Barriers to Innovation and the Innovative Performance of Portuguese Firms

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Abstract

This paper aims to identify and analyze the main limiting factors of innovation performance in terms of product and process innovation. The limiting factors to innovation make the innovation process of a firm difficult, which influences its innovation performance. The goal of this essay is to develop a theoretical support based on current reference approaches, corroborated by empirical support, which allows for the identification and analysis of the factors that restrict innovation activity and innovation performance.

The database is extracted from the Community Innovation Survey - CIS 2010, which was conducted under the responsibility of the Office of Planning, Strategy, Evaluation and International Relations/Ministry of Science, Technology and Higher Education (GPEARI/MCTES), in collaboration with the National Statistics Institute (INE), under the supervision of EUROSTAT. We have developed a logistic regression model that highlights the barriers to innovation and identifies the factors that limit innovation performance.

The analysis suggests that several barriers to innovation influence the Innovative performance of Portuguese firms. These results may be attributed to the fact that perceived barriers stimulate the firm to overcome these difficulties, which promotes the internal propensity to innovate. The most significant barriers identified in the study are the following: high innovation costs and perceived uncertainties in both the demand and market for new goods and services. This study shows that firms that do not have either qualified personnel to carry out innovation activities or sufficient market information are less likely to innovate than firms that do not experience these difficulties.

Keywords:

Introduction

This research aims to identify the barriers to innovation that influence the innovative process of Portuguese firms and their subsequent performance in product and process innovation.

According to Madrid-Guijarro, Garcia and Van Auken (2009) and Hidalgo and D'Alvano (2014), there are only a few studies about the barriers to innovation, which are primarily focused on technological innovation. The authors argue that understanding the factors that act as barriers to innovation can be useful for developing public policies that encourage innovation and assisting managers in promoting a culture of innovation in firms, which, according to Perel (2002), is one of the determinants of the survival and success of firms. Otherwise, Amara, D'Este, Landry and Doloreux (2016) argue that understanding the barriers to innovation improves the theories that explain why some firms do not want to innovate or actively engage in innovation.

In Portugal, the development of a set of initiatives aimed at strengthening the Innovative capacity and mechanisms of technological diffusion that overcome the barriers that firms experience has sparked the interest of entrepreneurs as well as the central government. More recently, several grants and incentives have been provided within the scope of Horizon 2020 (http://www.gppq.fct.pt/h2020/h2020.php retrieved on 08/06/2015) and Operational Program Portugal 2020 (https://www.portugal2020.pt/ retrieved on 08/06/2015). A strategic component is the qualification of Portuguese firms, which value the investments in innovative activities linked to the product, process, organizational methods and marketing and place special emphasis on investment in differentiation, diversification and innovation linked to the production of tradable and exportable goods and services, as well as activities that are technologically intensive and knowledge-based or value the application of R&D results in the production of goods and services.

Academically, interest in Portugal emerged during the last decade of the last century. While a few studies exist on the barriers to innovation in Portuguese firms, it remains a particularly pressing issue and is constantly being updated with the development of new Community Innovation Surveys (CIS) (Simões, 1996; Conceição and Ávila, 2001; Marques and Monteiro-Barata, 2005; Barbosa, 2006; Marques and Monteiro-Barata, 2006; De Faria et al, 2010). Thus, the main contributions of this study are as follows: the identification and analysis of the main limiting factors to innovation performance of product and process innovation that focus on the identification of their nature, origin and importance, the promotion of a better understanding of these factors and paving the way for future studies to identify good practices and overcome the constraints.

The identification of the barriers to innovation is essential to understanding firms' innovation processes overcoming these barriers (D'Este et al, 2012). Therefore, studying the factors that hinder the innovation process is crucial. It is interesting to note that the firms that are more involved in innovation activities are those that perceive and identify the barriers to innovation (D'Este et al, 2012). In this sense, D'Este et al (2012: 482) mention that "the ability to identify barriers in the firm is a result of the firm's involvement in innovation activities". In the same way, Hölzl and Janger (2014) infer that the barriers

are more relevant to firms featuring high instances of innovation and R&D than for firms that do not undertake their own R&D.

The literature review stresses that innovative performance varies from firm to firm and is determined by a large and complex number of factors that condition and limit the business innovation process. Knowing that the explanatory factors are not exhausted in the previously mentioned literature and undertaking an analysis based on the collected barriers to innovation according to the CIS 2010 (Community Innovation Survey 2010), we consider the following barriers: (1) insufficient equity capital; (2) a lack of funding sources; (3) high innovation costs; (4) a lack of qualified personnel; (5) a lack of information on technology; (6) a lack of information on markets; (7) a lack of partnerships within the innovation scope; (8) domination of the market by established firms; (9) uncertainty in terms of the demand/market; (10) the perception that innovation is unnecessary due to the existence of previous innovations; and (11) the perception that innovation is unnecessary due to a lack of demand/market. Referring to the actual approach to the subject, the authors of this paper consider business innovation to be a non-linear, evolutionary, complex and interactive process between a firm and the context in which it operates (Kaufmann and Tödtling, 2001). Thus, innovation is not something that firms engage in once and then forget or that happens by chance; rather, it is a capacity that needs to be developed and practiced often (Nunes and Silva, 2010).

This study aims to develop a theoretical basis, confirmed by empirical support that identifies and analyzes the fundamental factors that affect firms' innovation processes and their subsequent performance.

To test the hypotheses, we use secondary data belonging to the CIS 2010. The questionnaire was administered in Portugal under the supervision of Eurostat. The method used for data analysis is the logistic regression model, which best fits this type of variable and meets the objectives of this chapter.

The research in this chapter is structured as follows. In section two, we present the relevant literature on the topic of innovation and the barriers to innovation as constraining factors of innovation performance. In section three, we describe the sample, explain and characterize the variables used in the empirical study and present the logistic regression model that highlights the barriers to innovation. In section four, we analyze the data and discuss the results. Finally, we present the conclusions and implications for the future design and adoption of public policies that aim to overcome the modifying factors in the innovative performance of Portuguese firms.

Literature Review on Barriers to Innovation

Innovative performance varies from firm to firm and is influenced by internal, external, stimulating and restrictive factors, which exert a significant impact on the design, implementation and diffusion of innovation (Hadjimanolis, 1999; Conceição and Ávila, 2001; Perel, 2002; Landry et al, 2008; Garcia-Veja and López, 2010). In this context, we define the barriers to innovation as internal or external factors to a firm that decrease or even prevent the firm's propensity to innovate, reduce its ability to introduce and sustain a new or significantly improved product or process, affect innovative activity, prevent the

achievement of expected results and impact business performance (Perel, 2002; Lewandowska, 2014).

Despite the importance of the barriers to innovation in this study, some authors argue that, with the digital revolution, some barriers have already declined (Euchner, 2015).

In the analysis of barriers to innovation, we examine the data obtained from the CIS 2010 and consider the following conditioning factors in the innovation process at the corporate level, as shown in Table 1.

Table 1 - Barriers to Innovation

Lack of funds within your enterprise or group	Economic Factors
Lack of finance from sources outside your enterprise	
Innovation costs too high	
Lack of qualified personnel	Knowledge Factors
Lack of information on technology	
Lack of information on markets	
Difficulty in finding cooperation partners for innovation	
Market dominated by established enterprises	Market Factors
Uncertain demand for innovative goods or services	
No need due to prior innovations by your enterprise	Reasons not to innovate
No need because of no demand for innovations	

Source: CIS 2010 (CIS 2010:12)

Such limiting factors to innovation, also called barriers, obstacles or hindrance factors, hamper the innovation process of a firm, which influences its innovation performance. These barriers may be classified and grouped in different ways as external (or exogenous, arising when firms acquire resources or knowledge externally) and internal (or endogenous, normally associated with difficulties in implementing internal changes in their organizational processes) to the firm (Hadjimanolis, 1999; Thakur and Hale, 2013; Lewandowska, 2014). According to Saatcioglu and Ozmen (2010), the internal barriers include the following: (i) lack of qualified personnel; (ii) bureaucracy; (iii) lack of R&D, design, testing and other technical problems in firms; (iv) long timeline for return on innovation; (v) perception of innovation as risky; (vi) difficulty in controlling innovation costs; and (vii) financing innovation. Meanwhile, the external barriers include the following: (i) patent and license policies; (ii) lack of government incentives; (iii) foreign trade policy; and (iv) competition. As expressed in the above-mentioned table, the barriers to innovation are classified into (i) economic factors, (ii) knowledge factors, (iii) market factors and (iv) reasons not to innovate.

The economic factors are most important in terms of their impact innovation and are highly associated with a lack of internal and external funding, higher financing costs and greater financial risk (Frenkel, 2003; Vermeulen, 2005; Kenny and Reedy, 2006; Madrid-Guijarro, Garcia and Van Auken, 2009; Xie, Zeng and Tam, 2010; Lewandowska, 2014; Amara et al, 2016). The study conducted by Hadjimanolis (1999) identifies the role of financing problems in the development of new products and the role of bureaucracy as the greatest barriers to the innovation process. Other studies using the CIS data for industrial firms have identified the high costs and the lack of funding as the most frequently encountered obstacles, which are responsible for delays and the non-development of innovation projects (Silva, Leitão and Raposo, 2008). Regarding cancelled projects, other than high costs, the perception of excessive risks and the regulations and norms emerge as major barriers (Conceição and Ávila, 2001). The studies carried out by Barbosa (2006) and Segarra-Blasco, Garcia-Quevedo and Teruel-Carrizosa (2008) also conclude that the high investment costs influencing the innovative process are the main barrier to the development of technological innovation processes. Recent studies also highlight the lack of funding as a major barrier preventing firms from investing in R&D, at both the technological and employee training levels (Song and Oh, 2015; Yu et al, 2015). So, economic factors are very important because financing constraints and uncertainty of innovation projects affect the incentives of firms to invest in innovation (Hölzl and Janger, 2014).

Knowledge factors, which are related to the concept of absorptive capacity, include the lack of qualified personnel, a long-term view of leadership and corporate courage, a lack of information regarding technology and markets and the difficulty in finding cooperative partners for innovation projects. Among these factors, the lack of qualified personnel as a crucial factor in the innovation process has been highlighted (Perel, 2002; Frenkel, 2003; Kam et al, 2003; Vermeulen, 2005; Madrid-Guijarro, Garcia and Van Auken, 2009; Clark, 2010; Xie, Zeng and Tam, 2010; Hölzl and Janger, 2014; Song and Oh, 2015; Yu et al, 2015; Amara et al, 2016). In terms of innovation, the internal resistance to innovation is a factor that can jeopardize the competitiveness of a firm. For example, a high level of resistance from employees may be caused by the perceived risk of job loss following the introduction of an innovation. This resistance can be decreased through guarantees or compensation given to employees before the introduction of an innovation or by a reduction of the costs related to innovation (Zwick, 2002). The latest studies show that when conceived ideas are put into practice, the factors that hinder businesses are the lack of capacity in terms of internal efficiency and technical support and the lack of ability of workers (Najda-Janoszha and Kopera, 2014; Meijer, 2015; Song and Oh, 2015; Yu et al, 2015).

The lack of technological and market information is a barrier to the development of innovative corporate processes (Nunes and Silva, 2010) mainly due to the pressure currently exerted on firms by demanding and sophisticated customers, which provides a strong incentive to compete and innovate (Porter, 1990). As mentioned by Amara et al (2016), customers who are not receptive to the adoption of new products and replace firm products with competitive products constitute an obstacle to innovation. In this sense, the study carried out by authors et al (2008) concludes that the lack of customer receptivity to new products leads firms to demonstrate a lower propensity to innovate. A

firm that perceives that the market is not interested in new products has no incentive to innovate; this perception acts as an obstacle to innovation (Silva et al, 2009).

The difficulty in finding cooperative partners on projects in the field of innovation is an extremely important barrier to innovation, as financial incentives for innovation are one of the key requirements of innovative projects. Several studies have shown that collaboration between firms is a factor that drives innovation (Franco, 2003), as is collaboration between firms and their customers, suppliers (Xie Zeng and Tam, 2010), scientific and technological system entities and competitors (Xie, Zeng and Tam, 2010). We emphasize the fact that establishing contact with external sources of knowledge has an important influence on the innovative ability of firms (Fukugawa, 2006). Firms that establish relationships with external partners are more likely to introduce new products (Sawang and Matthews, 2010). However, it should be noted that many firms innovate successfully without resorting to cooperation partners, which suggests that the strategies based on firms' capabilities are significantly more important than those that involve foreign partners (Freel and Harrison, 2006).

The reasons for not innovating arise in this study as explanatory variables in the analysis, as several studies do not consider reasons for not innovating as barriers to innovation (Nunes and Silva, 2010).

Our study reveals that the barriers are the most important aspects of the study of business innovation, as each of the barriers may limit the process of design, implementation and diffusion of innovation. Thus, this research aims to consider the above-stated factors in identifying and analyzing the barriers to innovation and formulates the following research hypotheses, which will be the basis of the empirical test:

H1: The insufficiency of equity capital is negatively related to firms' propensity to innovate in products and processes.

H2: The lack of funding sources is negatively related to firms' propensity to innovate in products and processes.

H3: The high innovation costs are negatively related to firms' propensity to innovate in products and processes.

H4: The lack of qualified personnel is negatively related to firms' propensity to innovate in products and processes.

H5: The lack of information about technology is negatively related to firms' propensity to innovate in products and processes.

H6: The lack of information on markets is negatively related to firms' propensity to innovate in products and processes.

H7: The lack of partnerships in the field of innovation is negatively related to the propensity of firms to innovate in products and/or processes.

H8: The domination of the market by established firms is negatively related to firms' propensity to innovate in products and processes.

H9: The uncertainty in the demand/market is negatively related to firms' propensity to innovate in products and processes.

H10: The fact that it is unnecessary because there are previous innovations is negatively related to firms' propensity to innovate in products and processes.

H11: The fact that it is unnecessary due to the lack of demand/market is negatively related to firms' propensity to innovate in products and processes.

In accordance with the literature review carried out and the formulation of the hypotheses, the research scheme is presented in Figure 1 in which the different hypotheses are represented as barriers to innovation.
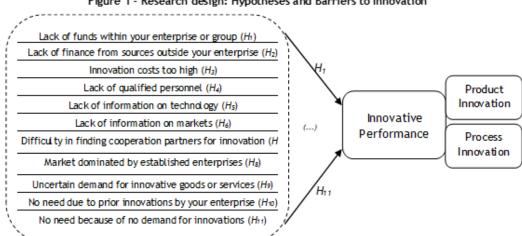
Figure 1 - Research design: Hypotheses and Barriers to Innovation

The formulated hypotheses are tested to generate knowledge and propose guidelines to encourage public and private entities to formulate measures and policy proposals that are aimed at improving innovation performance and overcoming barriers to innovation.

Research design

After forming the hypotheses for empirical testing, we briefly present the data, the choice of data analysis method and the characterization of the variables used in the study.

Presentation of data: Population and Sample

As previously mentioned, the data used in this research are those collected through the CIS 2010 survey, which is conducted under the responsibility of the Office of Planning, Strategy, Evaluation and International Relations/Ministry of Science, Technology and Higher Education (GPEARI/MCTES), in collaboration with the National Statistics Institute

(INE). The survey is based on the conceptual principles set out in the Oslo Manual (OECD, 2005) and the methodological recommendations of the Statistical Office of the European Communities (EUROSTAT).

According to the methodological notes from the GPEARI (2011), the data collection period was July 2011 through April 2012, and the reference period was 2008 through 2010.

The target population of the analysis includes industrial and service firms headquartered in the Portuguese territory, with at least 10 employees and belonging to Divisions 5 to 86 of the Classification of Economic Activities (CEA) Rev. 3. According to the data provided by the GPEARI relating to the firms included in the corrected sample, 6,160 firms provided valid responses to the survey, representing a response rate of 76% (GPEARI, 2011).

The firms in the sample are thought of as innovative in products or processes if they introduced new or significantly improved goods, services or processes during the period between 2008 and 2010.

Independent and dependent variables

Analyses of the barriers to innovation using the CIS data have been performed by various researchers, using data from European (Arundel, 1997; Romijn and Albaladejo, 2002; Gaul and Legros, 2004; Tourigny and Le, 2004) and Canadian firms through the adjustment of the same questionnaire (Baldwin and Lin, 2002).

In this study, the innovative performance is measured using the collected information at the level of innovation in products and processes, which is adopted as the dependent variable. This dimension is presented as a dichotomous variable based on binary data; it is set to 0 for firms that do not innovate and 1 for those that innovate, as shown in Table 2.

Table 2 - Variables of model: Barriers to Innovation in Product

Variables	Code/ Hypotheses	Measures
Dependent variable: Innovative Performance Innovation in product	IP	Type: Binary 1= firm innovated 0= firm not innovated
Independent Variables		
Lack of funds within your enterprise or group	Hfent/H1	Type: Nominal Categorical The firm percept barriers *0= irrelevant* *1= low* *2= medium* *3= high*
Lack of finance from sources outside your enterprise	Hcos/H3	
Innovation costs too high	Hper/H4	
Lack of qualified personnel	Htec/H5	
Lack of information on technology	Hpar/H7	
Lack of information on markets	Hdom/H8	
Difficulty in finding cooperation partners for innovation	Hdem/H9	
Market dominated by established enterprises	Hprior/H10	
Uncertain demand for innovative goods or services	Hfout/H2	*0= irrelevant+low* *1= medium* *2= high*
No need due to prior innovations by your enterprise	Hinf/H6	
No need because of no demand for innovations	Hmar/H11	

The independent variables are represented by the barriers to innovation. In this empirical research, the barriers are measured by the degree of importance of the factors considered to be impediments "to the activities or the firm's innovation projects or that influence the decision not to innovate" (CIS, 2010: 12). Information on these variables was obtained from the answers to question 8.1 of the CIS 2010. Each barrier is considered as a categorical variable of four levels, namely an irrelevant, low, medium and high perception of the barrier. This categorization emerges naturally from the questionnaire responses and corresponds to the degree of importance, with most of the independent variables taking this categorization. Regarding the model of barriers to product innovation, because of the number of sample firms containing the three variables associated with barriers, a categorization was proposed to discriminate the sample most relative to each of these three barriers; the categories created for each of these barriers are irrelevant and low, medium and high perception of the barrier.

A similar procedure is carried out for the barriers to the process innovation model in which the information on each barrier is treated as a categorical variable of four levels, namely an irrelevant, low, medium and high perception of the barrier (CIS, 2010: 12). Due to the small number of firms belonging to the sample that responded to three barriers, a categorization that most differentiates the sample in relation to each of these three barriers is proposed. The results are shown in Table 3.

Table 3 - Variables of model: Barriers to Innovation in Process

Variables	Code/ Hypotheses	Measures
Dependent variable: Innovative Performance Innovation in process	IP	Type: Binary 1= firm innovated 0= firm not innovated
Independent Variables		
Lack of funds within your enterprise or group	Hfent/H1	Type: Nominal Categorical
Lack of finance from sources outside your enterprise	Hfout/H2	The firm percept barriers
Innovation costs too high	Hcos/H3	*0= irrelevant* *1= low*
Lack of qualified personnel	Hper/H4	*2= medium*
Lack of information on technology	Htec/H5	*3= high*
Lack of information on markets	Hpar/H7	
Difficulty in finding cooperation partners for innovation	Hdom/H8	
Market dominated by established enterprises	Hmar/H11	
Uncertain demand for innovative goods or services	Hdem/H9	*0= irrelevant* *1= low* *2= medium + high*
No need due to prior innovations by your enterprise	Hprior/H10	*0= irrelevant + low* *1= medium* *2= high*
No need because of no demand for innovations	Hinf/H6	*0= irrelevant* *1= low + medium* *2= high*

Method: Logistic Regression Model

Bearing in mind the purpose of the investigation and the analysis of other empirical studies conducted previously (Conceição and Heitor, 2001; Kaufmann and Tödtling, 2001; Float, 2003; Varis and Littunen, 2010; Elche-Hotelano, 2011), logistic regression was identified as the most used model and the most appropriate analytical technique, given that the dependent variable or response is dichotomous. We present the model below:

Analysis and Discussion of Results

The analysis of the sample aims to identify the barriers to innovation that influence the innovative process and its subsequent performance in terms of product and process innovation. Thus, the general characterization of the firms in the sample obtained is presented in the following section, along with a preliminary analysis of product and process innovation implemented by firms.

The model of the barriers to product innovation highlights the results of the systematic and statistically significant correlation between the innovative business performance at the level of product innovation and the barriers to innovation. As some of the variables associated with the barriers are not statistically significant at the 5% level, we decided to provide the information for significant variables. First, the initial logistic regression model is performed for all of the barriers to innovation. As some are not significant, we proceed

12

to the execution of the model without these variables and consider the variable categorization that best differentiates the sample under study. Consequently, we obtain the final model that includes all of the estimates of the statistically significant regression parameters at the 5% level, using the *Wald statistic* as a statistical test.

Table 4 - Results of logit model of the barriers to product innovation

	B	S.E.	Sig.	Exp(B)
Innovation costs too high				
Low	0,790	0,117	0,000	2,204
Medium	0,826	0,106	0,000	2,285
high	0,527	0,112	0,000	1,694
Lack of qualified personnel				
Low	0,355	0,092	0,000	1,426
Medium	0,323	0,096	0,001	1,381
high	0,527	0,122	0,000	1,694
Lack of information on markets				
Medium	0,241	0,072	0,001	1,272
high	0,564	0,129	0,000	1,758
Uncertain demand for innovative goods or services				
Low	0,520	0,100	0,000	1,683
Medium	0,563	0,095	0,000	1,756
high	0,461	0,106	0,000	1,586
No need due to prior innovations by your enterprise				
Low	-0,319	0,073	0,000	0,727
Medium	-0,613	0,095	0,000	0,542
high	-0,847	0,148	0,000	0,428
No need because of no demand for innovations				
Medium	-0,558	0,083	0,000	0,572
high	-1,054	0,122	0,000	0,348
Lack of finance from sources outside your enterprise				
Medium	-0,181	0,077	0,019	0,835
high	0,017	0,082	0,832	1,018
Constant	-1,214	0,081	0,000	0,297
Model summary				
Correct predict (%)	65,2%			
Chi-Square	634,13	0,000		
Log likelihood	7590,91			
Number of cases (n)	3 406			

Regarding the adjustment quality of the final model, the results show that the predictive value of the model is 65.2%, which results from the comparison between the response variable values predicted by the model and the observed values. The result of the statistical chi-square test is 634.13, with a p-value that is lower than the 0.05 significance level. With a value of 7590.91, the log-likelihood statistics support the global significance of the model when compared with the null model.

The results show that most of the variables associated with the barriers to innovation are considered factors that impede the development of innovation activities and result in businesses having a lower propensity to innovate.

However, the estimated coefficients for the perceptions that innovation is "unnecessary due to the existence of prior innovations" and "unnecessary due to the lack of

demand/market for innovations" are negative, which shows that while firms perceive that it is unnecessary to engage in innovative activities, if they proceed with these activities, they will have a greater propensity to innovate. As such, these factors drive, rather than restrict, innovative activity. Thus, the null hypothesis of the non-existence of a relationship between the innovation performance of the firm and the perceptions "unnecessary due to the existence of prior innovations" or "unnecessary due to the lack of demand/market for innovation" can be rejected. Therefore, hypotheses H10 and H11 are confirmed.

The same applies to the factor "lack of funding from external sources". The heads of firms, having a medium degree of perception of the importance of this factor, tend to increase their levels of innovation. This may be caused by the perception that a lack of funding leads firms to cooperate to address the lack of external financing, which is referenced in the research conducted by Nunes (2008). This cooperation encourages businesses to innovate (Fonseca, 2010). Thus, the null hypothesis of the non-existence of a relationship between the "lack of funding from external sources" with an average degree of importance and the innovative performance of the firm within the product is rejected and hypothesis H2 is confirmed.

Hypothesis H3 combines a firm's performance in product innovation with high innovation costs, as shown in H3: High innovation costs are negatively related to firms' propensity to innovate in products. As noted earlier, the barrier associated with high innovation costs is expressed in terms of the degree of importance. Thus, the model results suggest that the perception of high costs has a significant negative effect on product innovation. Considering the level of reference "irrelevant", we determine that the punctual estimates of the parameters associated with the perceptions "low", "medium" and "high" are 0.790, 0.826 and 0.527, respectively. All of the estimates are statistically significant. By analyzing the estimates of the marginal effects on the dummy variables, we observe that the firm's propensity to engage in product innovation has a negative relationship with the perceived level of the barrier "high costs". It is noted that the ratio of advantages for firms is 2.20 for the "low", 2.28 for the "average" and 1.70 for the "high" degree of importance. Therefore, firms that belong to these three levels face difficulties while developing innovation activities, which leads to a lower propensity to innovate. The null hypothesis of the non-existence of a relationship between the variables is rejected and hypothesis H3 is confirmed.

Hypothesis H4 – The lack of qualified personnel is negatively related to firms' propensity to innovate in products – also confirms this model. The results suggest that the perceived lack of qualified staff has a negative and significant effect on a firm's propensity to engage in product innovation. Considering the level of reference "irrelevant" and the level of importance associated with the perceptions "low", "medium" and "high", it can be seen that the punctual estimates of the parameters are 0.355, 0.323 and 0.527, respectively, with advantage ratios of 1,426, 1,381 and 1,694. All of the estimates are statistically significant.

Observing these results, it appears that a firm's propensity to engage in product innovation has a negative relationship with the qualification level of the firm's employees. Therefore, firms should implement the recommendations of Cohen and Levinthal's theory (1989, 1990), which states that the higher the qualification level of a firm's staff,

the greater the firm's propensity to innovate. The study from author (2003) also shows that staff qualifications are higher in innovative firms than in non-innovative enterprises, making it necessary to invest in staff training. The results of this study are corroborated by Hoffman et al (1998) and Romijn and Albaladejo (2002), who argue that a lack of qualified staff can be a serious constraint to the development of the corporate innovation process.

An analysis of the sample firms represented in the previous table (Table 4) shows that the main difficulties involved in innovating within the market are caused primarily by a lack of market information and uncertainty in the demand/market. The results show that these variables are factors that slow the development of innovation activities and lead to a lower propensity to innovate among businesses. Thus, hypotheses H6 and H9 can be confirmed.

The model presented in Table 5 shows the results of the systematic relationship between the innovative performance in terms of process innovation and barriers to innovation. The procedure used in this model is equivalent to that implemented in the logistic regression model for the barriers to product innovation. The final model results are all estimates of statistically significant regression parameters at the 5% level, with the Wald statistic being used as a statistical test.

Table 5 – Results of logit model of the barriers to process innovation

	B	S.E.	Sig.	Exp(B)
Innovation costs too high				
Low	1,028	0,115	0,000	2,797
Medium	0,946	0,099	0,000	2,575
High	0,753	0,099	0,000	2,123
Lack of qualified personnel				
Low	0,301	0,102	0,003	1,352
Medium	0,311	0,102	0,002	1,365
High	0,684	0,128	0,000	1,982
Uncertain demand for innovative goods or services				
Medium	0,355	0,100	0,000	1,426
High	0,075	0,091	0,406	1,078
No need due to prior innovations by your enterprise				
Medium	-0,330	0,080	0,000	0,719
High	-0,738	0,133	0,000	0,478
No need because of no demand for innovations				
Low	-0,278	0,077	0,000	0,757
Medium	-0,681	0,093	0,000	0,506
High	-1,168	0,120	0,000	0,311
Lack of information on markets				
Medium	0,091	0,097	0,348	1,095
High	0,453	0,149	0,002	1,573
Constant	-0,806	0,075	0,000	0,446
Model summary				
Correct predict (%)	63,8%			
Chi-Square	650,39	0,000		
Log likelihood	7853,59			
Number of cases (n)	3 406			

Regarding the adjustment quality of the final model, the results show that the model's predictive value is 63.8%, resulting from the comparison between the response variable

values predicted by the model and the observed values. The result of the statistical chi-square test is 650.39, with a p-value less than the 0.05 significance level. The log-likelihood statistic, with a value of 7853.59, supports the global significance of the model compared to the null model.

The results obtained in the barriers to process innovation model show that most of the variables are viewed as factors that obstruct the development of innovation activities; consequently, businesses have a lower propensity to engage in process innovation, which is the case with the following barriers: the costs of innovation are too high (H3); the lack of qualified personnel (H4); uncertainty in the demand/market for new goods or services (H9); and a lack of market information (H6). Given the model's results for barriers, we can reject the null hypothesis of non-existence of a relationship with the breakthrough performance of the firm. Thus, hypotheses H3, H4, H6 and H9 are confirmed.

Some of the barriers experienced by firms during the development of innovation activities affect the success of firms when it comes to process innovation. Thus, firms that experience high innovation costs, a lack of adequate information on the markets and uncertainty in terms of the demand/market for the new goods or services are less likely to innovate than firms that do not encounter these difficulties. We also observe that the lack of qualified personnel to carry out innovation activities influences the propensity of firms to innovate and therefore constitutes an obstacle to process innovation. It should be noted that the influence on the firm to have a propensity not to engage in process innovation is greater as the perception of the importance of the barrier is enhanced. The study by Hoffman et al (1998) corroborates these facts by stating that a lack of skilled personnel can be a serious constraint to the development of the innovation process.

Regarding the model results for market barriers expressed by the perception that innovation is "unnecessary due to the existence of prior innovations" and "unnecessary due to the lack of demand/market for innovations", the estimated coefficients are negative, which may indicate that the greater the perceived barriers, the lower is the negative effect on the propensity of businesses engaging in process innovation. Thus, these factors present themselves as drivers of process innovation and not as hindrances to innovative activity. Consequently, the null hypothesis of a non-existence of a relationship between the innovation performance of the firm and the barrier "unnecessary due to the existence of prior innovations" or "unnecessary due to the lack of demand/market for innovation" is rejected, thus confirming hypotheses H10 and H11. These results are evident in the barriers to product innovation model.

Altogether, the results show that most of the variables associated with barriers to innovation are factors that impede the development of innovation activities; consequently, these barriers cause businesses to have a lower propensity to innovate in both products and processes. In the following table (Table 6), the barriers are synthesized; it is possible to reject the null hypothesis due to the non-existence of a relationship with the breakthrough performance of the firm. Thus, all of the hypotheses associated with all the marked barriers can be confirmed.

Table 6 - Summary of hypotheses validation

Barriers Independents Variables	Hypotheses	Product Innovation	Process Innovation
Lack of funds within your enterprise or group	Hfent/H1		
Lack of finance from sources outside your enterprise	Hfout/H2	✓	
Innovation costs too high	Hcos/H3	✓	✓
Lack of qualified personnel	Hper/H4	✓	✓
Lack of information on technology	Htec/H5		
Lack of information on markets	Hinf/H6	✓	✓
Difficulty in finding cooperation partners for innovation	Hpar/H7		
Market dominated by established enterprises	Hdom/H8		
Uncertain demand for innovative goods or services	Hdem/H9	✓	✓
No need due to prior innovations by your enterprise	Hprior/H10	✓	✓
No need because of no demand for innovations	Hmar/H11	✓	✓

Conclusions

This study aims to identify the barriers that influence firms' innovation processes and to analyze whether these barriers influence innovative performance.

The research, which begins by stipulating the theoretical field and loopholes that justify the empirical study, synthesizes the main considerations with regard to the barriers included in the proposed conceptual model's conclusions; these are empirically contrasted objects based on data from the Community Innovation Survey 2010.

Some of the barriers experienced by the firms in the sample during the development of activities and innovation projects produce effects on the success of businesses in terms of product and process innovation. Thus, firms that face high innovation costs, perceive uncertainties in the demand and the market for new goods and services and show a lack of personnel qualified to carry out innovation activities and a lack of market information are less likely to innovate than firms that do not experience these difficulties. We also observe that the lack of external financing influences the propensity of firms to engage in product innovation and creates an obstacle to innovation. However, it is found that firms that deem it unnecessary to innovate due to the existence of previous innovations or the lack of demand/market for innovations end up stimulating their innovation. These results may be attributed to the fact that the barrier of perception stimulates the firm to overcome these difficulties, thus promoting an internal propensity to innovate.

In terms of the contributions of this chapter, the results obtained allow us to propose future actions at the firm level, or by public and private actors with responsibility for fostering entrepreneurial innovation. Consequently, we propose designing public policies to promote innovation and make it possible to overcome the barriers to innovation. These measures are particularly important, given that Portuguese businesses consist mainly of micro, small and medium enterprises with few resources and a low qualification standard of human resources, both of which limit innovation performance. Therefore, we propose the public policy development based on designing a set of instruments and funding

incentives that favor innovation activities aimed at the market, the acquisition of new entrepreneurial skills, knowledge transfer and efficient technology for SMEs to further strengthen the innovation management practices of firms and encourage their development.

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