

BARRIERS TO BUSINESS INNOVATION IN SPANISH COMPANIES



Author: Irene Raro Gualda
E-mail: al226893@uji.es

Tutor: María Dolores Parra Robles

DEGREE IN ECONOMICS
EC1049- FINAL WORK OF DEGREE
ACADEMIC YEAR: 2015-2016
July 2016

ABSTRACT

This paper examines the barriers to business innovation in Spanish companies. In order to develop this study we have used statistics based on the Survey of Businesses Innovation carried out between the years 2006 and 2012, they belong to the Technological Research Panel (PITEC). We have also made four different estimations by distinguishing four different dependent variables that refer to innovation types listed in the Oslo Manual. Furthermore we have calculated a regression using panel data and a *probit* model. The main aim of this dissertation is to be able diagnose what has become a barrier to business innovation, in order to draw conclusions that can be useful for businesses. We will then conclude that the cost factor is one of the obstacles that most prevent companies in undertaking innovative activities.

JEL code: O30,Q55

Key words: innovation, barriers, Spanish companies, factors.

INDEX

1. INTRODUCTION	4
2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW	6
2.1. Concepts and types of innovation according to different authors	6
2.2 Factors affecting business innovation.....	8
Cost factors	10
Knowledge factors.....	11
Market factors	12
3. DATA	15
3.2 Descriptive Data.....	16
4. METHODOLOGY AND ESTIMATIONS	19
4.1 VARIABLES.....	21
4.1.1 Dependent variable.....	21
4.1.2 Independent Variables.....	23
5. RESULTS	25
6. CONCLUSIONS	29
7. BIBLIOGRAPHY	32
8. APPENDIX	34

LIST OF TABLES

Table 1. Literature review about factors that affect innovation13

Table 2. Econometrical regression results.....28

LIST OF FIGURES

Figure 1: Percentage of surveyed companies that are innovative.....16

Figure 2. Relevance of the interest variables to the surveyed companies.....17

Barriers to Business Innovation in Spanish Companies

1. INTRODUCTION

For over two hundred years and until relatively recently, labour and capital were considered the only factors that were directly attached to the growth of the economy. Education, knowledge and human capital were only considered external factors with relatively low impact on the economy. Nowadays this concept has changed dramatically, based increasingly on knowledge and information. This new knowledge-based economy is defined as one in which the generation and exploitation of new ideas, play a very important role in the generation of welfare (Edvinson y Malone, 1997; Bontis, 1998 y Robert Solow, 1924).

The innovation term is known as a key factor in the competitiveness of companies and nations (Galia and Legros 2004; Tourigny y Le 2004; Piso 2000). Freel (2000) stated that for a company to remain competitive with other companies is essential innovation, to thereby develop economic growth. Therefore innovation has become the most important engine of transformation and growth of enterprises. Innovation is the key to the transformation of the production structures in a country that is much needed right now especially in Spain, taking into account the economic recession in which we find ourselves.

Companies are aware that they can not only rely on reducing costs and increasing efficiency, they need to grow to be more competitive, and there is where innovation plays an important role throughout the value chain. Innovating not only on the product level, but it is also important the organizational innovation, the process innovation and the commercial innovation. In order for those to be successful, it is necessary to know it is necessary to know very well the market every company competes within. We have to assess the product that they are selling and also it is imperative to adapt the company to the current situation.

According to Cotec (2006), the delay in Spanish companies being in relation to other industrialized countries could lead to a reduction in competitiveness in our market. We start from a lower position than in other more competitive countries, nevertheless this does not mean that we cannot improve ourselves if we use the full potential of

knowledge that we owe. In order to improve this and to make our businesses more competitive, we must therefore analyse what are the causes of poor business innovation of Spanish companies. This analysis is necessary to design concrete policy actions to improve and stimulate business innovation.

This dissertation aims to analyse the main barriers to innovation of Spanish companies, during the period from 2006 to 2012. To conduct the research we have used a sample of over 7000 companies, obtained from the database PITEC (Technological Innovation Panel)¹. There are already some studies that examine such barriers to innovation in Spanish companies but specifically this study would examine the relationship between seven obstacles and product innovation, innovation process, organizational innovation and to commercial innovation. Due to the fact that a better understanding of barriers to innovation can help companies to encourage the development of an environment that encourages innovation and ultimately they would be able to design policies that could help more effectively and promote business innovation, (Hadjimanolis 1999).

According to the results thrown in this dissertation, cost variables are those that have a greater effect in the companies' decisions towards innovation, which are relevant in order to carry out any type of innovation. Furthermore, it is also important to consider whether if staff are enough qualified and the difficulty on finding partners.

Once raised the problem of the lack of barriers to innovation and described the purpose of the investigation, this dissertation is structured according to the following sections: On the first place, we will introduce a review of the literature and other previous research that has been done about the topic. Secondly, we will analyse the source from which the data have been extracted. Thirdly the research methodology used is described to achieve the purpose of the study, and we will also explain the econometric method used and the variables assessed. Furthermore, we will discuss the results obtained after the application of econometric model to the study sample. Finally in the last section of this paper the research findings are explained in further detail as well as the conclusions of our research.

¹ Translation note: *Technological Research Panel (PITEC)*, stands from the original Spanish body: *Panel de Investigación Tecnológica (PITEC)*.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Concepts and types of innovation according to different authors

We can define innovation as an idea, practise or object that is considered new for a person or a company (Rogers, 1983). Such innovation may already objectively exist because someone used it in the past, but we have to take into account that every time something is renewed and adapted it should be considered as innovation. This innovation can be considered as a method of generating changes in the management (Damanpour, 1991) and it is based on the commercial practice of an idea, i.e. to transform ideas into products, processes or services or to improve them in order to merchandise them. Innovation comes in response to a change in either business or environment as a way for the company to influence the environment. According to the Oslo Manual (2005), innovation refers to the inclusion or improvement of a new product; it also refers to the use of a new process, a different way of marketing and improvements in the management of the company. The concept of innovation is a relatively new concept, but it started to be introduced in some Adam Smith and David Ricardo's writings in the 70s.

Adam Smith in his book "The Wealth of Nations" (1776) mentioned that work division increases the production, and he also supported this by ensuring that if a person has a specific task, he/she will have an incentive on how to improve or how to perform this task and this individual would then focus on how to create new tools and machinery that helps him/her to achieve it. This work also includes the concept of *manufacturing secret* and Smith explains that the existence of this *secret* in a company can give the same competitive advantage than having a monopoly. Therefore when Adam Smith started speaking about this concept, he was including indirectly the concept of innovation.

On the other hand, David Ricardo (1817) mentioned that since the improvement of the techniques and the scientific discoveries within a company could lead to a growth in production while using the same amount of time and labour.

Another author who approached the topic of innovation was Karl Marx (1867), which stated that improving working techniques arises from the knowledge and the work done. He said the creation of tools arises from the needs of man, which achieves a marginal increase in labour productivity. Marx said that the technologic change is

needed in order to understand how productivity and economic dynamics are developed.

Howard Stevenson, conducted an analysis, in the 80s about entrepreneurship and innovation. According to him, innovation does not occur only when a new product is created, we also talk about innovation as a new form of management created within a company, or the way that production is changed, etc. (Castillo, 1999). Thus Howard Stevenson added that innovation is a broader concept, and this is not related solely to the creation of a new product, as claimed by Schumpeter and other writers of his time.

It is also important adding that although the innovation may be present in any situation and in any sector, it mainly takes places in companies. Peter Drucker (1985) in his book '*Innovation and innovative entrepreneur*' argues that changes within a company are good. But the employer is not necessarily the one that has to encourage them but he/she would look for them and to have any chance of success.

When researching about innovation, in literature we find different dimensions. These dimensions include: the types of innovation and the factors that may influence decisions to innovate within companies (Rogers, 1983).

As we can see, there are many definitions and explanations of the term innovation, concerning different areas, but ultimately all of them have implied that "To innovate means introducing changes in the way of doing things, in order to improve the final result. Thus, an innovation can be promoted from an action on the price of an item to conquer a market; as an improvement of an old product; or as the discovery of a new use for an existing product." (Ferrer Salat, 1984, quoted in *Business Confederation* Madrid, 1992).

Regarding the types of innovation, Boer and During (2001) provide a response to different criteria classification: the object –product innovation and process innovation; their impact –incremental and radical; the effect of innovation – continuity and rupture; and the origin and nature of innovation.

Another way to classify innovation is based its nature. Thus, Gopalakrishnan and Damanpour (1997) considered technological innovation and management innovation. Technological innovation appears from the use of technology as a way of introducing changes in a company, it is usually associated with changes in the means of

production. Management innovation involves innovations that cannot be included in products or processes. They are innovations in the commercial area, financial area and management area, which help strengthen the innovative power of the company.

Nevertheless the main classification of the different types of innovation that concern us, are the types of innovation in which we have focused this dissertation. This classification is based on the Oslo Manual (2005), which distinguishes four types of innovation: Product innovation is defined as the one that provides good or significantly improves a new service; process innovation is achieved through significant changes in techniques, materials and/or the software used; commercial innovation is how to use a marketing method that has not previously been used in the company; and finally the organizational innovation is the one that causes changes in the practices and procedures of the company.

2.2 Factors affecting business innovation

It is very common finding people involved in innovative activity when talking about innovation in businesses and companies. This means that when developing and creating new ideas, some new obstacles or barriers arise and those sometimes prevent companies from achieving their objectives of easy innovation. When analysing research studies that examine the factors that affect innovation, our findings show that there may be different theories and numerous obstacles that companies overcome in order to innovative. To conduct our research we have considered some of these factors as very relevant, therefore we have included them in our regression.

Hadjimanolis (1999) and Hewitt-Dundas (2006) discussed the theory of resources, this theory showed that differences in innovative activity among companies may be due to inequalities in their former resources. On the other hand, numerous studies show that the most important factors are related to costs, human resources, institutional constraints, organizational culture, the flow of information and government policy (Mohen and roller 2005; Baldwin and Lin 2002). There are authors who claim that due to their financial shortage, small businesses are the most affected by the barriers to business innovation.

Moreover, Guerra (2015) with a new method confirmed that as companies are introducing innovative activities, barriers to reach them look less relevant. The desire of

innovation of such companies is driving them to strive for success; they are therefore convinced that they could overcome such barriers. Contrarily, Tourigny and Le (2003), claim that the greater the degree of innovation of a company is, the more likely they would find barriers and problems to carry out those activities. They base this theory in the reflection that since the company would have a greater area to work on, they will potentially face more complications.

The decisions to whether engage or not in innovation activities within companies depend on the decisions taken by the leadership of each company individually. Furthermore, these decisions will be based on the barriers that are in the innovation process (Shiang and Nagaraj, 2011). The assessment of each Manager has a subjective character, since it is based on the perception that each of them can have about these barriers, this decisions would turn into the different behaviour that each company has to innovation (Mohnen and Rosa, 2002; Baldwin and Lin, 2002; Galia and Legros, 2004).

In the Oslo Manual factors that hinder innovative activities are also collected. The manual refers to economic factors, business factors, and other factors – such as the lack of technological opportunities, lack of infrastructure, lack of need for innovation due to previous innovations, weakness of property rights, regulation of taxes and the indifference of consumers towards the company's new products and processes.

We will divide the variables in our study in three different factors: the cost factor, knowledge factor and market factor. Garcia-Vega and Lopez (2010) after studying the factors affecting innovation in Spain concluded that one of the main factors delaying business innovation is the cost and financial. They also rank second the second factor that prevents innovation concerning the type of market and the lack of knowledge.

We are going to develop a literature review of the different authors who have analysed the cost factors, knowledge factors and market factors that influence business innovation.

Cost factors

One of the main problems in order to carry out different innovative activities is the high cost for companies to innovate. Previous studies have shown that companies that delay their innovative activities are most often the ones who encounter obstacles such as economic risk due to the fact that if they fail to penetrate in the market in the long term, the economical barriers would become harder to overcome in the future.

On the other hand, it is also important to note that we can find simultaneity of barriers within the same company. There are factors that are closely related such as cost and funding sources are commonly given at the same time within the same company (Galia and Lergos, 2004). Normally those companies, for which the high cost of innovation can be a barrier, are those with a lack of funds, insufficient solvency in the balance sheet of the company or lack of funding from external sources.

The challenge of financing innovation is much more complicated due to factors such as the risk produced by uncertainty to innovate, as well as the high costs and the difficulty of assessing the impact of a given innovation project (Freel 2000). There are usually some conflicts arising between the managers of the company, such as the needs of funds investing in innovation and risk aversion. Small businesses are the most subject to this conflict because they have limited financial resources. Whereas the companies that are willing to accept higher risks are normally bigger companies, (Souitaris 2001). These companies are aware that risk is necessary and they must accept it. We must work to overcome the problems that may arise and assume that the innovative process is long and it would eventually arise ideas that will not come to terms, but companies would have to accept the fact that innovation takes time and it is essential to assume risks and complications.

The risk and the increase of the funds demand are closely linked through financial theory. Activities that increase the demand of also increase their own risk. The cost of innovation and the funds demand can become therefore barriers that companies should bare in mind when innovating. Funding corporate debt can lead companies to decrease the quality of their innovations (Jensen and Meckling, 1976). The high risk of investing in innovation and the existence of information asymmetries can lead to problems with debt financing. An increase in debt, can lead to increased conflicts between lenders and the company. Several previous studies point out the negative impact of debt on innovation activity (Giudici and Paleari 2000).

In our study we have therefore included two variables that make reference to the cost factor. The first of them is the lack of funds within the company or group ($FACE1_{i,t-1}$) and the second of them are the high costs of innovation ($FACE3_{i,t-1}$). At the end of our research we will explain the results obtained from these variables, i.e. whether they become a barrier to innovate or not.

Knowledge factors

Knowledge factor is one of the keys to business success. The ability of a company use a machine to the fullest potential in order to make profit, or to create new products, services or processes depends on a great amount on the knowledge and skills of those whose job is to innovate. That is to say, the transformation of the potential efficiency that technology can offer depends on a great amount to the human resources used.

For that reason, one of the main difference between a company that innovate and another that does not innovate would be the provision of highly qualified human resources teams (Galende and de la Fuente, 2003). Innovative companies are able to recruit people with specific knowledge and skills required for innovation processes – they are highly aware of the importance of quality, communication skills, initiative and creativity, capacity for problem solving, capacity for cooperation, teamwork and flexibility.

On the other hand, technological advances are now increasing and more complex, due to the quick advances in technology and it is also owing to convergence between scientific and technological domains that were previously separated. These advances are forcing companies to keep employees capable of accompanying this progress. Usually, companies that invest in innovation successfully have training policies and they provide workers with the knowledge and skills needed to make the best possible use of new technologies, they also generate innovation constantly (Carter and Williams, 1957; Schock, 1974).

Companies that adopt innovation are required commitment and effort from all employees involved in such process (Acemoglu and Pishke, 1999). Baldwin and Lin (2002) argued that there is a very high reluctance to changes in some companies; this reluctance to innovation may be due to inadequate training or insufficient employee

skills. Hence it is a big challenge for the management of a company to be able to train well all their employees and making sure they know all the skills that their job requires. Hausman (2005) pointed out that generally managers of small businesses lack the skills to achieve successful innovation strategies.

In our study, we have included three variables that refer to knowledge factor. These are the lack of qualified members of the staff ($FACI1_{i,t-1}$) the lack of information technology ($FACI2_{i,t-1}$) and the difficulty in finding partners for cooperation ($FACI4_{i,t-1}$). At the end of our dissertation we explain the results obtained from the study of these variables and whether if it is possible to indicate if these factors are a barrier to innovate or not.

Market factors

Market factors are identified by many researchers as one of the most important agents that affect innovation within companies. Companies from all sectors innovate as an answer to market changes. Therefore, changes in the market cause companies that tend to innovate organizationally to be more competitive in order to answer to the market changes (Damanpour and Gopalakrishnan, 1998). It is important to add that there are other cases where companies innovate in order to get involved in the market itself.

It is vital to know the information about the factors of the business environment. For companies, to understand market opportunities, changes in the demand for goods, the policies of governments, allows them to create strategies that will help them to become more competitive (Galia and Lergos 2004). Therefore companies, who are not aware about the rules and market regulations and laws for the protection of innovations, have greater difficulties to innovate.

A barrier to business innovation can become from the lack of information on environmental factors, the lack of support from public administrations, the absence of rules and regulations and the difficulty of protecting innovations by companies (Frenkel 2003). Furthermore, especially in European countries, one of the most significant barriers to innovation nowadays is the lack of government support for business (Piatier, 1984).

On the other hand, another factor that encourages innovation is the competitive pressure between companies, since those companies seek to differentiate themselves from competitors or to achieve a competitive advantage by lowering unit costs (Porter, 1985). Katila and Shane (2005) found a positive relationship between the market factor uncertainty and the rate of innovation, they explained that companies that find themselves in markets with less stability, tend to have a higher encouragement for innovation. This is due to the fact that changes in the market affect companies that in order to survive and keep being competitive would seek innovation (Miller, 1989).

In our research we have included two variables concerning market factors. The following descriptions of the variables included are: Market dominated by established companies ($OTHERFACT1_{i,t-1}$) and uncertainty regarding the demand for goods and services ($OTHERFACT2_{i,t-1}$)². At the end of our dissertation we will explain the results and indicate whether or not these factors are significant in terms of innovation.

Table 1. Literature Review concerning factors affected by innovation.

FACTOR	VARIABLES	AUTHORS
Cost	High innovation cost	(Galia and Lergos 2004), Freel 200)
	Financial Compilation	García-Vega and López (2010), (Galia and Lergos 2004), Jensen and Meckling, 1976
	Limited Financial Resources	Souitaris (2001)
	Debt	(Giudici and Palean 2000).
Knowledge	Provision of qualified human resources	(Galende and de la Fuente (2003), Acemoglu and Pishke (1999)
	Knowledge of technological progress	Carter and Williams, 1957; Schock, 1974, Carter and Williams, 1957; Schock, 1974
Market	Market inestability	(Damanpour and Gopalakrishnan, 1998), Katila and Shane (2005), (Miller, 1989).
	Changes in the goods demand	Galia and Lergos (2004)
	Absence of rules and regulations	(Frenkel 2003)
	Lack of government subsidies	(Piatier, 1984)
	Competition behaviour	(Porter, 1985)

Source: Own Compilation

² See appendix 1 for further reference about research variables.

Given the important role that companies develop in innovation systems, economists have shown interest towards determining what different factors affect the decision about innovation. Table Number 1 shows a summary of the different variables that these authors have considered that influence the companies' innovative activity.

The factors that determine innovation may vary depending on a company's profile, that means that such factors would establish the different barriers that companies face towards innovation (Hösgkolan, 2010).

Consequently it is interesting to research the factors preventing companies to undertake innovative activities. These factors affect competitive level within companies, and have not been studied previously. There are some studies investigating innovative companies, but they would mainly focus on factors such as the size of the company, its legal form, their human resources, their degree of competitiveness of competing companies, their technology and the ability of companies for success of innovative activities (Cohen and Levin, 1989; Freeman, 1990; Cohen, 1995; Encaoua, Hall, Laisney and Mairesse, 2000; Kleinknecht and Mohnen, 2001). On the contrary, the studies that found concerning obstacles to innovation are very marginal, although we should highlight mainly Garcia-Vega and Lopez (2010); and Antonia Madrid-Guijarro (2009) research.

3. DATA

The data used for this project comes from the Technological Innovation Panel³ (PITEC) database, which is gathered by the Spanish Ministry of Economics and Competitiveness. The Technological Innovation Panel seeks to meet the statistical needs as an ideal tool that counts and analyses the evolution of technological activities of the Spanish companies throughout the time.

With data obtained since 2003, PITEC sheds light to some results by analysing more than 460 variables after surveying around 12.000 companies. This analysis allows building up temporal series in order to study the evolution and impact of the innovation in the businesses' sector; furthermore it helps us to identify the different innovation strategies adopted by companies. Being a fixed panel, an annual observation of the constituent companies is performed, which makes the data obtained are high quality and very reliable. The panel of companies is selected from national surveys conducted by the National Institute of Statistics in the field of innovation: "Survey on Technological Innovation in Business" and "Statistics on R&D".

The PITEC has the clear purpose of becoming a statistical reference tool in the analysis of the development of R&D in business nationwide. Thus it allows studying aspects of relevance, as the impact of innovation on productivity, the effect of the costs to innovate, the distribution of business investment between internal and external R&D.

To obtain information about the study variables, the National Statistics Institute conducted national surveys to different companies. The survey is part of the "General Plan of Statistics of Science and Technology" advocated by the Statistical Office of the European Union (Eurostat). The aim of the survey is to quantify the innovative activities of enterprises, among which especially the realization of R&D and the assessment of the effects of such activities.

The questionnaire gathers information on the general characteristics of the different companies, those are: the company's internal activity, their purchase of R&D, the different activities carried out by them in order to achieve technological innovation, their innovation in products and processes, other factors that hinder activities for technological innovation, the company's intellectual and industrial property rights, their revenues and payments for disembodied technology, their organizational innovation, their marketing innovation and their tax deductions for technologic R&D.

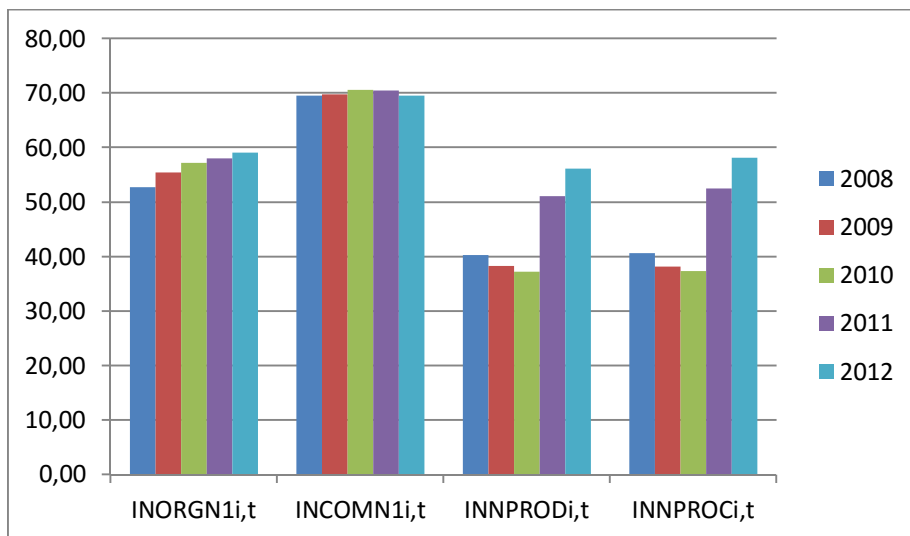
³ For further information, please visit: http://icono.fecyt.es/PITEC/Paginas/por_que.aspx

In our research we have used data from 2006 to 2012 because in 2006 there were more companies added to the sample and therefore the results turn into more interesting and reliable data than if we sampled since 2003 instead. On the other hand there have also added some interesting variables and whose data has not been found in the previous years. Data concerning organizational and commercial innovation are available only since 2008.

Below we are going to perform a descriptive analysis about some variables that we have used in our research, which we believe may be of interest. On the one hand we have analysed the answers of the companies surveyed about whether or not include the different types of innovation in their companies. On the other hand we have analysed the importance of the variables of interest for the companies in our study.

3.2 Descriptive Data

Figure 1: Percentage of surveyed companies that are innovative



Source: Own Compilation

On the first place we have been compiling data in one graph that represent the independent variables given in our surveys relating to four types of research.

The following graph represent the percentage of companies that innovate and also the percentage of companies that do no innovate from the sample of companies surveyed every year we have been carrying out the surveys. We have been distinguishing

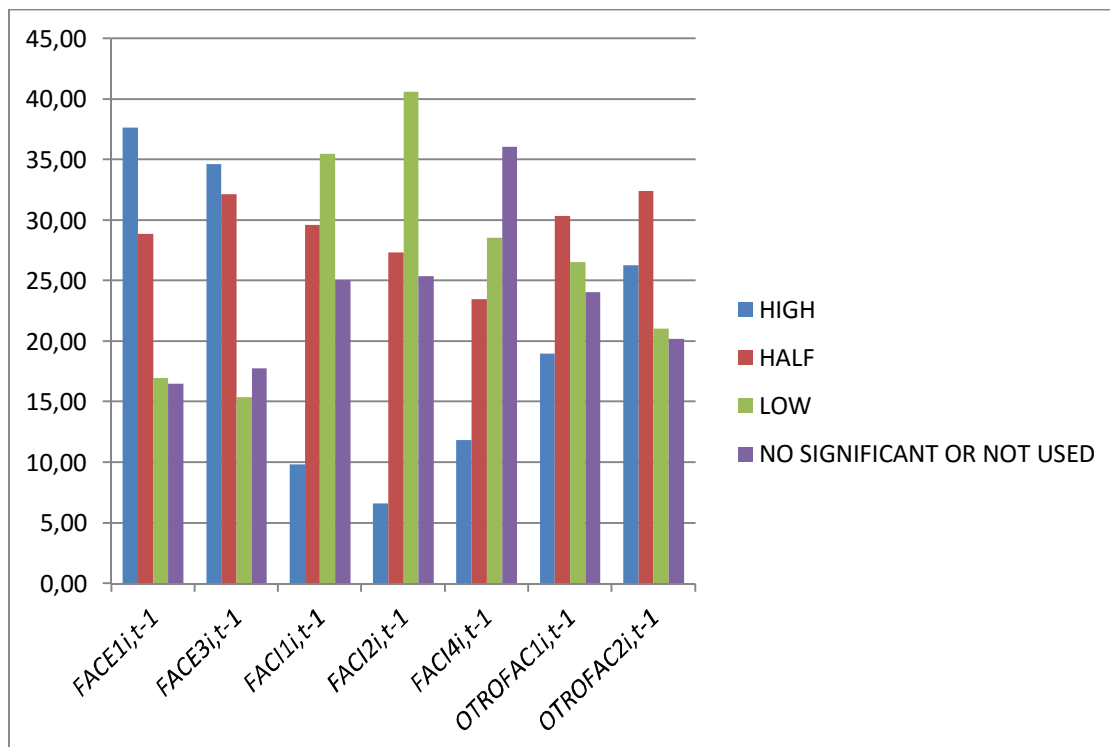
between the different types of innovation, such as: organizational innovation, commercial innovation, product innovation and process innovation.

We can distinguish some significant changes in the period 2008 to 2012 in which we focused our study.

In the first three years of our sample, the companies have not experienced noticeable changes. They are low on what product innovation and process concern –less than 40% of companies, and they have a significantly higher percentage of surveyed companies that used the commercial innovation –approximately 70%. And we found a slight increase organizational innovation from 52% to 56%.

In the years 2011 and 2012 surprisingly we observe that the companies surveyed increased significantly in product innovation and process innovation, leading to innovation in such more than 55% of the companies in which the survey was conducted, on the other hand the constant organizational innovation has been increasing slightly, reaching up to 58% of the companies surveyed.

Figure 2. Relevance of the interest variable to the surveyed companies.



Source: Own Compilation

Figure number 2 represents the importance that the surveyed companies give to the different factors that affect innovation.

The graph shows that cost is the factor that companies consider most relevant owing to the fact that it impedes the realization of innovative activities. This is narrowly related to the high cost of innovation ($FACE3_{i,t-1}$) and the lack of funds within the company or group ($FACE1_{i,t-1}$). Secondly we consider that companies find important the market factor, both the variable that refers to be dominated by established companies ($OTHERFACT1_{i,t-1}$), as the uncertainty regarding the demand for goods and services ($OTHERFACT2_{i,t-1}$). They depict markets as a moderately relevant obstacle for Spanish companies. Finally the knowledge factor is less important for the companies to innovate, since a large number of companies have given low relevance to these variables.

Moreover we are going to check if the importance that companies give to the studied factors coincides with the barriers that we have found in our research.

4. METHODOLOGY AND ESTIMATION

In order to carry out our estimation we have used a *probit* model for a panel dataset. We are going to explain what are panel statistics based on and where the *probit* model comes from.

An econometric panel data model is when it includes a sample of operators, or interest, in our case companies, for a certain period of time. The panel combines temporal data and structural data. In our research we have annual data of different variables that affect innovation, this data was interrupted for a period of five years. Therefore, it is a mixed database, with temporal character and transversally cross-sectioned.

An econometric panel data model is one that includes a sample of operators, or interest, in our case companies, for a certain period of time. That is, temporal dimension combines data and structural data. In our study we have annual data of different variables that affect innovation, for a period of five years interrupted. Therefore, a base is mixed data, time series and cross-section, which is a data panel.

The main objective of implementing and study such data panel, is to capture the unobservable heterogeneity, either between economic agents or to study as well as in the time. This technique allows for a more dynamic by incorporating the temporal dimension of the data analysis, which enriches the study, particularly in periods of greater changes. This method of analysing information in a panel model is very common in microeconomic studies.

The statistical method of our analysis is a *probit* model, we have chosen this model because our dependent variables are binary. The Probit regression is a nonlinear model specifically designed for binary dependent variables. Our methodology concerns adopting a nonlinear formulation requiring that the estimated values are between 0 and 1. The *probit* regression uses a standard normal distribution function. This probability distribution function results in probabilities between 0 and 1, and have a nonlinear growth. The *probit* model is based on regular cumulative distribution.

It is assumed that the decision to innovate or not depends on an Index I –known as latent variable. This given Index I is determined by one or several explanatory variables. The higher the Index is, the higher the probability that the company innovates would be. As we can see in the following formula:

$$I_i = \alpha + \beta X_i \quad (1)$$

Given the idea that I^* is a critical threshold, beyond which, if I exceeds I^* then the company is supposed to innovate. The threshold I^* , like I , is unobservable. Assuming that I is normally distributed with the same mean and variance is possible to estimate the parameters of the index and also some information about I^* .

$$P_i = P(Y = 1|X) = P(I^* \leq I_i) = P(Z_i \leq a + b X_i) = F(a + b X_i) \quad (2)$$

Where Z is a normal standard variable, $Z \sim N(0, s^2)$, F is the cumulative normal distribution function.

The estimate is made by MV (Maximum likelihood). Since each company i the likelihood function is the probability that there are innovated or not (1 or 0).

Moreover, in these models is not possible to directly interpret the estimates of β parameters, as they are nonlinear models. What we will do in practice is to look at the sign of the estimators. If the estimator is positive, it means that increases in the associated variable cause increases in $P(Y = 1)$ (although the magnitude of such are unknown). Conversely, if the estimator shows a negative sign, this implies that it increases in the associated variable that causes a decrease in $P(Y = 1)$.

In our case, to analyse the barriers to innovation of Spanish companies we use the following formula:

$$\begin{aligned} (P(\text{Innovación}) = 1) = & \\ & \beta_0 + \beta_1 \ln AGE_{i,t-1} + \beta_2 \ln SIZE_{i,t-1} + \beta_3 GROUP_{i,t-1} + \beta_4 EXPORT_{i,t-1} + \beta_5 FACI1_{i,t-1} + \\ & \beta_6 FACI2_{i,t-1} + \beta_7 FACI4_{i,t-1} + \beta_8 FACE1_{i,t-1} + \beta_9 FACE3_{i,t-1} + \beta_{10} OTHERFACT1_{i,t-1} - \\ & 1 + \beta_{11} OTHERFACT2_{i,t-1} + \delta_i + \gamma_t + \varepsilon_{i,t} \quad (3) \end{aligned}$$

We consider as the dependent variable the willingness to innovate of the companies and we are going to study the determinants of this willingness. Such factors can be varied, in this dissertation we have divided them in three different groups: knowledge factors, cost factors and market factors. On some of these variables the company will control capability over other such capacity will be reduced. We have included variables such as age, size, company group and exports explaining the dependent variable.

In the next section we will explain in detail the meaning of the variables that we have included in our equation. We have differentiated between dependent variables and independent variables, and within between explanatory variables and independent variables of interest.

4.1 Variables

4.1.1 Dependent variable

In our study we have made four different estimations with four different dependent variables that make reference to the four different types of innovation. We have followed the Oslo's Manual classification as we have mentioned before in the theoretical part: commercial innovation, organizational innovation, products innovation and processes innovation. The dependent variable of our model is a binary one, that is to say, it takes value 1 when the company innovates and 0 if it does not do it. The questionnaire included a series of questions are collected to determine whether or not companies innovate. In the following part we explain each of the four dependent variables in this dissertation.

To find out if a company introduces **commercial** innovation – that is using a marketing method not used before in the company. In the questionnaire there are a number of questions that the company has to answer:

- Has your company introduced any substantial changes on product design or in packaging of your goods or services?
- Has your company introduced new techniques or ways to promote your product?
- Has your company introduced new methods to increase the position of the product in the market or new ways of sales?
- Has your company introduced new methods to establish your prices of the goods or services?

If one of these answers is affirmative, it is considered that the company introduces business innovation. In the event that the company uses commercial innovation the variable $INCOMN1_{i,t}$ take the value 1, otherwise it would take the value 0.

To find out if the company introduces **organizational** innovation –changes in direction and organization under which the production and commercial activity of the company is developed. The questionnaire asked the following questions to the companies surveyed:

- Has your company introduced its new business practices in work organization or company procedures?
- Has your company introduced your new methods of organizing workplaces in your company with the objective of a better distribution of responsibilities and decision-making?
- Has your company introduced new methods of managing external relations with other firms or public institutions?

If one of these questions is affirmative, the company is considered that the company introduced organizational innovation. In the event that the company uses organizational innovation variable $INORGN1_{i,t}$ takes the value 1, otherwise it would take the value 0.

The **product** innovation –introduction into the market of goods or services new or improved significantly, was assessed to determine whether the company introduced this type of innovation in its production process or not, by the following questions:

- Has your company introduced real business innovations?
- Has your company introduced service business innovations?

If one of these questions is affirmative, it is considered that the company introduced product innovation. In the event that the company uses product innovation Variable $INNPROD_{i,t}$ take the value 1, otherwise take the value 0.

To find out if the company introduces **processes** innovation –implementing production processes, distribution methods or support activities to goods and services that are new or provide a significant improvement, in the questionnaire there are a number of questions that had to answer whether or not:

- Has your company introduced or improved significantly new business methods of manufacture or production of goods or services?
- Has your company introduced new or improved significantly any logistics systems or delivery methods for inputs distribution, goods or services?

- Has your company introduced new or improved significantly support activities for processes such as maintenance systems or computer operations, accounting or purchases?

If one of these questions is 'yes', it is considered that the company introduces innovation processes. In the event that the company uses process innovation Variable $INNPROC_{i,t}$ take the value 1, otherwise it would take the value 0.

4.1.2 Independent Variables

Explanatory Variables

Explanatory variables in our research are ones that involve: $lnAGE_{i,t-1}$, $GROUP_{i,t-1}$, $lnSIZE_{i,t-1}$ and $EXPORT_{i,t-1}$. In the review of the theory of innovation we have found that these variables may be relevant when investigating innovation within the company, and therefore we have included them in our study.

We have generated the variable age from two different variables included in the database PITEC, this variable is the result of subtracting the variable $lnANIOCREA_{i,t-1}$ the $lnYEAR_{i,t-1}$ variable, the result would be: $lnAGE_{i,t-1} = lnYEAR_{i,t-1} - lnANIOCREA_{i,t-1}$. Therefore the variable $AGE_{i,t-1}$ represents the years that have elapsed since the date of creation of the surveyed company, it is a logarithmic variable that takes the value of year t-1. The $GROUP_{i,t-1}$ variable represents the fact that the company belongs or not to a business group, it is a fictional variable that takes value 1 when the company belongs to a business group and 0 when not, it also takes the value year t-1. The $lnSIZE_{i,t-1}$ variable represents another factor that may affect the innovation process of a company, it is measured by the number of employees, in our research it is represented by a logarithmic variable that takes the value of year t-1. Finally the $EXPORT_{i,t-1}$ variable, is another fictional variable that takes value 1 when the company exports and value 0 when it does not do it. Exports are basically when the company sends a product or service to another part of the world beyond national borders for commercial purposes.

Interest variables

After analysing various papers related with the barriers to business innovation in Spain, aforementioned in the theoretical framework studies, we have selected seven variables of our data that we believe can influence companies to innovate. We also have divided these seven variables into the three different groups: cost factors, knowledge factors and market factors.

Among the **cost** factors we have two variables: $FACE1_{i,t-1}$ –lack of funds within the company or group, and $FACE3_{i,t-1}$ –high innovation costs. They are variables that describe the cost factor that may occur in companies. The two variables take values from 0 to 4 –being 4 not important and 1 highly important.

The variables measuring **knowledge** factor in our research are: $FAC1_{i,t-1}$ –lack of qualified staff, $FAC2_{i,t-1}$ –lack of technological information, and $FAC4_{i,t-1}$ –difficulty in finding partners for cooperation in innovation. These three variables also take values from 0 to 4. In our survey we asked managers to answer by giving a number from 1 to 4, with four being not relevant and one being really relevant.

The variables used in this study to measure **market** factors are: $OTHERFACT1_{i,t-1}$ – market dominated by established companies, and $OTHERFACT2_{i,t-1}$ –uncertainty regarding the demand for goods and services. This was managed in the same way as the aforementioned two factors.

Finally we introduce temporal γ_t and industry δ_i dummies to control everything that affects and is unnoticeable by the own industry and those unobservable factors that change over time, not representative factors that change over time and are place themselves outside the industry.

To make our econometric analysis we used the econometric program Stata 12 with *xtprobit* command. For each type of innovation we have made 3 different regressions, due to the fact that the variables of interest are correlated with each other, and thus we will obtain more reliable results.

5. RESULTS

Table 2 shows the results obtained from the aforementioned estimation.

In this analysis, we have analysed the meaning of each of the variables. Once we had selected the ones that are significant for the companies' innovation, we have analysed whether the effect is positive, i.e. if the factors studied are an incentive for innovation within companies, or if instead the effect is negative, i.e. a barrier to innovation.

The $InAGE_{i,t-1}$ Variable affects negatively all types of estimated innovation, but it is only significant in organizational innovation. Therefore the older a company gets, the less probable this company will innovate. This may be because more senior companies are better established in the market and they would not need innovation in order to survive. Meanwhile, emerging companies will have greater claim to innovate if they want to get a higher market share.

The $InSIZE_{i,t-1}$, is a significant variable in all types of innovation, this means that the more likely a company is to innovative in trade, organization, products and processes the more likely they will grow if they increase the size of the company. Therefore, this means that in the case of Spain, large companies tend to undertake more facilities and they develop more innovative activities than smaller companies.

This is owing to the fact that large companies usually have a higher number of businesses and have a higher budget devoted to innovation. On the other hand, according to various studies, it is shown that innovative companies increase the number of employees by approximately 10%, this reciprocal effect causes that innovative companies tend to be larger.

The $GROUP_{i,t-1}$ variable is significant only in organizational innovation. Therefore a company belonging to a group of companies is more likely to innovate organizationally than a company that does not belong to a business group. This may happen because when a company belongs to a group, they can manage their business on a more agile way. On the other hand, business groups have common directors who are probably more qualified managers than the ones working on individual companies.

The fact of a company is exporting its goods or services, has always a positive effect on all types of innovation. Therefore companies that export are more likely to innovate than companies that sell their goods within the national territory exclusively. These results are proven since several studies have shown that companies that ship their

products across their borders have a positive tendency to innovation over 15% more than companies that do not export their production.

Finally we will analyse the results of the variables of interest. As explained above, these variables have been classified in three groups, for which we made three different regressions. We have differentiated cost factors, market factors and knowledge factors.

Firstly we are going to explain the results of the factors of knowledge. The $FAC1_{i,t-1}$ variable –lack of qualified staff, is negatively significant for the product innovation and also for the process innovation. That is to say, when the lack of qualified members of the staff increases the probability of having commercial innovation and process innovation decrease, therefore, the lack of qualified members of the staff would be a barrier to the company's innovation. This is owing to the fact that the most educated workers are better able to solve problems and face entrepreneurial activities with less fear, in such way that they will incentivize more innovation in their companies. The following variable knowledge, $FAC2_{i,t-1}$ –is the lack of information about technology. This is not significant, that is to say, it does not have an influence when it comes to decision making whether to be innovative or not to be. The last variable included in our research refers to the knowledge factor with the $FAC4_{i,t-1}$ variable –that is the difficulty to find partners. This would only be significant for innovation in process, such as its meaningfulness is negative. That is to say that some companies who face difficulties finding partners are less likely to innovate, therefore this variable would become a barrier to the innovation processes.

The second factor to explain is the cost factor. Firstly we will explain the results of the $FACE1_{i,t-1}$ variable – the lack of funds within the company. This variable is a barrier to innovation in business processes, as the significance obtained is negative. The odds that a company innovates in processes would decrease when increasing the lack of funds within the company. The next variable cost factor is $FACE3_{i,t-1}$ –the high costs of innovation. This factor is a barrier to all types of innovation, thus the likelihood that Spanish companies innovate will decrease if innovation costs increase.

The last group of factors is the market factors, this includes the variables $OTHERFACT1_{i,t-1}$ –which represents a market dominated by established companies. Also $OTHERFACT2_{i,t-1}$ –which represents uncertainty regarding demand for goods and services. These variables are not significant when it comes to decision making about innovation in Spanish companies.

The aforementioned interpretation of the results is based solely on the sign of the effect of a change in the explanatory variable on the probability of innovating. Since, in a *probit* model, the magnitude of the effect of a change in one variable cannot be represented directly by the coefficient estimation for this purpose, in order to achieve that we should calculate first the marginal effects.

According to the results of the method used, the cost variables are those that have greater weight in the decision to innovate within companies, which are significant for all types of innovation. Furthermore, it is also important to consider whether if the companies' members of staff are qualified and the difficulties they face in partner finding.

Table 2. Econometrical regression results

VARIABLES	INCOMN1 _{i,t}	INCOMN1 _{i,t}	INCOMN1 _{i,t}	INORGN1 _{i,t}	INORGN1 _{i,t}	INORGN1 _{i,t}	INNPROD _{i,t}	INNPROD _{i,t}	INNPROD _{i,t}	INNPROC _{i,t}	INNPROC _{i,t}	INNPROC _{i,t}
<i>ln AGE</i> _{i,t-1}	0.00370 (0.0849)	-0.0512 (0.0727)	-0.0149 (0.0759)	-0.152* (0.0806)	-0.135** (0.0681)	-0.121* (0.0705)	-0.0543 (0.0682)	-0.0425 (0.0600)	-0.0107 (0.0635)	-0.0635 (0.0648)	-0.0428 (0.0571)	-0.0537 (0.0594)
<i>lnSICE</i> _{i,t-1}	0.395*** (0.0407)	0.342*** (0.0346)	0.382*** (0.0361)	0.668*** (0.0414)	0.592*** (0.0343)	0.643*** (0.0358)	0.448*** (0.0350)	0.442*** (0.0305)	0.475*** (0.0322)	0.595*** (0.0352)	0.559*** (0.0303)	0.572*** (0.0314)
<i>GROUP</i> _{i,t-1}	0.000400 (0.104)	0.0201 (0.0892)	-0.0188 (0.0923)	0.140 (0.0987)	0.203** (0.0839)	0.154* (0.0863)	0.120 (0.0866)	0.0692 (0.0766)	0.118 (0.0801)	0.0970 (0.0825)	0.0723 (0.0729)	0.138* (0.0751)
<i>EXPORT</i> _{i,t-1}	0.286*** (0.0795)	0.294*** (0.0666)	0.339*** (0.0694)	0.304*** (0.0767)	0.284*** (0.0636)	0.321*** (0.0658)	0.684*** (0.0702)	0.611*** (0.0604)	0.647*** (0.0632)	0.281*** (0.0669)	0.206*** (0.0576)	0.279*** (0.0598)
<i>FAC1</i> _{i,t-1}	0.0297 (0.0617)			0.0467 (0.0592)			-0.157*** (0.0561)			-0.111** (0.0539)		
<i>FAC2</i> _{i,t-1}	0.0292 (0.0694)			0.00277 (0.0673)			-0.0797 (0.0651)			-0.0671 (0.0622)		
<i>FAC4</i> _{i,t-1}	-0.0183 (0.0495)			0.0313 (0.0471)			-0.188*** (0.0452)			-0.0216 (0.0433)		
<i>FACE1</i> _{i,t-1}		-0.00502 (0.0508)			0.0443 (0.0482)			-0.0376 (0.0480)			-0.0903* (0.0462)	
<i>FACE3</i> _{i,t-1}		-0.0889** (0.0446)			-0.0874** (0.0423)			-0.188*** (0.0420)			-0.108*** (0.0402)	
<i>OTROFAC1</i> _{i,t-1}			0.0453 (0.0431)			0.0836 (0.0404)			-0.0670 (0.0411)			0.0204 (0.0386)
<i>OTROFAC2</i> _{i,t-1}			0.110 (0.0418)			-0.0100 (0.0395)			-0.00952 (0.0401)			-0.0494 (0.0377)
Constant	-2.820*** (0.311)	-2.628*** (0.280)	-3.124*** (0.275)	-2.714*** (0.297)	-2.481*** (0.263)	-2.862*** (0.257)	-1.165*** (0.252)	-1.257*** (0.234)	-1.668*** (0.231)	-2.416*** (0.246)	-2.305*** (0.228)	-2.483*** (0.221)
Observations	10,658	14,025	13,656	10,658	14,025	13,656	10,658	14,025	13,656	10,658	14,025	13,656
Number of IDENT	4,796	5,710	5,635	4,796	5,710	5,635	4,796	5,710	5,635	4,796	5,710	5,635
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
p	0	0	0	0	0	0	0	0	0	0	0	0
chi2	187.4	205.2	216.7	439.9	529.8	544.8	785.4	1072	1021	762.3	1079	1043

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

6. CONCLUSIONS

This study intended to research the barriers to business innovation, differentiating four main types of innovation –product innovation, process innovation, organizational innovation and commercial innovation, in the Spanish companies. The data used came from the database PITEC and it has been composed from a sample of more than 7000 companies all of them located within national borders.

We know that innovation affects companies when successfully compete within an increasingly globalized market; since innovation is one of the main drivers of productivity and is key for a company to be competitive. Therefore, once we know what are the barriers affecting business innovation we can support company managers in the process of strategy creating and we could also help Government in order to improve its policies in order to help a growth in the country's economy, to promote the job creation and ultimately to increase the wealth of the country.

Consequently, we believe that those companies that perceive innovation, as a potential source of competitive advantage, and value creation should rely on such ideas. In order to develop such innovation they will need help firstly eliminating all the barriers that can get in the way, they should also push aggressively to achieve their goals and thirdly they would need to cooperate with their business environment. Companies must act and cannot wait for other external endeavours –such as the government administration, to act upon themselves in order to promote such innovation on their behalf. Hence, innovative companies ensure their own survival while also contribute to the transformation of the business. Only by having a committed and active attitude makes possible to obtain profits from the effort invested on innovation, both in tangible terms –higher income; and intangible –skills development, better brand positioning in the market, networking, etc.

On the other hand, taking into account that our country finds itself in one of the biggest economic recessions of the contemporary history, encouraging innovation becomes a necessary task, taking into account also that, the budget invested in business is very low in comparison with the rest of European Union country members. Furthermore, according to COTEC 2014 report, which collects data from the INE 2012, only 4 of every 1,000 Spanish companies are innovative. This may be the case due to the fact that Spanish companies are not yet aware of how important the role of innovation is inside a company and they are probably not aware about the serious

problem that they face regarding to the loss of competitiveness. Hence it is important to highlight once more the importance of understanding the barriers to innovation.

We should note that there are no similar barriers to innovation for all countries, not even for the different regions within a country. Each country and each region has its own peculiarities and what has worked in a country does not necessarily work in another. However, this should not be a reason to believe that in Spain is not able to reach the levels of innovation than other more developed neighbour countries. Knowing the factors that encourage innovation and entrepreneurship, and knowing those that act against it, we could foreknow the actions that the companies must follow to successfully achieve innovation. Notwithstanding, following the appropriate steps does not guarantee success in this area due to the fact that even in the country does not achieve an immediate innovation in its businesses, the work towards innovation and the actions performed will have a positive impact on the entrepreneurial spirit and its economic situation.

Regarding the descriptive analysis of the factors that we have considered that could become a barrier to innovation, we find that the factor in relation to the costs is one of the most important obstacles that companies perceive when it comes to innovate. As noted in the theoretical framework, cost related issues are particularly important due to the difficulties in funding and because some of its inherent characteristics such as uncertainty and risk involved in innovation.

An important finding in our study is the differential impact on different types of innovation. Product innovation, process innovation, organizational innovation and marketing innovation are affected differently by the factors. Such affects product innovation and processes innovation is affected by internal factors such as lack of qualified staff and lack of financial resources. On the other hand, the difficulty in finding partner companies affects only the product innovation. We have observed that commercial innovation is affected by cost variables, such as lack of funds within the enterprise and high innovation costs. We note that the most important obstacles are associated with costs and this affects all types of innovation. An important finding is that although managers do not qualify human resources as an important barrier, a lack of a powerful human resources team has a negative impact on innovation in the company.

To understand the barriers to innovation can help managers to foster an innovative culture while avoiding a resistance to new ideas attitude. The alignment of a culture of

innovation with the business strategies of the company can lead to greater efficiency and organization success.

In conclusion, our results suggest a positive effect of the obstacles considered i.e. – factors related to financing, market factors and knowledge factors, on the probability of abandonment of innovation projects. Moreover, the greatest impediment obstacle supposed to innovate in business is the cost factor.

After further explanation of the conclusions drawn in this dissertation, there are several aspects to consider and we should mention a number of limitations and recommendations for companies.

On the one hand we have removed one of the barriers that most affects innovation such as its high cost. There are several factors that might cause this high cost. Therefore we have found that one of such factors is the problem of finding well-qualified employees to carry out a particular job. The difficulty of finding highly qualified staff implies that the salary of these professionals have to be higher, for them to stay in the company or even in the country. This is an important limitation towards innovation and it causes that the overall cost of undertaking innovative activities in a company becomes higher.

On the other hand, we found that another main barrier to innovation is the lack of funds, so companies wishing to innovate, usually seek financial assistance. Consequently, it would be interesting that in the future, the impact of public investment in innovation funding could be considered. This investment could be produced in order to determine whether or not to reduce the tendency to delay or halt innovation if they increase the state's funding.

7. BIBLIOGRAPHY

Adam, M. R., Rodríguez, J. M., y Montesa, J. O. (2002). *Análisis de Barreras a la Innovación Tecnológica en la PYME de la Comunidad Valenciana*, pp. 311-319.

AECA (1995). *Estrategia e Innovación de la Pyme Industrial en España*, Estudios Empíricos. Madrid: Asociación Española de Contabilidad y Administración de Empresas.

Baldwin, J., y Lin, Z. (2002). *Impediments to advanced technology adoption for Canadian manufacturers*. *Research policy*, 31(1), pp. 1-18.

Benito-Hernández, S., Platero-Jaime, M., y Rodríguez-Duarte, A. (2012). *Determinants of innovation in Spanish micro-enterprises: The importance of internal factors*. *Universia Business Review*, (33), p 104.

Bueno, M. J. S. (2008). *El proceso innovador y tecnológico: estrategias y apoyo público*. *Netbiblo*.

Cañibano, C. (2005). *El capital humano: factor de innovación, competitividad y crecimiento*. *Sexto congreso de economía*. Navarra.

Corchuelo, B., y Carvalho, A. (2013). *Obstáculos a la innovación y políticas públicas orientadas al fomento de la innovación*, pp. 231-258.

Cotec (2006). *Tecnología e Innovación en España*. Ed. Informe Cotec 2006. Madrid: Fundación Cotec para la Innovación Tecnológica.

Fernández, S. P., Magdaleno, J. A. R., y Zesati, R. E. F. (2014) *La influencia de las barreras a la innovación que limitan la competitividad y el crecimiento de las pymes manufactureras*.

Freel, M. (2000). *Barriers to Product Innovation in Small Manufacturing Firms*, *International Small Business Journal* 18(2), pp. 60–79

Galende, J., and J. De la Fuente (2003). *Internal Factors Determining a Firm's Innovative Behaviour*, *Research Policy* 32, pp. 715–736

García-Vega, M., y López, A. (2010). *Determinants of abandoning innovative activities: evidence from Spanish Firms*. 13(45), pp. 69-91.

Gutiérrez, H. A., Martínez, M. L. D. L. F., y Reza, M. N. B. (2010). *Propuesta Metodológica para evaluar la Gestión de la Innovación Tecnológica (GIT) en pequeñas y medianas empresas (PYMES)*. Méjico, 14(26), pp. 226-238.

Hadjimanolis, A. (1999). *Barriers to Innovation for SME in a Small Less Developed Country* (Cyprus), *Technovation* 19, pp. 561–570.

Kane, B., Crawford, J., & Grant, D. (1999). *Barriers to effective HRM*. *International Journal of Manpower*, 20(8), pp. 494-516.

Madrid-Guijarro, A., Garcia, D., y Van Auken, H. (2009). *Barriers to innovation among Spanish manufacturing SMEs*. *Journal of Small Business Management*, 47, pp. 465-488.

Miller, D. (1987). "The Structural and Environmental Correlates of Business Strategy," *Strategic Management Journal* 8, pp. 55–76.

Monterrey, N. L. (2010). *Study About the Perception on Innovation and Development Among the Managers of Small and Medium Companies*. Case Study. Daena: *International Journal of Good Conscience*,5(2), pp. 246-276.

Suárez, O. M. (2004). *Schumpeter, innovación y determinismo tecnológico*. *Scientia et Technica*, 2(25), pp. 209-213.

Zott, C., y Amit, R. (2010). *La importancia de innovar en el modelo de negocio*. *Revista de Antiguos Alumnos del IEEM*, 13(1), pp 65-70.

8. APPENDIX

Appendix 1: Variables used in our dissertation explanatory grid.

Dependent Variable	Description	Range
<i>INCOMN1_{i,t}</i>	Commercial innovation	1,0,Blank
<i>INORGN1_{i,t}</i>	Organizational innovation	1,0,Blank
<i>INNPROD_{i,t}</i>	Product innovation	1,0,Blank
<i>INNPROC_{i,t}</i>	Innovation process	1,0,Blank
Independent Variables	Description	Range
<i>InAGE_{i,t-1}</i>	Years old is the company	
<i>InSIZE_{i,t-1}</i>	Its number of employees	
<i>GROUP_{i,t-1}</i>	It belongs to a group of companies	1,0
<i>EXPORT_{i,t-1}</i>	Export volume, represents if the company exports	1,0
<i>FACI1_{i,t-1}</i>	Lack of qualified staff members	1,2,3,4
<i>FACI2_{i,t-1}</i>	Lack of technological information	1,2,3,4
<i>FACI4_{i,t-1}</i>	Difficulties to find partners to cooperate or innovate	1,2,3,4
<i>FACE1_{i,t-1}</i>	Lack of funding inside the company or group	1,2,3,4
<i>FACE3_{i,t-1}</i>	High costs of innovation	1,2,3,4
<i>OTHERFAC1_{i,t-1}</i>	Market dominated by established companies	1,2,3,4
<i>OTHERFAC2_{i,t-1}</i>	Uncertainty regarding the demand for goods and services	1,2,3,4

Source: Own Compilation from PITEC database.

Anexo 2: Summary statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
INCOMN1	33079	.1955924	.396662	0	1
INORGN1	33079	.3660631	.4817343	0	1
INNPROD	64230	.5804297	.4934925	0	1
INNPROC	64230	.562572	.4960732	0	1
TAMANO	64238	219.7012	882.4149	0	38756
GRUPO	64169	.3829731	.4861156	0	1
EXPORT	16782	18.37695	25.47764	0	100
FACI1	60283	2.731102	.9527432	1	4
FACI2	60283	2.832158	.8862494	1	4
FACI4	60283	2.924042	1.028066	1	4
FACE1	60283	2.21764	1.097081	1	4
FACE3	60283	2.19513	1.09403	1	4
OTROFAC1	60283	2.566329	1.059771	1	4
OTROFAC2	60283	2.418227	1.063865	1	4
año	67619	2007.799	2.736522	2003	2012
Cluster	67619	1.977565	.8965953	1	4
ANIOCREA	25927	1982.073	21.81475	1464	2010

Source: Own Compilation