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Decentralization in Research and Development activities

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1. Introduction

The focus of this study is based on how R&D affects to the companies in Spain, taking as outstanding variables both centralization and decentralization.

As defined by Schilling (2008), "*centralization is the degree to which decision-making authority is kept at top levels of the firm, while decentralization is the degree to which decision-making authority is pushed down to lower levels of the firm*". Another key term used along this study is innovation, to which Bessant and Tidd (2007) refer as "*the process of translating ideas into useful - and used - new products, processes or services*".

When companies decide to produce, they can either create a new product or to copy it from another successful firm. On both cases, when their intention is to innovate, they have to choose which organizational strategy they prefer in order to have the most efficient results. In consequence, a decision on the locations of their business units has to be done, and they can reach their purpose through two different forms: a centralized or a decentralized structure.

A centralized structure is characterized by merely one location business unit in which are concentrated all the different departments of the company, therefore all the activity of the firm takes place in one particular place. This structure makes able a greater level of communication inside the firm, and it also derives into a better coordination between the various areas that it holds. Moreover, it allows to the companies to have a greater scope as they are concentrating all their know-how and efforts into one specific aim.

On the other hand, decentralized structures are those in which there is a main business unit, but there are smaller locations found in specific destinations. It could be understood as a subdivision of the firm, which decides to transfer a department into a distinct region. On our case study, we are going to focus this particular locations on the perspective of R&D, hence the companies decide to apply this structure in order to improve their implementation of innovation, specifying their outcome to a distinguished target audience. Decentralizing implies some significant expenses, from the locations itself and from the research done behind this type of decisions. Also it can create some difficulties on the communication between all the departments of the company.

Nevertheless, what makes decentralized structures appealing is their ability to obtain substantially more information and knowledge than in centralized structures. Therefore it is a key decision when companies attempt to implement R&D strategies.

The purpose of our analysis is to determine which is the most common pattern when firms apply R&D in Spain, establishing whether if they prefer centralized or decentralized structures. We are going to study the data from a number of Spanish companies, and develop some interpretations from the results obtained in order to observe their behavior when they utilize innovation. We own information from the years 2006 and 2012, and we are going to apply a "Hypothesis test for differences between means" to subsequently compare the resolution for both structures. Based on a handful of predictions, we have established three Hypothesis, which we will later on introduce.

Throughout this analysis we will also obtain a response on their evolution from 2006 to 2012. Between these six years economical difficulties have been a common path in the European Union, since a crisis started around 2008. Thus,

taking into account their behavior will enable us to examine which have been the effects of these recent events.

Ultimately, we are going to compare this results to previous studies done before, as it is the article written by Leiponen A. and Helfat C. (2010), which follows a similar model to ours thought it is applied to data from Finland. Innovation and organizational structure are the focus of our study. Along these terms will be further analyzed the relationship between these parameters, their efficiency, as well as their impact into the companies. Firstly, we will introduce some studies previously written about how companies incorporate R&D into their structures, and following it will be the exposure of our Hypothesis to later present the empirical analysis that is going to be used. Ultimately the results obtained will support or refuse our assumptions.

2. Theorist Standpoint

2.1 Review of the literature

Previous researches written about the relationship between R&D and organizational structures have been reviewed in order to develop this study. They are closely related to our subject, and we are now going to analyze their resemblances.

Among them is encountered the research done by DeSantis, Glass, and Morris-Ensing (2002), that contains a detailed analysis on centralized and decentralized R&D related to innovation, which is the same relationship that is going to be examined on our case study. This article provides a short background about R&D development, in which explains that the only structure available until approximately 1980 was centralization. Since then, technological improvements have allowed to the companies to invent a new approach for innovation, more efficient and competitive such as decentralized R&D. It also mentions an intermediate level between centralization and decentralization, which upcoming studies have also referred to, however we are going to keep the focus of our analysis on centralized and decentralized structures.

Another study that is related to our topic is the one written by Schilling M. (2008). On this book can be found a chapter focused as well on centralized and decentralized R&D activities, but taking into account a new variable, the size of the company. As it might be easier to think at a first glance, bigger companies are able to obtain bigger revenues, therefore they can invest more on R&D. This companies can benefit from economies of scale and learning curve. On the other hand, small firms can not rely on such scenarios, but they often support innovation and are more flexible than big firms. Into our analysis, which will be based on data from Spanish companies, size will be also considered as an outstanding variable. We are going to study whether if decentralized structures are more common in smaller or larger firms, which it is an interesting point to investigate because Spain is mainly formed by small companies as the Spanish Organization for PYMES assures (Data from the "Dirección General de Industria y de la Pequeña y Mediana Empresa" (2012). Ministerio de Industria, Energía y Turismo. Reviewed on the 2nd of May 2015 from: www.ipyme.org). On these lines can be found the article written by Arora A., Belenzon S., Rios L. (2013) in which centralized, decentralized and hybrid (a mix of both) firms have been analyzed in the three different dimensions: research, external knowledge

and firm structure. From the analysis done, we can take some main conclusions that are interesting to further understand our topic. They justify some studies done before that assume a relationship between a company's structure and the degree of innovation, in which we will also deep into. A point that has not been taken into account before is that decentralized structures are linked to an external orientation. This means that, in order to obtain information, these companies use strategies as acquisitions to improve their knowledge on the market. Getting to know better the behavior of each type of company will help us to upgrade our knowledge on the understanding of the decisions of the company. On our analysis, we will pay attention to the importance of patents requested as a tool for knowledge obtainment and how they relate to an innovation approach.

Within the studies previously written we could drastically distinguish two different lines of thought, which can be divided between those who prefer a centralized structure and those who rather a decentralized one. Despite this, most of the literature based on the relationship argued on this study agrees that at least some degree of decentralization is more convenient than a completely centralized company. In between both conflicting attitudes, there is a wide range of opinions and thoughts in which can fit most studies.

This hybrid structures have as usual, its advantages and disadvantages. As Argyres N. and Silverman B. refer on their article (2004), these type of organization structure tends to use acquisition in order to innovate, but this can lead to an increasing competence inside the company. That is why they affirm that increasing centralization on an hybrid structure improves innovation at any rate.

There are two variables not yet addressed to which Argyres and Silverman talk about. One of them is the influence of the type of structure on technological development, which they assume that it is always increased on centralized structures. Second is the authority placement into R&D fundings, which it impacts on its best when it is centralized and consecutively leads to a greater innovation level. As we can see, this study clearly defends centralization before any other structure. Through our own results, we will be able to answer whether these affirmations coincide with ours.

One of the main influences on our case study which has addressed this problematic is the one written by Leiponen A., and Helfat C. (2010). This article is based on data from a number of Finnish companies, analyzing how various variables affect to the level of decentralization of a company. Through four hypothesis, it explains the effect of innovation output and external knowledge into size and structure. At the same time, innovation has been distinguished between imitation and the actual "*new-to-market innovation*", as it is been called on the article. We will take this study as a base to create our own, based on Spanish numbers and companies. This will allow us as well, to compare both countries based on the results, being both part of Europe but actually having a very different approach to markets and business on the whole.

On this article we can also find the pros from a having multiple R&D business units, which they assume to be a higher external knowledge and better innovation output. On the other hand, none the previous articles and books reviewed before drew attention to the costs of this type of structure, due to degree of coordination that takes their implementation. The number of R&D

locations per firm is a main factor when it comes to understand if a decentralized structure is worth its expenses.

The ultimate structure is, relating to the Finnish market, a decentralized approach although it has to be kept down to no more than two locations for R&D. Within the development of our case based on Spanish numbers, we will see if this results can be justified.

Being both Finland and Spain part of the European Union, we can refer to the statement done by von Zedtwitz M. and Gassmann O. (2002:582), in which they assume that “*European companies have been most aggressive in establishing foreign R&D outputs*” in compare to Japanese and American countries. In other words, European firms tends to locate their R&D units abroad more often that American or Japanese do. As they prove, these two countries are more fond of taking advantage of their national market. Consequently we should presume that Finland and Spain follow a similar pattern, so we will be able to compare them and dispute this claim which seems to be too wide to assign to all european countries overall.

Despite analyzing how R&D interferes on the companies, we can also distinguish between both research and development, meaning that each one leads to a different approach of innovation. On this same study recently mentioned, Zedtwitz and Gassmann discuss about the different levels in which these approaches can be applied, combining a higher or lower amount from one or another. We will use as well this distinction between these two components of innovation, and we will relate them to their expenses and observe the relationship established within organizational structure and R&D investments.

In our data will be found a number of variables, which are going to help us further understand this clash of thoughts and doings between what we have called until now as a whole, R&D. Hence, this study talks about research as a bigger investment that companies do in order to create newness, which will helps them reach high level innovation. This is usually used by centralized firms. However, decentralized companies tend to make use of a more development-based approach, since they already have the benefits from the knowledge acquired through the detached business units. Consequently, their innovation levels increase in a lower rate.

Nevertheless this relationships are going to be validated in our analysis and will lead us to solid conclusions about R&D implementation in Spain.

2.2 Hypothesis

As A. Leiponen and E. Helfat (2010:3) wrote, “*Decentralized R&D organizations will focus more on product- and market-specific innovation than a centralized organization*”. This means that centralized structures lead to a greater innovation due to the capability of obtaining more information about the company as a whole, while decentralized structures tend to focus more on the region or the specific location where it is placed. This is an usual point of view in many studies written about innovation, which sets the path for our first Hypothesis, and only by testing our data we will get the corresponding conclusions for the Spanish companies examined.

Centralizing supposes to accumulate the entire company on one particular spot, which provides more proximity between departments and in consequence

there are benefits such as greater interaction, easier transferring of information, and a better setup for discussion and dialogue. Therefore, all these advantages allow them to obtain a larger amount of knowledge that later on will translate into greater innovation. This innovation is the one defined as radical, because it is often a new addition to the market that has been developed through intense research. However, applying this conservative procedure has also a weak point, which is that they miss on external knowledge and their innovations are more broad and not particular for a specific spot.

Decentralizing solves the obstacles of centralized structures, but they also carry some disadvantages which are frequently related to the expenses that takes their implementation. It is clear that increasing the number of units and place them on a strategic spot from which the company will try to specialize their knowledge involves some high spendings. It might also reflect the fact that sometimes, these companies have a lower technological progress, because of the costs from the structure by itself. This may seem despite everything a quite powerful statement to do, owing to the possibility of the firms to not necessarily behave this way. As von Zedtwitz and Gassmann mention on their research (2002), decentralization on itself does not lead to innovation. There is a need for communication in order to produce as an efficient R&D structure, which often is considered as an obstacle in these type of structures due to the higher number of departments in which the firm can be divided. Though, consequently as the information flows, it can develop into new ideas not thought before and create a new addition to the market. Both benefits and weaknesses seem to be possible in this structure, although it is as always, about creating a balance between them to make it work.

Hence, many factors can oscillate the outcome of applying a centralized or decentralized structure, therefore the following hypothesis shows how we expect the market to react facing each one:

HYPOTHESIS 1 (H1). *Centralized companies tend to apply a more radical innovation based on their internal knowledge, where as decentralized companies rely on incremental or imitative innovation.*

Into the costs involving R&D, we have earlier distinguished between research and development as two different approaches to innovation. As for how much a company spends on each one, preceding literature has shown us that frequently centralized and decentralized follow a certain pattern.

Research is commonly assigned to centralized firms because, as we previously mentioned, these structures have a lack of information and knowledge about specific destinations that their products may reach. In order to improve this circumstances, these companies have to make a higher investment on research, which we are going to divide between basic and applied. The first one is used on earlier stages of the study, and later on it is used an applied research to obtain some accurate findings. This intense investigation frequently leads to radical innovation, as we referred to in Hypothesis 1. Through the process of upgrading their specific knowledge, they are able to accomplish greater newness. Therefore centralizing is considerably associated to bigger research spendings when they attempt to apply a R&D procedure.

From the opposite position, development is closely related to decentralized structures. The precise location of their business units provides them with some

valuable benefits such as having a better proximity with the customer and their behavior, and a better adaptation to each destination. In consequence, they might not invest intensely on research, but their main expenses are focused towards development costs.

Throughout our case study, we are going to analyze if Spanish centralized and decentralized companies follow this same path and how these firms tend to arrange their R&D investments. Based on the expected response of the market, on Hypothesis 2 we can clearly see the point of our previous interpretation:

HYPOTHESIS 2 (H2) *Higher research costs are related to a centralized structure, whereas higher development costs are associated to a decentralized one.*

Next feature that is going to be examined is the number of patents requested by the firms. We are going to use it as a tool for measuring R&D inside the companies. Tallying how many patents a company creates will allow us to find out if this instrument actually leads to greater innovation when it is applied on centralized and decentralized structures.

When a company solicits a high number of patents, it means that it is creating plenty of innovation which is new to the market. We assert on Hypothesis 1 that this type of innovation is associated with centralized structures.

Therefore it might seem at a first glance that this measure is related to barely centralizing approaches, however decentralized firms can also benefit from this tool. What we can assure is that a greater number of patents will be related to a greater level of innovation.

Other studies have also studied this relationship, like Arora, Belenzon and Rios (2013) mention on their article. They have proved that, despite the previous statements, there is a high correlation between decentralization and patents, unlike centralized companies which do not employ nearly as many of them. This is supported by the common association between decentralizing and external orientation. These companies are more keen on applying a more expansive point of view because of the location of their business units.

Despite the fact that patents requesting has also some expenses involved, most of the companies value it as a mechanism to reach greater R&D. Through our data analysis we are going to support or refuse these speculations. Thus arises our next Hypothesis:

HYPOTHESIS 3 (H3). *Centralized companies will have higher number of patents in compare to decentralized companies, due to their more intense innovation levels.*

3. Empirical analysis

3.1 Data

The source that provide us the information used along this study comes from The Technological Innovation Panel (PITEC), which studies the evolution of innovation in Spanish companies throughout the years.

This information has been collected through a compulsory questionnaire that companies have to complete every single year. It consist of a wide range of

questions related to innovation and technology, which have to be answered in a truthful and honest way. The organism in charge of this is the “Instituto Nacional de Estadística”, following the rules established on the Eurostat by the European Union. In order to guarantee its development is found COTEC, an organism that studies innovation’s technology in Spain. As they say on their own website, PITEC was created in order to “*offer an statistical instrument for innovation analysis, and to help carrying out scientific studies which could be used as a base for future public or business purposes*” (Data from “COTEC”. (1990). Reviewed on the 9th April 2015 from: www.cotec.es)

The Spanish Government supports as well the development and growth of the spanish firms as a way of improving our society, by using an entity called OCDE (which stands for “Organización para la Cooperación y el Desarrollo Económicos”) that holds its own platform to encourage innovation on the companies.

The data used contains samples from the years 2006 and 2012, from a number of 5751 (in 2006) and 4763 (in 2012) Spanish companies which belong to the manufacture sector. It also addresses a large number of variables that cover most of the features that can be relevant in order to achieve some strong conclusions through this analysis.

According to the national statistics institute (INE, Instituto Nacional de Estadística), Spain is a country with more than 46 million of population, which can be considered as a medium size compared with other countries from Europe and overall. The INE provides also interesting information, which can relate to decentralization, about the number of locations that Spanish firms have outside their own nation. It indicates that these companies have as many locations in Europe than outside the continent. Inside Europe the most preferred spots are, in this order: Portugal, France and United Kingdom. Worldwide are also usual both North and South America. On the manufacture sector, Spain had in 2012 an total amount of 881 locations placed abroad, which is more than at any other activity (Data from the “Instituto Nacional de Estadística”. (1989). Reviewed on the 10th of April 2015 from: www.ine.es)

3.2 Variables

On our empirical analysis, several variables have been used for the purpose of justifying our three hypothesis. They are meant to measure innovation and we are going to divide them depending on how they affect it.

Explanatory variables. There will be three variables within our analysis which are going to set the path for all of the Hypothesis proposed. They are also those which we previously defined as the main focus of this analysis, therefore these variables are the ones that will lead us to definitive conclusions and deliver a resolution for our Hypothesis.

One of them, distinguishes between the type of industry in which each one operates. We are going to cut down the sector belonging of each company to only analyze the manufacturing ones. Therefore no services companies are going to be included on our test. Our initial sample will considerably be narrowed down when this filter is applied, although it will be more precise for the upcoming conclusions to have a specific sector being analyzed.

Aside from this, the other variable that we are going to consider is “R&D structure” and it differentiates between centralized and decentralized companies. First we are going to measure our data through a binary method in which 0 and 1 define whether the company is either centralized (0) or decentralized (1). Hence, when the “Hypothesis test for differences between means” is applied, both variables have to be separated in order to obtain some right results. Taking the overall data, any company which does not classify between either this two categories, will be not taken into account. To conclude the explanatory variables utilized, the last one is “size” . We are going to use it into a second test to divide the decentralized manufacture companies between those that are smaller companies and those that are larger companies. Small companies will be those with less than 200 employees, and large are those with more than 200 workers. Using also the binary method, small firms will be represented by (0) and large firms with (1). This analysis is going to be also relevant because Spain is made up mostly by medium or small sized firms, and since the focus of this study are decentralized activities on R&D, we are going to differentiate them depending on their size and observe how it affects to the responses for each variable.

Innovation outcome variables. On this sorting we are going to classify those three variables that come out as a result of applying innovation. First ones belong to Hypothesis 1 and are those related to sales, and another one comes from Hypothesis 3, and it refers to the number of patents requested. All three variables use data which involves two years of evolution, which will vary depending on the time period analyzed.

Two variables have been used to test Hypothesis 1, first one being the percentage of the sales corresponding to innovations considered as new for the company (named “New-to-company Inn”). Second variable is the percentage of sales which is due to innovations considered as new to the market (named “New-to-market Inn”). Inside the first category we can also include imitation, which is often used in decentralized structures when they are trying to create newness into a specific location. This two variables are one of the main assumptions done in order to distinguish between centralized and decentralized structures, also proposed in similar studies which consider the outcome of innovation as a major effect for organizational structures.

On Hypothesis 3, we analyze patents and how these reflect on the type of structure that a company uses, more specifically, how many patents a company requests during a specific period of time. If a firm owns many patents, it means that this company is innovating. Patents petition are a common activity when companies pursue innovation because it allows them to obtain information and knowledge about the desired destination, therefore is frequently used by companies attempting decentralization. This variable will be called “Patents requested”.

R&D costs variables. Hypothesis 2 uses three variables that measure research and development as two independent concepts from each other. Inside research we can find basic research and applied research, which some studies usually relate to centralized structures due to their need for obtaining information in order to innovate. Two variables measure research: first off, one measures de percentage of costs from R&D that come from basic research,

which will be known as “Basic-R costs” . Second, another variable measures the percentage of costs from R&D that come from applied research, called “Applied-R costs”. We consider as basic the study done on a first stage of the investigation, and consecutively appears applied research when it is fulfilled the information obtained on the earliest stage.

The other variable used shows the percentage of costs from R&D that are spent in technological development. This one will be called “D costs” and it is often assigned to decentralized firms. The reason why, is because these companies already own information about their environment thanks to the specific location of each unit, therefore their next step is applying this knowledge to produce a new addition to the market.

3.3 Methods

The data obtained has been used throughout a series of steps in order to get some final conclusions. The mainly important analysis is the “Hypothesis test for differences between means”, which allows us to synthesize information from a big number of companies to later on compare and analyze them. It consist on “*testing the equality of two means*” which will conclude being equal or unequal, as Carter, Griffiths and Lim (2008:717) resume on their book.

Another related research done around this method is discussed by Newbold (1997:7). He refers to the means as a tool used to measure centralization, and it is defined as “*a ensemble of numerical observations which is the sum of the value of the conjunct divided by the number of observations, hence its average*”.

On our case study only manufactory companies have been taken into account, avoiding those that are based on services. The samples range from the years 2006 and 2012, which enable us to make a comparison based on the results, which despite the short period of time between them, have quite enough differences when it comes to the world’s health economy and how companies approach their investments.

First are found on Table 3 and Table 4 the “Descriptive statistics” analysis done on each of the variables from our Hypothesis, which is going to serve as an initial glance for their behavior. We have taken the data from 2006 and 2012, and after we have limited the number of companies by sector, it has been applied the statistical test. We obtained the mean and the standard deviation for each variable, which will help us to explore the relationship among them and how they have been oscillating between the period time analyzed. The mean here encountered is, unlike the one previously found, associated with each variable on the whole and not using any subsample. Finally we also obtained the minimum and maximum results achieved for each one.

Apart from this, we are going to continue with our analysis using the “Hypothesis test for differences between means”. We have separated from the initial data owned between two subsamples, the first one discriminated between centralized and decentralized structures. The second subsample refers to the extension of decentralized companies, which can be considered as small or large. Therefore we are now going to explain the procedure used through their observation:

As seen before on our case study, our principal concern is how centralized and decentralized structures affect to innovation, and they are found on Table 1 and

Table 2. Therefore, firstly we have to distinguish the data of the companies between both types, using a binary system in which 0 belongs to centralized companies and 1 belongs to decentralized ones. The mean from each one is going to be used towards exchanging observations that can validate or deny the three hypothesis introduced before. Hence, for each variable used in each hypothesis there is going to be a mean from the years 2006 and 2012 for both centralized and decentralized companies, and the one that is greater is going to be considered as the major user of a certain variable. This mechanism will be used as a tool for measuring centralization and decentralization.

Once we have separated the data from a specific variable depending on its organizational structure, we are going to find their mean, and notice which one is greater. This will be a first ratification to perceive if our hypothesis is refused or accepted. Next up we should draw our attention to the difference found between these two means, which often will result in 0. This suggest that both are equal and in consequence the hypothesis is null, though we can not trust this affirmation, and we should further examine either if it is correct or not. At this spot appears what is commonly called " Student's t-test".

As P. Newbold explains on his book (1998:244), "*we can use Student's t-test to obtain the degrees of freedom (1 - alpha) for each mean on a average population when the variance is unknown*". This test can be found with one or two tails, in which the first one supports that a mean is bigger than another mean, however the test with two tails simply reports that both means are not equal. Therefore, due to its wider meaning, we are going to be using the test with one tail.

The outcome obtain on this test is going to be compared with some significance levels (alpha) which range from 0'1, 0'05, and 0'01. When it is lower than one of this levels, we will able to refuse the statement on both means being even.

While comparing them we should point out that the lower the significance level beaten, the more valid this result is. Thus, if the test with one tail yields to a number lower than 0'01, we will be validating that centralized and decentralized means are not alike on a distinct variable with the finest level of significance.

The same approach used on the "Hypothesis test for differences between means" for decentralization has been also used when measuring the size of these companies, found on Table 5 and Table 6 . This time the data has been taken without any alteration, and we again used a filter to maintain only the manufacture companies in our analysis. Afterwards we filtered again to obtain only the data for decentralized firms and separated them between smaller and larger sized companies, and proceeded exactly as we did earlier on the first test done. Using again the binary method with 0 and 1, 0 belongs to small firms and 1 is assigned to wider firms. The means obtained for each feature has been later on compared in order to conclude their influence.

The Student's t-test has been also applied into these variables affected by limitations on their scope, along the same terms as it has been used before. To summarize the methods used on our study, we used a "Descriptive statistics" analysis for each variable and then used a "Hypothesis test for differences between means" for distinguishing between centralized and decentralized firms and later on between small or large decentralized firms.

4. Results

4.1 Descriptive Statistics

In order to be capable of a better understanding of the behavior of our variables, we have applied a descriptive analysis on both data from the years 2006 and 2012. Comparing the results obtained and shown on Table 3 and Table 4, it is going to be clearer how these are evolving.

[Table 3] Descriptive Statistics in 2006				
Variables	Mean	Standard deviation	Minimum	Maximum
New-to-company Inn	1'331	1'639	0	4'615
New-to-market Inn	0'946	1'475	0	4'615
Basic-R costs	0'172	0'708	0	3'931
Applied-R costs	1'677	2'037	0	4'615
D costs	2'008	2'113	0	4'615
Patents requested	0'614	4'339	0	234

[Table 4] Descriptive Statistics in 2012				
Variables	Mean	Standard deviation	Minimum	Maximum
New-to-company Inn	0'975	1'511	0	4'615
New-to-market Inn	0'673	1'319	0	4'615
Basic-R costs	0'143	0'637	0	3'931
Applied-R costs	1'302	1'926	0	4'615
D costs	1'527	2'041	0	4'615
Patents requested	0'624	7'321	0	366

This statistics have been applied in order to accomplish a broader analysis. The principal information reported are the mean and the standard deviation for each variable.

Despite the upcoming analysis done in which we will examine the mean of either centralized and decentralized firms or small and large firms, we are now collecting this information for our six variables individually without any other division than using only data from manufacture companies.

First we are going to take notice of the mean obtained on each variable. On Hypothesis 1 we examine innovation for the company and new-to-market innovation. When we make a comparison between 2006 and 2012, we find out that the mean for these two variables is lower in 2012. "New-to-company Inn" has resulted in 1'331 in 2006 and 0'975 in 2012. "New-to-market Inn" is 0'946 in 2006 and 0'673 in 2012. This can suggest that, if there is approximately the

same number of manufacture companies on both years, these firms are not innovating as much and in consequence the mean is reduced.

Next is Hypothesis 2, whose variables are the level of expenses on basic research, applied research, and development. We encounter the same reaction than in Hypothesis 1. The mean and the standard deviation are lower in 2012 than in 2006, hence we should suppose that the companies participating are not spending as much on R&D, therefore the mean decreases. The “Basic-R costs” variable goes from 0’172 to 0’143, and “Applied-R costs” from 1’677 down to 1’302. As for the spendings on development, they decrease from 2’008 in 2006 to 1’527 in 2012.

Ultimately there is Hypothesis 3, which refers to the number of patents requested. Its mean has increased from 0’614 in 2006 to 0’624 in 2012, unlike the previous Hypothesis. This improvement comes from decentralized companies, which as we will see on Table 1 and Table 2, have increased notably their patents requesting. If the previous statistics have proved that there are lesser R&D investments and therefore have emerged less innovations, as a result we can conclude that the companies are deciding to apply R&D by soliciting more patents. For this reason we can expect firms to believe that this is an efficient and beneficial manner to lead their decentralized structure firms. Besides this it has also raised the standard deviation for patents.

From now on, we are going to solve our Hypothesis and expose their results. We are first going to discuss them according to data from 2012, because it is the information that is closer to today’s circumstances. Following there will be a comparison between the results from 2006 and 2012.

4.2 Radical vs. Incremental Innovation

[Table 2] Hypothesis test for differences between means from centralized and decentralized companies in 2012

Variables	Mean CENTR	Mean DECENTR	Greater mean		
New-to-company Inn	0'960	1'462	DECENTR		
New-to-market Inn	0'652	1'213	DECENTR		
Basic-R costs	0'133	0'379	DECENTR		
Applied-R costs	1'242	2'534	DECENTR		
D costs	1'479	2'651	DECENTR		
Patents requested	0'483	3'605	DECENTR		
Variables	Means differential	Degrees of freedom	P(T<=t)one tail	Hypothesis null	Level of significance achieved
New-to-company Inn	0	244	0'000	refused	0'01
New-to-market Inn	0	239	0'000	refused	0'01
Basic-R costs	0	232	0'000	refused	0'01
Applied-R costs	0	243	0'000	refused	0'01
D costs	0	247	0'000	refused	0'01
Patents requested	0	223	0'037	refused	0'05

On Table 2 is shown the result of testing Hypothesis 1, in which we affirmed that being both radical and incremental innovation an outcome of different uses for R&D, decentralized companies mainly produce lower or incremental impact on the market when it comes to developing new products, including imitation as a commune practice, whereas centralized companies are more focused towards producing radical innovation achieved through its bigger and more concentrated unit which it is in consequence able to have a greater effect on the market. We have two variables that have been tested in order to support some conclusions on this Hypothesis, being the data used from the year 2012 from Spanish companies belonging to the manufacture sector.

Firstly has been examined the variable that measures how much incremental innovation a company applies. This sort of innovation it is new for the own firm but it is not revolutionary or new to the market. Comparing the means obtained from both centralized and decentralized companies we can get a sense of which organizational structure takes a greater part on this type of innovation. The result obtained shows us that in 2012 Spanish decentralized-structured firms had more impact on creating incremental innovation than centralized ones did. Their mean is 1'462 while centralizing has a 0'96.

Before ultimately contrasting Hypothesis 1, we have to definitely be aware of the results of the other variable tested. This is related to radical innovation, and despite our predictions, the means derived from the test reveal that decentralized companies have higher new-to-market innovation than centralized companies. The mean for various business units is 1'213 and for one centralized structures is 0'652. This can be due to either a lower ability of centralized companies for creating new products and not taking enough advantage of their bigger size, or perhaps decentralized firms that have been using the knowledge collected throughout their located units as a way of expanding and growing overall.

Hence this results, we do not give complete support to Hypothesis 1. The unexpected conclusion of the radical innovation variable comes to show us that in Spain decentralizing is an overall superior way of organizational structure for companies, when it comes to the outcome produced. The following Hypothesis will clarify us how decentralized companies function in order to get this greater results. The mean of these firms is big enough in compare with centralized ones, to say that there is a significant influence on the level of innovation of a company with the procedure used on their structure related decisions.

As we previously introduced, we also obtained the Student's t-test included on Table 2, which has enabled us to complement the results obtained. Using this method we achieve that in every single variable we do not give support to the Hypothesis which presumes that the means are equal, and therefore there is difference between the means from centralized and decentralized companies.

4.3 Investing on Research vs. Development

Following variables analyzed are the three ones that relate to Hypothesis 2, which add the importance of expenses into our study. Depending on how a company is oriented, it will distribute their spendings one way or another, and in addition it will allow us to get to know how companies behave and which is their belief and thoughts about what it is more important to make an investment in. On this Hypothesis we distinguish between research and development costs.

We assure that centralized companies focus their expenses on research and decentralized ones do so on development. The explanation behind this statement is that centralized structures have a bigger need for acquiring and investing on research because of their lower information sources. Higher expenses on investigation are required because, although their setup makes them possible to produce on a high scale, their lack of location creates the need for a higher amount of knowledge in order to reach their large level production. On the other side are found the decentralized companies, which are supposed to already possess this information through their specifically located units. Therefore, we assume that their main concern when they are settling their expenses is more oriented towards development rather than research. The three variables used are basic research, applied research and development, and on Table 2 can be found the test executed. To start up with this analysis, we are first going to examine the variable "basic research". This reveals that the mean for centralized companies (0'133) is lower than the one from decentralized companies (0'379). This breaks down our affirmation, in which we assumed that research is the base for radical innovation, therefore centralized companies. Next variable is going to clarify more in deep this results.

Variable "applied research" is the following tested sample. As we could have expected from the resolution of the previous variable, we find that applied research expenses are greater on decentralized firms. Centralizing has a mean of 1'242 while decentralized has 2'534. Therefore we can definitely forecast a trend in which decentralizing seems to overtake centralized structures, and even though they own an advantage because of the knowledge collected, they still invest plenty on research.

To conclude this R&D costs test, we are going to study the variable "development". We expected to find a higher level of development expenses on decentralized companies, and Table 2 presents an understanding with this claim, in which the mean of these companies (2'651) is higher than centralizing (1'479). This ratifies the statement done about decentralized companies on Hypothesis 2, so the resolutions done around this variable are supported and decentralized structures are those that spend more in development. The basis of development costs is to reach a greater outcome when the information obtained is being transferred in order to apply it into our innovation process. It is in consequence, as important as research expenses, since it is highly influential on the final result.

Accordingly to this analysis, we can once more not completely justify Hypothesis 2, but we can certainly say that decentralized companies are the ones that invest more on innovation on the whole. They display higher spendings on both research and development, and it might seem that they can also get better innovation because of this being a bigger concern than for centralized companies. Thus we can again foresee than decentralizing can lead to greater upcoming conclusions than centralizing.

Regarding the Student's t-test, we obtained again that the means from both structures are not even and in consequence the null Hypothesis is not accepted.

4.4 Number of patents requested

To conclude the analysis of our Hypothesis, we are going to ultimately discuss the relationship between the number of patents requested on the organizational structure of the companies. The variable patents is relevant on this study because it shows how much the companies are innovating. Hence the more patents solicited, the higher innovation level a company holds.

As Hypothesis 3 suggest, we presume that centralized companies usually request a larger number of patents. At first glance this might seem like a right prognostication, because as we said before, on Hypothesis 1 we assumed that centralized companies produce radical innovation, which developed into higher level of innovation. However our test might not lead to this same result.

On Table 2 there is the means for centralized and decentralized companies referred to patents. It is noticeable that the mean for decentralized companies (3'605) is higher than the mean for centralized companies (0'483). This finding makes sense when we relate it to the result obtained on Hypothesis 1, in which we find out that are actually decentralized companies those who achieve radical innovation.

Therefore we have to reject Hypothesis 3 and instead reply that decentralized companies have greater number of patents requested in compare with centralized ones.

Previous studies have also analyzed the influence of patents depending on each organizational structure. On the article written by Arora A., Belenzon S., and Rios L. (2013) they prove that decentralized firms, according to their own data which is based in the US, have a much higher number of patents (87%) in contrast with centralized firms (11%). They prove that "*whereas centralized firms derive more value from internal R&D, decentralized firms do so from externally acquired patents*". (Arora, Belezon & Rios, 2013:1)

What this means is that centralizing is provided with higher internal knowledge whereas decentralizing has great external knowledge, in which case patents are a common tool.

Another study that considers patents as a relevant feature is addressed by Argyres N. and Silverman B. (2004). They claim that if decentralized companies have a lower level of innovation efficiency, these firms are going to need to apply some mechanisms such as patents in order to compensate this lack of newness.

Lastly once again we have obtain that relating to the Student's t-test analysis, the Hypothesis null is rejected and therefore the means from centralized and decentralized firms are uneven.

4.5 Evolution of the organizational behavior of the companies throughout the recent years

At this spot, we can recapitulate and see how decentralized companies have reacted lately and how it is been the behavior of the newcomers into the market. The number of manufacture companies in 2006 is 5751, of which 4188 are centralized and 352 decentralized structures. Besides from this, we find that in 2012 there are 4763 manufacture companies. 4455 from these are centralized and 224 decentralized. The firms that belong to the manufacture sector but do not apply any of our innovation variables, will be considered as

empty. This is the reason why if we put together the number of centralized and decentralized companies, we still do not reach the total of manufacture companies for each year.

	CENTRALIZED	DECENTRALIZED	TOTAL	empties	TOTAL MANUFACTURE
2006	4188	352	4540	1211	5751
2012	4455	224	4679	84	4763

In order to take notice of which has been the gradual evolving of our variables , we are now going to discuss the development of centralized and decentralized firms by comparing the results obtained in 2012 (Table 2) with the“Hypothesis test for differences between means” applied on data from 2006 (Table 1).

[Table 1] Hypothesis test for differences between means from centralized and decentralized companies in 2006

Variables	Mean CENTR	Mean DECENTR	Greater mean		
New-to-company Inn	1'303	1'498	DECENTR		
New-to-market Inn	0'909	1'239	DECENTR		
Basic-R costs	0'167	0'318	DECENTR		
Applied-R costs	1'585	2'255	DECENTR		
D costs	1'879	2'631	DECENTR		
Patents requested	0'634	1'239	DECENTR		
Variables	Means differential	Degrees of freedom	P(T<=t)one tail	Hypothesis null	Level of significance achieved
New-to-company Inn	0	415	0'013	refused	0'05
New-to-market Inn	0	401	0'000	refused	0'01
Basic-R costs	0	388	0'000	refused	0'01
Applied-R costs	0	413	0'000	refused	0'01
D costs	0	418	0'000	refused	0'01
Patents requested	0	387	0'0299	refused	0'05

If we take a glance to Table 1, we can analyze and compare the data from 2006 and 2012 from our variables so we can justify this results.

As for the three Hypothesis tested, we achieve the same results than in the year 2012. In all the variables, the bigger mean is the one from decentralized companies. Even though there are less firms that decentralize, the main fact is that these do apply innovation. They innovate in both incremental and radical forms, and allocate part of their expenses on basic research, applied research and development. This shows that decentralizing has currently been better appreciated for the firms that consider innovation as one of the main points for potential success. The biggest gap is found on the number of patents requested, since it has especially grown from 2006 to 2012. Decentralized firms had a patent's mean of 1'239 in 2006 while in 2012 it increased until 3'605. Thus as we found on our previous patent analysis, firms realize that this type of tools grant them positive feedback, such as greater knowledge and information about their surroundings.

Relating to the Student's t-test, there are also no dissimilarities from the test exposed before. For a mean differential of 0 we find that this hypothesis is denied when comparing with the significance levels.

It makes sense that the market does not drastically change over the course of six years since Spain has a solid economy and it is a developed and consolidated country. Then it is the volume of the manufacture sector which actually shows the evolving done throughout the period analyzed. The response of the Hypothesis is accurate because, if it is assured in Hypothesis 1 that decentralized companies are those which produce more innovation overall (new for the company and new for the market), consequently they will have been investing higher volume of spendings in R&D as Hypothesis 2 says. Besides, greater innovation can be caused by a large number of patents solicited. Therefore we can start to see a tendency in which progressively decentralized structures are the most common choice when companies are attempting innovation. This can be due to the fierce competence that forces firms to constantly produce new products, and they have found in decentralizing the most efficient way to do so. Moreover, it seems to be as well a natural progression for the companies, because everyday the world is more accessible and frontiers are less though. Also Europe and consequently Spain have suffer an outstanding economical crisis since 2008, so this study reflects too how firms reacted in front of this unexpected state of affairs.

4.6 "Size" as an added variable

Prior to this point, we have been studying the responses of the companies taking as an only differentiating variable whether if they had centralized structures or not. However, the market is much more complex and many other features describe as well their behavior.

For this reason we have further analyzed the manufacture sector. We have taken only the decentralized companies from our data, and we have classified the companies between small or large size firms. The companies considered as small are those which have less than 200 employees on their crew, and in consequence large firms are those that have more than 200 of them.

This is an outstanding variable and key variable for the market organization in Spain, because the main part of the companies existing are recognized as small and as a result they are the ones that make the Spanish economy keep on operating on the whole (Data from the "Dirección General de Industria y de

la Pequeña y Mediana Empresa" (2012). Ministerio de Industria, Energía y Turismo. Reviewed on the 30th of April 2015 from: www.ipyme.org).

	SMALL DECENT	LARGE DECENT	TOTAL DECENT
2006	187	164	351
2012	89	134	223

On the Table above is found the number of either smaller or larger decentralized firms that belong to the manufacture sector in Spain, both in 2006 and 2012. At a first glance, we can see that there is a divergence between the number of decentralized firms. The amount of small and large companies is lower in 2012, and therefore there are less companies that decentralize. Though the higher decrease comes from those with a small size.

Being the years analyzed situated previously and after the economical crisis, it is fair to justify this results by saying that the effects that this caused on the economy are, among others, the considerable disappearance of many companies. Hence relating this to our study, innovation has also been affected by this contraction of the economy.

We mentioned previously the disadvantages of decentralized structures, in which the high expenses involved are a main downside. Therefore the fact that there are fewer small firms that apply this structure can be due to their difficulties in order to overcome its costs. If the results obtained are not good enough, all the investments done in order to apply R&D can not be worth it. Large companies have also decreased, but in a lower rate. In consequence, this may be because they have greater economical and financial capability, which allows them to overcome easily this type of situations.

Some previous studies have also written about the size of the companies and their impact, like Schilling (2008) does in her book, discussing if bigger firms are necessarily better. In favor of wider size companies are found aspects like greater financing, larger volume of sales to compensate the costs of R&D, economies of scale and learning curve advantages, and so on. These characteristics make possible for these companies to undertake greater risks and projects. Though as it mentions, "*as a firm grows, its R&D efficiency might decrease because of a lost of managerial control*" (Shilling, 2008). The research done by Schilling concludes that a solution for many big firms is to create smaller divisions within the same company, or to decentralize and locate different business units on separated spots.

4.7 "Hypothesis test for differences between means" for decentralized companies

As we previously did, we are going to apply the "Hypothesis test for differences between means" though this time it is going to be used only on decentralized structures, separating them between those that are small or big firms. Our previous analysis concluded into greater application of R&D from decentralized

companies. Consequently we are going to study the six variables introduced in our analysis with this current subsample, with data from 2006 and 2012 for a forthcoming comparison.

[Table 5] Hypothesis test for differences between means from small and large decentralized companies in 2006

Variables	Mean SMALL	Mean LARGE	Greater mean		
New-to-company Inn	1'429	1'576	LARGE		
New-to-market Inn	1'125	1'369	LARGE		
Basic-R costs	0'256	0'389	LARGE		
Applied-R costs	2'023	2'519	LARGE		
D costs	2'185	3'139	LARGE		
Patents requested	0'433	2'158	LARGE		
Variables	Means differential	Degrees of freedom	P(T<=t)one tail	Hypothesis null	Level of significance achieved
New-to-company Inn	0	346	0'191	accepted	-
New-to-market Inn	0	346	0'071	refused	0'10
Basic-R costs	0	339	0'078	refused	0'10
Applied-R costs	0	348	0'009	refused	0'01
D costs	0	349	0'000	refused	0'01
Patents requested	0	173	0'004	refused	0'01

On Table 5 we can see that in 2006 were large companies those which used the most a decentralized structure. On the two variables from Hypothesis 1, we obtain that for “New-to-market Inn” and “New-to-market Inn” the means for large companies are greater, therefore this means that big companies are those which innovate more. It is also important to mention that referring to the costs from decentralizing, smaller firms will often have more difficulties for their implementation. This is translated into more products created by big companies. The ones that are new for the company have a mean of 1'429 for small firms and 1'576 for large firms. The variable that measures innovation for the market shows a 1'125 for small companies and a 1'369 for the large ones.

Hypothesis 2 measures the expenses done on R&D, and again are large companies those that spend more in innovating. Basic research (0'256 small firms and 0'389 large firms) applied research (2'023 small firms and 2'519 large firms) and development spendings (2'185 small firms and 3'139 large firms) are representing how much these companies invest on their R&D structure, and as we said before, big companies entail bigger revenues therefore they are more favorable to take riskier decisions when it comes to innovating. As a result they make greater investments than small companies.

Last variable is the number of patents requested, which in 2006 had a mean of 0'433 for small firms and 2'158 for large ones. It is considerably more significant

in big companies, which is related to the statement just done about their R&D spendings on Hypothesis 2. They have more economical capability for obtaining this external knowledge by soliciting a higher number of patents. Overall we can say that in 2006 decentralized large structures were taking a greater use of R&D. We are now going to observe this test applied on data from 2012:

[Table 6] Hypothesis test for differences between means from small and large decentralized companies in 2012

Variables	Mean SMALL	Mean LARGE	Greater mean		
New-to-company Inn	1'448	1'472	LARGE		
New-to-market Inn	1'085	1'298	LARGE		
Basic-R costs	0'344	0'403	LARGE		
Applied-R costs	2'345	2'660	LARGE		
D costs	2'193	2'956	LARGE		
Patents requested	0'371	5'753	LARGE		
Variables	Means differential	Degrees of freedom	P(T<=t)one tail	Hypothesis null	Level of significance achieved
New-to-company Inn	0	177	0'455	accepted	-
New-to-market Inn	0	184	0'152	accepted	-
Basic-R costs	0	193	0'320	accepted	-
Applied-R costs	0	176	0'126	accepted	-
D costs	0	172	0'002	refused	0'01
Patents requested	0	133	0'032	refused	0'05

On the year 2012 this same test yields to the same results, in which large firms have greater means in each variable analyzed. On Hypothesis 1, the innovation new for the company has a practically equal mean for both sizes (1'448 small firms and 1'472 large firms), but on the innovation new for the market bigger companies (1'298) are clearly beyond smaller ones (1'085). This suggests that while decentralizing leads to imitation or incremental innovation in general, when we refer to radical innovation are larger companies those that put it into practice the most.

Into the costs of R&D, we obtain that basic research has a mean of 0'403 for large companies and of 0'344 in small companies, as for the results on applied research we get a mean of 2'66 for the first ones and 2'345 for the second ones. Therefore, as it happened on 2006, big companies spend more on research. The spendings done on development are as well greater on larger companies (2'193 small firms and 2'956 large firms). Hence, we conclude that large decentralized companies spent more on R&D that smaller decentralized companies in 2012.

In Hypothesis 3, we find out that large companies have an outstanding mean for patents requested (5'733) in compare to small companies (0'371). Thus big firms are more keen on soliciting patents as a mechanism for implementing R&D. This number has also increased considerably since 2006.

Recapitulating the analysis done between 2006 and 2012, we captured that the number of manufacture companies and therefore of decentralized manufacture companies has decreased. This fact is probably due to the economical state of affairs that has occurred in Europe and Spain within this period of time. In consequence, as we have seen on the "Descriptive Statistics" analysis, R&D has been negatively affected by the lesser amount of companies found on the market. It might be caused in part by the response of the firms, which may rather to preserve their primary investments to maintain their survival. On this circumstances, smaller companies can be considered as weaker when we refer to the strengths to overcome difficulties, therefore they understand R&D as a riskier challenge than large companies. Hence, they tend to apply a centralized structure, which is the reason why we obtained greater results for large decentralized firms.

4.8 Evaluating Spanish vs. Finish results

On the literature reviewed on point 2.1, we mentioned a reasonably similar analysis done on data from Finland, written by Leiponen A. and Helfat C. (2010). These two lands serve also as an example for northern and southern economies in Europe.

As they point out on their article, Finland is certainly a small country in which live around 5'2 million of habitants, which is substantially fewer population that in Spain (46 millions). Despite its size, it owns a diverse and fairly spread industrial and commercial activity through its territory. Leiponen and Helfat have analyzed how decentralization relates to external knowledge and innovation output. It is a recent study done in 2010 that uses also Hypothesis based on their assumptions, and their findings have determined which are the main features for companies that apply R&D in Finland. We are now going to relate them to our results, making a comparison between some similar presumptions effectuated.

The first Hypothesis proposed on the Finish analysis is very comparable to our Hypothesis 1, in which we related centralized structures with a radical level of innovation and decentralized structures with incremental and imitative innovation. Our results showed us that in Spain are actually decentralized companies those that produce radical innovation, also known as new-to-market, as well as incremental. However the results in Finland are not alike, proving that when companies have three or more locations, they do not produce new-to-market innovation. Nevertheless, they found that these companies could produce radical newness if there had only two locations, which they justify by saying that "*This result is limited to two R&D locations, which could reflect... the fact that Finland has fewer location choices than a larger country*" (Leiponen & Helfat, 2010:11). We can deduce from this statement that because Spain is a broader country, decentralizing seems to be the most efficient organizational structure for a R&D strategy, and the results obtained have guaranteed it. This Finish analysis has another variable which is associated with this previous one, which relates decentralized structures with a wider innovation outcome.

They affirm that “*multiple locations of innovation activity are positively associated with wider applicability of innovation output*” (Leiponen & Helfat, 2010:13), which seems accurate with the radical innovation early discussed. Therefore we can see that the only fact that makes a difference between the data from Spain and Finland is their demography. Larger countries are able to ease decentralized business units, which at the end of the day lead to greater innovation overall. Both are first world economies and they follow a similar pattern on the structure of their markets.

5. Conclusions

5.1 Discussion

The purpose of our analysis is to study the behavior of centralized and decentralized structures when they are implementing R&D, as well as their development during 2006 and 2012, based on data from Spain.

This aim has been pursued through a “Hypothesis test for differences between means”, which has examined the three Hypothesis that we have proposed and their consequential variables. These variables are new-to-market innovation, innovation new merely for the company or imitation, expenses on basic research and applied research, expenses on development and ultimately, number of patents requested. Only manufacture companies have been considered through this analysis.

We have first applied a “Descriptive Statistics” test in order to foresee the expected response of our variables, and then we have used the difference between means as a method to distinguish between centralized and decentralized companies within our data. Making a comparison among both means obtained, we have been able to assess which one is higher, and in consequence which one makes greater use of R&D. We have later applied this same test to only decentralized structures, differentiating between their size. Lastly we have compared our findings to a similar study done previously about data from Finland, to briefly observe possible similarities between two different countries and their approach to innovation.

This procedures have lead us to some results and conclusions that we are now going to resume:

To begin with, we used the “Descriptive Statistic” analysis for each variable and compared their evolution from 2006 to 2012. We found out that actually all of them have decreased excepted from the number of patents requested. This has allowed us to make some presumptions about the upcoming results. Therefore, companies have been allocating less costs on R&D and in consequence they create less innovations, although the number of patents has improved as a valuable mechanism for reaching this purpose.

Next we applied the “Hypothesis test for differences between means” for centralized and decentralized companies, in other words, the response of each variable depending on their organizational structure. As for 2006 and 2012, during both scenarios is found the same conclusion, which is that decentralizing has greater implementation of R&D. Decentralized companies have higher spendings on research and development, and they produce more innovation overall (new-to-company and new-to-market). They also make a larger

requesting of patents. In front of this state of affairs, we have further analyzed this type of structure to comprehend their procedure more in deep.

The same "Hypothesis test for difference between means" has been applied to decentralized firms differentiating between either small or large companies. Also for 2006 and 2012, our findings suggest that larger decentralized companies are making a better use of our innovation variables. Probably due to their wider revenues, they are capable to invest more on R&D and patents requesting, and therefore they produce more innovation.

To bring this recapitulation to a close, we can conclude that having a number of located business units while being a large size company involves a more favorable setup for R&D implementation.

5.2 Implementations

The main contribution of this study is getting to know how R&D structures proceed in Spain. It has enabled us to achieve a better understanding of what are and how perform centralized and decentralized structures when they attempt to achieve innovation. Thanks to the six variables introduced, we have taken notice of what we consider to be some of the main features to deeply investigate this relationship. Innovation produced, R&D costs and patents requested have served as a tool to complete our presumptions and lead to ultimate conclusions.

This study can be useful for those companies that are deciding to apply a decentralized structure, or for those that are willing to implement R&D. It can be also fitting for those workers in charge of the innovation procedures inside their firm.

5.3 Limitations and future extensions

Some of the restrictions that can be found on this case study are the availability of data from exclusively 2006 and 2012, which in forthcoming analysis could be completed with more years in consideration, larger samples or more recent data.

Another limitation that can be considered is that we have only taken into account the companies that belong to the manufacture industry. Therefore, in other circumstances and with another intention, future studies could analyze this subject focusing on other sectors. Moreover we have centered our attention to the relationship between centralized and decentralized companies when they apply R&D, however there are other points of view that can be associated with this structures. For example, not relating it to innovation, and examine if sales are increased when firms implement a decentralized approach.

It could be also beneficial for our analysis to obtain similar studies like ours, like in the case of Finland, but with other countries to get broader and wider conclusions.

On upcoming analysis, it could be investigated the relationship with size and centralized structures, as we have done with decentralized companies. It would also be interesting to include new variables into the test, for example external knowledge or mergers and acquisitions.

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