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GLOBAL OPEN INNOVATION: THE EFFECTS OF IPRs AND CONTRACTS

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ABSTRACT

This study set out to investigate the use of formal protection mechanisms (formal contracts and IPRs) in interorganisational R&D collaboration with various types of partners within and across national borders. Considering the scarcity of studies that analyse both IPRs and formal contracts in the context of open innovation with different partner types located both nationally and abroad, our study contributes with new evidence about the actual formal mechanisms that are used in R&D endeavours with external partners. Our results suggest that firms mainly engaged in R&D collaboration with local firms mainly rely on contracts and agreements as formal protection mechanisms, while companies with mostly international R&D partners seem to enable knowledge exchange in the context of open innovation by means of IPRs.

Keywords: *Open innovation, internationalisation, appropriability*

1. INTRODUCTION

After more than a decade since the term "open innovation" (OI) was coined by H. Chesbrough (see Chesbrough, 2003) thousands of related papers have been written and the topic has increasingly received attention (Chesbrough and Bogers, 2013). Yet there are a number of unanswered questions regarding open innovation particularly when comparing national and international settings. Global sourcing and collaboration may indeed provide access to new and more advanced knowledge and technology (see e.g. Kotabe et al., 2008). On the other hand, studies on advanced product development show that innovation and knowledge integration processes are characterised by fuzzy interfaces between different technologies and competencies, a complexity that requires proximity, co-location and integration of key activities (e.g. Huang and Rice, 2013). Moreover, several previous studies report that local networks continue to be critical for innovation (see e.g. Liu et al., 2013; Podmetina and Smirnova, 2013). A possible explanation is that some knowledge might be easier to extract in geographically close networks. However, to get the same innovation benefits from distant partners, a larger degree of integration efforts may be required, hence including additional costs (Praest Knudsen and Bøtker Mortensen, 2011).

There is thus a geographical dilemma regarding the location of external partners in innovation. In this paper we address this dilemma by differentiating between national (local) and international (global) partners. Moreover, we look at formal protection mechanisms that firms tend to use for bridging boundaries in open innovation in both national and international settings. The formal protection mechanisms were grouped into intellectual property rights (IPRs) and formal contracts. We also define openness in terms of partner variety and partner depth. The purpose of this paper is to investigate

how the use of different types of formal mechanisms affects openness when considering collaborations with various types of local and foreign partners. This focus is furthermore a direct response to the very recent suggestion for further investigation of how different kinds of appropriability mechanisms link to different kinds of openness (Laursen and Salter, 2014)

2. THEORETICAL BACKGROUND

2.1 DIMENSIONS OF OPENNESS

In a recent study Chesbrough and Bogers (2013) suggest an improved definition for open innovation:

“Open innovation is a distributed innovation process based on purposively managed knowledge flows across organizational boundaries [...] These flows of knowledge may involve knowledge inflows to the focal organization, knowledge outflows from a focal organization or both.”

Since one of the core questions in open innovation regards how openness is affected by other factors or dimensions of the collaboration, it becomes crucial to quantify openness in order to measure these effects. Previous studies have measured openness according to various dimensions, for instance: partner breadth (number of different kinds of partners chosen for collaboration) and partner depth (intensity of partner involvement) (see e.g. Laursen and Salter, 2006), innovation phases (Lazzarotti et al., 2011) or content of the collaboration (Huizingh, 2011). Laursen and Salter (2014) also make a distinction between openness in terms of search and innovation collaboration. In this paper we will focus on the latter. Openness can be measured using additional dimensions. One perspective would be to measure openness in terms of proximity. Previous literature identified various types of proximity as mechanisms that facilitate successful knowledge transfer between actors (see e.g. Boschma, 2005). Research mainly differentiates between three proximity dimensions that are considered to be relevant for inter-organizational collaboration: geographical proximity, organizational proximity and technological proximity (see Knoben and Oerlemans, 2006).

Although *geographical proximity* in the context of open innovation has been a topic of interest (see e.g. Capaldo and Petruzzelli, 2014; Molina-Morales et al., 2011), the actual concept of geographic proximity is not clearly defined. Some studies refer to it as pure spatial proximity without distinguishing between country boundaries (e.g. Aslesen and Onsager, 2009) while others compare national and international approaches (see e.g. Patel et al, 2013; Arvanitis and Bolli, 2013; Balland, 2010). Some studies even suggest a balanced approach (both local and foreign partners) would be more advantageous (Patel et al., 2013). Furthermore, integrating knowledge from distant actors requires efforts which may entail additional costs (see e.g. Praest Knudsen and Bøtker Mortensen, 2011). Thus, the spatial dissolution of partners remains a dilemma.

Another dimension of openness already investigated in prior studies is *partner depth*. Some studies have argued that the choice of a particular kind of partner is often determined by the “complementarity of resources” and identify different objectives for different types of R&D collaborations: in the case of vertical R&D co-operations involving suppliers or clients, the goal is to find complementary resources and gain market information, while the purpose of co-operations with public institutions is to

gain access to new technology and increases the number of patents (see e.g. Miotti and Sachwald, 2003; Santamaria and Surroca, 2011). Prior research also indicates that successful R&D collaborations for product innovation are mainly determined by ease of knowledge access rather than breadth of knowledge (see e.g. Un et al., 2010).

Several studies distinguish between different types of outcomes as result of collaborations with different partners: cooperation with suppliers and competitors usually involve incremental innovations and increase productivity performance, cooperation with universities and competitors are essential for innovating and selling new products, while radical innovations are facilitated by cooperation with customers or universities (see e.g. Belderbos et al., 2004). Mioti and Sachwald (2003) find that when choosing international partners the main goal is not necessarily R&D collaboration rather than access to foreign markets; their results also show that collaborations with academic partners such as universities stimulate patenting. Belderbos et al., (2014) distinguish between different types of partners when sharing IP ownership in R&D collaborations. However, they only focus on co-owned patents in terms of IPRs and they differentiate between academic partners, inter-industry and intra-industry partners. Belderbos et al. (2014) find that there are lower risks of appropriation in partnerships with universities, while there seem to be greater challenges for IP co-ownership when partner firms are within the same industry.

2.2 FORMAL CONTRACTS AND INTELLECTUAL PROPERTY RIGHTS (IPRS)

Another way to view open innovation is from a knowledge integration perspective (Berggren et al., 2011). Chesbrough et al, (2006) point out that knowledge exchange is at the core of the open innovation process. The knowledge exchange between partners in open innovation also raises further questions on the protection of intellectual property and even more so when considering different types of boundaries (e.g. geographical ones).

Even though knowledge integration is a widely researched topic, there is scarce research about the actual mechanisms that are used in interorganisational collaborations. Moreover, there is hardly evidence on which types of proximity/boundaries trigger different types of knowledge integration mechanisms. Engaging in knowledge exchange in the context of open innovation would entail crossing certain boundaries, starting with the boundary of the firm, which becomes “porous” in open innovation as described by Chesbrough (2003). Other researchers have identified further barriers in the process of knowledge integration between firms, for instance: geographical distance, differences in language and culture, different ICT systems and difficulties occurring in the attempt to obtain useful data (Corallo et al., 2012). Edelman and Volchek (2010) particularly refer to open innovation barriers and mention: legislative and cognitive barriers, emphasizing the importance of knowledge in open innovation cooperation. Some prior research refers to knowledge transfer mechanisms as either being formal (contracts, controls) or informal (trust) ones (see e.g. Zhang and Zhou, 2013).

Formal contracts and intellectual property rights (IPRs) are two different types of legislative barriers. Previous studies identified IPR either as a legislative boundary (e.g. Edelman and Volchek, 2010) or a means to protect knowledge and enable knowledge exchange (e.g. Arora and Gambardella 1994). When engaging in knowledge exchange with external partners, firms also require knowledge protection mechanisms. Some identify patents as most often used intellectual property protection mechanisms

(Hertzfeld et al., 2006) while others claim that firms use mechanisms other than patents to protect innovations (Cohen et al., 2002). Bogers (2011) identify licensing as a particularly important knowledge transfer mechanism. Laperche (2011) argues that intellectual property rights (IPR) have an important “coordination function” in the context of open innovation by reducing different types of transaction costs or solving patent disputes (licenses, patent pools). Additionally IPRs can have an either defensive or offensive role. Schmiele (2013) researches the possible IP infringements by foreign competitors and further analyses whether firms that innovate internationally are more exposed to such infringements. The findings indicate that companies engaged in international R&D activities present a higher risk of losing knowledge to their local competitors from foreign countries. Researchers have also suggested that stronger IPR regimes stimulate firms’ openness (Gallini, 2002; Laursen and Salter, 2006; Henkel et al., 2014).

2.2.1 THE USE OF IPRs AND FORMAL CONTRACTS IN OPEN INNOVATION

Previous literature shows that IPRs influence the rate of innovation, particularly in developed countries and that “innovative activities and IPRs are complementary” (see e.g. Schneider, 2005) and even argues that certain IPRs, e.g. patents are central to the matter of appropriability in open innovation (see e.g. West, 2006). Moreover, research signals a need for further investigations as to the way IPRs are used in the context of open innovation and to their actual role. For instance, West (2006) stresses the need for further investigation and comparison between various intellectual property protection mechanisms (e.g. patents, copyrights, trade secrets), confirmed by Cockburn (2007) who indicates that the “trade in technology is very poorly measured”. Hertzfeld et al. (2006) point out to the lack of understanding and the shortage of empirical studies about how intellectual property protection mechanisms are used in research partnerships. Moreover Hertzfeld et al. (2006) emphasize the fact that the choice of intellectual property protection mechanisms in research partnerships is contingent upon a number of factors, for instance: the type of knowledge to be exchanged, the type of partners, the industry; however, prior literature provides insufficient information on how these choices are made and how they affect openness. Zobel et al (2014) also draw attention to the scarcity of empirical studies and the lack of consensus regarding the role of “formal intellectual property” in open innovation. They also stress the need to fill the gap in understanding about the way formal intellectual property is associated with openness.

Few studies analyse the role of both intellectual property rights and formal contracts in the context of open innovate. For instance, Hagedoorn and Ridder (2012) research the role of formal contracts and IPRs in an open innovation context; while their results show that firms engaged in open innovation commonly protect their intangible assets by the means of IPR, they also find that companies are strongly inclined to used formal contractual agreements with their innovation partners, Hagedoorn and Ridder (2012) also point out that the choice in formal protection mechanisms depends on factors such as variety of partners or dynamics of the market; however, they do not go in-depth with linking specific types or number of partners or their location to the focal firms’ choice of formal protection mechanisms.

There are previous studies that emphasize the differences between IPRs across national boundaries. There has been relatively extensive research on the topic of intellectual property rights and formal contracts across national boundaries. Hagedoorn et al. (2005) stress the importance of differences between international IPRs and the influences these

might have on the choice of type of collaboration in R&D partnerships. West (2006) argues that open innovation can be “affected by changes to de jure IP protection”, fact which becomes even more sensitive in the presence of more than one IP protection system. Sasaki et al (2010) point out to the “increasingly complicated relationship between products and patents and the development of open innovation” and also to the “internationalization of innovative activities”. Trimble (2015) points to the growing rate at which IP activities cross national boundaries and at the same time signals that national IP laws are more often drafted only for local (national) purposes. Bogers (2011) provides a framework for inter-firm R&D collaborations where IPRs are considered to be a characteristic of knowledge embodiment, university partnerships, partner variety and firm size are characteristics of collaboration, while geographical distance (proximity) is listed as a relational dimension. Bogers (2011) however recommends different types of strategies based on several case studies and does not analyse in depth what kinds of formal protection mechanisms are used depending on partner variety and depth in a larger data set and while also considering national and international collaborations.

The above literature review clearly points out to the fact that there is a gap in understanding how and if the use of formal protection mechanisms varies in collaborations with national and international partners. There is thus a stringent need to investigate how IPRs and formal contracts are used in open innovation when considering geographical proximity across national boundaries. This is also in line with Laursen and Salter (2014) suggestions for further research on appropriability and openness.

2.3 RESEARCH QUESTIONS AND ANALYSIS MODEL

The purpose of this paper is to fill the gap in understanding how formal protection mechanisms (formal contracts and IP) affect a firm’s openness. The lack of clarity regarding this matter has also been pointed out in previous research (Zobel et al. 2014;). We thus propose two research questions (RQs), illustrated in the analysis model, that will help reduce this tension.

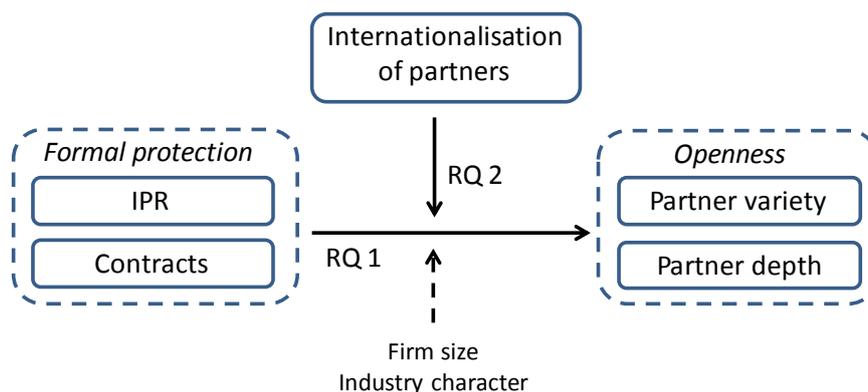


Figure 1. Analysis model

RQ1: How do formal protection mechanisms influence a firm's openness (i.e. the willingness to collaborate on innovation cross-border)?

RQ2: What are the effects of formal protection mechanisms on firms' collaboration strategies (partner variety and partner depth) when also taking into account the extent of international partners?

3. METHODOLOGY

3.1 SURVEY

The paper's empirical part relies on data from an international survey on open innovation, which covers a representative sample of manufacturing firms (codes 10-32 and 98 in NACE Rev. 2) with more than 10 employees in Italy, Finland and Sweden (see Manzini et al., 2013). To be able to pool data common guidelines were used for the survey design and the data collection process (see Forza, 2002). The on-line survey was answered by 415 R&D managers (or a corresponding person knowledgeable about open innovation). The number of employees in the studied firms varies between 10 and 56 000, with a mean value of 867 employees (standard deviation 4239) and a median value of 50 employees.

The survey concerns firms' collaboration with external partners in innovation (i.e. development of new products, services or processes) during the past five years. The questionnaire includes questions on strategy and motives, contextual factors, openness, relational factors and performance outcomes. The focus in the current paper is on questions that capture the internationalisation of R&D partners in the open innovation processes, the use of appropriability strategies and on the variety and depth of partner collaboration. In order to improve the quality of the instrument a pilot test of the questionnaire was done by colleagues and target respondents in selected firms.

3.2 CONSTRUCTS

From the analysis model we can see that the main constructs concern two types of formal protection mechanisms, the internationalisation of partners and the variety and depth of partner collaboration. All answers are measured by seven-point Likert scales, ranging from 1=not at all to 7=to a very high extent.

The protection mechanisms were captured via a question asking: "*Please indicate the extent to which your company uses the following intellectual property protection mechanisms when collaborating with external partners in innovation activities*". Based on previous studies on IP appropriability strategies (e.g. Arundel, 2001; de Faria and Sofka; 2010; Alexy et al, 2009; Hertzfeld et al., 2006) eight different mechanisms were suggested. In order to distinguish formal IPR mechanisms such as patents from formal contracts and agreements (see Hagedoorn and Ridder, 2012) we conducted an explanatory factor analysis which gave the factors displayed in Table 1.

The partner constructs captures which kind of partner the firm collaborate with in open innovation (partner variety or breadth) and how intensive (depth) the collaboration is with each of these partners. The approach follows Laursen and Salter (2006), even though we used a more fine-grained scale to measure depth. The respondents were asked to rate the extent to which the firms collaborate with eight specified stakeholders in innovation activities over the last 5 years. The eight partners were reduced in an exploratory factor analysis, that resulted in two factors representing partner depth for academic/consultants and value chain partners respectively (see Table 1). While

competitors and firms from other industries loaded equally on these two factors, we added them as single item factors in the analysis. Partner breadth was defined by summing up the number of partners that the firms have engaged in their open innovation processes (min 1 and max 8, median 5, mean 5.26 and std. dev. 1.95).

	IPR	Contracts & agreements	Academia/ consultants	Value chain partners	Innovative industry
<i>Formal protection mechanisms</i>					
Patents	.813				
Design	.811				
Trademarks	.805				
Trade secrets		.887			
Contracts & agreements		.887			
<i>Partners</i>					
Universities, R&D centres			.799		
Consultants/ intermediaries			.633		
Government agencies			.799		
Customers				.758	
Suppliers				.810	
Consumers (Competitors)				.633	
(Firms in other industries)					
<i>Industry character</i>					
Products based on technology breakthrough.					.740
Technology changes fast					.751
Important to follow technology develop.					.805
Technological complexity increases					.826
High mix of disciplines and technologies					.819
Surveilling many technologies important					.837
	<i>Explan.</i>	<i>Explan.</i>	<i>Explor.</i>	<i>Explor.</i>	<i>Explor.</i>
Variance explained	65.6%	78.7%	33.9%	27.2%	63.6%
Cronbach's alpha	0.737	0.729	0.691	0.584	0.885
N	415	415	415	415	415

Table 1. Results of factor analysis (explanatory and exploratory)

The partners' internationalisation was measured by a single item capturing to what extent (scale 1-7) the R&D activities are performed by external partners located abroad. This variable was used to form three clusters, which are displayed in Table 2.

	Extent of international partners	Firm size (ln)	Innovative industry
1. National partners group	1.37 [2,3]	4.31	-.148 [2,3]
2. Balanced group	2.43 [1]	4.33	.175 [1]
3. International partners group	5.12 [1,2]	4.69	.253 [1]

Table 2. Three cluster of firms with different extent of international partners in OI (Significant differences between the groups' mean values noted within parentheses)

As control variables in the regression analysis we use firm size, in terms of number of employees (the natural logarithmic value), and the perceived innovativeness of the industry (see e.g. Gassmann, 2006; Huizingh, 2011).

4. RESULTS

Table 3 reveals that use of contracts & agreements (together with the contextual factor innovative industry) explains the extent to which firms collaborate with international partners.

<i>Dependent variable:</i> <i>Extent of international partners</i>	All firms
IPR	.083
Contracts & agreements	.151**
Firm size (ln)	.080
Innovative industry	.114*
Adj R2	.081
F	9.726**
N	415

Table 3. Protection strategies influence on firm's collaboration with international partners in open innovation

Table 4 displays how partner variety (breadth) is influenced by the protection mechanisms, both for all firms and for the groups defined by having international partners (RQ2). The results show that contract & agreements influence firms that have mainly local innovation partners, while firms with mainly international partners are explained by IPR such as patents, design and trademarks.

<i>Dependent variable:</i> <i>Partner variety (breadth)</i>	National partners group	Balanced group	International partners group	All firms
IPR	-.007	.057	.318*	.035
Contracts & agreements	.212**	.078	-.005	.174**
Firm size (ln)	.240**	.195^	.115	.208**
Innovative industry	.143*	.282*	.061	.193**
Adj R2	.163	.137	.090	.166
F	12.394**	5.033**	2.429^	20.75**
N	240	111	64	415

Table 4. Protection strategies influence on partner variety (breadth) given the extent of international partners in OI

In Table 5 we show how the protection mechanisms influence depth in partner collaboration for two of the firm groups. We have omitted the balanced group due to space limitations, but also because the results are, as expected, in between these two groups. For the firms with mainly national R&D partners the intensity of collaboration with academia/consultants and value chain partners is explained by contracts & agreements, while IPR is negatively influencing collaboration depth with firms in other industries. For competitors the protections mechanisms provide no explanation. For the group with mainly international partners IPR influences the depth of collaboration with both academia/consultants and competitors, while it has no explanatory value for the other partners.

<i>Dependent variable: Partner depth (intensity) for specified partners</i>	National partners group				International partners group			
	Academia/consultants	Value chain partner	Competitors	Firms in other industries	Academia/consultants	Value chain partner	Competitors	Firms in other industries
IPR	.051	.009	-.096	-.156*	.322*	.234	.441**	.178
Contracts & agreements	.189**	.188*	.031	.102	.178	-.148	-.070	-.047
Firm size (ln)	.312**	-.091	.078	.001	-.046	-.065	-.237	-.034
Innovative industry	.038	.147*	.025	.235**	.087	.052	-.003	.266^
Adj R2	.178	.059	-.005	.054	.142	-.028	.082	.033
F	13.65**	4.65**	.688	4.35**	3.40*	.602	2.29^	1.494
N	240	240	240	240	64	54	54	64

Table 5. Protection strategies influence the depth (intensity) of partner collaboration given the extent of international partners in OI (balanced group omitted)

Finally we can note that the contextual variables have significant explanatory value for both partner variety and depth.

5. DISCUSSION

The purpose of this paper was to reduce the tension field between formal protection mechanisms and firms' openness. Before providing answers to the two research questions, a relevant result for the discussion part of this paper is also the relationship between the formal protection mechanism and the use of international partners in R&D processes. Our findings showed that the extent of international partners is mainly explained by contracts and agreements.

The first research question concerned how different formal protection mechanisms influence a firm's openness. The results show that the openness of the firms in our data set is mainly explained by formal contracts & agreements and that the choice of formal contracts influences the extent of international partners. This result is partly in line with prior studies which stress the importance of the differences between international IPRs

and also the influences these might have on the choice of type of collaboration in R&D partnerships (Hagedoorn et al., 2005; West, 2006; Sasaki et al., 2010). Since IPR regimes may vary considerably from country to country, firms that engage in open innovation, particularly the ones with international R&D partners, may rely to a higher extent upon formal contracts as formal protection mechanisms in their collaborations.

Research question number two asked: How do formal protection mechanisms affect a firm's collaboration strategies (partner variety and partner depth) when also taking into account the extent of international partners?

When considering the partner variety across the three groups: national, balanced and international, the national group's openness in terms of partner variety is mainly explained by the use of contracts & agreements; for the balanced group being in an neither formal contracts nor IPRs have significant effects on this group's openness. The openness of the third group with mostly international partners in open innovation is strongly linked to the use of IPRs. This finding is discussed in detail further below. The fact that companies use both IPRs and contracts & agreements in open innovation and that their formal protection mechanism of choice seems to be contingent upon other factors such as partner depth or partner location is in line with previous studies that also found firms rely on both types of formal mechanisms when engaging in collaborations with external partners (see e.g. Hagedoorn and Ridder, 2012).

When analysing openness in terms of partner depth, we find that the choice of either formal contracts or IPRs varies across the three groups. The use of IPRs in collaborations with companies from other industries has a negative effect on the national group's openness, while being in an innovative industry has a positive influence. The former outcome appears to contradict prior studies which identify greater challenges for IP co-ownership when partner firms are within the same industry (e.g. Belderbos et al., 2014). However, the afore-mentioned previous research only focused on IP co-ownership in the shape of co-patents, a complementary role between the results can also be considered.

The use of formal contracts in partnerships with academic or public partners explains the national group's openness and so does the focal firm's size. The fact that the firms in the group with mostly national R&D partners substantially rely on formal contracts in academic partnerships is consistent with prior findings suggesting lower risks of appropriation in partnerships with universities (Belderbos et al., 2014), hence a less acute need to use IPRs as formal protection mechanisms.

For the balanced group, the only significant influence is observed for the presence in an innovative industry in the collaborations with value chain partners. Neither the use of formal contacts nor the use of IPRs has any significant role in the openness of the balanced group's towards the four types of partners considered in the analysis. This could suggest that the balanced group relies to a greater extent on informal protection mechanisms.

In the case of the internationalised R&D group the use of IPRs explains both the openness towards academic partners and even stronger towards competitors. The latter is confirmed by previous research, e.g. Schmiele (2013), who points out that companies engaged in international R&D activities present a higher risk of losing knowledge to

their national competitors from foreign countries, hence the stringent need to enforce IPRs. Moreover, this particular result of our analysis is in line with prior studies which argue that the purpose of co-operations with public institutions is to gain access to new technology and increases the number of patents (see e.g. Miotti and Sachwald, 2003; Santamaria and Surroca, 2011), thus explaining the significance of the use of IPRs in collaborations with academic partners.

6. CONCLUSIONS

This study set out to investigate the use of formal protection mechanisms (formal contracts & agreements and IPRs) in inter-organisational R&D partnerships with various types of partners within and across national borders. Considering the scarcity of studies that analyse both IPRs and formal contracts separately in the context of open innovation with different partner types located both nationally and abroad (see e.g. Laursen and Salter, 2014; Zobel et al., 2014; West, 2006), our study contributes with new evidence about the actual formal mechanisms that are used in R&D endeavors with external partners.

As expected, when considering the effects of formal protection mechanisms on the openness (in terms of partner variety and partner breadth) of the three groups (national, balanced and international) towards external partners in different locations, we found that the choice of formal mechanisms varies.

At first glance the national group's openness is explained by the use of formal contracts while the international group's openness is positively affected by the use of IPRs. However, we found further differences when conducting a more fine-grain analysis and dividing the partners into four groups.

The national group's openness is explained by the use of formal contracts in the collaborations with both academic and value chain partners but it is negatively influenced by the use of IPRs in partnerships with firms from other industries. Firm size and being in an innovative industry also explain the local group's collaborations with academic partners and firms from other industries, respectively. The balanced group's openness is mainly explained by being in an innovative industry and this only applies to the partnerships with value chain partners. Finally, in the case of the third group with mostly international partners, the use of IPRs when engaging in collaborations with both academic partners and competitors explains this group's openness.

The managerial implications for our results are that firms mainly engaged in R&D partnerships with local firms can expect to rely mainly on formal contracts as formal protection mechanisms, while companies with mostly international R&D partners should expect to enable the knowledge exchange by means of IPRs. Furthermore, firms collaborating with national (local) academic/consultants partners are estimated to use formal contacts rather than IPRs. On the other hand, for companies with mostly international R&D partners, the use of IPRs as formal protection mechanisms is expected to be strongest when dealing with academic/consultant partners and competitors.

Even though our results represent a valuable contribution to the understanding of how formal protection mechanisms are used in open innovation in international contexts, the

study has its own limitations. Based on these limitations future research threads could be suggested. An interesting future research topic would be to analyse both formal and informal protection mechanisms. This can be furthered by investigating the effects that these mechanisms have on firm performance. Moreover, the individual IPRs and their effects on performance could be analysed, especially since previous studies mainly focus on specific IP protection mechanisms and their roles or effects, e.g. patents (Zobel et al., 2013) or licensing (Bogers, 2011).

REFERENCES

- Alexy O., Criscuolo P., Salter A., (2009). Does IP strategy Have to cripple open innovation? *MIT Sloan Management Review*, 51 (1), 71-77.
- Arora, A., & Gambardella, A. (1994). The changing technology of technological change: general and abstract knowledge and the division of innovative labour. *Research policy*, 23(5), 523-532.
- Arvanitis, S., & Bolli, T. (2013). A comparison of national and international innovation cooperation in five European countries. *Review of Industrial Organization*, 43(3), 163-191.
- Belderbos, R., Carree, M. and Lokshin, B. (2004), Cooperative R&D and firm performance, *Research Policy*, 33, pp. 1477-1492
- Arundel, A. (2001) The relative effectiveness of patents and secrecy for appropriation. *Research Policy*, 30 (4), 611–624.
- Aslesen, H. W., & Onsager, K. (2009). Knowledge bases, open innovation and city regions. In The Summer Conference 2009 on CBS (pp. 17-19).
- Belderbos, R., Cassiman, B., Faems, D., Leten, B., & Van Looy, B. (2014). Co-ownership of intellectual property: Exploring the value-appropriation and value-creation implications of co-patenting with different partners. *Research Policy*, 43(5), 841-852.
- Berggren, C., Bergek, A., Bengtsson, L. Söderlund, J. and Hobday, M. (Eds.) (2011), Knowledge integration and innovation, Oxford University Press, Oxford, UK.
- Bogers, M. (2011). The open innovation paradox: knowledge sharing and protection in R&D collaborations. *European Journal of Innovation Management*, 14(1), 93-117.
- Boschma, R. A., (2005), Does geographical proximity favour innovation? , *Economie et Institutions – n°6 et 7 – 1er et 2e semestres 2005*, pp. 111-127
- Capaldo, A., and Petruzzelli, A.M., (2014), Partner Geographic and Organizational Proximity and the Innovative Performance of Knowledge-Creating Alliances, *European Management Review*, DOI: 10.1111/emre.12024
- Chesbrough, H.W.(2003), The Era of Open Innovation, *MIT Sloan Management Review*, Vol.44, No. 3, pp. 34-41
- Chesbrough, H., Vanhaverbeke, W., & West, J. (Eds.). (2006). *Open innovation: Researching a new paradigm*. Oxford university press.
- Chesbrough, H., & Bogers, M. (2014). Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. *New Frontiers in Open Innovation*. Oxford: Oxford University Press, *Forthcoming*.
- Cockburn, I., & Verità, M. (2007, June). Is the market for technology working? Obstacles to licensing inventions, and ways to reduce them. In *Monte Verità Conference The Economics of Technology Policy in Ascona, Switzerland*.
- Corallo, A., Lazoi, M., & Secundo, G. (2012). Inter-organizational knowledge integration in Collaborative NPD projects: evidence from the aerospace industry. *Knowledge Management Research & Practice*, 10(4), 354-367.
- de Faria P. and Sofka W. (2010) Knowledge protection strategies of multinational firms—A cross-country comparison. *Research Policy*, 39 956–968.

- Edelmann, J., & Volchek, D. Open innovation in cross borders-advantages or disadvantages? Strategic options analysis. *Frontiers of Open Innovation*, 5.
- Forza, C. (2002). Survey research in operations management: a process-based perspective. *International Journal of Operations & Production Management*, 22 (2), 152–194.
- Gallini, N. T. (2002). The economics of patents: Lessons from recent US patent reform. *Journal of Economic Perspectives*, 131-154.
- Hagedoorn, J., Cloudt, D., & Van Kranenburg, H. (2005). Intellectual property rights and the governance of international R&D partnerships. *Journal of International Business Studies*, 36(2), 175-186.
- Hagedoorn, J., & Ridder, A. K. (2012). *Open innovation, contracts, and intellectual property rights: an exploratory empirical study*. UNU-MERIT, Maastricht Economic and Social Research and Training Centre on Innovation and Technology.
- Henkel, J., Schöberl, S., & Alexy, O. (2014). The emergence of openness: How and why firms adopt selective revealing in open innovation. *Research Policy*, 43(5), 879-890.
- Hertzfeld, H. R., Link, A. N., & Vonortas, N. S. (2006). Intellectual property protection mechanisms in research partnerships. *Research Policy*, 35(6), 825-838.
- Schneider, P. H. (2005). International trade, economic growth and intellectual property rights: A panel data study of developed and developing countries. *Journal of Development Economics*, 78(2), 529-547.
- Huang, F., & Rice, J. (2013). Does open innovation work better in regional clusters?. *Australasian Journal of Regional Studies*, The, 19(1), 85.
- Huizingh, EKRE. (2011). Open innovation: State of the art and future perspectives, *Technovation*, 31, pp. 2– 9.
- Knoben, J., and Oerlemans, L:A:G:, (2006), Proximity and inter-organizational collaboration: A literature review, *International Journal of Management Reviews*, Vol. 8, Issue 2, pp. 71-89
- Kotabe, M., Murray, J.Y. and Mol, M.J. (2008), “Global sourcing strategy and performance: A ‘fit’ versus ‘balance’ perspective”, *Research in Global Strategic Management*, Vol. 14, No. 14, pp. 259-278.
- Laperche, B. (2012). How to coordinate the networked enterprise in a context of open innovation? A new function for intellectual property rights. *Journal of the Knowledge Economy*, 3(4), 354-371.
- Laursen, K. and Salter, A., (2014), The paradox of openness: Appropriability, external search and collaboration, *Research Policy*, 43 (5), 867–878.
- Laursen, K. and Salter, A., (2006), Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms, *Strategic Management Journal*, 27, 2, 131–150.
- Lazzarotti V., Manzini R., Pellegrini L. (2011). Firm-specific factors and the openness degree: a survey of Italian firms, *European Journal of Innovation Management*, 14, 4, 412-434
- Liu, J., Chaminade, C. and Asheim, B. (2013), “The geography and structure of global innovation 3 networks: a knowledge base perspective”, *European Planning Studies*, Vol. 21, pp. 1-18.
- Manzini R., Lazzarotti V., Pellegrini L., Bengtsson L., Lakemond N., Tell F., Öhrwall Rönnbäck A., Ölundh G., Garcia Martinez M., Kianto A., Pikko H., Sanchez M. (2013), Are We Actually in the Open Innovation Era? Current Practices of European Manufacturing Companies. Proceedings of the 14th International CINet Conference, 8-11 September 2013, Netherlands, 592-614.
- Miotti, L. and Sachwald, F., (2003), Co-operative R&D: why and with whom? An integrated framework of analysis, *Research Policy*, 32, pp. 1481, 1499
- Molina-Morales, F.X., Garcia-Villaverde, P.M., Parra-Requena, G., (2011), Geographical and cognitive proximity effects on innovation performance in SMEs: a way through knowledge acquisition, *International Entrepreneurship and Management Journal*, (December 2014), DOI: 10.1007/s11365-011-0214-z
- Nieto, M.J. and Santamaria, L., (2007), The importance of diverse collaborative networks for the novelty of product innovation, *Technovation*, 27, pp. 367–377

- Patel, P.C., Fernhaber, S.A., McDougall-Covin, P.P., Van Der Have, R.P, (2012), Beating competitors to international markets: the value of geographically balanced networks for innovation, *Strategic Management Journal*, DOI: 10.1002/smj.2114
- Praest Knudsen, M. and Bøtker Mortensen, T. (2011). Some immediate - but negative –effects of openness on product development performance, *Technovation*, 31, pp. 54–64.
- Sachwald, F., (2009), Global networks of open innovation, national systems and public policies, Directorate of Research and Innovation, French Ministry of Higher Education and Research, 2009
- Santamaria, L., & Surroca, J. (2011). Matching the goals and impacts of R&D collaboration. *European Management Review*, 8(2), 95-109.
- Sasaki, H., Sakata, I., Kajikawa, Y., & Tomobe, H. (2010, July). Network of international intellectual property rights research activity for national IP policy. In *Technology Management for Global Economic Growth (PICMET)*, 2010 Proceedings of PICMET'10: (pp. 1-7). IEEE.
- Schmiele, A. (2013). Intellectual property infringements due to R&D abroad? A comparative analysis between firms with international and domestic innovation activities. *Research Policy*, 42(8), 1482-1495.
- Trimble, M. (2015). Advancing National Intellectual Property Policies in a Transnational Context. *Maryland Law Review*, 74(2).
- Un, C.A., Cuervo-Cazurra, A. and Asakawa, K., (2010), R&D Collaborations and Product Innovation, *Journal of Product and Innovation Management*, 27, pp. 673-689
- West, J. (2006). Does appropriability enable or retard open innovation. *Open Innovation: Researching a New Paradigm*, 109-133.
- Zobel, A. K., Balsmeier, B., & Chesbrough, H. Does Patenting Enable or Inhibit Open Innovation?.
- Zhang, Q., & Zhou, K. Z. (2013). Governing interfirm knowledge transfer in the Chinese market: The interplay of formal and informal mechanisms. *Industrial Marketing Management*, 42(5), 783-791.