

The Effects of Knowledge from Collaborations on the Exploitative and Exploratory Innovation Output of Greek SMEs

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Abstract. *There is very limited research linking the collaborations of Greek SMEs and their innovation output. This paper uses the exploitation / exploration framework and links it to the knowledge flows towards SMEs coming through their collaborations. It explores three types of knowledge, namely managerial, technological and market-related. It finds that the exchange of management knowledge has a positive and significant effect on exploratory innovation only, the exchange of technical / technological knowledge has a negative and significant effect on exploitative and exploratory innovation output, and the exchange of market knowledge does not have an effect on any type of innovation output. Also, partnering with same nationality firms has a negative effect on exploratory innovation and particularly for exploitative innovation the existence of a collaboration manager has a negative effect. Most of these findings are corroborated by interviews with 10 managers of Greek SMEs.*

Keywords: *collaborations, innovation, exploitation, exploration, SME, Greece.*

Introduction

Empirical analysis shows an unwillingness of the Greek private sector to invest in R&D and the low productivity of innovation (Beneki, Giannias & Moustakas, 2012) in times of economic crisis. Moreover, Archibugi and Filippetti (2011) have noted that in the case of Greece the current recession has had the worst impact on firms' innovation investments amongst all European countries. Under such conditions of crisis, it is worth investigating whether open innovation practices would be beneficial to the Greek private sector. The open innovation perspective allows for the penetrating of novel technology, product, and market landscapes that extend beyond the actual core business of firms and would be difficult to be discovered by isolated individual firms (Chesbrough, 2007). Collaborations are important means for open innovation (Sammarra & Biggiero, 2008) because they allow firms to share knowledge and resources (e.g. Bierly, Damanpour & Santoro, 2009) with partners (Gulati, Dialdin & Wang, 2002). Knowledge from external relationships is important, as it expands a firm's knowledge base (Bierly et

al., 2009) that can be applied to commercial ends (e.g. Spithoven, Clarysse & Knockaert, 2010), thus enhancing innovation capability.

(Li & Tang, 2010). Huggins and Johnston (2010) define knowledge as “information that changes something or somebody, either by becoming grounds for action or by making an individual or an institution capable of different or more effective action”. So, according to the open innovation perspective, innovation can emerge by combining and recombining knowledge elements coming from networking through collaborations (Bauer & Leker, 2013; Wang et al., 2014). Huggins (2010) suggests that open innovation is the very reason behind the decision of building or entering an inter-organizational collaboration network. The concept of “network capital” emerges as the calculated inter-organizational collaborative relationship investments, which in turn could provide access to knowledge and, therefore, economic returns to the network members involved (Huggins, 2010).

Theory development

According to Huizingh (2011), the concept of open innovation will be gradually integrated in the innovation management practices throughout the coming years, transforming itself into the new status quo in the way business operates. However, in the case of the Greek business environment there is clear deficit of research on the effect of collaborations (as an open innovation practice) on the innovation output of firms (Livieratos, 2009). Moreover, SMEs are major actors for innovation in Greece under economic crisis conditions (Beneki et al., 2012) and, consequently, the question arises as to the current state of Greek SMEs’ open innovation benefits in terms of their collaborations. Open innovation may provide an opportunity for Greek SMEs to enhance their competitive advantage against larger companies (van de Vrande et al., 2009), it requires the establishment of networks with customers, institutions, and other organizational entities (Lee et al., 2010; van de Vrande et al., 2009) and it may range from informal arrangements to strategic alliances (Sammarra & Biggiero, 2008).

In the literature, the knowledge-based view concentrates on the creation of competitive advantage through the transfer and conversion of explicit and tacit knowledge (Shu et al., 2012; Windsperger & Gorovaia, 2011). According to Sammarra and Biggiero (2008), in the broad context of the knowledge-based view, successful innovation is linked to three different knowledge types, as far as inter-organizational knowledge transfer is concerned:

1) Technological knowledge: This type of knowledge refers to the required know-how for product and process development (Samarra & Biggiero, 2008) and it may broaden the horizon of potential opportunities in relation to technological advances by fostering a more effective understanding and evaluation of such advances (Clarysse, Wright & van de Velde, 2011).

2) Market Knowledge: Market knowledge concentrates on an organization's knowledge capital in association with customers' needs and behaviors, along with competitors' behavior (de Luca & Atuahene-Gima, 2007). According to Bao, Sheng and Zhou (2012), there are two ways of collecting such information: either through a traditional marketing research or from external sources in the value chain such as distributors and/or suppliers. 3) Managerial Knowledge: Managerial knowledge refers to every aspect of organizational management ranging from strategic planning and decision making to human-, financial- and IT management, as well as operations and marketing management (Fu, Revilla Diez & Schiller, 2013). In addition, Samarra and Biggiero (2008) suggest the inclusion in the aforementioned organizational capabilities of strategic networking capability, as a very significant source of competitive advantage.

The purpose of this study is thus to explore the types of knowledge that Greek SMEs exchange and share with their inter-organizational partners: (1) technological knowledge, (2) market knowledge, and (3) managerial knowledge, and their effects on a firms' innovation output. The first research question is whether SMEs exchange all three types of knowledge through their collaborations. The second research question relates to the relationship between different types of knowledge acquired through inter-organizational collaborations and the innovation output of Greek SMEs. Furthermore, as empirical contributions have confirmed that the effects of collaborations on innovation output are contingent on the type of innovation task at hand – exploratory and/or exploitative, a contingency research approach is more effective (Bauer & Leker, 2013; Hernández-Espallardo, Sánchez-Pérez & Segovia-López, 2011; Yamakawa, Yang & Lin, 2011). Exploratory innovation refers to the creation of knowledge that differs from that used by a focal firm in prior innovations even though this knowledge may have been in existence earlier elsewhere (March, 1991). Exploitative innovation focuses on the refinement and extension of a focal firm's existing knowledge (March, 1991). However, an empirical investigation of the effects of technological, market, and managerial knowledge flowing through a firm's inter-organizational collaborations on its exploratory and exploitative innovation is non-existent for the case of Greek SMEs and this paper

attempts to fill this literature gap (Bierly et al., 2009; Hernadez-Espallardo et al., 2011).

Methodology

The present study acquired data from senior managers of Greek SMEs in order to obtain factual information on firms' demographics and the collaborations of the sampled organizations (e.g. Van de Vrande et al., 2009). The list of candidate firms was acquired from the website of the Athens Chamber of Commerce and Industry. The sample chosen was cross-sectional and contained high-tech as well as low-tech SMEs. The interviewees completed telephone and web-based questionnaires, and the response rate of 11% is considered normal (Saunders, Lewis & Thornhill, 2012). The dependent variables are *Number of exploitation products* and *Number of exploration products* (Rothaermel & Deeds, 2004). Exploitation products are products based on knowledge internal to a firm for longer than the last 3 years, and exploration products are those based on new knowledge that a firm acquired in the last 3 years. Since the two dependent variables, *Number of exploitation products* and *Number of exploration products* are count variables with non-normal distribution (see Figure 1) and because of fear of overdispersion in the data, Negative Binomial regression models were run using the robust option to obtain robust standard errors for the parameter estimates (Cameron & Trivedi, 2009) to control for mild violation of underlying assumptions and because we need to be consistent (i.e. asymptotically unbiased) but we do not want to have to assume homoskedasticity and normality of the random error terms.

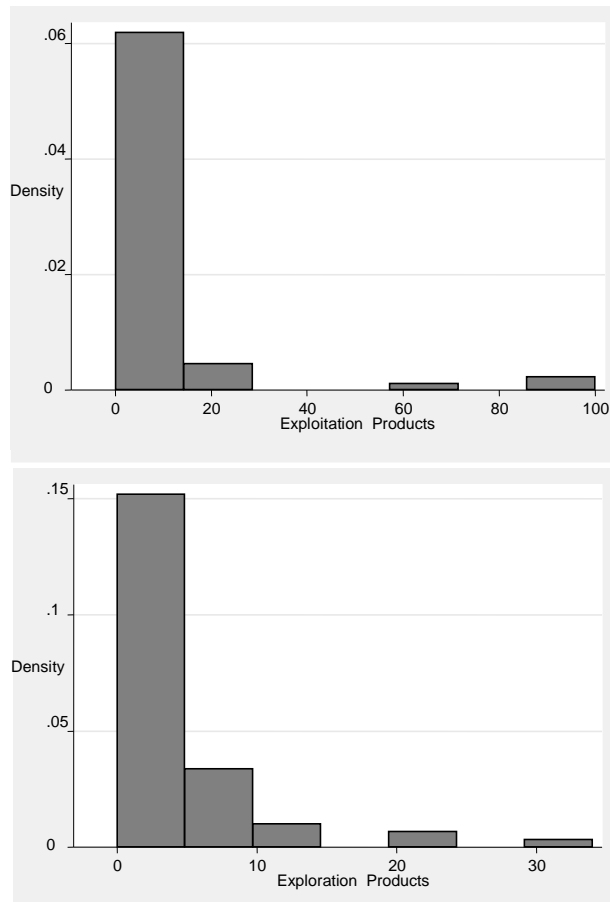


Figure 1. Distribution of the dependent variables

The independent variables are the *Exchange of management knowledge*; *Exchange of technological knowledge*; *Exchange of market knowledge*, *Number of collaborations*; *Collaboration experience*, as defined in the Appendix. *Number of collaborations* is important because previous research (Sampson, 2005; Hernández-Espallardo et al., 2011) has indicated that knowledge regarding learning on how to collaborate with partners - based on which certain norms are developed in the collaboration relationship concerning its purposes, procedures, and goals, as well as language, culture, and traditions - is key to successful exchange of knowledge within partnerships. *Collaboration experience* is measured by the number of years that a firm has had involvement with collaborations. It refers to organizational procedures

that foster the accumulation of knowledge related to past and ongoing relationship experience of an organization in order to develop collaboration management know-how. For a firm that has no or little alliance experience, forming an alliance may enable it to draw important lessons with regard to the approach the partner uses and be able to faster climb on the learning curve. By looking at the partner's approach on the alliance process, its internal structures, processes, tools and dedicated human resources, the focal firm can evaluate and improve its own internal alliance management processes. A more effective alliance management process might be a key contribution in a more effective and/or efficient achievement of the strategic goals of an alliance. For instance, prior experience would reduce risks and costs for the firms involved by enabling quick mobilization of knowledge between partners (Hoang & Rothaermel, 2005).

Based on previous research, e.g. Fritsch and Kauffeld-Monz (2010), Spithoven, Vanhaverbeke and Roijakkers (2013), and Najafian and Colabi (2014), several control variables were also included, as outlined in the Appendix: *Strength of ties* (Refers to the frequency of interaction between partners); *Trust in ties* (Refers to the existence of trust in a collaboration); *Social capital* (Refers to whether partners share the picture of the collaboration and the business environment); *Age of the firm*; *Number of employees*; *Number of employees in R&D*; *Number of patents*; *Collaboration manager* (Refers to the existence of a manager dedicated to the day-to-day running of collaborations); *Same nationality* (Partners come from the same country); *Formal collaboration*; *High tech firm* (Dummy variable as to whether the firm is in the high tech sector). As the distributions of some of these variables were non-normal some variables were transformed by taking the natural logarithm (see Table 1).

Table 1. Descriptive statistics of all the variables

Variable (Obs=67)	Mean	Std. Dev.	Min	Max
-----+				
Number of exploitation products	6.64	4.89	0	23
Number of exploration products	3.21	2.24	0	11
log(Number of collaborations)	1.25	0.86	0	3.91
log(Collaboration experience)	1.48	0.88	-0.69	3.21
Exchange of management knowledge (Likert scale)	4.31	1.45	1	7
Exchange of technological knowledge (Likert scale)	4.97	1.33	1	7
Exchange of market knowledge (Likert scale)	4.40	1.44	2.5	7
-----+				
Strength of ties (Likert scale)	5.49	1.25	2	7
Trust in ties (Likert scale)	5.63	0.75	3.67	7
Social capital (Likert scale)	5.42	0.85	1.75	7
log(Age of the firm)	2.19	1.03	-0.69	3.95
log(Number of employees)	2.34	1.10	0	5.52
log(Number of employees in R&D)	1.03	0.85	0	2.56
Number of patents	0.61	1.29	0	5
Collaboration manager (dummy variable)	0.40	0.49	0	1
Same nationality (dummy variable)	0.65	0.37	0	1
Formal collaboration (dummy variable)	0.78	0.37	0	1
High tech firm (dummy variable)	0.52	0.50	0	1

Finally, we additionally interviewed managers from 10 SMEs in relation to the learning level (intra-organizational versus inter-organizational) of their firms, providing a more detailed picture of the learning activities related to their firms' collaborations. The aim of these interviews was to build explanatory case studies as a way to uncover situations or phenomena (Yin, 2009).

Results

The descriptive statistics are shown in Table 1 and it is worth noting that Greek SMEs exchange management, technological and market knowledge with their partners almost at equal levels and with similar standard deviation levels.

The majority of the participating SMEs consider the relationships with their partners as a significant source of knowledge, suggesting that their partners are a "main source of knowledge" (Client Service Manager - Beetroot), "provide a rich information-versatile network" (Project Manager - Innovathens), "are important sources of knowledge" (Head of Integrated Management Systems - Intergeo) especially for "a knowledge-intensive start-up" (Founder and CEO - Aterin), or that through a combination between "the partnerships and the human resources" (Co-Founder and CEO - Goodvidio) they "enrich their knowledge base and expand their operations horizon", as collaborations permit co-creation as "a crucial stage at the product or service

development process” (Client Service Manager - Beetroot). In contrast to these statements, the Sales and Marketing Executive of AMD Telecom provides a different viewpoint indicating that “as far as the provided services are concerned the knowledge is created internally”.

The majority of the participants also underline the importance of knowledge acquisition through collaborations as a source of competitive advantage, e.g. as the Client Service Manager of Beetroot states, it is “highly linked to innovativeness”, which “plays a vital role in the competitive capacity of the firm”, a statement that is also supported by the Project Manager of Innovathens who suggested that “the competitive capacity is linked to the innovativeness of a firm”. Further supporting evidence comes from at least two sources:

“As a start-up, we developed a new business model and for this very reason we receive consulting and mentoring services through which we built a network around the firm that helps in acquisition of information and knowledge. The presence of a network formed by mentors, advisors, clients, and the human resources of the firm supports the improvement of our business model and contributes to the acquisition of information. Through this network we map and track the competition. When it comes to customized services we are talking about uniqueness of course. The knowledge that derives from the clients is reflecting the needs of the market. We are a young firm and thus if we do not acquire this knowledge we will not be able to develop our innovation capacity.”
(Co-Founder and CEO - Goodvidio)

“There are currently five waste management organizations established in Greece where the industry is still young and thus our knowledge base is not yet fully expanded. Therefore we aim at acquiring as much knowledge as possible from various sources in order to further develop our innovation capacity and improve our provided services.” (Head of Integrated Management Systems - Intergeo)

“Naturally access to information is very helpful in terms of increasing our market competitiveness. We acquire knowledge and information from external sources in order to become better and stronger in the market by transforming the incoming knowledge to innovation and hence value. We have to distribute internally the acquired knowledge from external sources in order to succeed. Such procedures are explicitly planned in our firm in order to further develop and grow as a firm.” (Founder and CEO - Aterin)

The VIF collinearity diagnostics and correlations are shown in Table 2 and the VIF coefficients are low indicating no significant problem with

multicollinearity. Table 3 shows the results for the regression model for *Number of exploitation products* and Table 4 for *Number of exploration products* respectively (please see the tables in the Appendix).

The results indicate that the exchange of management knowledge has a positive and significant effect on exploratory innovation only, the exchange of technological knowledge has a negative and significant effect on exploitative and exploratory innovation output, and the exchange of market knowledge does not have an effect on any type of innovation output. Also, partnering with same nationality firms has a negative effect on exploratory innovation probably because it reduces the requisite variety in resources required for exploration and risk taking. For exploitative innovation the existence of a collaboration manager has a negative effect probably because exploitation requires the transfer mostly of explicit knowledge and a collaboration manager may be superfluous in this case in that s/he increases the cost of transferring explicit knowledge through collaborations. This is corroborated by the following statements:

"There are individuals inside the organization that are entirely responsible for the collaborative relationship management. However, in reality all personnel are occupied with this process in addition to their other duties. If only a small team inside the organization was occupied with this duty there would be a possibility of losing some talents in the process. But now, each and every one inside the organization can contribute to this process through their network of relationships." (Co-Founder and CEO - GoodVidio)

"There are certain procedures in order to evaluate the performance of our partners and hence improve the coordination of our collaboration. In this context, there is a refinement of the interaction with each partner. More concretely, such evaluating procedures are mainly established for the partners with whom the largest proportion of our turnover is produced." (Sales and Marketing Executive - AMD Telecom)

The results also indicate that trust built in the collaborations promotes exploratory and exploitative innovation, which is corroborated by the following statements:

"We aim at taking the communication one step further with each partner. We organize and proceed to visits and meetings with our partners on a regular basis. Before we establish a partnership we inform our potential partners about our policy; we tend to collaborate only with organizations that are professionally certified. This makes our choices relatively safer as far as the culture and the administrative environment of each partner are concerned. We

operate on this basis in order to build an honest communication from the very beginning which is bound to help in the future as far as the enhancement of their task performance is concerned.” (Head of Integrated Management Systems - Intergeo)

“The more we learn about our partners the more effective the coordination of our collaborations becomes by discovering their strengths and their weaknesses, as well as the different information and knowledge resources that they can provide to us. It is important to learn more and more about your partners in order to collaborate effectively by understanding their strategic context.” (Founder and CEO - Aterin)

For exploratory innovation, the quantitative results indicate that management knowledge exchange with partners has a positive effect, probably because it saves time and resources, thus reducing the risk associated with exploratory innovation. For instance:

“Generally, we concentrate on the capabilities and the constraints of our partners in the context of their strategic and administrative policy or the state of their country politics. If we do not know the gap in the operations of our partner how can we contribute in the relationship? We need to know with whom we are going to contact individually and what they want from the management perspective. Strategically, we need to know the business model of our partners in order to proceed to collaboration. Naturally, we try to be synchronized with the needs of each collaboration depending on the personality that we deal with taking always into consideration the presented capabilities and constraints.” (Co-Founder and CEO - Goodvidio)

“In the framework of specific procedures that aim at the improvement of our relationships we distribute questionnaires to our partners in relation to our collaboration, and based on their feedback we proceed accordingly to actions concerning the enhancement of our partnership coordination.” (Head of Integrated Management Systems - Intergeo)

The quantitative results indicate that the exchange of technological knowledge with partners has a negative effect on exploitative and exploratory innovation, which may be an indication of a closed innovation strategy by Greek SMEs, when it comes to sourcing technological knowledge through their collaborations. Indeed interviews with managers revealed that technological knowledge is not really shared with partners either because it is trivial and all competitions have it or because it is a source of competitive advantage that needs to be safeguarded within the company:

"In terms of technical knowledge we don't share it with our partners, because there are some barriers such as the fear of being substituted or copied by the competition." (Sales manager – AMBIX)

"Technological knowledge is a part of our innovation strategy because our state of the art technology enable us to produce new products. Hence we don't share this knowledge with any partner." (Manager – Cartotecnica)

"We can't share our products' recipes, ingredients or any sensitive data with our partners because it could be easily copied by the competition. In terms of technology, our machineries and hardware are the same as the competition's, but slightly adapted to fit our special needs. Thus we don't have strict barriers for sharing this knowledge." (Business Development Manager – Athens Breweries)

"Concerning technological knowledge, we don't have any concerns [about confidentiality], because we use similar, if not the same technology, as the competitors and partners." (Sales manager – Dynamiki)

Finally, the quantitative results indicate that the exchange of market knowledge with partners does not have an effect on any type of innovation output, and that managerial knowledge does not affect exploitative innovation. Anecdotal evidence suggests that market and managerial knowledge is considered a strategic asset for future growth, thus it affects exploratory innovation only.

"Market knowledge is the most important one because it is the only one that bears new ideas and identifies the gaps. After that these gaps, products or consumer needs may be fulfilled with the right combination of managerial and technological/technical knowledge. Managerial and market know-how is considered as my firm's core competence. Thus, it is our organizational secret recipe." (Sales manager – AMBIX)

"Because the structural changes in the market and consumer needs are both a continuous process, managerial and market knowledge are considered more important for my firm. Being the market leader, as my firm is, it is a little bit scratchy if you share managerial and market knowledge) with your partners. Confidentiality is not a taboo, it is a vital element of our strategy, and maybe the reason [why] we stand in the leading position." (Business Development Manager – Athens Breweries)

"Both managerial market and market knowledge have proved to be more important in our industry than the technological/technical type of knowledge. Identifying and filling the gap in the market is a part of the managerial

knowledge and the market know how. Managerial and market knowledge is all about the expertise our people have acquired. Thus, they can be considered as a kind of confidential knowledge and they cannot be shared with our partners because they are not a part of our corporate culture. (Sales manager – Dynamiki)

Conclusion

This paper studied the role of inter-organizational collaborations as facilitators of knowledge flows and innovation. The most important finding for managers is that Greek SMEs do not transform technological knowledge from their collaborations into exploratory or exploitative products. From the qualitative results, it is evident that Greek SMEs do not exchange sensitive technological knowledge with partners and they spend their effort to exchange trivial technological knowledge. The quantitative results indicate that the exchange of such trivial technological knowledge is detrimental to the innovation output as it wastes time and managerial resources. In other words, Greek SMEs have not developed a true open innovation capability when it comes to the exchange and development of technological knowledge, so they rely on the traditional closed model of innovation and their R&D departments. SMEs may be hesitant to apply the open innovation model because it can lead to many conflicts over IP, conflicts of monetization, direction of innovation and also revenue share unless iron clad agreements are in place. Risk sharing could also become contentious. So this study indicates that Greek SMEs do not see an open innovation policy for technological knowledge as an opportunity to improve on the low productivity of innovation in times of economic crisis, as indicated by Beneki, Giannias and Moustakas (2012).

This is so despite that evidence by Archibugi and Filippetti (2011) that in the case of Greece the current recession has had the worst impact on firms' innovation investments amongst all European countries. The possible explanation for this is that it is expensive and risky for an SME to develop an open innovation capability and that the open innovation model is primarily one-sided with large corporations feeding of smaller firms. However, the results indicate that Greek SMEs do exchange managerial knowledge with partners and it positively feeds into exploratory products. This may be an indication that Greek SMEs have developed an open innovation policy when it comes to managerial knowledge because it is not so expensive or risky to exchange such knowledge, which may mitigate some of the risk of exploration. Trust may also play a role in this case, as trust is paramount in

the collaborations of Greek SMES, and it also has a positive effect on exploration.

Naturally, the present study has been affected by standard limitations for this kind of research that include the relatively small size of the sample due to the low response rate as many organizations were unwilling to participate (Fu, Revilla Diez & Schiller, 2013). Future research may involve a quantitative study with a greater number of participating firms from different sectors of the economy and in a period of economic growth, so that macroeconomic effects on innovation output are eliminated.

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Appendix

Exchange of management knowledge:

Do you exchange management knowledge with your partner?

Very Little 1 2 3 4 5 6 7 Too much

Exchange of technological knowledge:

Do you exchange technological knowledge with your partner?

Very Little 1 2 3 4 5 6 7 Too much

Exchange of market knowledge:

Do you exchange market knowledge with your partner?

Very Little 1 2 3 4 5 6 7 Too much

Number of collaborations

Number of collaboration currently involved in

Collaboration experience

Number of years since the first collaboration started

Strength of ties

How frequent is the contact with this partner?

Rarely 1 2 3 4 5 6 7 More than once per week

Trust in ties

Would you characterize your relationship with your partner as a fair and just one by all aspects?

Agree 1 2 3 4 5 6 7 Disagree

Social capital (Cronbach alpha = 0.872)

Is there an atmosphere of collaboration and trust in our inter-organizational agreements?

Agree 1 2 3 4 5 6 7 Disagree

Our partners show strong commitment to our common projects.

Agree 1 2 3 4 5 6 7 Disagree

We share the same goals with our partners in our common projects.

Agree 1 2 3 4 5 6 7 Disagree

We share with our partners common opinions about the business environment and the factors of success.

Agree 1 2 3 4 5 6 7 Disagree

Age of the firm

How many years has your firm been in operation?

Number of employees

How many people are employed by your firm?

Number of employees in R&D

How many people are employed in the R&D department?

Number of patents

How many patents does your firm hold?

Collaboration manager

Is there a dedicated manager who runs the collaborations of your company?
(Yes/No)

Same nationality

Is your partner from the same country as your company? (Yes/No)

Formal collaboration

Is this a formal collaboration? (Yes/no)

Table 2. Correlations and collinearity diagnostics (*p<0.05)

		VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
--																				
(obs=67)																				
--																				
Number of exploitation products	(1)	2.01	1.00																	
Number of exploration products	(2)	1.60	0.20	1.00																
		0.13																		
log(Number of collaborations)	(3)	1.62	0.00	0.15	1.00															
		0.97	0.25																	
log(Collaboration experience)	(4)	2.91	0.04	-0.07	0.18	1.00														
		0.72	0.60	0.17																
Exchange of management Knowledge	(5)	3.13	-0.22	0.01	0.00	0.08	1.00													
		0.68	0.91	0.95	0.50															
Exchange of tech Knowledge	(6)	3.74	-0.14	-0.05	-0.02	0.39*	0.47*	1.00												
		0.27	0.68	0.87	0.00	0.00														
Exchange of market Knowledge	(7)	1.86	0.02	0.10	0.12	0.11	0.22	0.23	1.00											
		0.83	0.42	0.37	0.40	0.08	0.08													
Strength of ties	(8)	4.08	-0.20	-0.04	0.09	0.28*	0.54*	0.51*	0.43*	1.00										
		0.13	0.72	0.46	0.04	0.00	0.00	0.03												
Trust in ties	(9)	4.34	0.20	0.08	0.17	0.12	0.12	0.44*	0.47*	0.39*	1.00									
		0.13	0.51	0.19	0.35	0.35	0.00	0.04	0.00											
Social capital	(10)	3.47	-0.09	0.01	0.19	0.11	0.37*	0.15	0.26*	0.28*	0.41*	1.00								
		0.50	0.88	0.15	0.41	0.00	0.23	0.02	0.03	0.00										
log(Age of the firm)	(11)	2.53	0.07	-0.05	0.01	0.67*	-0.04	0.19	-0.09	0.01	0.08	-0.09	1.00							
		0.60	0.67	0.91	0.00	0.73	0.14	0.45	0.50	0.54	0.46									
log(Number of employees)	(12)	2.71	0.01	-0.13	0.18	0.34*	-0.09	0.04	-0.05	0.08	0.25	0.13	0.38*	1.00						
		0.33	0.30	0.17	0.01	0.49	0.73	0.70	0.53	0.06	0.33	0.00								
log(Number of employees in R&D)	(13)	1.97	-0.17	-0.05	-0.02	0.05	0.12	0.28	0.01	0.02	0.22	0.24	-0.05	0.50*	1.00					
		0.26	0.65	0.86	0.71	0.41	0.56	0.54	0.84	0.13	0.11	0.67	0.00							
Number of patents	(14)	1.50	0.07	-0.01	-0.11	0.20	0.06	0.13	-0.16	-0.05	0.13	0.15	0.18	0.09	0.26	1.00				
		0.58	0.91	0.40	0.11	0.62	0.13	0.22	0.69	0.31	0.24	0.16	0.46	0.07						
Collaboration manager	(15)	1.92	-0.14	0.20*	0.25	0.18	-0.081	0.08	0.23	0.07	0.23	0.17	0.05	0.10	0.14	0.13	1.00			
		0.27	0.03	0.05	0.17	0.54	0.54	0.07	0.59	0.07	0.18	0.70	0.41	0.35	0.31					
Same nationality	(16)	2.48	0.26*	-0.01	0.10	-0.06	0.10	-0.11	0.31*	0.14	0.20	0.10	-0.16	-0.32*	-0.11	-0.02	-0.06	1.00		
		0.04	0.90	0.40	0.44	0.37	0.01	0.26	0.12	0.42	0.21	0.01	0.44	0.87	0.61					
Female collaboration	(17)	2.35	0.17	-0.03	0.29*	0.18	0.21	0.24	0.06	0.40*	0.23	0.11	0.03	0.19	-0.01	-0.13	-0.13	-0.05	1.00	
		0.18	0.77	0.02	0.15	0.10	0.06	0.63	0.01	0.08	0.38	0.78	0.15	0.92	0.32	0.14	0.65			
High tech firm	(18)	1.69	-0.14	-0.24	0.11	0.12	-0.04	-0.00	-0.23	0.06	-0.14	0.01	0.15	0.35*	0.26	0.01	-0.07	-0.33*	0.08	1.00
		0.27	0.07	0.39	0.34	0.72	0.97	0.07	0.64	0.26	0.31	0.26	0.01	0.08	0.90	0.35	0.01	0.53		

Table 3. Negative binomial regression for dependent variable Number of exploitation products

Negative binomial regression		Number of obs	=	67
Dispersion	= mean	Wald chi2(16)	=	111.41
Log pseudolikelihood = -108.35539		Prob > chi2	=	0.0000

		Robust		
Number of exploitation products		Coef.	Std. Err.	z P> z
-----+-----				
log(Number of collaborations)		-.0190322	.1190789	-0.16 0.873
log(Collaboration experience)		.1711528	.1354936	1.26 0.207
Exchange of management knowledge		.0315134	.1002216	0.31 0.753
Exchange of technological knowledge		-.2585562	.1268366	-2.04 0.042
Exchange of market knowledge		.0170137	.0855191	0.20 0.842
Strength of ties		-.1635154	.1003059	-1.63 0.103
Trust in ties		.4269292	.1769744	2.41 0.016
Social capital		-.1699663	.1501799	-1.13 0.258
log(Age of the firm)		.0332597	.1154705	0.29 0.773
log(Number of employees)		.0864875	.1001249	0.86 0.388
log(Number of employees in R&D)		-.1479091	.1304159	-1.13 0.257
Number of patents		-.0837913	.0812169	-1.03 0.302
Collaboration manager		-.4349683	.1888792	-2.30 0.021
Same nationality		.5078014	.2759141	1.84 0.066
Formal collaboration		.4048496	.2770917	1.46 0.144
High tech firm		.0713561	.1779437	0.40 0.688
Constant		1.460261	.5530007	2.64 0.008
-----+-----				
/lnalpha		-2.449508	.8132264	.043403 -.8556138
-----+-----				
alpha		.086336	.0702107	.0175377

Table 4. Negative binomial regression for dependent variable Number of exploration products

Negative binomial regression		Number of obs =		67	
Dispersion = mean		Wald chi2(16) =		78.29	
Log pseudolikelihood = -81.518936		Prob > chi2 =		0.0000	

		Robust			
Number of exploration products		Coef.	Std. Err.	z	P> z

log(Number of collaborations)		.0836248	.0986341	0.85	0.397
log(Collaboration experience)		.1441136	.1626389	0.89	0.376
Exchange of management knowledge		.1889913	.0790855	2.39	0.017
Exchange of technological knowledge		-.3944923	.1191958	-3.31	0.001
Exchange of market knowledge		.0434124	.0799443	0.54	0.587
Strength of ties		.1063777	.0903419	1.18	0.239
Trust in ties		.4687203	.2294665	2.04	0.041
Social capital		-.4291554	.1341193	-3.20	0.001
log(Age of the firm)		-.0307444	.1280857	-0.24	0.810
log(Number of employees)		-.1821304	.1172683	-1.55	0.120
log(Number of employees in R&D)		.1045432	.1363202	0.77	0.443
Number of patents		-.1097697	.0622506	-1.76	0.078
Collaboration manager		.2255168	.2120045	1.06	0.287
Same nationality		-.5644885	.2916624	-1.96	0.050
Formal collaboration		-.3227069	.3300685	-0.98	0.328
High tech firm		-.2708204	.1796268	-1.51	0.132
Constant		2.064986	.5907208	3.50	0.000

/lnal		-16.16376	3.071424	22.18364	-10.14388

alpha		9.55e-08	2.93e-07	2.32e-10	.0000393
