

MAPPING THE PATTERNS OF COOPERATIVE ARRANGEMENTS FOR INNOVATION

-

A DETAILED LESSON

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CONTEXTUALIZATION

The present report, titled "Mapping the Patterns of Cooperative Arrangements for Innovation – A Detailed Lesson," fulfills the requirements outlined in Artº 8 (alínea c) of Decreto-Lei nº 239/2007, 19th June.

It is presented as a research manuscript that draws upon the candidate's prior publications, both as a sole author and in collaboration with colleagues. The content was developed considering master students as an audience.

This document is structured to provide a comprehensive exploration of the topic, which has two primary motivations. Firstly, the candidate is responsible for teaching Economics of Regional Development, a compulsory subject within the Masters in Tourism Economics and Regional Development offered by the School of Economics at the University of the Algarve. The curriculum of this program includes the study of networking and innovation, making it pertinent to incorporate empirical research on this subject into the teaching material. By producing this lesson, the candidate not only revises and enhances their lectures but also offers students valuable insights derived from empirical research.

Secondly, the report reflects the candidate's personal research interests, particularly in the scope of innovation and the interaction between networking and innovation performance. By aligning the report with both pedagogical and research objectives, the candidate intends to enrich the academic discourse and provide practical insights that can inform both teaching and research concerns.

The present document is organized into seven interconnected parts:

1. The abstract provides a concise summary of the research.
2. The introduction outlines the research objective along with the relevance of studying the motivations and patterns underlying cooperative arrangements for innovation across diverse partner types.

3. A second section is dedicated to stress the role of cooperation and discuss the distinctive features of each cooperative partner.
4. A third section is dedicated to the factors influencing cooperation, such as the absorptive capacity of the firm, cost and risk sharing, types of innovation performed, and background variables.
5. The fourth section introduces the data used and outlines the research hypothesis.
6. The fifth section presents and discusses the findings of the binomial logistic models.
7. Finally, the conclusion wraps up the manuscript by highlighting contributions to theory and discussing the limitations encountered during the research process.

ABSTRACT

This study aims to provide insights into the drivers behind firms' decisions to engage in cooperative arrangements towards innovation. The research intends to explore the presence of cooperation for innovation between firms and various types of external partners and to investigate the attributes that make firms more likely to participate in such networking.

We considered the absorptive capacity of the firm, along with the need to share costs and risks, as key determinants of cooperation for innovation. The list of predictors also covered the type of innovation and firm characteristics.

The study reveals that firms encountering difficulties in accessing external knowledge often collaborate, particularly with consultants, to access specialized expertise crucial for innovation. Additionally, financially constrained firms collaborate with suppliers and academic institutions to manage costs and access public funds, highlighting cooperation's role in cost-sharing and obtaining external financial resources. Moreover, market uncertainties drive collaboration with universities and customers to gain insights and mitigate risks, while intense competition prompts cooperation with competitors, underscoring cooperation's strategic importance in addressing market challenges and leveraging partner expertise. In terms of innovation type, firms introducing "new to the market" innovations prefer collaboration with customers, stressing the importance of aligning partner selection with the pursued innovation type.

Our findings contribute to theoretical understanding by clarifying the complex interplay of motivations and patterns underlying cooperative arrangements for innovation across diverse partner types, firm characteristics, and industry sectors within the Portuguese context.

Keywords: Cooperation, Networking, Innovation, CIS 2020, Community Innovation Survey, Portugal.

1. Introduction

The ongoing ability of firms to learn and capitalize on new business opportunities through acquired knowledge, is widely regarded by scholars as a crucial solution to prevent firms from becoming locked in obsolete technological paths. By accessing external markets, ideas, and technologies, firms can go beyond their own limitations while gaining insights into the technological trajectories of their competitors. Case studies conducted across Europe offer both empirical and theoretical perspectives on how firms benefit from external relationships along the value chain (Alvarez, Marin, & Fonfria, 2009; Arndt & Sternberg, 2000; Cantner, Conti, & Meder, 2010; Mazzola, Bruccoleri, & Perrone, 2009). Enterprises are induced to revise their strategies in order to survive and adapt to rapidly changing factors such as technology, customer preferences, and competitive dynamics. This involves reshaping their activities, particularly in the range of innovation development. Traditionally, the innovation development process involved two strategies: internal knowledge generation (to make) or external knowledge acquisition through purchasing (to buy) (Veugelers & Cassiman, 1999). However, theorists have identified a third strategy for knowledge acquisition: to cooperate with external agents (Navarro, 2002).

This study aims to shed light on the motivations driving firms' decisions to engage in cooperative arrangements for innovation. The research seeks to examine the prevalence of innovation cooperation between firms and various types of external partners, as well as to explore the characteristics that make firms more motivated to participate in such collaborative networks.

The paper addresses a significant research gap by providing empirical insights into the cooperative patterns of innovative Portuguese firms, which have been understudied at a large-scale level. Through a review of existing literature, it was possible to confirm that this study represents an important effort to comprehensively examine cooperative arrangements for innovation within Portuguese firms.

Searching for scientific articles within the peer-reviewed scientific database Scopus enabled the identification of 21 articles addressing the central question: does the article investigate cooperation for innovation within Portuguese firms using the extensive dataset provided by the Community Innovation Survey (CIS)? The final list was organized into two thematic domains: the role of networking and external sources in fostering innovation within firms, and factors influencing the dynamics of cooperation (as depicted in Annex 1).

The several studies are mainly concerned with understanding innovation patterns and the role of cooperation in contributing for innovation performance, not as much as with the other way around.

From the list, only four papers focus on the factors influencing the decision to engage in cooperation for innovation.

Mendes et al. (2023) found that investments in innovation activities positively correlate with firms' inclination to cooperate. They highlighted the significant role of asset acquisition, innovation introduction, knowledge acquisition, and other related activities in driving business cooperation. However, this study doesn't provide insights into cooperation with different types of partners. Janeiro et al. (2013) examined factors influencing collaboration between service firms and universities for innovation activities. They emphasized the importance of innovation success, radical innovations, and innovation intensity in fostering links between innovative service firms and universities. This study is confined to the services sector and focuses solely on links between firms and universities. De Faria & Schmidt (2012) explored factors determining firms' cooperation with foreign partners on innovation activities. They concluded that firm size and the significance of protection methods for knowledge positively affect the decision to cooperate abroad. Here, the focus was on the partner's location, irrespective of the partner type.

De Faria et al. (2010) stand out as the most significant contribution to the literature on this topic. Their work is fundamental in identifying the distinguishing characteristics between cooperative and non-cooperative firms in Portugal. The authors found that firms operating in high-technological industries, possessing higher levels of absorptive capacity and

innovation investment, and prioritizing the management of incoming spillovers, are more likely to value cooperation partners in the innovation process. Nevertheless, while the study acknowledges various types of cooperation partners, it does not investigate into detail about each partner.

In contrast to previous research, the present study aims to map out cooperative arrangements for innovation between firms and different types of partners across the value chain. Through a detailed examination of the characteristics and dynamics of these cooperative relationships, this study seeks to understand how firms actively participate in collaborative activities with various partners while pursuing both product and process innovations.

2. Horizontal and vertical relationships towards innovation

The literature widely supports the role of cooperation in enhancing innovation performance (Becker & Dietz, 2004; Abramovsky et al., 2005; Sampson, 2007). External sources play a crucial role in the innovation process, drawing from various points along the value chain, such as customers, suppliers, and competitors (Von Hippel, 2005; Powell et al., 1996). The selection of these sources depends on the firm's motives for cooperation. For instance, firms seeking knowledge tend to engage in more vertical cooperation with suppliers, customers, and research institutions, rather than horizontal collaboration (Miotti & Sachwald, 2003; Frankort, 2016).

Firms may enter into cooperative agreements with partners chosen based on factors like similarity and complementarity (Amara & Landry, 2005; Arranz & de Arroyabe, 2008; Foray, 1991). Avoiding engagement with external networks may result in missing valuable opportunities for knowledge exchange (Chesbrough, 2003; Laursen & Salter, 2006).

2.1 Vertical cooperation

Customers and suppliers play important roles in the vertical value chain of a firm, exerting a great influence on innovation performance. Due to the non-competitive nature of these cooperation agents, their impact is substantial.

The existence of 'sticky information'—information that is costly to obtain, transfer, and use—intensifies the necessity for firms to collaborate with consumers (Sánchez-González et al., 2009). Consumers, as external partners, contribute significantly to a firm's knowledge base. They facilitate the identification of new ideas for products and solutions, offer insights into customer attitudes, and provide early indications of emerging market trends. Examples of such contributions flourish in both manufacturing and service sectors, as well as in public sector institutions, where successful product innovation is closely tied to customer cooperation (Freel & Harrison, 2006; Sánchez-González & Herrera, 2014). High-tech industries, in particular, benefit from customers' insights into technological trends and the development of higher-quality products (Brettel & Cleven, 2011; Tether, 2002; Von Hippel, 2005). This collaborative principle is particularly applicable when a product introduces a high level of novelty, as user experiences prove to be vital in reshaping existing designs or generating ideas for new models and applications. Firms often involve customers directly in the innovation process, especially in designing new products. Beyond enhancing product design, these collaborations rationalize the innovation process, reducing both time and costs (Jeppesen, 2002).

Another form of vertical or non-competitive cooperation exists in the relationship with suppliers. Håkansson & Eriksson (1993) posit that suppliers are fundamental to business success, with the Japanese car and electronics industries exemplifying successful partnerships with suppliers for innovation (Bidault et al., 1998). Suppliers, possessing specific knowledge and competencies, serve as sources of innovative ideas and critical technologies. Large enterprises, focusing on core competences and downsizing, increasingly collaborate with suppliers to ensure a supply of quality inputs. This collaboration not only enhances product and process development but also contributes to quality improvement, market adaptation, productivity, and flexibility (Bayona et al., 2001; Santamaría & Rialp,

2007; Tether, 2002). When commercial objectives, such as entering new markets or internationalization, are vital, suppliers become preferred partners (Bayona et al., 2001; Santamaría & Rialp, 2007). In addition to supporting in the development of products and processes, suppliers contribute to cost reduction, mitigating the risks associated with new product development (Chung & Kim, 2003).

2.2 Horizontal cooperation

Establishing a relationship with competitors is usually referred to as horizontal cooperation. Competitors are an external source that can be involved in the innovation process (Von Hippel, 2005). The primary goal is to reduce investment risk, address market uncertainty, and share costs (Harabi, 2002; De Sousa et al., 2015). Von Hippel (2005) suggests that enterprises enhance their products and processes by learning from competitors through the exchange of know-how. This knowledge, particularly valuable for firms lacking high levels of internal technological competence (Cohen & Levinthal, 1990), is easily accessed and exploited. While the appeal of this cooperative approach is evident, there are associated risks, including the potential for competitive behaviour and the spillover of critical knowledge to competitors (Miotti & Sachwald, 2003). Firms are more inclined to cooperate with competitors when their appropriability level is high, reducing the risk of free-riders, and when incoming spillovers are also high, allowing for shared risks and costs (De Sousa et al., 2015). As a result, cooperation is more likely to occur in protected areas or involve sharing non-vital knowledge. Enterprises tend to avoid areas that may intensify competition and instead favour cooperation in addressing common issues (Cassiman & Veugelers, 2002; Tether, 2002). This collaborative spirit is often observed in activities such as joint participation in basic research projects (Tether, 2002).

2.3 Universities and research institutes and Consultants

Cooperation relationships with scientific agents serve as crucial spillover transmission mechanisms, especially in technology-intensive sectors (Castro Martínez & Fernández de

Lucio, 2006; Ponds et al., 2010). These partners can play an important role in contributing to new scientific and technological knowledge (Drejer & Jørgensen, 2005), given that this type of collaboration does not bring any commercial risk, unlike cooperation with competitors, since the focus is on generating R&D knowledge of a primary or generic nature and not on introducing it in the market (Miotti & Sachwald, 2003). Universities and research institutes constantly create and develop scientific knowledge, offering a valuable option to complement the internal R&D efforts of enterprises and share costs. Enterprises often choose this source to benefit from public funds allocated to research (Bayona et al., 2001; Cassiman & Veugelers, 2002; Fontana et al., 2006; Miotti & Sachwald, 2003; Dachs et al., 2004). Frequently, collaboration with these agents becomes a prerequisite for securing public funding for projects. However, enterprises must possess a critical in-house R&D capability to effectively absorb the scientific knowledge generated externally (Cohen & Levinthal, 1990).

In addition to universities and research institutions, enterprises seek complementary sources of knowledge when innovation development lags or does not meet expectations. Consultants and experts emerge as viable solutions in such cases (Tether, 2002). These agents provide specialized knowledge, facilitate the articulation of specific innovation needs and solutions, and enable the transfer of ideas among enterprises (Bessant & Rush, 1994). Moreover, consultants and experts, being external to the firm, bring different perspectives to the enterprise (Bruce & Morris, 1998).

2.4 Summing up.

Table 1 summarizes the main findings of the section, presenting a compilation of the main features of the different cooperation partners.

Table 1 Main features of the different cooperation partners.

Partners	Main features	References
Customers	<ul style="list-style-type: none"> ✓ Source of knowledge as it helps firms to identify new ideas about products and solutions ✓ Helps firms to understand customers' attitudes, and identify new market trends in advance ✓ Valuable partner for complex technologies and high level of product novelty 	<p>Sánchez-González & Herrera (2014) Freel & Harrison (2006) Brettel & Cleven (2011) Von Hippel (2005) Amara & Landry (2005)</p>
Suppliers	<ul style="list-style-type: none"> ✓ Source of innovative ideas ✓ Guarantee a supply of quality inputs ✓ Promote high degree of efficiency ✓ Promote quality improvement and market adaptation ✓ Promote productivity, flexibility, and reduction of production costs 	<p>Håkansson & Eriksson (1993) Tether (2002) Bayona et al. (2001) Santamaría & Rialp (2007) Chung & Kim (2003)</p>
Competitors	<ul style="list-style-type: none"> ✓ Promotes reduction in investment risk and market uncertainty ✓ Promotes cost-sharing ✓ Comprise risks associated with the possibility of competitive behaviour and spillover of key knowledge ✓ Is more likely to occur either in protected areas or in sharing knowledge that is not vital 	<p>Harabi (2002) de Sousa et al. (2015) Miotti & Sachwald (2003) Tether (2002) Cassiman & Veugelers (2002)</p>
Universities and R&D institutions	<ul style="list-style-type: none"> ✓ Complement the firm's R&D ✓ Allow to share costs ✓ Allow enterprises to benefit from public funds destined to research 	<p>Bayona et al. (2001) Cassiman & Veugelers (2002) Fontana et al. (2006) Miotti & Sachwald (2003) Dachs et al. (2004)</p>
Consultants	<ul style="list-style-type: none"> ✓ Source of specialized knowledge ✓ Promote articulation of specific innovation needs, solutions and allow idea transfer among enterprises ✓ Bring to the enterprise different points of view as they are external elements to the firm 	<p>Tether (2002) Bessant & Rush (1994) Bruce & Morris (1998)</p>

Source: Own elaboration.

3. Determinants of cooperation

This study aims to comprehend how firms actively engage in cooperative activities, involving their active participation with other enterprises or institutions in accomplishing product and process innovations.

These cooperative activities represent what we term a 'marketless' conception of networking. While some argue that 'marketless' conceptions of social networks are overstated and need balance with a stronger emphasis on formal transactions in the social embeddedness of small firms (Staber, 2011), they remain crucial knowledge sources for small firms.

Firms may collaborate with suppliers, customers, competitors, universities, consultants, and other partners from Portugal, other EU countries, or worldwide. In this study, we don't focus on the scale (geography of partners) or the scope (diversity of partners) of cooperation. Studies like Cesário & Fernandes (2019) and Arvanitis & Bolli (2013) confirm that internationally based networkers have deeper concerns in responding to international demands for quality and innovation. It is reasonable to expect that an increase in the scale (geographic) and scope (variety) of the firms' network is associated with better innovation performance.

We examine the presence of cooperation with different types of partners to provide insights into the cooperative arrangements of Portuguese innovative firms, irrespective of geography and the number of partners simultaneously used by the firm. Although the available data doesn't allow to measure the direct success of the participation in collaborative networks for innovation, we aim to investigate the reasons behind cooperation and the features of participating firms.

The innovation development process involves three main approaches: making, buying, or collaborating with external agents to acquire specific competencies or knowledge. Firms

choose to cooperate when their internal knowledge or skill base is insufficient or ineffective and can be enhanced by external inputs (Veugelers & Cassiman, 1999).

Maintaining a competitive advantage solely through internal research and development (R&D) has become more challenging due to technological advancements and market instability. Given the complexity of the current business landscape, enterprises need to complement their internal sources and capabilities with external ideas, collaborating with a wide range of actors.

Incentives to cooperate include searching for complementary technologies and knowledge, gaining access to new markets (Freire & Gonçalves, 2022), and sharing expenses and uncertainty. Other benefits include leveraging synergies, recognizing economies of scale and scope, and benefiting from government support (Veugelers & Cassiman, 1999; Becker & Dietz, 2004; Enkel et al., 2009).

Furthermore, literature provides evidence that the absorptive capacity of a firm (Cohen & Levinthal, 1989, 1990) is an essential precondition for the successful absorption of externally generated knowledge, i.e., knowledge from competitors, suppliers, customers, public research institutions, and universities (Arvanitis & Bolli, 2013). Firms' ability to capitalize on externally generated knowledge significantly enhances their prospects of being successful innovators. This capability is closely linked with the decision to engage in formal collaborative research with other firms and institutions. By partnering with external entities, firms gain access to a broader pool of expertise, resources, and perspectives, which can stimulate innovation and drive competitive advantage (Abramovsky et al., 2008).

Firms actively involved in creating or managing new knowledge are better equipped to absorb external spillovers. They are also more skilled at protecting their own knowledge, thus placing greater importance on cooperation partners. Engagement in R&D activities not only shapes firms' decisions to collaborate but also affects the significance they attribute to their cooperation partners (De Faria et al., 2010).

The mainstream literature supports the notion that a firm's absorptive capacity is manifested through its involvement in ongoing research activities together with the qualification of its human resources (Clausen, 2013; Fritsch, 2003; Fritsch & Lukas, 2001; Gallego et al., 2013; Van Beers & Zand, 2014).

Therefore, besides the need to share costs and risks, it is also reasonable to expect that the reasons behind cooperative arrangements might be related to the conduct of R&D activities (namely in a more consistent basis) alongside the enhancement of employee expertise. Such efforts represent viable avenues through which firms can increase their internal absorptive capacity and incoming spillovers.

Besides the above determinants, and although firms engaging on cooperative initiatives for innovation are inherently innovators, the type of the innovation pursued can significantly shape the cooperative dynamics and outcomes.

Evidence from literature (Amara & Landry, 2005; Arranz & de Arroyabe, 2008; Foray, 1991) shows that high-level innovation, being more demanding, drives firms to seek complex knowledge from external sources. The complexity and novelty of the innovation pursued may necessitate different degrees of collaboration and diverse partner selection criteria. High-risk, high-reward innovations may demand closer collaboration with trusted partners to mitigate risks and capitalize on shared insights, whereas less risky innovations may afford more flexibility in partner selection and collaboration intensity.

Furthermore, different types of innovation, mean variable collaborative requirements, resource allocations, and knowledge-sharing mechanisms. For instance, firms focusing on radical or disruptive innovations may seek collaborations with external partners possessing complementary expertise or resources, while those concentrating on process innovations, more oriented to cost reductions, may prioritize cooperation with suppliers (Tether, 2002).

Finally, background characteristics (such as size, sector, and ownership) are considered determinants for firms' decisions to engage in cooperative arrangements towards innovation.

A firm's ownership status can affect access to resources. Firms that are part of an enterprise group (domestic or foreign owned) could have access to resources that substantially exceed the firm's own resources (De Faria et al., 2010; OCDE, 2018). The literature is not unanimous about how this influences the propensity for engaging in cooperative arrangements. On one hand, firms can present themselves as more attractive as cooperation partners in terms of power and prestige (Teher, 2002). Also, foreign owned firms might benefit more from agreements with local customers and competitors to understand local conditions (Un & Rodríguez, 2018). On the other hand, these firms already have access to external resources, which might reduce their need to cooperate to seek them (Van Beers & Zand, 2014).

Similar, the firms' size is not always an evident indicator of more or less cooperation. We might expect that smaller firms have less internal resources, and thus be more likely to engage in cooperative arrangements. On the other hand, larger firms might have the power or be in a better position to do so (De Faria et al., 2010). In the end, the relationship between the propensity to cooperate and size increase is variable depending on the partner. We can expect the propensity to collaborate with suppliers, customers, competitors, universities and research institutions to increase with size as in the works of (De Faria et al., 2010), Tether (2002) and Van Beers & Zand (2014).

Regarding sectoral activity, the positive effect of cooperation on innovation performance was confirmed in technology-intensive sectors (De Faria et al., 2010), such as pharmaceuticals, biotechnology, telecommunications, and semiconductors (Staropoli, 1998; Quintana-García & Benavides-Velasco, 2004; Sampson, 2007).

In the current study, we include sectoral differences in order to understand the other way around, if firms in higher technology sectors will be more likely to be engaged in cooperation for innovation, as in Fernandes, Cesário & Barata (2017), who acknowledged sectoral differences in cooperation initiatives. The authors identified the sectors more willing to engage in cooperation initiatives to accomplish innovation, including computers, health, information and communication, and construction.

4. Empirical Design

4.1 Data source

This study relies on data sourced from the Community Innovation Survey (CIS), the primary statistical instrument of the European Union (EU) designed for monitoring Europe's progress in the field of innovation. The CIS is widely utilized in investigations of firm innovation activities, being the most comprehensive source of information on such activities among European firms.

For this research, we utilized the CIS 2020 version (DGEEC, 2022), covering the period from 2018 to 2020 and encompassing data from 13,509 sampled Portuguese firms. In addition to dealing with an extensive dataset that includes all primary, industry, and service sectors, the CIS has the advantage of addressing various dimensions associated with the innovation processes of firms across Europe.

Annex 2 provides the list of variables used in the current study and their respective codification.

4.2 Conceptual framework and research hypotheses

4.2.1 Absorptive Capacity

Given the above, the measurement of Absorptive Capacity involves assessing the engagement level in permanent research activities and the qualification of human resources.

Firms were queried about the importance of various factors hindering their decision to initiate innovation activities between 2018 and 2020 (CIS, 2020). The variables "lack of skilled employees" (OSKILL) and "lack of access to external knowledge" (OKNOW) were employed. It is anticipated that a shortage of skilled employees (OSKILL) would have a

negative impact, while challenges related to access to external knowledge (OKNOW) might lead firms to seek collaborations to overcome these barriers.

Regarding the capability to absorb external knowledge through R&D, CIS provides variables to measure occasional in-house R&D activities (RDOC) or continuous activities (RDCT), indicating the presence of permanent R&D staff. The expectation is that the propensity to engage in cooperative arrangements for innovation will be positively correlated with the consistent conduct of R&D activities (Tether, 2002; Schmidt, 2005).

Therefore:

H1: Firms facing challenges due to a lack of skilled employees are less likely to engage in cooperative arrangements due to a weaker absorptive capacity.

H2: Firms encountering difficulties accessing external knowledge are more likely to engage in cooperative arrangements to overcome these challenges.

H3: Firms involved in continuous R&D activities are more likely to engage in cooperative arrangements due to a stronger absorptive capacity.

4.2.2 Need to Share Costs and Risks

As indicators of the necessity to share costs, we utilized the variables: lack of internal finance (OFIN), lack of credit (OCRED), difficulties with subsidies (OSUB), and difficulties with high costs (COSTS). These variables were extracted from the list of factors hindering enterprises' decisions to initiate innovation activities.

To represent the need for risk-sharing, we employed the variables: difficulties with uncertain market demand (UNCERT) and too much competition (COMP). These variables were also drawn from the list of factors impeding enterprises' decisions to initiate innovation activities.

The hypotheses are as follows:

H4: Firms facing challenges related to a lack of internal finance, lack of credit, difficulties with subsidies, or high costs are more likely to engage in cooperative arrangements to share costs.

H5: Firms encountering difficulties due to uncertain market demand or excessive competition are more likely to engage in cooperative arrangements to mitigate risks.

4.2.3 Type of innovation

As per the CIS, a firm may be involved in one or more of the following situations: a) product innovation, referring to a new or improved good or service that significantly differs from the firm's previous offerings and has been introduced to the market; b) process innovation, occurring when a firm implements a new or significantly improved production process, or new and significantly improved methods of supplying services or supporting activity; and c) ongoing or abandoned innovation activities. A firm is considered innovative if any of these situations apply.

Concerning product innovations, they can either be new to the market or identical to products already offered (only new to the firm). Innovations that are new to the market are considered more demanding in terms of resources. Therefore, we might anticipate that this type of innovation is more closely associated with the presence of cooperative arrangements compared to process innovations.

Hence, the hypothesis is as follows:

H6: Firms that develop new to the market innovations are more likely to engage in cooperative arrangements for innovation due to their higher resource demands.

4.2.4 Firms' background characteristics

Lastly, firm characteristics are acknowledged in the literature as being related to the nature and patterns of innovation. Size, sector, and ownership are included in the analysis as background variables determinant to cooperation.

Thus:

H7: Firms' size, ownership status, and sector influence the propensity to engage in cooperative arrangements for innovation.

The following section presents the results for the estimation of regressions for cooperation with each type of partner (i.e., suppliers, customers, competitors, universities and research institutions, and consultants). These models were identified as models 1, 2, 3, 4, and 5.

The list of all the dependent variables and the explanatory variables used in the models are presented in Annex 2. The sample description is given in Annex 3, while the results for the 5 models are presented in Annex 4.

By assessing cooperation with different types of partner organizations, we are likely to better understand the motivations for these relationships than if we only look at cooperation in general (Tether, 2002) as different types of cooperation are determined by different drivers (Belderbos et al., 2004).

5. Results and Discussion

5.1 Description of the sample

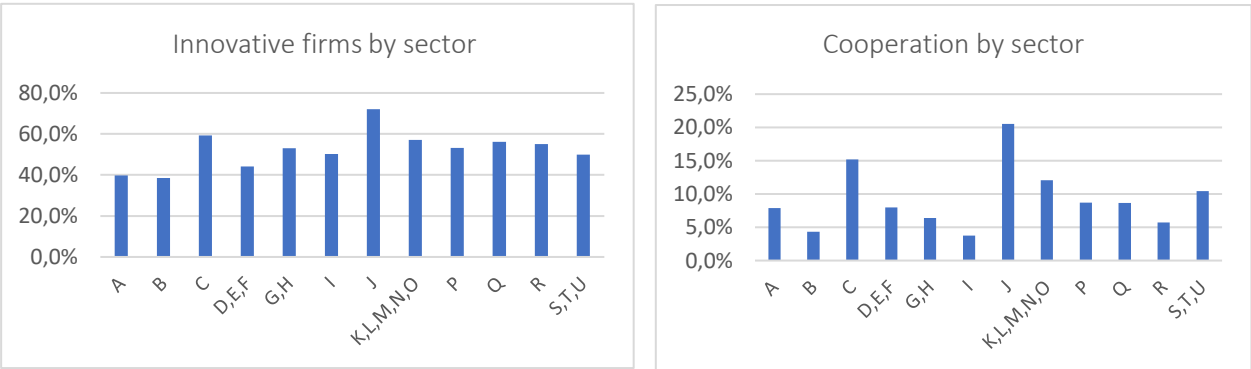
The total sample of 13.509 Portuguese firms covered by CIS 2020 exhibits the sectoral distribution presented in Annex 3. Construction, electricity, water, and gas utilities are included in the additional sector "Utilities." The sample is evenly distributed among all the NACE REV3 sectors represented, except for the retail trade, which alone represents 11.3% of the sample. More than 70% are small firms, with fewer than 49 employees, and around 30% belong to a group of firms (Portuguese or foreign-owned).

More than half of the sample claims to be innovative (55%). From the subsample of 7.412 innovative firms, only 17.7% claimed to have cooperated towards innovation. The predominant partner is suppliers (10.5%), followed by consultants (9.4%) and universities

and R&D institutions (9.1%). Horizontal cooperation is the least utilized by firms (2.5%), confirming concerns about cooperation vs. competition raised by this type of arrangement (Miotti & Sachwald, 2003). As expected, process innovation, being less input-demanding, is more predominant than product innovation (52%). Only half of product innovators were new to the market, meaning they introduced innovations that were new to the market (26%). Annex 3 presents the main results for the whole sample and the subsample of innovative firms.

A more detailed sectoral overview (Figure 1) reveals that the sectors claiming to be more innovative are not always the ones registering the highest occurrences of collaborative arrangements towards innovation. The Information and Communication sector claims a higher percentage of innovative firms and a higher percentage of firms engaging in cooperation for innovation. Manufacturing firms and Financial, insurance, etc., also present a coherent performance. Conversely, the accommodation and food service present a relatively good performance in terms of innovation, but it is the sector with the lower incidence of cooperation. The sector of mining and quarrying and the art and sports sector present a similar result. Although not directly challenging the mainstream theory about the importance of cooperation for innovative performance, these results require a more in-depth analysis to better understand the reasons behind them.

Figure 1 Innovation and cooperation for innovation, by sector.



Source: Own elaboration.

5.2 The binomial logistic regression models

5.2.1 The adequacy of the model and goodness of fit

The quantitative contribution of each considered predictor was compared using binomial logistic regression models, constructed through iterative maximum likelihood estimation, given the nature of the dependent variables.

Logistic regression has less restrictive assumptions for statistical tests compared to ordinary least squares regression. There is no formal requirement for multivariate normality, homoscedasticity, or linearity of the independent variables within each category of the dependent variable (Menard, 1995). However, the issue of multicollinearity, which pertains to very high correlations among the independent variables, does apply to logistic regression. High multicollinearity affects the reliability of the coefficients. Variance Inflation Factors (VIFs) (Myers, 1990) and tolerance tests (Menard, 1995) were conducted to address this concern.

The goodness of fit of the model was assessed using the Omnibus test of model coefficients. This test evaluates the null hypothesis that the coefficients of the variables are all jointly equal to zero for each model. Additionally, the Hosmer and Lemeshow Test was performed to test the null hypothesis that the model adequately fits the data for each model.

The detailed results are presented in Annex 4.

5.2.2 Discussion of Results

Following these procedures, the logistic regression results using stepwise method, are presented. Stepwise logistic regression is designed to find the most parsimonious set of predictors that are most effective in predicting the dependent variable. Variables are added to the logistic regression equation one at a time, using the statistical criterion of reducing the -2 Log Likelihood (-2LL) error for the included variables. The process of adding more variables stops when all the available variables have been included or when it is not possible to make a statistically significant reduction in -2LL. Annex 4 list the odds ratio (EXP(B)) and

the significance level for the Wald statistic for the final independent variables in the five models proposed. The analysis of the odds ratios allows comparing the effect size of each independent variable on the dependent's odds. Among the significant predictors, it is possible to identify which ones produce higher positive (odds ratios > 1) or negative (odds ratios < 1) effects on the odds of a firm engaging in cooperation for innovation. When the independent variable is categorical, the odds ratios need to be interpreted in terms of the left-out reference category.

Our analysis focuses on the motivations behind collaborations, categorized by different types of partners. We considered a list of factors deterring innovation, assuming cooperation as a way of overcoming those difficulties. Some of these factors are associated with the absorptive capacity of the firm, while others serve as proxies for the firm's need to share costs and risks. The list of predictors also included the type of innovation and firm's characteristics. Not all of them were included in the models because they lack statistical significance. For that reason, H1 could not be confirmed.

Firms encountering difficulties with access to external knowledge were more likely to collaborate with consultants, as these partners provide specialized knowledge and skills (Bessant & Rush, 1994) that offer a wide range of valuable inputs for innovation development. This confirms **H2**, indicating that firms facing a lack of access to external knowledge are more likely to engage in cooperative arrangements to access those resources, particularly with consultants.

For the firms considering this factor has relatively important (medium) in hampering the decision to start innovation activities, the odds to engage in cooperative arrangements with consultants are 1.609 times the odds of a firm not considering this factor as a restraint.

Regarding the R&D activities, the option of conducting these activities continuously was not a variable included in any model because of a lack of statistical significance. We expected the propensity to engage in cooperative arrangements for innovation to be positively related to the conduct of R&D activities more consistently (Tether, 2002; Schmidt, 2005). Still, we could not confirm this result directly. On the other hand, the engagement in

occasional R&D activities revealed a negative relationship with cooperation arrangements with all the types of partners, confirming, partially **H3**, that firms engaged in R&D activities in a more consistent basis are the ones with more propension to engage in cooperative arrangements for innovation, independently of the partners. A descriptive analysis of the data allowed to confirm these results, although not captured by any model. The null hypothesis that cooperation for innovation was independent from the engagement in continuous R&D activities was rejected ($p=0.000$).

Firms that reported difficulties due to a lack of internal finance were more inclined to engage in cooperation with suppliers, as these partners provide valuable assistance in terms of efficiency, cost reduction, and managing the costs and risks associated with new product development (Chung & Kim, 2003).

For the firms considering this factor as highly important in hampering the decision to start innovation activities, the odds to engage in cooperative arrangements with suppliers are 1.564 times the odds of a firm not considering this factor as a restraint.

On the other hand, firms facing challenges related to a lack of credit were less likely to cooperate with universities and research institutions. In contrast, those experiencing difficulties with subsidies were more likely to collaborate with these partners. The odds exceed twice those of firms unaffected by such constraints.

This may be attributed to the relationship between enterprises and these institutions, allowing firms to benefit from public funds allocated for research (Bayona et al. 2001; Cassiman & Veugelers, 2002; Fontana et al. 2006; Miotti & Sachwald, 2003; Dachs et al., 2004), with access to those funds being contingent on the firms' financial capacity. These results confirm **H4**, highlighting cooperation as a means to share costs, especially in collaborations with suppliers, universities, and research institutions.

Furthermore, firms expressing concerns about excessive competition were more likely to cooperate with competitors (the odds are more than twice the odds for a firm not considering this factor as a restraint), while those struggling with uncertain market demand were more likely to collaborate with universities and customers. For the firms considering

this factor as highly important, the odds to cooperate with these partners are 1.697 times the odds of a firm not affected by it. This suggests that firms leverage partnerships with these entities to gain market insights and reduce risk, confirming **H5** namely for competitors, universities, and customers.

The type of innovation introduced significantly influenced firms' decisions to engage in cooperative arrangements. Firms introducing "new to the market" innovations were more likely to participate in cooperative activities. These innovators, in particular, were inclined to cooperate with all partners except competitors. Among all the partners, radical innovators showed a higher probability of cooperating with customers, as these non-competitive partners have a significant impact on innovation activities, serving as a valuable resource for identifying new ideas and market opportunities (Brettel & Cleven, 2011). For a firm introducing new to the market innovations, the odds to engage in cooperative arrangements with costumers are 1.808 times the odds of a firm not doing it. This result confirms **H6**, indicating that firms developing new to the market innovations are more likely to engage in cooperative arrangements for innovation, except with competitors.

Finally, background variables were considered. The results reveal that the propensity for cooperation with each partner increased with enterprise size. This influence was more pronounced in collaborations with universities, research institutions, consultants, and suppliers. These results aligned with the findings of works of Tether (2002) and Van Beers & Zand (2014). A higher incidence of cooperation with the academy and consultancy sectors among larger firms may reflect their higher level of awareness of cooperation possibilities with these partners. Regarding suppliers, as in Tether (2002) this may be the result of the power of larger firms over the supply-chain.

Additionally, regarding ownership, belonging to a domestic group positively impacted the propensity for cooperation with suppliers and competitors, while belonging to an international group reduced the odds for cooperation with universities and research institutions. This confirms the idea that firms can present themselves as more attractive as cooperation partners because of being part of an enterprise group. Regarding foreign owned firms, we expected these ones to benefit more from agreements with local

customers and competitors to understand local conditions, but not with national academic organizations, thus this result is not surprising.

We included sectoral differences to understand whether firms operating in higher technology sectors were more likely to engage in collaborative innovation efforts. However, our findings did not substantiate this idea. The primary sector demonstrated the highest willingness to participate in cooperative initiatives aimed at fostering innovation, closely followed by firms in "Other Service Activities" and the "Financial, Insurance, Real Estate, Consulting, and Administrative" sectors.

Nevertheless, sectoral differences were identified, thereby validating H7, that firm size, ownership status and sector affiliation influence the propensity to engage in cooperative arrangements for innovation.

6. Conclusions, contributions, and further research

6.1 Concluding remarks and contributions

Our analysis has provided valuable insights into the motivations and patterns of cooperative arrangements for innovation across diverse types of partners. Several key findings emerge from our investigation.

Firstly, our results confirm that firms engaging in R&D activities on a more consistent basis, thus enhancing their absorptive capacity, exhibit a greater propensity to participate in cooperative innovation initiatives, regardless of the type of partners involved.

Secondly, the study confirms that firms facing challenges in accessing external knowledge, are more inclined to engage in cooperative arrangements for innovation, especially with consultants. This aligns with the literature highlighting the role of external knowledge in innovation (Bessant & Rush, 1994) and emphasizes cooperation as a means to access specialized expertise.

The study provides insights into how firms experiencing financial constraints collaborate with suppliers to manage costs and with universities and research institutions to access public funds. This validates the role of cooperation in cost-sharing and accessing external financial resources, as highlighted in previous research (Chung & Kim, 2003; Dachs et al., 2004).

Firms facing market uncertainties are more likely to collaborate with universities and customers to gain insights and mitigate risks. Similarly, those encountering intense competition are inclined to cooperate with competitors. These findings underline the strategic role of cooperation in addressing market challenges and leveraging partner expertise to navigate competitive landscapes.

The study also reveals that firms introducing "new to the market" innovations are more inclined to engage in cooperative arrangements, particularly with customers, and except with competitors. This emphasizes the importance of partner selection based on the type of innovation pursued, highlighting customers' role in radical innovation processes.

Finally, the analysis demonstrates that firm size positively influences cooperation propensity with the various partners, emphasizing larger firms' awareness and power dynamics. Moreover, ownership status impacts cooperation patterns, with domestic ownership positively influencing cooperation with suppliers and competitors.

Although sectoral differences did not confirm the expectation that higher technology sectors would exhibit more cooperative behavior, the study validates that sector affiliation influences cooperation propensity. This underscores the need to consider industry-specific dynamics when analyzing collaborative innovation efforts.

Overall, besides the practical implications, these findings contribute to theoretical understanding by rationalizing the motivations and patterns underlying cooperative arrangements for innovation across diverse partner types, firm characteristics, and industry sectors of Portuguese innovative firms.

6.2 Limitations and further research

This study has limitations that suggest directions for further research.

Firstly, we did not consider the geographic scale of cooperation, as highlighted by Arranz & de Arroyabe (2008) and Van Beers & Zand (2014). Similarly, the scope of cooperation, including the number of partners involved, was not addressed. Existing literature suggests that the number of partners can significantly impact innovation performance, but findings on this matter remain inconclusive, as noted by Belderbos et al. (2004) and Van Beers & Zand (2014).

Moreover, while functional diversity appears to exert a significant influence on decisions regarding cooperation for radical innovation, geographical diversity seems to have a greater impact on incremental innovation efforts (Van Beers & Zand, 2014).

Our study did not explore these analyses. Addressing these gaps in future research could provide a more comprehensive understanding of cooperative innovation dynamics. By examining the geographic scale, scope, and diversity considerations, we can offer valuable insights for firms aiming to optimize their collaborative innovation strategies across various contexts.

Also, only the importance of incoming spillovers was addressed in this study. While incoming spillovers may incentivize firms to engage in cooperation, outgoing spillovers present a contrasting effect, potentially impeding innovative activities due to the fear of internal knowledge leakage to competitors. Incorporating data on the appropriability level of the firm could enhance the accuracy and depth of the results (as in De Faria et al., 2010).

Moreover, the study failed to validate the prevailing assumption in the mainstream literature that sectors with higher levels of technology would demonstrate greater cooperative behavior. Conducting a more detailed analysis to explore the reasons behind the obtained results, would enhance the value of the study's findings.

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ANNEXES

Annex 1 Studies focusing on cooperation for innovation within Portuguese firms utilizing CIS.

Thematic	Authors	Title	Year	Source
The role of networking and external sources in fostering innovation within firms	Mendes, T., Braga, V., Correia, A., Silva, C.	Linking corporate social responsibility, cooperation and innovation: the triple bottom line perspective	2023	Innovation and Management Review
	Mascarenhas, C., Marques, C., Ferreira, J.J., Galvão, A.	University-Industry Collaboration in a Cross-Border Iberian Regions	2022	International Regional Science Review
	Leitão, J., Pereira, D., de Brito, S.	Inbound and outbound practices of open innovation and eco-innovation: Contrasting bioeconomy and non-bioeconomy firms	2020	Journal of Open Innovation: Technology, Market, and Complexity
	Moura, D.C., Madeira, M.J., Duarte, F.A.P.	Cooperation in the field of innovation, absorptive capacity, public financial support and determinants of the innovative performance of enterprise	2020	International Journal of Innovation Management
	Hochleitner, F., Arbussà, A., Coenders, G.	Evolution of inbound openness profiles in the innovation practices of small and medium-sized enterprises in Spain and Portugal	2020	International Journal of Entrepreneurship and Innovation Management
	Cesário, M., Fernandes, S.	Smart innovation strategy and innovation performance: An empirical application on the Portuguese small and medium-sized firms	2019	Regional Science Policy and Practice
	Lopes, L.F., Godinho, M.M.	Innovation and Productivity in Services: A Methodological Approach	2019	International Journal of Innovation and Technology Management
	Leitão, J., de Brito, S., Cubico, S.	Eco-innovation influencers: Unveiling the role of lean management principles adoption	2019	Sustainability
	Moura, D.C., Madeira, M.J., Duarte, F.A.P., Carvalho, J., Kahilana, O.	Absorptive capacity and cooperation evidence in innovation from public policies for innovation	2019	International Journal of Innovation Science
	Correia, A., Braga, V., Machado, A., Braga, A.	Strategies and obstacles for marketing innovation activities	2019	Global Business and Economics Review

	Simao, L., Franco, M.	External knowledge sources as antecedents of organizational innovation in firm workplaces: a knowledge-based perspective	2018	Journal of Knowledge Management
	Fernandes, S., Cesário, M., Castela, G.	Modern innovation challenges to firms and cities: The case of Portugal	2018	Journal of Technology Management and Innovation
	Cesário, M., Agapito, D., Almeida, H., Fernandes, S.	The use of design as a strategic tool for innovation: an analysis for different firms' networking behaviours	2017	European Planning Studies
	Fernandes, S., Cesário, M., Barata, J.M.	Ways to open innovation: Main agents and sources in the Portuguese case	2017	Technology in Society
	Correia, A., Braga, A., Braga, V.	Innovation in Portuguese firms, using CIS2010	2017	WSEAS Transactions on Business and Economics
	Natário, M., Braga, A., Couto, J., Tiago, T.	Territorial standards for innovation: Analysis for the regions of Portugal	2012	Revista de Estudios Regionales
	Silva, M.J., Leitão, J.	Cooperation in innovation practices among firms in Portugal: do external partners stimulate innovative advances?	2009	International Journal of Entrepreneurship and Small Business
	José Silva, M., Leitao, J., Raposo, M.	Barriers to innovation faced by manufacturing firms in Portugal: how to overcome it for fostering business excellence?	2008	International Journal of Business Excellence
Factors influencing the dynamics of cooperation	Janeiro, P., Proença, I., Gonçalves, V.D.C.	Open innovation: Factors explaining universities as service firm innovation sources	2013	Journal of Business Research
	De Faria, P., Schmidt, T.	International cooperation on innovation: Firm-level evidence from two European countries	2012	Innovation: Management, Policy and Practice
	De Faria, P., Lima, F., Santos, R.	Cooperation in innovation activities: The importance of partners	2010	Research Policy
	Mendes, T., Braga, V., Correia, A., Silva, C.	Linking corporate social responsibility, cooperation and innovation: the triple bottom line perspective	2023	Innovation and Management Review

Source: Own elaboration.

Annex 2 Description of the variables.

Variable	Description	Codification
<i>Dependent Variables</i>		
INNOV	Product, process, ongoing innovation	1=Yes; 0=No
COOPsup	Cooperation for innovation w/ suppliers	1=Yes; 0=No
COOPcomp	Cooperation for innovation w/ competitors	1=Yes; 0=No
COOPclient	Cooperation for innovation w/ clients	1=Yes; 0=No
COOPuni	Cooperation for innovation w/ univer. and R&D	1=Yes; 0=No
COOPcons	Cooperation for innovation w/ consultants	1=Yes; 0=No
<i>Explanatory Variables</i>		
Absorptive Capacity		
OSKILL	Lack of skilled employees	0=NAC; 1=Low; 2=Medium; 3=High
OKNOW	Lack of access to external knowledge	0=NAC; 1=Low; 2=Medium; 3=High
RDCT	In-house R&D activities, continuously	0=NAC; 1=Low; 2=Medium; 3=High
RDOC	In-house R&D activities, occasionally	1=Yes; 0=No
Need to Share Costs		
OFIN	Lack of internal finance	0=NAC; 1=Low; 2=Medium; 3=High
OCRED	Lack of credit	0=NAC; 1=Low; 2=Medium; 3=High
OSUB	Difficulties with subsidies	0=NAC; 1=Low; 2=Medium; 3=High
COSTS	High costs	0=NAC; 1=Low; 2=Medium; 3=High
Need to Share Risks		
UNCERT	Uncertain market demand	0=NAC; 1=Low; 2=Medium; 3=High
COMP	Too much competition	0=NAC; 1=Low; 2=Medium; 3=High
Type of Innovation		
PROC	Process innovation only	1=Yes; 0=No
RAD	New product is new to the market	1=Yes; 0=No
Firms' Background		
SIZE	Number of Employees	1=10-49; 2=50-250; 3>=250
SectorA	Agriculture, Forestry and Fishing	1=Yes; 0=No
SectorB	Mining and Quarrying	1=Yes; 0=No
SectorC	Manufacturing	1=Yes; 0=No
Utilites	Utilities	1=Yes; 0=No
SectorGH	Wholesale, Retail Trade, Transport. and Storage	1=Yes; 0=No
SectorI	Accommodation and Food Service	1=Yes; 0=No
SectorJ	Information and communication	1=Yes; 0=No
SectorKLMNO	Financial, Insurance, R. Estate, Consult. and Admin.	1=Yes; 0=No
SectorP	Education	1=Yes; 0=No
SectorQ	Human Health and Social Work Activities	1=Yes; 0=No
SectorR	Arts, Sports and Recreation	1=Yes; 0=No
SectorS	Other Service Activities	1=Yes; 0=No
GROUPPT	Ownership: PT group	1=Yes; 0=No
GROUPFR	Ownership: Foreign owned	1=Yes; 0=No

Source: Own elaboration. NAC = Not A Constraint

Annex 3 Description of the sample.

Variables	All Firms N (%)	Innovative Firms N (%)
Sector of activity		
Agriculture, Forestry and Fishing	495 (3.7)	197 (2.7)
Mining and Quarrying	184 (1.4)	71 (1.0)
Manufacturing	2526 (18.7)	1499 (20.2)
Utilities	1066 (7.9)	470 (6.3)
Wholesale, Retail Trade, Transportation and Storage	3329 (24.6)	1768 (23.9)
Accommodation and Food Service	505 (3.7)	254 (3.4)
Information and communication	823 (6.1)	593 (8.0)
Financial, Insurance, Real Estate, Consulting and Administrative	2870 (21.2)	1640 (22.1)
Education	380 (2.8)	202 (2.7)
Human Health and Social Work Activities	612 (4.5)	344 (4.6)
Arts, Sports and Recreation	298 (2.2)	164 (2.2)
Other Service Activities	421 (3.1)	210 (2.8)
Total	13509 (100)	7412 (100)
Number of Employees		
10-49	8840 (72.2)	4319 (66.2)
50-249	2613 (21.3)	1608 (24.7)
250+	793 (6.5)	596 (9.1)
Total	12246 (100)	6523 (100)
Ownership		
PT Group	2842 (21.0)	1926 (26.0)
Foreign owned Group	1557 (11.5)	1096 (14.8)
Innovative Firms (Product/process/ongoing innovation)		
Process Innovation	...	6721 (45.2)
Product Innovation	...	3886 (52.4)
Product Innovation, new to the market	...	1929 (26.0)
Cooperation towards innovation		
Any partner	...	1315 (17.7)
Suppliers	...	779 (10.5)
Competitors	...	182 (2.5)
Customers	...	507 (6.8)
Universities	...	677 (9.1)
Consultants	...	695 (9.4)

Source: Own elaboration based on SPSS output.

Annex 4 Results for the logistic binomial models.

	M1 Suppliers EXP(B) (sig)	M2 Competitors EXP(B) (sig)	M3 Customers EXP(B) (sig)	M4 Univers. & Research EXP(B) (sig)	M5 Consultants EXP(B) (sig)
H1 Lack of skilled employees	--	--	--	--	--
H2 Lack of access to external knowledge	--	--	--	--	1.214 (0.197) 1.609 (0.008) 0.431 (0.090)
H3 Continuous R&D Occasional R&D	-- 0.738 (0.024)	-- 0.534 (0.009)	-- 0.443 (0.000)	-- 0.374 (0.000)	-- 0.557 (0.000)
Lack of internal finance	L 1.699 (0.001) M 1.211 (0.256) H 1.564 (0.025)	--	--	--	--
H4 Lack of credit	--	--	--	0.645 (0.034) 0.516 (0.004) 0.417 (0.003)	--
Difficulties in obtaining public subsidies	--	--	--	1.711 (0.015) 2.733 (0.000) 2.112 (0.004)	--
Costs too high	--	--	--	--	--
H5 Uncertain market demand	--	--	L 1.633 (0.011) M 2.134 (0.000) H 1.697 (0.000)	1.530 (0.022) 1.379 (0.087) 1.951 (0.008)	--
Too much competition	--	L 1.124 (0.726) M 2.183 (0.007) H 2.877 (0.002)	--	--	--
H6 New to the market prod. innovation	1.539 (0.002)	--	1.804 (0.000)	1.580 (0.001)	1.450 (0.009)
H7 <u>Ownership</u> PT Group	1.743 (0.000)	1.793 (0.006)	--	--	--
Foreign Group	--	--	--	0.477 (0.000)	--
<u>Sector</u> Agricultur, Forest, Fish	--	3.885 (0.035)	3.680 (0.024)	3.090 (0.039)	--
Information and com.	0.623 (0.008)	--	--	--	0.537 (0.002)
Fin, Insur, R. Est, Cons	--	--	1.569 (0.011)	--	1.698 (0.002)
Other Service Activities	3.176 (0.019)	--	--	--	1.609 (0.000)
Manufacturing	--	0.588 (0.034)	--	--	--
Wholesal, Retail, Trans	--	--	--	0.575 (0.007)	--
<u>Size</u> 50-249	1.293 (0.096)	1.102 (0.716)	0.927 (0.666)	1.280 (0.118)	1.523 (0.010)
+250	2.761 (0.000)	2.182 (0.004)	1.727 (0.002)	3.682 (0.000)	3.358 (0.000)
<i>N (Observations)</i>	7412	7412	7412	7412	7412
<i>% corrected predicted cases</i>	74.4	92.5	80.5	74.3	76.9
<i>VIF's</i>	<10	<10	<10	<10	<10
<i>Tolerance</i>	>0.1	>0.1	>0.1	>0.1	>0.1
<i>Omnibus test (sig)</i>	0.000	0.000	0.000	0.000	0.000
<i>Hosmer Lemeshow test (sig)</i>	0.806	0.671	0.540	0.687	0.338

Source: Own elaboration based on SPSS outputs.

-- Variables not included in the model.

L, M and H stand for low, medium, high, relative to the importance of each factor in hampering the enterprise decision to start innovation activities.