Innovación y Gestión del Conocimiento

Barriers to Innovation and Innovative Performance of Portuguese Firms

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Abstract

This paper aims to identify and analyze the main limiting factors to innovation performance in terms of product and process innovation. The limiting factors to innovation, difficult the innovation process of a firm and consequently influence its innovation performance. Thus, it is intended with this essay to develop a theoretical support based on current reference approaches, corroborated by an empirical support which allows identifying and analysing the restraining factors of innovation activity and of innovation performance.

The database is extracted from the Community Innovation Survey - CIS 2010, 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. In order to identify the limiting factors to innovation performance a logistic regression model concerning the barriers to innovation is performed.

The analysis suggests that several barriers to innovation have influence on the Innovative performance of Portuguese firms. These results may be due to the fact that the barrier of perception stimulates the firm to overcome these difficulties, promoting the internal propensity to innovate. The most important barriers perceived in the study are: high innovation costs, perceive uncertainties in the demand and the market for new goods and services and show a lack of qualified personnel to carry out innovation activities and a lack of market information are less likely to innovate than firms that do not experience these difficulties.

Keywords: Barriers to Innovation, Networks, Innovative Capacity, CIS.

1. Introduction

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

According to Madrid-Guijarro, Garcia and Van Auken (2009) and Hidalgo and D'Alvano (2014), however, there are only a few studies on the barriers to innovation, mainly focused on technological innovations. The

authors argued that understanding the factors that act as barriers to innovation can be useful for developing public policies that encourage innovation and for assisting managers in promoting a culture of innovation in firms, which in the opinion of Perel (2002) is the one of the determinants of survival and success of firms. . Otherwise, Amara, D'Este, Landry and Doloreux (2016) argue that understanding the barriers to innovation help improve the theories that explain why some firms do not want to innovate or not to engage more intensely in innovation.

In Portugal this matter has sparked the interest of entrepreneurs as well as the central government through the development of a set of initiatives aimed at strengthening the Innovative capacity and the mechanisms of technological diffusion to overcome the barriers experienced by firms. More recently, several grants and incentives have been provided within the scope of Horizon 2020[1] and Operational Program Portugal 2020[2]. A strategic component is the qualification of Portuguese firms, valuing the investments in innovative activities linked to the product, process, organizational methods and marketing, with special emphasis on investment in the scope of differentiation, diversification and innovation linked to the production of tradable and exportable goods and services, as well as activities that have high technological intensity and knowledge or that value the application of R&D results in the production of goods and services.

Academically, the interest in the area in Portugal emerged in the last decade of the last century. Although a few studies exist on the barriers to innovation in Portuguese firms, it remains a particularly pressing issue and is constantly being updated in line 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 contribution of this study involves the identification and analysis of the main limiting factors to innovation performance in terms of product and process innovation, focusing on the identification of their nature, origin and importance, promoting a better understanding of them 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 understand firms' process of innovation and to be able to overcome these barriers (D'Este et al, 2012), and it is therefore crucial to study the factors that hinder the innovation process. 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 the most (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) refer that the barriers are more relevant by firms featuring high innovation and R&D intensities than by firms which do not undertake 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 to undertake an analysis based on the collected barriers to innovation through the CIS 2010 (*Community Innovation Survey*

[1] Horizon 2020 (http://www.gppq.fct.pt/h2020/h2020.php retrieved on 08/06/2015)
[2] Programa Operacional Portugal 2020 (https://www.portugal2020.pt/ retrieved on 08/06/2015)

2010), the following barriers are considered: (1) equity capital insufficiency; (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) the market being dominated 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 approaches 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 practised often (authors, 2010).

This study aims to develop a theoretical basis, confirmed by empirical support, to identify and analyse fundamentally the factors that affect firms' process of innovation and consequently their performance.

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

The research in this chapter is structured as follows. In section two the relevant literature on the topic of innovation and the barriers to innovation as constraining factors of innovation performance are presented. In section three the sample is described and, subsequently, the variables used in the empirical study are explained and characterized and the logistic regression model concerning the barriers to innovation is presented. In section four the data are analysed and the results are discussed. Finally, we present the conclusions and implications for the future design and adoption of public policies aiming to overcome the conditioning factors in the innovative performance of Portuguese firms.

2 Literature Review on Barriers to Innovation

Innovative performance varies from firm to firm and is influenced by a number of factors, both internal and external and both stimulating and restrictive, 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 prevents its propensity to innovate, that is, that reduce its ability to introduce and sustain a new or significantly improved product or process, affecting the innovative activity, preventing achieve expected results and with impact on business performance (Perel, 2002; Lewandowska, 2014).

Despite the importance that the barriers to innovation have in this study, some authors argue that some are already declined, mainly due to the digital revolution, which enables the sharing of knowledge and needs (Euchner, 2015).

In the analysis of barriers to innovation, the data obtained from the CIS 2010 are taken into account and the following conditioning factors in the innovation process at the corporate level are considered, as shown in Table 1.

Table 1 – Barriers to Innovation

Barriers to innovation	Factors
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 for not 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 to innovation, hamper the innovation process of a firm and consequently influence its innovation performance. These barriers may be classified and grouped in different ways into external (or exogenous, that arise when firms acquire resources or knowledge externally) and internal (or endogenous, normally associated with difficulties to implement internal changes in their organizational processes) to the firm (Hadjimanolis, 1999; Thakur and Hale, 2013; Lewandowska, 2014). According Saatcioglu and Ozmen (2010) the internal barriers include: (i) lack of qualified personnel; (ii) bureaucracy; (iii) lack of R&D, design, test and other technical problems in firms; (iv) long time for return for innovation; (v) perception of innovation as risky; (vi) difficulty to control innovation costs; and (vii) finance of innovation; while external barriers include: (i) patent and license policy; (ii) lack of incentives applied by government; (iii) foreign trade policy; and (iv) competition policy. 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 the most important group of factors impact on innovation and are highly associated with a lack of funding, both internally and externally, as well as higher financing costs and 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) highlighted the role of financing problems in the development of new products and the role of bureaucracy as the most important 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, being the origin of delays and of the non-development of innovation projects (authors, 2008). Regarding cancelled projects, beyond the high costs, the perception of excessive risks and the regulations and norms emerge as the major barriers (Conceição and Ávila, 2001). The studies carried out by Barbosa (2006) and Segarra-Blasco, Garcia-Quevedo and Teruel-Carrizosa (2008) also concluded that the high investment costs influence the innovative process as the main barrier to the development of technological innovation processes. Recent studies have also highlighted the lack of funding as a major

barrier that prevents firms from investing in R&D, not only at the technological level but also at the level of employee training (Song and Oh, 2015; Yu et al, 2015). So, the economic factors are very important because they affect the incentives of firms to invest in innovation due to financing constraints and the uncertainty of innovation projects (Hölzl and Janger, 2014).

The knowledge factors, related to the concept of absortive capacity, cover the lack of qualified personnel, a long-term view of leadership and corporate courage, the lack of the lack of information about the technology and the markets and the difficulty in finding partners for cooperation in 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). The internal resistance to innovation is a factor that can jeopardize the competitiveness of a firm in terms of innovation. A high level of resistance from employees may be caused, for example, by the fact that they consider that they are at risk of losing their job 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 a reduction of the costs related to innovation (Zwick, 2002). The latest studies have shown the factors that hinder businesses when it comes to putting the conceived ideas into practice, among which 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 information about the technology and the market are barriers to the development of the innovative corporate process (authors, 2010) mainly due to the pressure currently exerted on firms by demanding and sophisticated customers, providing 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 replacing firm products for product of competitors, constitute an obstacle to innovation. In this sense the study carried out by authors et al (2008) concluded that the lack of receptivity of customers 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 and thus this perception acts as an obstacle to innovation (authors et al, 2009).

The difficulty in finding partners for cooperation on projects in the field of innovation can be considered an extremely important barrier to innovation, as in many systems of financial incentives for innovation one of the key requirements is to present partnerships in innovative projects. Several studies have shown that collaboration between firms is a factor that drives innovation (Franco, 2003), as well as 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 a large number of firms innovate successfully without resorting to cooperation partners, suggesting that the strategies based on firms'

capabilities are significantly more important than those involving foreign partners (Freel and Harrison, 2006).

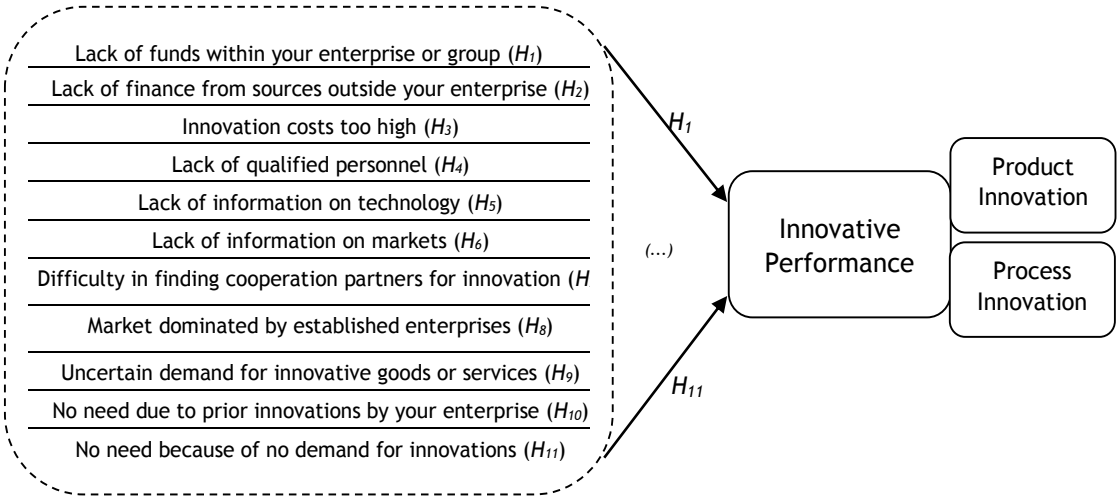
The reasons for not innovating arise in this study as explanatory variables in the analysis, because it was found that several studies did not consider the reasons for not innovating as barriers to innovation (authors, 2010).

The barriers are revealed as one of 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 identify and analyse the barriers to innovation, considering the above-stated factors, and formulates the following research hypotheses, which will be the basis of the empirical test:

- *H_1: The insufficiency of equity capital is negatively related to firms' propensity to innovate in products and processes.*
- *H_2: The lack of funding sources is negatively related to firms' propensity to innovate in products and processes.*
- *H_3: The high innovation costs are negatively related to firms' propensity to innovate in products and processes.*
- *H_4: The lack of qualified personnel is negatively related to firms' propensity to innovate in products and processes.*
- *H_5: The lack of information about technology is negatively related to firms' propensity to innovate in products and processes.*
- *H_6: The lack of information on markets is negatively related to firms' propensity to innovate in products and processes.*
- *H_7: The lack of partnerships in the field of innovation is negatively related to the propensity of firms to innovate in products and/or processes.*
- *H_8: The domination of the market by established firms is negatively related to firms' propensity to innovate in products and processes.*
- *H_9: The uncertainty in the demand/market is negatively related to firms' propensity to innovate in products and processes.*
- *H_{10}: The fact that it is unnecessary because there are previous innovations is negatively related to firms' propensity to innovate in products and processes.*
- *H_{11}: 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 to be tested are represented in terms of barriers to innovation.

Figure 1 – Research design: Hypotheses and Barriers to Innovation



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

3 Research design

Following the formulation of the hypotheses to be tested empirically, we briefly present the data, the choice of data analysis method and the characterization of the variables used in the study.

3.1 Presentation of data: Population and Sample

As previously mentioned, the data used in this research are those collected through the CIS 2010 survey, 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 between July 2011 and April 2012, although the reference period concerned was between 2008 and 2010.

The target population on which the analysis is focused 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 considered to be innovative in products or processes if they introduced new or significantly improved goods, services or processes during the period between 2008 and 2010.

3.2 Independent and dependent variables

Analyses of the barriers to innovation using the CIS data have been performed by various researchers, using for this purpose data from European firms (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 did not innovate and 1 for those that innovated, 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 as 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. Thus, more specifically, each barrier is considered as a categorical variable of four levels, namely an *irrelevant*, *low*, *medium* and *high* perception of the barrier. This categorization emerged naturally from the data obtained from the questionnaire responses given and corresponding to the degree of importance, with most of the independent variables taking this categorization. However, regarding the model of barriers to product innovation, due to the number of sample firms in three variables associated with barriers, a categorization was proposed

that would discriminate the sample the most in relation to each of these three barriers; the categories created for each of these barriers were an *irrelevant and low*, *medium* and *high* perception of the barrier.

A similar procedure is carried out for the model of barriers to process innovation, in which the information on each barrier is considered 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 would discriminate the sample the most in relation to each of these three barriers, as shown in Table 3, was proposed.

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 The firm percept barriers *0= irrelevant* *1= low* *2= medium* *3= high*
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	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*

3.3 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:

4 Analysis and Discussion of Results

The analysis undertaken aims to identify the barriers to innovation that influence the innovative process of the sample and, consequently, its performance in terms of product and process innovation. Thus, the general

characterization of the firms in the sample based on the data obtained is presented in the following section, along with a preliminary analysis of innovation implemented by firms in terms of products and processes.

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, given the size of the table it was decided to provide the information of significant variables. First, the initial logistic regression model is performed for all the barriers to innovation. As some of them are not significant, we proceed to the execution of the model without these variables, and we consider the variable categorization that most discriminates the sample under study. As a consequence, we obtain the final model, the results of which present all 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			

egarding the adjustment quality of the final model, the results show that the predictive value of the model is 65.2%, 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 634.13, with a p-value lower than the 0.05

significance level. The log-likelihood statistics, with a value of 7590.91, support the global significance of the model compared with the null model.

The results show that most of the variables associated with the barriers to innovation are considered as factors that impede the development of innovation activities; consequently, they cause businesses to have 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" have a negative sign, which may show that firms perceive that it is unnecessary to engage in innovative activities, but, if they proceed with these activities, they will have a greater propensity to innovate. In this light, these factors are not restrictive of innovative activity but rather drivers of it. 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, by having a medium degree of perception of the importance of this factor, lead them to boost their level of innovation. This is possibly due to what has already been referenced in the research carried out by Nunes (2008), namely that the perception of a lack of funding leads firms to cooperate to address the lack of external financing. 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 can be rejected. Therefore, hypothesis *H2* is confirmed.

Hypothesis *H3* combines a firm's performance in product innovation with innovation costs that are too high, as shown in *H3*: *High innovation costs are negatively related to firms' propensity to innovate in products*. As noted earlier, the barrier associated with too high innovation costs is expressed in terms of the degree of importance. Thus, the model results suggest that the perception of high costs has significant negative effects on product innovation. Considering the level of reference "irrelevant", it can be seen that the punctual estimates of the parameters associated with the perceptions "low", "medium" and "high" are, respectively, 0.790, 0.826 and 0.527. All the estimates are statistically significant. By analysing the estimates of the marginal effects of the dummy variables, we observe that the firm's propensity to engage in product innovation has a negative relationship with the level of perception of the barrier "too 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 important levels face difficulties in the development of innovation activities; consequently, this means that businesses have a lower propensity to innovate. The null hypothesis of the non-existence of a relationship between the variables can be rejected. Thus, 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. Thus, the model results suggest that the perception of a 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, respectively, 0.355, 0.323 and 0.527 and the ratios of advantages are 1,426, 1,381 and 1,694. All the estimates are statistically significant.

When considering these results, it appears that a firm's propensity to engage in product innovation has a negative relationship with the level of qualification of the firm's employees. Therefore, firms have to 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 carried out by author (2003) also showed that staff qualifications are higher in innovative firms than in non-innovative enterprises, so it is necessary to invest in staff training. The results of this study are also corroborated by Hoffman et al (1998) and Romijn and Albaladejo (2002), who argued that a lack of qualified staff can be a serious constraint to the development of the corporate innovation process.

For the total number of firms in the sample, by analysing the previous table (Table 4), it appears that the main difficulties involved in innovation within the market are due mainly to the lack of information on markets and the uncertainty in the demand/market. The results show that these variables are factors that slow down the development of innovation activities and consequently mean that businesses have a lower propensity to innovate. Thus, hypotheses *H6* and *H9* can be confirmed.

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

As regards 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 statistics of log-likelihood, with a value of 7853.59, support the global significance of the model compared with the null model.

The results obtained in the model of the barriers to process innovation show that most of the variables are considered to be factors that obstruct the development of innovation activities and consequently mean that businesses have a lower propensity to engage in process innovation, as in the case of 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 relating to these 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 can be confirmed.

Some of the barriers experienced by firms in the sample, during the development of innovation activities, produce effects on 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 goods or new services by customers are less likely to innovate than firms that do not encounter these difficulties. It is also found that the lack of qualified personnel to carry out innovation activities influences the propensity of firms not to innovate and therefore constitutes an obstacle to process

innovation. It should be noted that, as the perception of the importance of the barrier is enhanced, the greater is the influence on the firm to have a propensity not to engage in process innovation. 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.

In 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 have negative signs, which may indicate that the greater the perception of the barriers, the lower the negative effect on the propensity for businesses to engage in process innovation. Thus, these factors present themselves as drivers of process innovation and as not restrictive of innovative activity. Consequently, the null hypothesis of 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" can be rejected, thus confirming hypotheses *H10* and *H11*. These results were evident in the model of the barriers to product innovation.

All in all, it can be said that the results show that most of the variables associated with barriers to innovation are considered to be factors that impede the development of innovation activities; consequently, they cause businesses to have a lower propensity to innovate both in products and in 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 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	✓	✓

5 Conclusions

This study aims to identify the barriers that influence firms' innovation process and to analyse whether they can influence their innovative performance.

Following the research carried out, which began by setting out the theoretical field and the loopholes that justify the empirical study, the main considerations are synthesized in regard to the barriers that are included in the proposed conceptual model's conclusions and that are empirically contrasted objects based on the 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 qualified personnel to carry out innovation activities and a lack of market information are less likely to innovate than firms that do not experience these difficulties. It is also found that the lack of external financing influences the propensity of firms to engage in product innovation and therefore constitutes an obstacle to innovation. However, it is found that firms that consider it to be 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 due to the fact that the barrier of perception stimulates the firm to overcome these difficulties, promoting the internal propensity to innovate.

In terms of the contributions of this chapter, the results obtained allow us to propose future actions at the level of firms or public and private actors with responsibilities for fostering entrepreneurial innovation. Consequently, we propose the design of public policies to promote innovation and to 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, which limit innovation performance. We therefore propose the development of public policies based on the proper design of a set of instruments and funding incentives that favour innovation activities aimed at the market, the acquisition of new entrepreneurial skills, knowledge transfer and efficient technology for SMEs to strengthen further and consolidate the innovation management practices of firms and encourage their development.

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