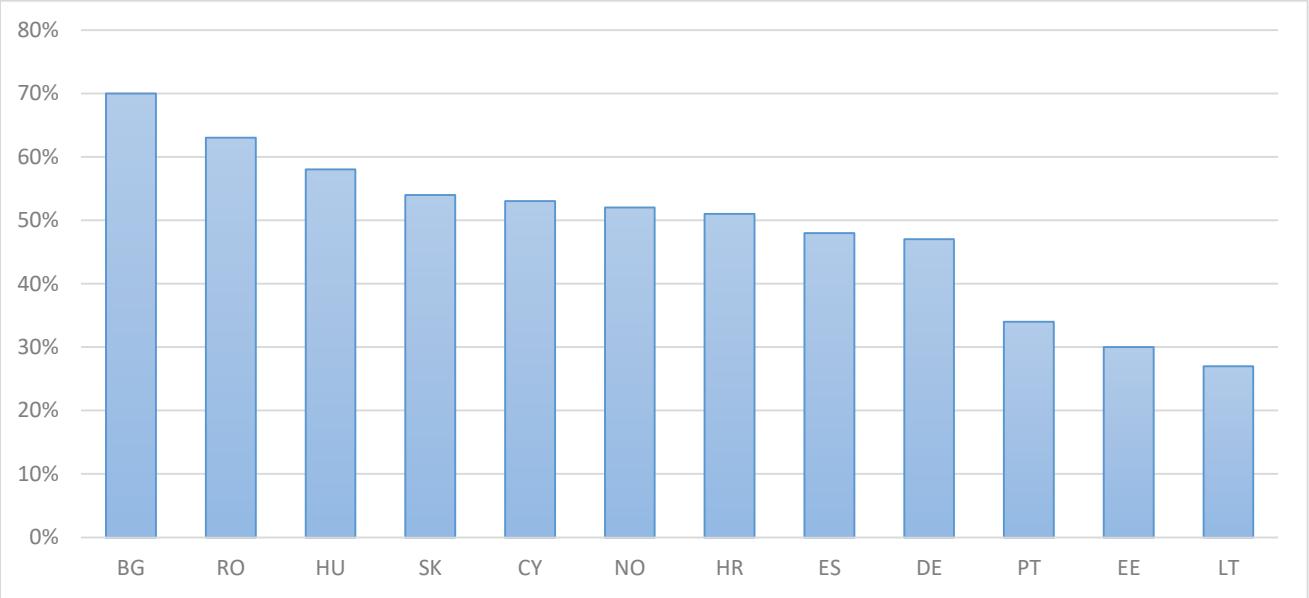
Dependent variable capturing **innovation performance** take values from 0 to 12. It shows how many innovation activities were implemented in the past 3 years among the 12 innovation platforms. On average, the most innovative companies were found in Portugal with an average of 3,2 platforms implemented, while on the other hand this value in Bulgaria was only 0,88. The average of the 12 selected countries was 2,03.

[2] From the 13 available datasets the Slovenian didn't have enough data to include to our models, therefore it was excluded from the calculations.

The theoretical maximum value of the **networking intensity** (external information sources) variable is 30, while this value was reached only by some Portugal companies and the highest number of external information sources was used in Norway (with an average of 6,58) and the less in Bulgaria (1,61).

Networking scope variable (number of innovation activities) ranges between 0 and 12 (see Appendix II). It should be noted that in the two South-Eastern European countries the vast majority of the companies do not have any innovation activity for higher innovation performance (in Bulgaria 70%, while in Romania 63%). Among the others, on the average the half of the companies don't have any innovation at all and the share of such companies is the lowest in Estonia (30%), Lithuania (27%) and in Portugal (34%). This also means that in these three latter countries the share of the companies with at least one innovative activity is the highest (Figure 1).

Figure 1 The share of companies without any innovation activities in the selected countries



Source: own calculation based on CIS (2012)

From Appendix II. it is also clearly visible that the most commonly used innovation was the "*Significant changes to the aesthetic design or packaging of a good or service*" and the "*New or significantly improved goods*", while the less attractive innovations to the companies are the "*New methods of organising external relations with other firms" and "New or significantly improved services*". Based on the data we can also say that in general, the relative importance of the several innovation activities was similar in all the countries with some exceptions (e.g. in Hungary and in Romania the importance of "New or significantly improved methods of manufacturing" and "New or significantly improved supporting activities" was lower compared to the others, while on the contrary "*New or significantly improved supporting activities*" was relatively much more important in Portugal. "*New methods of pricing goods or services*" was more important in Lithuania and Portugal, and the "*New or significantly improved logistics*" in Cyprus).

The variable which shows the **strategic importance** of introducing new or significantly improved goods or services ranges from 0 to 3 (zero, low, medium and high importance). With an average of 1,98 it was the highest in Portugal and with 0,8 the lowest in Cyprus.

The level of **market obstacle** was measured on a 0-15 scale, containing 5 different types of barriers each with a 0-3 scale. The average level of this indicator was 7,38 in the selected countries. The least obstacles were measured in Germany (with an average of 7,27). On the contrary, this value was the highest in the Baltic countries (Lithuania 10,19 and Estonia 10,27).

The average value of **market openness** of the selected countries was 0,84, with most opened companies in Hungary (1,8) and the less in Bulgaria (0,47) and Romania (0,48).

Regarding the size of the companies included to the survey we can say that the average **total turnover** of the companies was 39,445 million EUR, with the highest average in Germany and the lowest in Bulgaria.

Results

Appendix III presents the results of double hurdle estimation of innovation network tails on innovation performance in the selected European food industries. Both selection and outcome model hypotheses were confirmed by the estimation. The statistically significant regression results prove that the number of networking tails (scope) contributes to the innovation in all countries analysed, as well as networking intensity, play an important role in explaining innovation performance in all the selected food industries (except in Lithuania and Slovakia where the results were not statistically significant). Furthermore, firm's openness to foreign markets and strategic goals for enhancing innovation similarly stimulate innovation performance. It contributes to the behavioural theory of the innovation (Theory of Reasoned Actions). Market obstacles also stimulate the Bulgarian and Hungarian food companies to go forward the competition and to accelerate its innovation activity to preserve its market position. We can state that in the majority of the selected EU countries, the innovation performance similarly and significantly depends on company's size and its strategic goals. The importance of companies' size suggests the validity of the Schumpeterian (1942) model of innovation.

Conclusion

The food sector plays a significant role in the European Union, by contrast, innovation activity in food processing sector may depict different picture in Western and Eastern Europe. Our findings in the food industry are generally in line with the performances indicated by the European Innovation Scoreboard for all the industries. Bulgaria and Romania are one of the least innovative countries, while among the countries included to our sample Germany and Norway took the leading position. From the others in the sample Portugal, Estonia and Lithuania had better innovation-oriented characteristics, especially compared to the other Eastern European countries.

Understanding the relationship between innovation and performance in both large and small firms is relevant for researchers, policy-makers, and managers of large and small companies alike. Our paper analysed why the food companies in 12 European food industries did not engage in innovation activities, and if they did so, what were the main drivers of their innovation performance.

Frist, we explored the impact of innovation network intensity (modes of cooperation) and networking scope (networking sources) on innovation performance in the EU food industries. Second, our selection hypotheses tested the role of international openness and market obstacles to innovation. Third, control variables as company size and strategic goals were also tested by our econometric models.

Our data were derived from EU Community Innovation System (CIS) survey in 2012, by a harmonised survey questionnaire.

We employed Cragg (1971) double hurdle linear and exponential model to estimate the role of innovation networks on innovation performance. This method also helps in overcoming the selection bias problem.

Outcome model shows that if the network relationships (networking scope, how many information sources they utilize) were weak in term of internal sources, the food companies do not innovate at all (H4). Moreover, estimation results prove that networking intensity (H1) played a significant role in explaining innovation engagement in the food industry in the EU (Chesbrough 2003, Fertő et al. 2016, Chen et al. 2011).
The selection model results suggest that companies internationally not exposed to the global market requirements are less likely to innovate because they do not force to be innovative by their competitors (H2). Company's size (H5) and market obstacles (H3) were also determinant factors of firm's innovation decisions in line with the findings of Aissaoui (2014).
The motivation for innovation is also significantly determined by firm's attitude and strategic goals in line with the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975; Postma 2013). In sum, innovation performance significantly depends on company's size and its strategic goals. Interestingly, the market obstacles are rather stimulating factors of firm's innovation confirming the Schumpeterian approach to innovation. The results – where statistically significant – shows similarities among the countries, though the influence of the several factors may somehow differ.

In conclusion, those companies who were able to innovate in the examined food processing industries generally had a positive vision and well-maintained innovation network relationships (H6).
Results revealed that Western European food processing companies innovate more than Eastern European ones (especially Bulgaria, Romania, Hungary, Slovakia, and Cyprus). Our findings also emphasize that the food industry in Europe has shifted from the "open innovation" paradigm into the mutuality based "networking innovation" one, where we need to take into consideration the behavioural aspects of innovation performance as well.

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Appendix

Appendix I.

Descriptive statistics of variables[3]

	BG					CY					DE				
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Innovation performance	1548	0,88	1,82	0	11	144	3,05	3,81	0	12	315	1,75	2,26	0	11
Networking intensity	1548	1,61	4,14	0	25	144	5,29	7,78	0	27	315	4,67	6,13	0	21
Networking scope	1548	0,90	2,27	0	10	144	2,26	3,21	0	10	315	2,70	3,53	0	10
Strategic behaviour	1548	1,25	1,07	0	3	144	0,80	1,29	0	3	258	1,88	0,98	0	3
Market obstacles	1548	7,72	4,36	0	15	144	8,16	3,42	0	15	315	7,27	4,40	0	15
Market openness	1548	0,47	0,73	0	2	144	0,51	0,79	0	2	315	0,49	0,77	0	2
Total turnover in 2012 (million €)	1548	3,34	13,80	0	304	144	8,11	15,40	0	102	315	213,00	702,00	0	6000

	EE					ES					HR				
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Innovation performance	108	2,16	2,33	0	12	2146	1,94	2,68	0	12	195	2,37	3,25	0	12
Networking intensity	108	6,29	6,03	0	25	2146	4,72	6,62	0	27	195	4,37	6,88	0	25
Networking scope	108	3,72	3,24	0	10	2146	2,58	3,52	0	9	195	2,33	3,45	0	10
Strategic behaviour	108	1,82	0,87	0	3	0					195	1,79	1,00	0	3
Market obstacles	108	10,27	3,07	0	15	2146	0,00	0,00	0	0	195	8,73	3,46	0	15
Market openness	108	1,06	0,75	0	2	2146	1,04	0,89	0	2	195	0,78	0,90	0	2
Total turnover in 2012 (million €)	108	12,90	21,50	0	116	2146	34,30	110,00	0	2290	195	23,10	52,00	0	374

[3] BG: Bulgaria, CY: Cyprus, DE: Germany, EE: Estonia, ES: Spain, HR: Croatia, HU: Hungary, LT: Lithuania, NO: Norway, PT: Portugal, RO: Romania, SK: Slovakia

	HU					LT					NO				
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Innovation performance	440	1,29	1,97	0	10	89	3,07	3,13	0	12	290	1,59	2,19	0	10
Networking intensity	440	3,12	6,25	0	28	89	5,80	7,62	0	25	290	6,58	8,76	0	29
Networking scope	440	1,58	3,10	0	10	89	3,17	3,91	0	10	290	3,32	4,33	0	10
Strategic behaviour	440	1,73	0,96	0	3	89	1,93	1,00	0	3	0				
Market obstacles	440	9,87	3,48	0	15	89	10,19	3,69	0	15	290	0,00	0,00	0	0
Market openness	440	1,80	1,01	0	3	89	1,24	0,87	0	2	290	0,56	0,80	0	2
Total turnover in 2012 (million €)	439	20,60	53,50	0	514	89	31,20	52,00	0	273	290	70,90	219,00	0	2300

	PT					RO					SK				
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Innovation performance	323	3,20	3,36	0	12	536	1,46	2,47	0	12	92	1,58	2,58	0	11
Networking intensity	323	6,52	7,94	0	30	536	2,07	5,35	0	27	92	3,23	5,86	0	19
Networking scope	323	3,45	4,01	0	10	536	1,03	2,62	0	10	92	1,75	3,09	0	10
Strategic behaviour	323	1,98	0,90	0	3	535	1,66	0,93	0	3	92	1,67	0,98	0	3
Market obstacles	323	9,28	3,00	0	15	536	8,14	3,29	0	15	92	8,98	3,23	0	15
Market openness	323	1,00	0,91	0	2	536	0,48	0,70	0	2	92	0,65	0,73	0	2
Total turnover in 2012 (million €)	323	17,50	61,70	0	683	536	15,70	39,70	0	435	92	22,70	40,10	0	206

Source: own calculation based on CIS (2012)

Appendix II.

Types of innovation in the selected countries[4]

	BG	CY	DE	EE	ES	HR	HU	LT	NO	PT	RO	SK
No innovation	70%	53%	47%	30%	48%	51%	58%	27%	52%	34%	63%	54%
New or significantly improved goods	12%	24%	23%	44%	24%	30%	19%	40%	31%	32%	11%	24%
New or significantly improved services	1%	15%	4%	3%	6%	5%	1%	8%	1%	14%	3%	3%
New or significantly improved methods of manufacturing	8%	28%	14%	33%	29%	22%	9%	31%	17%	33%	9%	14%
New or significantly improved logistics	2%	32%	7%	16%	7%	13%	2%	12%	5%	17%	5%	9%
New or significantly improved supporting activities	3%	28%	8%	22%	14%	21%	5%	26%	6%	30%	5%	8%
New business practices for organising procedures	8%	26%	15%	9%	25%	25%	11%	15%	16%	29%	13%	13%
New methods of organising work responsibilities and decision making	8%	26%	17%	14%	23%	23%	10%	26%	17%	29%	19%	13%
New methods of organising external relations with other firms	4%	14%	7%	5%	9%	13%	5%	15%	7%	15%	7%	4%
Significant changes to the aesthetic design or packaging of a good or service	13%	27%	21%	35%	21%	30%	23%	44%	24%	44%	25%	32%
New media or techniques for product promotion	10%	35%	17%	16%	15%	20%	18%	31%	17%	30%	19%	18%
New methods for product placement or sales channels	8%	31%	14%	10%	13%	18%	13%	26%	13%	18%	14%	12%
New methods of pricing goods or services	11%	17%	10%	8%	9%	18%	12%	33%	6%	28%	16%	8%

Source: own calculation based on CIS (2012)

Note: more types of innovation could be selected therefore the sum of the percentages can be more than 100%

[4] BG: Bulgaria, CY: Cyprus, DE: Germany, EE: Estonia, ES: Spain, HR: Croatia, HU: Hungary, LT: Lithuania, NO: Norway, PT: Portugal, RO: Romania, SK: Slovakia

Appendix III.

Cragg's double hurdle regression results[5]

BG			**CY**			**DE**		
Outcome model	Linear	Exponential	Outcome model	Linear	Exponential	Outcome model	Linear	Exponential
Total turnover (log)	0,427***	0,057***	Total turnover (log)	0,033	-0,007	Total turnover (log)	0,15	0,027
Strategic behaviour	1,118***	0,143***	Strategic behaviour	0,979***	0,171***	Strategic behaviour	0,872***	0,175***
Networking scope	0,394***	0,047***	Networking scope	0,296**	0,039*	Networking scope	0,298***	0,066***
Cons	-8,177***	-0,366	Cons	2,792	1,370**	Cons	-3,065	-0,146
Selection model			Selection model			Selection model		
Strategic behaviour	0,175***	0,175***	Strategic behaviour	-0,212	-0,216	Strategic behaviour	0,383***	0,383***
Market openness	0,208***	0,208***	Market openness	0,055	0,055	Market openness	0,261*	0,261*
Market obstacles	0,040***	0,040***	Market obstacles	-0,008	-0,008	Market obstacles	-0,01	-0,01
Networking intensity	0,260***	0,260***	Networking intensity	1,113	1,111	Networking intensity	0,175***	0,175***
Cons	-1,532***	-1,532***	Cons	-0,894**	-0,894**	Cons	-1,048***	-1,048***
pseudo R^2	0,1809	0,2352	pseudo R^2	0,2861	0,3472	pseudo R^2	0,1717	0,2494
N	1,548	1,548	N	144	144	N	258	258

[5] BG: Bulgaria, CY: Cyprus, DE: Germany, EE: Estonia, ES: Spain, HR: Croatia, HU: Hungary, LT: Lithuania, NO: Norway, PT: Portugal, RO: Romania, SK: Slovakia

EE		
Outcome model	Linear	Exponential
Total turnover (log)	0,941***	0,135***
Strategic behaviour	-0,009	-0,009
Networking scope	0,354*	0,073**
Cons	-14,624***	-1,573**
Selection model		
Strategic behaviour	-0,21	-0,21
Market openness	0,2	0,2
Market obstacles	0,011	0,011
Networking intensity	0,301***	0,301***
Cons	-0,576	-0,576
pseudo R^2	0,1932	0,3029
N	108	108

ES		
Outcome model	Linear	Exponential
Total turnover (log)	0,539***	0,074***
Strategic behaviour	N/A	N/A
Networking scope	0,433***	0,056***
Cons	-8,931***	-0,423**
Selection model		
Strategic behaviour	N/A	N/A
Market openness	0,204***	0,204***
Market obstacles	N/A	N/A
Networking intensity	0,153***	0,153***
Cons	-0,712***	-0,712***
pseudo R^2	0,1305	0,1758
N	2,146	2,146

HR		
Outcome model	Linear	Exponential
Total turnover (log)	0,616**	0,109**
Strategic behaviour	0,923*	0,177**
Networking scope	0,325**	0,049**
Cons	-9,420**	-1,034
Selection model		
Strategic behaviour	0,185	0,185
Market openness	0,001	0,001
Market obstacles	0,019	0,019
Networking intensity	0,247***	0,247***
Cons	-1,155***	-1,155***
pseudo R^2	0,1888	0,2405
N	195	195

HU		
Outcome model	Linear	Exponential
Total turnover (log)	0,207**	0,053**
Strategic behaviour	0,866***	0,203***
Networking scope	0,255***	0,062***
Cons	-3,640**	-0,608
Selection model		
Strategic behaviour	0,247***	0,247***
Market openness	0,312***	0,312***
Market obstacles	0,061**	0,061**
Networking intensity	0,212***	0,212***
Cons	-2,217***	-2,217***
pseudo R^2	0,2138	0,2997
N	440	439

LT		
Outcome model	Linear	Exponential
Total turnover (log)	N/A	0,04
Strategic behaviour	N/A	0,138
Networking scope	N/A	0,088***
Cons	N/A	-0,134
Selection model		
Strategic behaviour	N/A	0,561**
Market openness	N/A	0,480*
Market obstacles	N/A	-0,075
Networking intensity	N/A	1,435
Cons	N/A	-0,686
pseudo R^2	N/A	0,2719
N	N/A	89

NO		
Outcome model	Linear	Exponential
Total turnover (log)	0,231*	0,058**
Strategic behaviour	N/A	N/A
Networking scope	0,344***	0,076***
Cons	-3,398	-0,479
Selection model		
Strategic behaviour	N/A	N/A
Market openness	-0,122	-0,122
Market obstacles	N/A	N/A
Networking intensity	0,129***	0,129***
Cons	-0,700***	-0,700***
pseudo R^2	0,1941	0,2816
N	289	289

PT			RO			SK		
Outcome model	Linear	Exponential	Outcome model	Linear	Exponential	Outcome model	Linear	Exponential
Total turnover (log)	0,19	0,039*	Total turnover (log)	0,452***	0,096***	Total turnover (log)	N/A	0,100*
Strategic behaviour	0,950***	0,153***	Strategic behaviour	-0,729**	-0,111*	Strategic behaviour	N/A	-0,076
Networking scope	0,544***	0,100***	Networking scope	0,362***	0,060***	Networking scope	N/A	0,087***
Cons	-3,542*	-0,099	Cons	-3,981	-0,374	Cons	N/A	-0,884
Selection model			Selection model			Selection model		
Strategic behaviour	0,446***	0,446***	Strategic behaviour	-0,034	-0,034	Strategic behaviour	N/A	0,168
Market openness	0,227**	0,227**	Market openness	0,298***	0,298***	Market openness	N/A	0,496*
Market obstacles	-0,017	-0,017	Market obstacles	-0,014	-0,014	Market obstacles	N/A	0,089
Networking intensity	0,164***	0,164***	Networking intensity	0,349***	0,349***	Networking intensity	N/A	1,93
Cons	-1,067***	-1,067***	Cons	-0,594***	-0,594***	Cons	N/A	-2,150***
pseudo R^2	0,1895	0,2537	pseudo R^2	0,1465	0,1856	pseudo R^2	N/A	0,3588
N	323	323	N	535	535	N	N/A	92

legend: * p<0.1; ** p<0.05; *** p<0.01

Source: own calculation based on CIS (2012)