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Open innovation and the comparison between startups and incumbent firms in Spain[1]

La innovación abierta y la comparación entre las *startups* y las empresas establecidas en España

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I. INTRODUCTION

Amadeus, the Spanish leader in technology solutions for the global travel and tourism industry, has opened its code library to third-party developers, and has built strong partnerships with academic labs and leading IT players in order to spur innovation. Like Amadeus, other large companies, such as IBM, Intel, Philips, Unilever, and Procter & Gamble, have abandoned the traditional close innovation models and instead adopted an open innovation model (Chesbrough, 2012). Startups are following in their footsteps and engaging with larger firms in open innovation activities. For example, startups connect with Amadeus in three ways: first, startups bring to life their ideas by using Amadeus' interfaces; second, startups connect their value propositions to Amadeus' technology and experience; third, startups receive investment or engage in partnerships with Amadeus (Emiliejessula, 2016). As such, startups are an important driver of innovation and economic growth, as they introduce innovations that changes the competitive rivalry in an industry, and thereby threaten the competitive advantage of incumbent firms (Adelino, Ma, & Robinson, 2014; Boyer & Blazy, 2013; Eftekhari & Bogers, 2015; Schumpeter, 1934). However, most research on open innovation focuses on large and incumbent firms, with a minor emphasis on startups.

Startups and incumbent firms both play important roles in generating innovations and economic growth, but they contribute to the innovation ecosystem and economic development in different ways.

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EXECUTIVE SUMMARY

This study compares the open innovation strategy between startups and incumbent firms over a period of ten years (2004-2013). Using a sample of startups and incumbent Spanish firms, we find that they differ considerably, and that this has implications for management. Incumbent firms and startups differ in terms of their use of external cooperation activities as a source of innovation. The lack of financial and human resources of startups leads them to open their borders more than incumbent firms, and startups benefit from being flexible, as they have yet to implement routines. This boosts startups' innovation performance.

RESUMEN DEL ARTÍCULO

Este estudio compara la estrategia de innovación abierta entre *startups* y empresas establecidas por un periodo de diez años (2004-2013). Usando una muestra española de *startups* y empresas establecidas, encontramos que difieren considerablemente, y ello tiene implicaciones para la dirección de empresas. Las empresas establecidas y las *startups* se diferencian en términos de su uso de las actividades de cooperación externas como fuente de innovación. La falta de recursos financieros y humanos de las *startups* les lleva a abrir sus fronteras más que las empresas establecidas, y las *startups* se benefician de ser flexibles porque no han implementado rutinas todavía. Esto impulsa el resultado de innovación de las *startups*.

There are notable differences between startups and incumbent firms in terms of resource endowments, external cooperation and innovative capabilities for reaching high innovation performance. In order to understand the innovation ecosystem, it is important to understand how both types of firm can contribute to the economic prospects from their specific positions, and then benefit from these prospects. The aim of this study is therefore to compare the open innovation strategies between startups and incumbent firms. Based on an investigation of the extent to which both types of firms use external cooperation to generate new innovations over a ten year period, we can extract how the firms learn, how they are similar or different in their approaches to open innovation, and accordingly how they adapt their innovation strategies.

The aim of this study is therefore to compare the open innovation strategies between startups and incumbent firms.

Using a longitudinal sample of startups and incumbent Spanish firms from the Spanish Technological Innovation Panel (PITEC), collected by the Spanish National Statistics Institute (INE), and taking the year 2004 as the focus year, we compare startups and incumbent firms on three main issues, 1) firms' degree of open innovation measured by the extent to which they engage in external cooperation during innovation activities, 2) radical innovation performance, and 3) incremental innovation performance. In this way, we contribute to the limited research that has studied the open innovation phenomenon in the context of startups, and directly compare the innovation activities of startups with those of incumbent firms to show the case of an innovation ecosystem in one particular country, namely Spain. We conclude the paper by presenting how this study provides relevant implications for practitioners.

2. ENGAGING WITH EXTERNAL SOURCES

Open innovation usually implies cooperating with different external agents, such as customers, suppliers, competitors, universities or research centers (Wallin & von Krogh, 2010). The motivation to cooperate with external partners differs between startups and incumbent firms, mainly due to differences in resource endowments and legitimacy to develop and commercialize innovations. Startups are handicapped by their smallness and newness (Stinchcombe, 1965). Because of their small size, startups usually do not have the human and financial resources to bring a new technology or product to the market

KEY WORDS
Startups; open innovation; cooperation; radical innovation; incremental innovation.

PALABRAS CLAVE
Startups; innovación abierta; cooperación; innovación radical; innovación incremental.

(Neyens, Faems, & Sels, 2010). External sources are therefore considered essential in the startups' innovation process, since startups can acquire the resources they lack (Hite & Hesterly, 2001) or get access to complementary assets (Colombo, Grilli, & Piva, 2006). Because of their newness, startups lack reputation and legitimacy, as both reputation and legitimacy are built up over time (Neyens et al., 2010). External partners enhance the strategic position and legitimacy of a startup (Eisenhardt & Schoonhoven, 1996), since they act as endorsements by building public confidence about the value of the startup and its products (Stuart, 2000). An example of how a startup has cooperated with an external partner to overcome its inadequacies is the case of Social&Beyond, a Spanish startup that developed a marketing application that transforms retailers' free Wi-Fi systems into a social media marketing pool. Social&Beyond lacked the track record to sell to big retailers. To compensate for this, they cooperated with Telefonica, who included the social media tool into their new broadband deals. This meant access to customers and therefore also revenue stream for Social&Beyond (Nesta, Founders Intelligence, & Startup Europe Partnership, 2015).

Collaborating with external partners is also important for incumbent firms, but it is a strategic decision, and a central question they ask themselves is whether to collaborate or hire internal resources. The incumbent firms' motivation to cooperate with external partners is to get a sustainable competitive advantage rather than to overcome a lack of resource endowment. By accessing partners' knowledge base, they can increase their opportunities for knowledge recombination, and thereby also find new ways of exploiting their own resources or speeding up the process (Teece, 2007). For example, Acciona, a leading Spanish corporation in the development and management of infrastructure, renewable energy, water and services, has collaborated with Ennomotive, an open platform for innovation in engineering, with the goal to use Ennomotive's open innovation platform to receive proposals about battery monitoring from experts around the world (Acciona, 2015). For incumbent firms, an increase in cooperation activities can also be due to an increase in the diversity of the different types of partners (Bogers, 2011), as different partners help meet different goals and objectives. The Spanish electric company Endesa, for instance, is aware of the current innovation ecosystem, and it has launched a platform called Opinno, which gathers experts from throughout the world (Opinno, 2016). Endesa thereby accesses valuable information from partners from distant countries, extending their reach to partners.

3. TYPES OF INNOVATION: RADICAL AND INCREMENTAL

Compared to incumbent firms, startups are often characterized by their innovative capabilities, potentially outperforming incumbents. However, the literature is not clear about whether in reality startups are able to exploit these innovative capabilities and achieve a better innovation performance than incumbent firms.

On the one hand, the lack of financial resources of startups (Stinchcombe, 1965) hinders the innovation process, since they do not have enough financial resources to cover high R&D expenses. As a consequence, startups turn to external investors to raise money for innovation, but this process can be difficult due to the high uncertainty of the startup's innovation processes and information asymmetries between the startup and its investors (Katila & Shane, 2005). Moreover, the limited market knowledge of startups puts them in a disadvantageous position in comparison to incumbent firms. This is highly relevant, for example, when startups engage in markets based on standardized products since, in contrast to incumbent firms, startups have not developed innovation routines yet, nor have they an extended knowledge base on the industry (Katila & Shane, 2005). In contrast, incumbent firms have created routines and knowhow to use their existing knowledge and resources for innovation.

On the other hand, startups have demonstrated that they are highly innovative precisely because they do not have formal and rigid routines that might block more unstructured innovation processes. Startups have therefore been described as being more flexible than incumbent firms (Hyytinen, Pajarinen, & Rouvinen, 2015; Katila & Shane, 2005). In contrast to incumbent firms, startups do not suffer from structural inertia (Criscuolo, Nicolaou, & Salter, 2012), which limits the ability of firms to introduce innovations because it restricts firms from making adjustments changing the way they do things (Criscuolo et al. 2012; Katila and Shane 2005).

Studies on the innovation performance of the firm emphasize that it is important to explore the differences in the innovation process with regards to different degrees of novelty, which range from radical to incremental innovation (Laursen & Salter, 2006). Radical innovation refers to a firm's ability to develop products that are new to the market, whereas incremental innovation is understood as the ability to develop products that are new to the firm (OECD, 2005). Building on this distinction, startups are said to be better suited to develop radical innovations than incumbent firms since they are viewed as a source of

"creative destruction" (Schumpeter, 1934). Their flexibility and absence of formal routines allow them to introduce revolutionary products to the market; products which squeeze the products of incumbent firms out of the market. As a consequence, numerous startups are recognized for their innovative capabilities; for example, the Spanish startup Emotion Research Lab impressed in the Open Innovation Business Contest with presenting a radical innovation; a device that through facial recognition could determine consumers' emotions to improve sales of products and services (Everis, 2017). Startups are entrepreneurially oriented and open to disruptive technologies and opportunities (Hyytinen et al., 2015). As the firm becomes larger, it loses the ability to enter emerging markets (Christensen & Overdorf, 2000).

The degree of novelty is lower for incremental innovation, as this does not require the same levels of innovative capabilities and disruptive innovation outcomes as radical innovation activities (Elfring & Hulsink, 2003). One key element in incremental innovation is capturing the rents of those innovations (Elfring & Hulsink, 2003). In this sense, since incumbent firms are usually in possession of the complementary assets (Teece, 1986), it is likely that they will get a better incremental innovation performance. Nevertheless, incremental innovations could put aside previous products of the firm, and thus the firm will lose income from its overall product portfolio. Since startups' innovative efforts do not cannibalize existing products (Arrow, 1962), as could happen for incumbent firms, startups may be encouraged to introduce incremental innovations as well.

4. EMPIRICAL DATA: THE DIFFERENCES BETWEEN STARTUPS AND INCUMBENT FIRMS

To investigate whether there are differences between startups and incumbent firms in terms of cooperation breadth and innovation performance, we used a representative panel sample of Spanish firms from the Spanish Technological Innovation Panel (PITEC) database, collected by the Spanish National Statistics Institute (INE). The database has a wide sector coverage including both manufacturing and service sectors, and it is representative of the population of Spanish firms. The present article uses data from 2004 to 2013[3]. We split our sample into two groups; startups[4] and incumbents[5]. In total, there were 343 startups in 2004, and 4540 incumbent firms[6]. **Table 1** describes the variables that we used for

our analyses. Below we examine the evolution each of the three variables, comparing startups with incumbent firms.

Table 1. **Variable description**

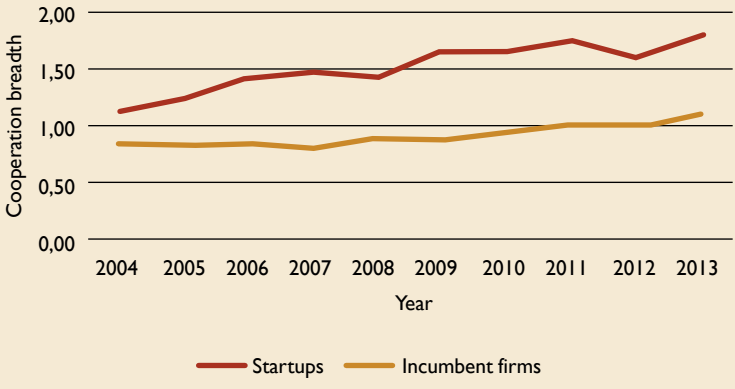
VARIABLE	DESCRIPTION	VALUE	REFERENCES
Cooperation Breadth	Addition of seven sources of R&D cooperation: suppliers, customers (public and private), competitors, consultants, universities, public research centers and technological centers.	0-7	Laursen & Salter (2014)
Radical Innovation Performance	Proportion relative to turnover of new or strongly improved products that the company introduced to the market and that were new to the market.	0-100	Laursen & Salter (2006)
Incremental Innovation Performance	Proportion relative to turnover of new or strongly improved products that the company introduced to the market and that were new to the firm.	0-100	Laursen & Salter (2006)

Cooperation breadth

Firstly, we propose that due to the lack of resources in startups, they collaborate with more partners than incumbent firms. In **Figure 1**, we compare the evolution of cooperation breadth for startups and incumbent firms. The average of cooperation breadth is higher for startups than for incumbent firms. Specifically, the average of cooperation breadth was 1.15 sources for startups, while it was 0.85 sources for incumbent firms in 2004. In 2013, the average of cooperation breadth for startups had grown by 54.5%, while the growth for incumbent firms was 26.8%. These figures show a general increase in firms' cooperation patterns, but stronger for startups. To compare whether the differences in cooperation breadth between the two groups are statistically significant, we conducted a t-test, and as expected, we found that the average cooperation breadth of startups was higher than that of incumbent firms at a 1 per cent significance level[7]. In other words, our data suggests that startups are significantly more engaged in cooperation activities than incumbent firms. Startups cooperate with external agents to overcome their smallness and newness, seeking to enhance

their innovation performance. Startups often lack different types of resources, which makes cooperation with different partners a necessity, so the cooperation breadth of these firms is higher than the cooperation breadth of incumbents.

Figure 1. **Evolution of cooperation breadth**



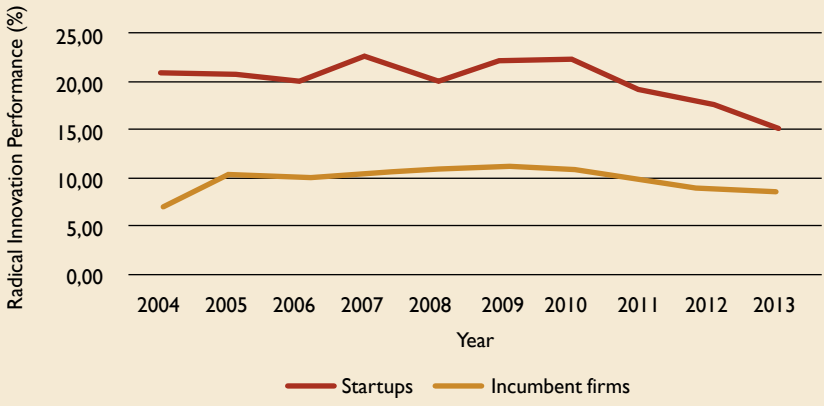
Source: Own elaborated from FECYT & INE (2016)

Radical innovation performance

Secondly, we investigated whether startups are more innovative and thereby have a higher innovation performance than incumbent firms. We did this by examining both radical and incremental innovation. **Figure 2** shows the evolution of the radical innovation performance for startups and incumbent firms, and we observe that it is higher for startups than for incumbent firms over the ten-year period analyzed. In 2004, the average of startups' radical innovation performance reached 20.69%, while it was 6.93% for incumbent firms. The figure also reveals that the radical innovation performance kept relatively steady for incumbent firms. On the contrary, the average of startups' radical innovation performance dropped 24.69% over the 10 years. This might be due to the fact that startups lose their competitive advantages of flexibility and few formal routines after being in business for more than five years. To test the difference on radical innovation performance between startups and incumbent firms, we performed a t-test of mean comparison and found that, at a 1 per cent significance level, the startups' radical innovation performance

is higher than that of incumbent firms[8]. Hence, startups overturn incumbent firms since they are able to introduce revolutionary products into the market and improve their innovation performance.

Figure 2. **Evolution of radical innovation performance**



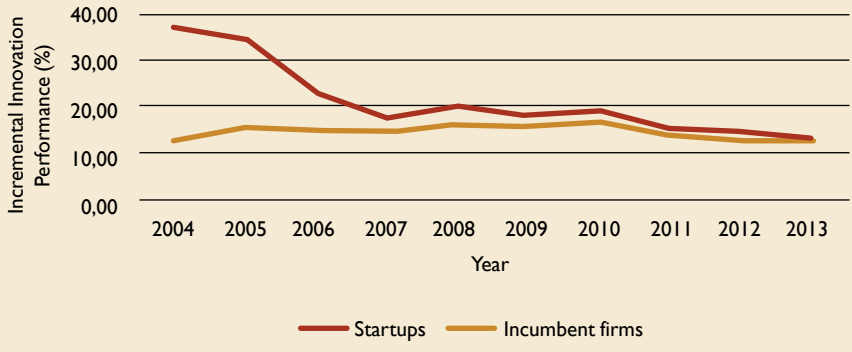
Source: Own elaborated from FECYT & INE (2016)

Incremental innovation performance

With regard to incremental innovation performance, there are arguments in favor of both a higher incremental innovation performance for incumbent firms and a higher performance for startups. In **Figure 3**, we present the evolution of incremental innovation performance for startups and incumbent firms. This Figure shows interesting results, since there is a sharp drop in the level of incremental innovation for startups; it decreased by 64.33% over the ten-year time period examined. In 2004, we observe a high difference in the average incremental innovation performance between startups (3.98%) and incumbent firms (12.96%), but this difference decreases over time, up to the point of disappearing. In 2013, the average incremental innovation performance was slightly higher for incumbent firms (13.26%) than for startups (13.19%). Again, we conducted a t-test to compare the differences between startups and incumbent firms with regard to their incremental innovation performance. Considering the ten-year period, we found a significant difference at a 1% of significance level: on average incremental innovation performance is higher for startups than incumbent firms. Nevertheless, since our graphs show that

the tendency is much greater during the early years than later, we conducted a year-by-year t-test to estimate when the differences are no longer present. We found that the difference on the average incremental innovation performance between startups and incumbent firms disappears approx. 5 years after a startup was established (year 2009 in our data). There are several possible reasons for this. It might be explained by the fact that, by that time, startups already have products in the market, so they no longer enjoy the benefit of newness, but they cannibalize their own products. In other words, as startups become established, their incremental innovations are reduced to a level equivalent to that of incumbent firms. Furthermore, given the nature of the startups, i.e. them being risk seeking (as compared to incumbents that are more risk adverse), we would expect them to focus their energy on introducing radical innovations to the market, as shown above (in the previous section on radical innovations), leaving little or no resources to pursue incremental innovation, and therefore the steep drop.

Figure 3. **Evolution of incremental innovation performance**



Source: Own elaborated from FECYT & INE (2016)

5. CONCLUSION

The aim of this study was to compare the open innovation strategy between startups and incumbent firms. Drawing on panel data on Spanish firms from PITEC, our results conclude that startups and incumbent firms differ in terms of cooperation breadth, radical innovation performance and incremental innovation performance. These results support previous research, which claims that startups have innovative capabilities and that they are better suited to develop radical innovation (e.g. Christensen & Overdorf, 2000; Hyytinen et al., 2015). In particular, this study is in line with Criscuolo et al. (2012) who, using data from the UK innovation survey, found that startups have a higher proportion of sales from innovative products than incumbent firms, and that startups also have a higher likelihood of generating product innovations than incumbent firms. We extend this analysis by distinguishing on the basis of the degree of innovation and analyzing it from an open innovation perspective, as well as adding a longitudinal view. In other words, we differentiate between radical and incremental innovation and we incorporate the variable cooperation breadth into the analysis. The longitudinal perspective allows us to study the evolution of the open innovation strategy for startups and incumbent firms. At the same time this perspective sheds light on startups' maturity process and their evolution to becoming incumbent firms[9].

This study has relevant implications for practitioners and policy makers. First, in recent decades, models of innovation suggest that managers should cooperate with external partners to enhance innovation outcomes, to increase market share and to survive in the current competitive market. Cooperation activities by large incumbent firms are often in the public eye, for example, Microsoft cooperated with IBM, Apple and UNIX to deal with the uncertainty they were facing over the future of microcomputer operating systems (Grant & Baden-Fuller, 2004). However, our results show that incumbent firms are less open than startups. We recommend that managers from incumbent firms increase their breadth of cooperation, since they could benefit from more diverse knowledge in their innovation activities and enhance their innovation performance.

Second, startups find in their partners the resources and legitimacy that they lack. Hence, having an open innovation strategy is especially relevant for them. Managers of new firms who have not implemented an open innovation model should consider the benefits

of opening their innovation processes and engaging with external partners to improve innovation performance.

Third, startups and incumbent firms bring variety to the innovation ecosystem. Startups' flexibility and their absence of formal routines boost their innovative capabilities, thereby leaving room for the creation of radical innovations. Managers at startups are therefore operating in a very different setting than that of managers in incumbent firms. While startups' managers have more freedom because they are not restricted by internal routines and procedures, managers of incumbent firms are operating in organizations with set structures and routines, and employees expecting certain approaches to innovation. As a consequence, each type of firm plays a different role in the innovation ecosystem.

Fourth, we found that startups have better radical innovation performance than incumbent firms. In this setting, managers struggle with established corporate values and "the way of doing things", limiting their abilities to introduce radical innovations. Our results therefore go hand in hand with Christensen & Overdorf's (2000) research, in which they suggest that the best way to address radical innovations is through the creation of new organizational spaces to develop these innovative activities. They propose three mechanisms for this: 1) create new organizational structures within the company, 2) spin out an independent organization that carries out the new processes, and 3) acquire a new organization whose processes and values fit with the new processes and integrate that firm into the organization. We add to their mechanisms, and suggest that incumbent firms should engage with startups to increase their radical innovation performance.

Fifth, our study analyzed the evolution of the open innovation strategy for a period of ten years. This allowed us to observe how firms' reliance on open innovation processes changes over a period of time. The rather low levels of open innovation shown could be due to difficulties in implementing open innovation. Many firms experience a wealth of managerial challenges in effectively implementing open innovation strategies (e.g. dealing with employee attitudes affected by the "Not Invented Here" syndrome). It could take time before managers develop their capacities to successfully implement an open innovation strategy. For example, Italcementi, the leading Italian cement manufacturer, evolved from being a closed innovator to become an open innovator, but it faced a significant challenge

and clearly required a remarkable change in the organization and management systems (Chiaroni, Chiesa, & Frattini, 2011). We warn managers that the positive outcomes of open innovation processes might not be easily achieved, as deeply rooted routines need to be challenged. We recommend that managers be patient, and ensure that the right incentive structures are in place to unfold open innovation activities properly.

Finally, the longitudinal study also reveals the evolution of startups' innovation strategies. We evidenced how the startups' incremental innovation performance sharply decreases after some years. Startups' managers should be aware that the advantageous position of high radical and incremental innovation capacities does not go on forever. There is a time when the startup becomes an incumbent firm, with a portfolio of products and a set of values and routines. If the startup's strategy is to remain with a startup culture and exploit the benefits of high innovation performance, managerial focus on not routinizing firm structures must be maintained, despite the temptation to "fall into old routines".

From a policy perspective, our study also provides relevant implications. In an era of open innovation, policy makers should design targeted policies that increase knowledge sharing between firms. These policies should take into account the different roles of startups and incumbent firms for the national economy and innovation system. Large and high-intensive R&D firms are currently those that benefit most from policies that provide incentives for cooperation (Barge-Gil, 2010), but policies should also focus on startups, because they are also implementing open innovation models, and as we show, to an even higher extent than incumbent firms. Policies should therefore support startups, since they are the motor of the economy for many countries, such as Spain.

Finally, this study suffers some limitations. Our startup sample represents 4% of the sample of PITEC firms. This figure is slightly lower than the proportion of startups in Spain, since the birth rate in 2004 was almost 10% (INE, 2016) of the total number of firms. Our sample could suffer from some survivorship bias, since PITEC only provides information about firms that were in business. Nevertheless, we do not expect our results to be biased, since PITEC follows a representative method to select the sample of firms, and since we compared the initial conditions for some control variables (internal R&D, firm size and market scope) between survivors and non-

survivors and we did not find any significant difference. This study was tested using a sample of Spanish firms, but we expect that the results are generalizable across countries. Despite these limitations, this study brings important conclusions about the differences between startups and incumbent firms on developing innovations and the study suggests how managers can cope with open innovation strategies.

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NOTES

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3. PITEC was created in 2003, but the questionnaire suffered important modifications in 2004, so we used the year 2004 rather than 2003. In this way, we could also ensure that we observed data before and after the financial crisis in 2008 to elucidate whether external factors influenced the results.
4. Start-ups are defined as firms that answered yes to the question about the firm was newly established during the last three years.
5. Firms that in 2004 had been in business for more than 10 years.
6. The average size over the 10-year period is 39 employees for startups, and 421 employees for incumbent firms. 54% of the startups are high-tech firms, while 18% of incumbent firms operate in high-tech sectors. In our robustness checks we tested industry differences.
7. Year-by-year t-tests also show a 1% of significance level in all years.
8. Year-by-year t-test also show a 1% of significance level in all years.
9. As a robustness check, we split the sample between high-tech and low-tech firms and reran the same analyses as presented in the main results. All the main results were confirmed, although the year-by-year t-tests for incremental innovation performance revealed that, for low-tech firms, the significant differences between startups and incumbent firms disappear in 2007; while for high-tech firms they do so in 2011.