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Inter-organizational cooperation and organizational innovativeness

A comparative study

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ABSTRACT

Purpose. This paper aims at integrating previous studies investigating the relationship between inter-organizational cooperation and organizational innovation. Earlier research provides mixed results regarding this relationship. In this article, it is argues that this may be due to an empirical bias in these studies since they tend to focus on one sector, one type of innovation, or one country. Using a cross-national comparative datasets enables to account for these potential biases and establish the relationship between inter-organizational cooperation and organizational innovation.

Design/methodology/approach. The study examines the effect of inter-organizational cooperation on product, process, organizational and market innovation, using data from 32 European countries and 6 different sectors (n = 27,019). The data are analyzed using logistic regression analysis.

Findings. The analysis shows that there is a positive relationship between inter-organizational cooperation and organizational innovation, even when controlled for common innovation-variables including general characteristics, organizational structure, organizational culture, HR strategies, networking interaction and external knowledge acquisition.

Originality/value. In contrast to most prior studies that rely on data from one sector, one country, and one innovation type, this study examines the relationship between inter-organizational cooperation and organizational innovativeness by taking into account multiple sectors, countries, and types of innovation. This intends to generate more robust results regarding the link between inter-organizational cooperation and organizational innovativeness

Keywords: inter-organizational cooperation, product innovation, process innovation, organizational innovation, market innovation.

INTRODUCTION

Research investigating the relationship between inter-organizational cooperation and organizational innovativeness is far from conclusive (Becheikh et al., 2006; Crossan & Apaydin, 2010; Fagerberg et al, 2012; Lazonick, 2013; Hynes & Elwell, 2016). While some studies find a positive association between cooperation with other organizations and innovation (Ahuja, 2000; Faems et al., 2005; Morris et al., 2007; Gnyawali & Park, 2009; Tsai, 2009; Nieto & Santamaría, 2010; Ritala & Hurmelinna-Laukkanen, 2013; Tomlinson & Fai, 2013; Antolin-Lopez et al., 2015), other studies show that this relationship is negative or nonexistent (Lööf & Heshmati, 2002; Freel, 2003; Belderbos et al., 2004). These mixed outcomes may result from differences between these studies regarding their *context* and the *kind of innovation* that it investigates. We argue that these differences should be taken into account to get a better understanding of the relationship between inter-organizational cooperation and the innovativeness of organizations.

With regard to contextual characteristics there are several reasons why this may affect the results (Pavitt, 1984; Dosi, 1988; Cohen & Levin, 1989). As prior research shows, the innovativeness of organizations varies across sectors, for example because investments in R&D differ between sectors (Malerba, 2005). Furthermore, market structure, market heterogeneity, and industrial dynamics vary among sectors (Miller & Friesen, 1983; Nelson & Winter, 1982), which may also affect the relationship between inter-organizational cooperation and innovativeness (Alexiev et al., 2016). Adding to this, Keupp et al. (2012) conclude that many innovation studies claim that their outcomes are generalizable, research have the tendency to focus on high-tech sectors. Hence, what is known about the link between cooperation between organizations and innovation may be skewed and Keupp et al. (2012) suggest that other sectors should be included in the analysis as well. Besides that, it is argued

that such studies should also rely on information about organizations to take the political and institutional context into account (Freeman, 1995).

Regarding the kind of innovation, Pittaway et al. (2004) conclude that most studies focus on product innovation. They point out that other kinds of innovation, like process innovation and organizational innovation are understudied in the field of inter-organizational cooperation. Recently, researchers have tried to gain insight in the variables that determine these other forms, such as the innovation of organizational processes (for an overview see for example Crossan & Apaydin, 2010). Still, additional work is needed to answer the question if inter-organizational cooperation relates to different kinds of innovation (and, in addition to that whether different kinds of cooperation relate to different kinds of innovation). Not answering this question seems problematic since design and development differs from production and marketing of products or services, in the way these processes are organized and the resources and skills they require. Arguably, the relationship between inter-organizational cooperation and process, organizational and marketing innovation might differ from product innovation.

Acknowledging that context and the kind of innovation matter for understanding the link between inter-organizational cooperation and organizational innovativeness, means that we need to broaden the scope of existing studies. In this paper, we do so by including organizations from different sectors and investigating several kinds of innovations. Hence, our contribution to the literature is mainly empirical and asks the question: how are inter-organizational cooperation and organizational innovation related across sectors? And if they are associated, does this hold for different kinds of cooperation and innovation? To examine these questions, we use the European Company Survey (ECS; Eurofound, 2015). The ECS contains information about representative samples of organizations across all sectors of the

economies of 32 European countries. Besides that, it contains information about different kinds of cooperation and includes several indicators of innovativeness.

THEORIES OF COOPERATION AND INNOVATION

The relationship between inter-organizational cooperation and innovativeness of organizations is somewhat paradoxical: while the gains of cooperation seem to be obvious (for example because organizations get access to new information through their ties with other organizations), these gains are not always reached (Dooley et al., 2015; Koster, 2016). That there are benefits and risks associated with inter-organizational cooperation follows from several theories (Barringer & Harrison, 2000), namely transaction costs economics, the resource-based view, social network theory, and organizational learning. These theories focus on different aspects related to inter-organizational cooperation. Based on these theories it is possible to create a list of the benefits and risks of cooperation between organizations.

All four approaches provide arguments for a positive association between inter-organizational cooperation and organizational innovation. The transaction cost approach argues that cooperation between organizations is possible if they device a well-functioning governance structure (Williamson, 1991; Zajac & Olsen, 1993), the resource-based view argues that organizations can obtain valuable resources through inter-organizational cooperation (Peteraf, 1993; Barney, 2001), social network theories (Brass et al., 2004; Cammarano et al., 2016) emphasize that access to these resources depends on the networks of organizations, and organizational learning theory argues that information sharing may increase organizational competencies through inter-organizational learning (Mowery et al, 1996).

While these approaches show that inter-organizational cooperation is possible, they also emphasize the other side of cooperation, like the failure of developing governance

structures, that access to the resources of partners is not granted automatically, that dense social networks can hinder innovation (Gulati, 2007,), and that inter-organizational learning depends on the absorptive capacity of the organizations (Lane & Lubatkin, 1998; Zahra & George, 2002; Gerke et al., 2017). In other words, these two sides to the link between inter-organizational cooperation and organizational innovativeness do not follow from one the theoretical perspectives. Instead each of them shows that there are benefits and risks to inter-organizational cooperation. These benefits and risks are discussed in more detail below.

Benefits of cooperation

There are several reasons why there is a positive association between inter-organizational cooperation and organizational innovativeness. The first argument relates to the *resources* that organizations need to be innovative. Organizations that combine these resources in unique ways can be more innovative than other organizations. If organizations do not have these resources, they can access them through external ties (Nooteboom, 1994; Schermerhorn, 1975). And, joining forces with other organizations allows investing in the relations with other organization, which hence induces relational rents (Dyer & Singh, 1998). Such resources can be embedded in inter-organizational routines and processes. According to several theoretical and empirical arguments, inter-organizational cooperation is beneficial as it can provide a way to access complementary assets (Teece et al. 1997) or to access these resources in a more cost-effective way (Hagedoorn, 2002), and can result in a wider range of connections, enabling access to diverse and distant resources outside the direct cooperative framework (Colombo et al., 2011; Laursen & Salter, 2006).

Secondly, inter-organizational cooperation can be a means for spreading the *risks* of innovating across organizations. Innovation processes have a high level of outcome uncertainty (Koster & Lambooij, 2016), as it is unclear whether investments in innovation

will generate the desired outcome. Inter-organizational cooperation can reduce these risks for individual participants, by sharing the costs involved, reducing the time span of innovation and increasing the possibility of success. As expenses involved in innovating can be considerable, sharing the costs of innovating can contribute to reducing these risks and enabling organizations while simultaneously pursuing multiple innovation projects (Veugelers, 1997, Belderbos, et al., 2012). Besides that, cooperation may be strategically motivated when the outcome of the innovation process is unclear for a longer period of time. Inter-organizational cooperation provides the means to engage in high-risk activities outside the organization's boundaries, limiting the consequences of failure for the partners involved (Hagedoorn, 2002).

Finally, cooperation between organizations can lead to *knowledge transfer*, stimulating the generation of new ideas and contributing to interactive learning (Ahuja, 2000; Tsai, 2009). Innovation increasingly requires complex and multidisciplinary knowledge, especially in markets dominated by knowledge intensity and specialization. External know-how can, rather than substitute or complement, stimulate innovation (Veugelers, 1997). As innovation involves the creation of 'new things', the outcome of innovation is unknown. Organizations involved in innovation therefore increasingly depend on not just transferring knowledge, but engaging in interactive learning to create know-how collectively (Lundvall, 2010).

Risks of cooperation

Besides the benefits of inter-organizational cooperation for innovations, it can also be argued that cooperation with other organizations can hinder organizational innovation. Firstly, cooperation can result in *loss of control* as it creates inter-dependency among organizations. Inter-organizational cooperation implies sharing of control over the partnership. Especially when partners differ in size and the extent to which they invest in the partnership, smaller

partners may experience a loss of control (Gnyawali & Park, 2009). Powerful organizations that have the highest level of control within the inter-organizational entity, may force others to steer the cooperation in a direction less desired by the smaller partners (Sulej et al., 2001). As a result, smaller partners may be placed in a vulnerable position. Their ability to engage in multiple partnerships, in order to alleviate this risk, is limited. Therefore, cooperation may, in time, lead to inter-dependency, limiting the flexibility of the cooperating partners.

Secondly, an organization engaged in inter-organizational cooperation is at risk of *opportunistic behavior* of its partner(s) (Van Haverbeeke, 2002). Especially when cooperating with larger competitors, organizations are in danger of losing their proprietary knowledge, resulting in legal issues (Gnyawali & Park, 2009). To lower the risk of opportunism and free riding, partners resort to existing networks to get information that lowers that risk (Gulati, 1998). Partner selection should therefore not merely be resource-based, but also trust-based and network embedded to avoid technological leakage and opportunistic behavior (Gulati, 2007). It requires partners to balance collaboration in good faith and monitoring the costs and benefits of the partnership. Such negative effects mainly depend on how organizations structure their collaborative ties; if they focus on dyads, rather than the wider network, opportunism and conflicts are more likely to be a problem (Davis, 2016).

Finally, the gains from cooperating can be limited, due to *difficulties in the transfer of knowledge*. Knowledge transfer can be limited due to differences in how partners structure, utilize and transmit knowledge, but also in the kind of knowledge that is being transferred (the more tacit this knowledge is, the more difficult it is to transfer between organizations) (Lam, 1997). Furthermore, partners may not recognize and value new information, assimilate it, and apply it to commercial ends, meaning that their absorptive capacity is low (Cohen & Levinthal, 1990). Organizations constrained by a limited knowledge exposure might experience more difficulties in exploring new and related knowledge.

KINDS OF INNOVATIVENESS AND INTER-ORGANIZATIONAL COOPERATION

So far, we have used the term innovation to refer to different kinds of innovation in which organizations can be involved. Furthermore, we have used the term inter-organizational cooperation to refer to the existing ties between organizations, without mentioning the content of these ties. Nevertheless, different kinds of organizational innovation and inter-organizational cooperation can be distinguished. Regarding organizational innovation we distinguish four different kinds, namely product innovation, process innovation, organizational innovation and market innovation. This reflects a theoretical distinction that goes back to Schumpeter (1934).

To deepen our understanding of inter-organizational cooperation, we acknowledge that ties between organizations differ. In this study we distinguish inter-organizational on the basis of the partnerships' key activities: (1) inter-organizational cooperation on design and development; (2) inter-organizational cooperation on the production of goods or services; and (3) inter-organizational cooperation on the marketing en sales of goods or services.

HYPOTHESES

In the previous section, we state that there may be a positive or a negative relationship between inter-organizational cooperation and organizational innovativeness and we distinguish four kinds of innovations and three kinds of inter-organizational cooperation. In the hypotheses below relations are specified, connecting a selection of these inter-organizational relations and innovation.

Product/service innovation

Cooperation on product innovation focuses on working together during the design and development phase of products or services, working towards improving products or services.

Given the knowledge intensity of this phase, interacting with other organizations might bridge gaps in information, scientific knowledge, resources and competencies (Romijn & Albaladejo, 2002), but could arguably involve difficulties in knowledge transfer. This leads to the following two hypotheses:

H1a: Product or service innovation is positively related to inter-organizational cooperation on design and development.
H1b: Product or service innovation is lower among organizations engaged in inter-organizational cooperation on design and development.

Process innovation and organizational innovation

Although the majority of research on inter-organizational cooperation and innovation concerns product innovation, the mechanisms that drive product innovation, could, at least partly, have the same effects on other forms of innovation. Alternatively, different innovation efforts can be associated with different strategies. Where product innovation is mainly associated with technological competitiveness, process and organizational innovation are mostly driven by price competiveness (Pianta, 2005). Defining process innovation as introducing new methods of production and organizational innovation as new forms of organization (Schumpeter, 1934), we can relate process and organizational innovation to different cooperative processes. We suggest that inter-organizational cooperation on product innovation emphasizes the design and development phase, while process innovation and organizational innovation is aimed at the production of products or services. Process and organizational innovations do not lead to new products or services as such, but they reflect the necessary preconditions for producing them. We therefore propose that:

H2a: Process innovation is higher among organizations engaged in inter-organizational cooperation on the production of goods and services.
H2b: Process innovation is lower among organizations engaged in inter-organizational cooperation on the production of goods and services.

H3a: Organizational innovation is higher among organizations engaged in inter-organizational cooperation on the production of goods and services.
H3b: Organizational innovation is lower among organizations engaged in inter-organizational cooperation on the production of goods and services.

Market innovation

Although the term 'market innovation' is closely linked to opening up new markets (Schumpeter, 1934), it involves improving the mix of target markets and how these are served (Johne, 1999) and can even be considered as 'the successful change of existing market structure, the introduction of new market devices, the alteration of market behavior, and the reconstitution of market agents' as defined by Kjellberg et al. (2015). Given this diversity in the outcome of market innovation, it is likely to be more complex and difficult to study than product innovation. Although the term 'market innovation' has been used frequently in recent literature, its precise meaning is not always clear (Kjellberg et al, 2015). This diversity also has a profound impact on studying the relationship between inter-organizational cooperation and market innovation, moreover since the outcome of market innovation is partly collective in nature. A collective approach, involving a multitude of organizations, and long-term exchange relationships, is a necessary precondition to change the existing market structure (Onyas & Ryan, 2015). The introduction of market devices, such as new business models and

marketing methods, can, however, suffice with small-scale inter-organizational cooperation. In this study we therefore take a more direct approach to market innovation and propose:

H4a: Marketing innovation is higher among organizations engaged in inter-organizational cooperation on sales or marketing of products or services.
H4b: Marketing innovation is lower among organizations engaged in inter-organizational cooperation on sales or marketing of products or services

CONCEPTUAL MODEL

When examining the proposed hypotheses, we need to take into account that inter-organizational cooperation is one of several innovation variables identified in the literature. An extensive review of recent empirical studies on innovation in manufacturing firms shows that industry type, regional differences, knowledge and technology acquisition, government and public policies, surrounding culture and networking all determine the ability to innovate (Becheikh et al., 2006). In a systematic review of literature on organizational innovativeness, Crossan & Apaydin (2010) identify several determinants of organizational innovation, such as environment (industry, environmental determinants, geo systems and networks), organization (organizational determinants, size, impediments, competitiveness, stage of adoption and contextual determinants) and individual and group determinants. In order to control for confounding effects, general characteristics, organizational structure, organizational culture, human resource strategies and external determinants have been introduced into our research model (see Figure 1).

FIGURE 1 ABOUT HERE

METHODS

Data

We used data from the third European Company Survey (ECS, 2013) to investigate the relationship between inter-organizational cooperation and innovation, taking into account sector specific, country specific and innovation type specific effects. The ECS is collected by Eurofound, an EU agency that provides information, advices and has expertise on living and working conditions, industrial relations and managing change in Europe, on the basis of comparative information, research and analysis. The main focus of the ECS 2013 is on work organization, workplace innovation, HR practices, employee participation and social dialogue. It includes data from 32 countries consisting of the 27 EU Member States and Croatia, Macedonia, Iceland, Montenegro and Turkey. Organizations participating in the ECS 2013 originate from a broad spectrum of sectors and include small, medium-sized and large enterprises. Table 1 provides an overview of the composition of the sample. For the present study, data from the Management Questionnaire of the ECS, focusing on industrial relations and innovation, were selected. We concentrated on the following blocks in the questionnaire: company characteristics, changes in the establishment, employee characteristics, work organization practices, team work and team rotation, outsourcing and collaboration, and human resource management practices.

TABLE 1 ABOUT HERE

Measures

Measuring innovation, involves assessing innovation input, process or output, or the connections between them (Carayannis & Provance, 2008; Hagedoorn & Cloodt, 2003). Indirectly, innovation can be derived from measuring R&D expenditures, patent counts or

patent citations. Direct measurement involves innovation count, such as new product or process announcements. Providing a useful framework for measuring product innovation, these forms of measurement are still limited for measuring process, organizational and market innovation performance. Where significantly outstanding methods to measure process innovation are limited (Ayhan et al., 2013), measuring organizational innovation and market innovation proves even more difficult, given their diversity and complexity. Additional problems arise when applying existing indirect innovation measurements to organizational and market innovation, as all of the proposed measurements automatically draw the attention towards measuring R&D input or patents, favoring technical product innovation. Even when using multiple indicators, these methods largely disregard administrative innovations, limiting its use for assessing organizational and market innovation. To overcome these shortcomings, attention can be shifted towards measuring the subject of innovation, using firm-based data. Over the last decades, these subjective measures of innovation have become increasingly popular (Hong et al., 2012) as they provide a number of advantages (Archibugi & Pianta, 1996). The information collected can be related to the industrial structure and innovation can be matched to other data at organizational and industry level. Moreover, it includes both successful and unsuccessful innovating organizations, allowing for comparison. It also enables the collection of data in other sectors such as service industries. Data collected via firm-based surveys may, however, be subject to human error or bias, and require high response rates and large-scale datasets.

Dependent variables: four kinds of innovation

In this study the data from the ECS 2013 surveys' management questionnaire were analyzed. Organizations indicate whether they, since the beginning of 2010, introduced change to their establishment. Managers specified whether they had introduced (1) any new or significantly

changed products or goods (2) any new or significantly changed processes, either for producing goods or supplying services (3) any organizational change and (4) any new or significantly improved marketing methods. In this study these binary data were used to measure the dependent variables in the research model being (1) product innovation (2) process innovation (3) organizational innovation and (4) market innovation (0=No; 1=Yes).

Independent variables

Respondents were asked to indicate whether they cooperated with other organizations on (a) the design or development of new products or services (b) the production of goods or services and (c) sales or marketing of goods or services. These data provided the means to dichotomously measure the independent variables in our model (0=No; 1=Yes).

Control variables

Finally, several control variables were included based on prior research. Using the systematic review on innovation by Becheikh et al. (2006), internal and external innovation variables were identified in the dataset. These variables include internal innovation variables, general characteristics, firm's structure, culture and strategy were examined more closely and external innovation variables like knowledge acquisition and external orientation of the organization.

General characteristics of the organization were taken into account by looking closer at the organization's size and experience with innovation. When examining innovativeness of organizations, small and medium sized enterprises (SMEs) appear to develop and use innovation in a different way than larger organizations (Smith et al., 1991; Hausman, 2005). Although the classic Schumpeterian debate over organizational size and innovation is complex, several studies lean towards a positive correlation (Smith et al., 1991; Stuart, 2000; Gnyawali & Park, 2009; Nieto & Santamaría, 2010).

Arguably SMEs face more resource restraints to innovate (Tsai, 2001), and large organizations can benefit from economies of scale in design and development, production and marketing (Stock et al., 2002). Therefore, we control for 'organization size', distinguishing between small (10-49 employees), medium sized (50-249 employees) and large organizations (more than 250 employees).

A second general characteristic was included, aimed at determining the organization's experience with innovation. By considering the accumulated experience and knowledge within the organization as proxies for past performance and future absorptive capacity (Zahra & George, 2002), a positive relationship is suggested between past performance and absorptive capacity and innovation (Tsai, 2009). Data from the ECS 2013 on the share of employees over 50 years of age and the share of employees with a university degree were used to operationalize experience and absorptive capacity.

Effects of the organizational structure were studied by including structural flexibility and team decision-making of the organization. It is assumed that innovation can be improved by adopting organic organizational structures, particularly for larger and more mature organizations (Sine et al, 2006). These structures are characterized by a lack of formally defined tasks and an emphasis on horizontal as opposed to vertical coordination (Burns & Stalker, 1961). Teamwork and teamwork cohesion, the ability to ensure that the employees within a team have complementary skills and interactions, are proposed to positively affect organizational learning, increasing innovation performance (Montes et al, 2005). Considering the structural flexibility, the total number of hierarchical levels of the organization was retrieved from the ECS dataset. To measure team decision-making, respondents' indications on whether tasks are distributed by a superior (0) or team members decide amongst themselves by whom tasks are performed (1), were incorporated.

A further control variable that was introduced aims at determining the influence of the organizational culture on innovation. Empirical studies suggest that creating a culture favoring quality control and continuous improvement may enhance innovation (Becheikh et al., 2006). The ECS database provides information on whether organizations are engaged in keeping record of good practices or lessons learned (0=No; 1=Yes). Furthermore, it indicates whether monitoring of quality of production processes or service delivery takes place within the establishment (0=No; 1=Yes). These variables were used as indicators for a culture promoting innovation.

A final internal innovation determinant that was regarded in this study, involves the impact of human resource strategies on innovation performance. Training of personnel (Souitaris, 2002) and financial incentives (Koberg et al., 1996), are assumed to positively correlate with innovation (Becheikh, 1996). In this study three factors incorporating human resource strategies were considered, measuring the percentage of employees who recently received on the job training, whether the establishment uses payment by result schemes (0=No; 1=Yes) and whether forms of variable extra pay for individual performance exist within the organization (0=No; 1=Yes).

Looking at external determinants of innovation, attention was shifted towards network interaction and external knowledge acquisition. Moving away from cooperation within the supply chain or with competitors on design and development, production and marketing, attention was paid to other network interactions. Cooperation outside the network interface, but inside the network infrastructure using third parties, can positively influence organizational innovation (Pittaway et al, 2004). Hence, membership of employers' organizations was introduced as a proxy for measuring networking interaction outside the direct cooperative ties included in the independent variables (0=No; 1=Yes).

Lastly, the ECS dataset was analyzed on whether respondents were involved in monitoring external ideas or technological developments. Companies engaged in monitoring external ideas and development were asked to indicate if they used staff assigned specifically to this task (0=No; 1=Yes, as part of responsibilities of general staff; 2=Yes, using staff specifically assigned to the task). Empirical studies show that the use of knowledge external sources is associated to organizations generating better innovation results (Vivas & Barge-Gil, 2015).

In addition to internal and external innovation determinants, the relationship between inter-organizational cooperation and innovation was controlled introducing country and sector dummies, for the countries and sectors as presented in Table 1.

Analysis

The hypotheses are tested using a binary logistic regression analysis. The logistic regression model (Pregibon, 1981; Winship & Mare, 1984) enables to investigate binary dependent variables, in this case indicating whether the organization innovated or not (with 0/1) and the independent cooperation variables. We do this is in a number of steps. First we construct a model with one predictor variable, to see if there is a relationship between inter-organizational cooperation and innovation as proposed in the hypotheses. And then we extend the model by introducing the control variables 'general characteristics' (size of the organization, percentage of employees with university degree, and percentage of employees over 50 years old), 'organizational structure' (number of hierarchical levels and decision making on task distribution by team members), 'organizational culture' (keeping record of good practices or lessons learned and monitoring of quality of production processes or service delivery), 'human resource strategies' (percentage of employees received on the job training, payment by result, and variable extra pay for individual performance), and 'external determinants'

(networking interaction and informal knowledge acquisition). Furthermore, 32 country dummies and 6 sector dummies were added to the model to account for sector or country specific effects. Finally the most influential control variables were tested for interaction effects. Adding these control variables allows investigating whether the initial relationships remains after adding them.

Following this procedure, H1 was tested using variables 'product innovation' and 'cooperation on the design and development of new products or services', and determining the size of the odds ratio, where Exp(β) >1 favors H1a and Exp(β) <1 favors H1b. After testing H1, an identical approach was adopted to test H2, H3 and H4 using variables 'cooperation on the production of goods or services' and 'process innovation' (H2) respectively 'organizational innovation' (H3) and 'cooperation on sales or marketing of goods or services' and 'market innovation' (H4).

RESULTS

Tables 2, 3, 4 and 5 display the results of testing H1, H2, H3 and H4. In each table the outcome of the logistic regression and the results including the control variables are shown per innovation type.

There is a positive and significant effect of inter-organizational cooperation on all four types of innovation. The effect sizes appear to indicate a stronger impact on process innovation, organizational innovation and market innovation as opposed to product innovation. Results show that companies engaged in inter-organizational cooperation are 1.751 times more likely to achieve a positive result on process innovation and 2.055 more likely on organizational innovation than organizations that are not inclined to cooperate on the production of goods and services. Comparing these effect sizes using odds ratios should, however, be interpreted with some consideration, given the difference in composition of the

population groups cooperating on design and development and the groups cooperation on production and marketing and sales (Mood, 2010).

TABLE 2 ABOUT HERE

The results, including the control variables for H1a and H1b, as presented in Table 2, indicate that the effect of cooperation on product innovation decreases from 0.342 to 0.184, but remains statistically significant. This supports the hypothesis that companies engaged in inter-organizational cooperation on design and development are more likely to introduce new or significantly changed products or services, as proposed in H1a. Notable are the effects of informal knowledge acquisition, human resource strategies and the employee's level of education. These demonstrate that monitoring of external ideas and technologies (β=0.406), on-the- job training (β=0.215), payment by result (β=0.245), variable extra pay (β=0.240) and higher formal education (β=0.229), all significantly contribute to product innovation.

Table 3 shows the results of testing H2a and H2b for multiple predictors. The results reveal a positive and significant relationship between cooperation on production and process innovation, confirming the proposed hypothesis H2a. By introducing the control variables the effect size decreases from 0.560 to 0.290, resulting in an odds ratio of 1.337. Both internal and external determinants of innovation display a significant effect. Informal knowledge acquisition and organizational culture reveal the largest effect sizes on process innovation. Within a organizational culture, keeping record of good practices or lessons learned (β=0.308) and monitoring of quality of production processes (β=0.546) appear to be important determinants for process innovation.

TABLE 3 ABOUT HERE

TABLE 4 ABOUT HERE

Inter-organizational cooperation on the production of goods and services also interacts positively with the likelihood of introducing organizational change, as illustrated in Table 4. The results show an effect size of 0.429 and an odds ratio of 1.535, supporting H3a. Again the results show the significance of informal knowledge acquisition, but also, as opposed to product innovation, reveal a strong conducive effect of the organizational structure, favoring horizontal over vertical structures for enabling organizational innovation. A second aspect of organizational structure, being decision making on task distribution by team members, however proved non-significant.

This effect does not occur when examining market innovation, as presented in Table 5. These results also indicate a positive effect from inter-organizational cooperation, confirming H4a. The effect of cooperation on marketing and sales on market innovation remains significant at 0.349 and an odds ratio of 1.437, when controlled for innovation variables. Different variables, however, affect this relationship, where, next to informal knowledge acquisition, mainly human resource strategies appear to enhance market innovation.

TABLE 5 ABOUT HERE

CONCLUSION AND DICUSSION

Theoretical implications

This study empirically investigates the relationships between inter-organizational cooperation and organizational innovativeness. We used ECS data, which allows including organizations from multiple sectors and countries, to improve generalizability and to consider confounding

alternative industry and country settings. Furthermore, the differential effect of inter-organizational cooperation on product innovation, process innovation, organizational innovation and market innovation was examined. The results demonstrate that there is a positive relationship between cooperation and innovation. This relationship holds for the four innovation types investigated here, controlling for other characteristics, economic sector, and country effects.

In addition, the results indicate that cooperation is more beneficial for process, organizational and market innovation than for product innovation. These outcomes suggest that innovation enhancing mechanisms, such as accessing complementary resources, spreading the risks of innovation and engaging in interactive learning have a more decisive impact on these innovation types. Alternatively, product innovation might be more at risk of loss of control, inter-dependency, opportunism, free riding and difficulties in knowledge transfer. Results, however, primarily indicate a possible effect of knowledge transfer. First of all, the analysis displays a significant impact of employee quality on product innovation performance. This is derived from the ratio of employees with a university degree, a known proxy for the quality of an organization's human resources. Employee quality is regarded as a common determinant for technical product innovation (Becheikh et al., 2006; Tsai, 2009), and a precondition for exploiting technical knowledge (Zahra & George, 2002). The result of this study indicate a similar effect in the population examined, thus stressing the appropriateness of organizational learning theory for explaining differential product innovation results.

Similarly, this study reveals a significant effect of informal knowledge acquisition on innovation. Informal knowledge acquisition enhances formal knowledge by combining explorative and exploitative skills (March, 1991; Simsek, 2009). Although this effect occurs on all four forms of innovation, prior research suggests that explorative oriented cooperation is more beneficial to innovations aimed at creating new technologies and products (Faems et

al, 2005). Theoretically, the dominant impact of informal knowledge acquisition on all innovation types, points towards learning theory and absorptive capacity. The results from this study indicate that these mechanisms play a similar role in all four types of innovation.

Finally, the analysis points towards typical innovation determinants influencing process and organizational innovation. The occurrence of process en organizational innovation is predominantly related to the organization's structural flexibility and the organizational culture. An emphasis on horizontal as opposed to vertical coordination proved to be a good predictor for both innovation types. Process innovation appears to benefit particularly from creating a culture favoring quality control and continuous improvement.

The findings of this study contribute to a better understanding of the relationship between inter-organizational cooperation and innovation, when studied in a broader context than the traditional product innovation / high tech and manufacturing environment. Many scholars point towards a gap in research, when predicting differential innovation behavior in low and medium tech industries (Malherba 2005; Keupp et al., 2012), or when examining other types of innovation (Pittaway et al., 2004). We conclude that, although the direction of the interaction is similar to product innovation, the size of the interaction effect differs, as do the mechanisms causing them. Despite these differential effect sizes and mechanisms, the theoretical paradigms explaining them, appear to be identical for all innovation types.

Practical implications

Alongside the scientific implications, this study suggests that managers, trying to enhance their innovativeness, can, in general, benefit from working together with other organizations. The benefits from cooperation seem to outweigh the risks involved. Especially when improving process and organization, inter-organizational cooperation is a valuable strategy.

Managers should also consider adopting an explorative approach towards knowledge acquisition. Actively monitoring external ideas and developments enhances all types of innovation, especially when staff is assigned specifically to this task. Finally, the results indicate that managers should explore human resource strategies that broaden the possibilities of on the job training and promote financial incentives for individual employees.

Limitations and further research

This study manifested some limitations that point towards further research. Although using firm-based data provides many advantages, the binary measurement of cooperation and innovation performance limits further exploration of the results. Understanding how and why cooperation positively influences innovation performance, requires a more detailed insight in the configuration and dynamics of the cooperation network. Recent studies show that choice of cooperation partners affect innovation (e.g. Antolin-Lopez et al., 2015). This includes examining partnerships between organizations and their suppliers and customers, partnerships with competitors and partnerships that stretch beyond these ties, utilizing third parties such as trade associations, knowledge centers, universities, consultants and innovation intermediaries. These data can, partly, be derived from other sources, such as the Community Innovation Study (CIS). For further research, combining these datasets is recommended.

To account for spatial differentials, data from a large number of countries were included in this study. However, the 32 countries incorporated, represent EU member states or countries affiliated with the European Union. Arguably, these countries' innovation infrastructures show substantial similarities. Including data from countries with a less developed innovation infrastructure further improves the generalizability of the results.

We assumed that the mechanisms that drive product innovation could produce similar effects on other forms of innovation. Hence, innovation determinants were used, derived from

systematic reviews on product innovation variables. However, as suggested by Pianta (2005), product innovation is mainly associated with technological competitiveness, while process and organizational innovation are mostly driven by price competiveness. These differential forces are reflected in the differential effect sizes and the differential influence of control variables in this study. This suggests that different innovation efforts should be associated with different strategies. This calls for a more fine-grained approach by distinguishing between innovation determinants specifically tailored to process, organizational and market innovation, when studying the effect of inter-organizational cooperation.

Finally, the results show that cooperation is more beneficial for process, organizational and market innovation than product innovation. From a practical point of view, this does not correspond with the lack of attention that process innovation, and particularly organizational and market innovation have received in scientific research on inter-organizational cooperation and innovation (Pittaway et al., 2004; Fagerberg et al., 2012). To further the understanding of the interaction between cooperation and innovation, empirical studies on the interaction between organizational innovation and market innovation applied to specific industry and country settings, is necessary.

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TABLES

Table 1. Descriptives

Sector	Frequency	Percent
Industry	9088	33.6
Construction	2045	7.6
Commerce and hospitality	6466	23.9
Transport and communication	2144	7.9
Financial services and real estate	1460	5.4
Other services	5441	20.1
Total	26644	98.6
Missing	375	1.4
Total	27019	100.0

Company size (employees)	Frequency	Percent
10-49	13755	50.9
50-249	8764	32.4
250+	4500	16.7
Total	27019	100.0

Country	Frequency	Percent
Belgium	971	3.6
Bulgaria	504	1.9
Czech Republic	987	3.7
Denmark	981	3.6
Germany	1470	5.4
Estonia	497	1.8
Ireland	488	1.8
Greece	1001	3.7
Spain	1474	5.5
France	1462	5.4
Croatia	450	1.7
Italy	1528	5.7
Cyprus	451	1.7
Latvia	505	1.9
Lithuania	494	1.8
Luxembourg	505	1.9
Hungary	1016	3.8
Malta	280	1.0
Netherlands	1010	3.7
Austria	972	3.6
Poland	1436	5.3
Portugal	1002	3.7
Romania	503	1.9
Slovenia	498	1.8
Slovakia	496	1.8
Finland	992	3.7
Sweden	997	3.7
United Kingdom	1501	5.6
Iceland	451	1.7
Montenegro	282	1.0
Macedonia	448	1.7
Turkey	1367	5.1
Total	27019	100.0

Table 2. Logistic regression of product innovation

		Standard				Standard		
	β	Error		Exp(β)	β	Error		Exp(β)
Cooperation on production of goods or services	0.342[a]	0.035	***	1.408	0.184[b]	0.046	***	1.203
Internal Determinants								
General characteristics								
Size of the organization					0.068	0.033	*	1.070
Employees with university degree					0.229	0.048	***	1.257
Employees over 50 years old					0.295	0.114	*	1.343
Organizational structure								
Hierarchical levels					0.900	0.049		1.095
Decision making on task distribution by team members					0.037	0.051		1.038
Organizational culture								
Keeping record of good practices or lessons learned					0.169	0.050	**	1.184
Monitoring of quality of production processes					0.322	0.137	*	1.380
HR strategies								
Percentage of employees received on the job training					0.215	0.049	***	1.240
Payment by result					0.245	0.046	***	1.278
Variable extra pay individual performance					0.240	0.047	***	1.271
External determinants								
Networking interaction								
Membership of employers' organization					0.038	0.051		1.038
Informal knowledge acquisition								
Monitoring of external ideas/ technology development					0.406	0.072	***	1.501

[a] R^2=.007 (Nagelkerke). Model $\chi^2(1)$=93.959
[b] R^2=.073 (Nagelkerke). Model $\chi 2(45)$=534.339
*p<0.05 **p<0.01 ***p<0.001
Country-specific and sector-specific dummies are included, but not reported. Results are available on request.

Table 3. Logistic regression of process innovation

		Standard				Standard		
	β	Error		Exp(β)	β	Error		Exp(β)
Cooperation on production of goods or services	0.560[a]	0.032	***	1.751	0.290[b]	0.042	***	1.337
Internal Determinants								
General characteristics								
Size of the organization					0.149	0.031	***	1.160
Employees with university degree					0.189	0.045	***	1.208
Employees over 50 years old					0.118	0.102		1.125
Organizational structure								
Hierarchical levels					0.163	0.045	***	1.177
Decision making on task distribution by team members					-0.019	0.049		0.982
Organizational culture								
Keeping record of good practices or lessons learned					0.308	0.046	***	1.361
Monitoring of quality of production processes					0.546	0.138	***	1.726
HR strategies								
Percentage of employees received on the job training					0.338	0.045	***	1.401
Payment by result					0.219	0.043	***	1.245
Variable extra pay individual performance					0.324	0.044	***	1.383
External determinants								
Networking interaction								
Membership of employers' organization					0.172	0.048	***	1.188
Informal knowledge acquisition								
Monitoring of external ideas/ technology development					0.700	0.060	***	2.013

[a] R^2=.025 (Nagelkerke). Model $\chi^2(1)$=313.304
[b] R^2=.140 (Nagelkerke). Model $\chi 2(45)$=1239.652
*p<0.05 **p<0.01 ***p<0.001
Country-specific and sector-specific dummies are included, but not reported. Results are available on request.

Table 4. Logistic regression of organizational innovation

		Standard				Standard		
	β	Error		Exp(β)	β	Error		Exp(β)
Cooperation on production of goods or services	0.720[a]	0.032	***	2.055	0.429[b]	0.043	***	1.535
Internal Determinants								
General characteristics								
Size of the organization					0.288	0.031	***	1.334
Employees with university degree					0.194	0.045	***	1.214
Employees over 50 years old					0.275	0.104	**	1.316
Organizational structure								
Hierarchical levels					0.347	0.046	***	1.415
Decision making on task distribution by team members					0.002	0.050		1.002
Organizational culture								
Keeping record of good practices or lessons learned					0.153	0.047	**	1.165
Monitoring of quality of production processes					0.116	0.135		1.123
HR strategies								
Percentage of employees received on the job training					0.330	0.046	***	1.390
Payment by result					0.187	0.044	***	1.205
Variable extra pay individual performance					0.259	0.045	***	1.296
External determinants								
Networking interaction								
Membership of employers' organization					0.306	0.048	***	1.358
Informal knowledge acquisition								
Monitoring of external ideas / technology development					0.491	0.062	***	1.634

[a] R^2=.040 (Nagelkerke). Model $\chi 2(1)$=513.452
[b] R^2=.189 (Nagelkerke). Model $\chi^2(45)$=1724.118
*p<0.05 **p<0.01 ***p<0.001
Country-specific and sector-specific dummies are included, but not reported. Results are available on request.

Table 5. Logistic regression of market innovation

		Standard				Standard		
	β	Error		Exp(β)	β	Error		Exp(β)
Cooperation on sales or marketing of products or services	0.480[a]	0.030	***	1.616	0.349[b]	0.039	***	1.437
Internal Determinants								
General characteristics								
Size of the organization					0.071	0.029	**	1.074
Employees with university degree					0.170	0.041	***	1.185
Employees over 50 years old					0.122	0.100		1.130
Organizational structure								
Hierarchical levels					0.089	0.042	*	1.093
Decision making on task distribution by team members					0.036	0.045		1.037
Organizational culture								
Keeping record of good practices or lessons learned					0.187	0.042	***	1.205
Monitoring of quality of production processes					0.304	0.105	**	1.355
HR strategies								
Percentage of employees received on the job training					0.272	0.043	***	1.313
Payment by result					0.233	0.040	***	1.263
Variable extra pay individual performance					0.176	0.041	***	1.193
External determinants								
Networking interaction								
Membership of employers' organization					0.074	0.045		1.077
Informal knowledge acquisition								
Monitoring of external ideas / technology development					0.665	0.057	***	1.945

[a] R^2=.018 (Nagelkerke). Model $\chi^2(1)$=259.331
[b] R^2=.112 (Nagelkerke). Model $\chi^2(45)$=1110.481
*p<0.05 **p<0.01 ***p<0.001
Country-specific and sector-specific dummies are included, but not reported. Results are available on request.

FIGURES

Figure 1. Research Model