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Document de treball n.17- 2016

DEPARTAMENT D'ECONOMIA – CREIP
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Edita:

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www.fcee.urv.es/departaments/economia/public_html/index.html
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Adreçar comentaris al Departament d'Economia / CREIP

ISSN edició en paper: 1576 - 3382
ISSN edició electrònica: 1988 - 0820

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Science and technology parks and firm growth

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Abstract:

This paper aims to contribute to understanding the role played by Science and Technology Parks in fostering firm growth. Public policies have given such parks a central role but empirical research has not come to a consensus on whether there is a link between in-park location and firm growth. Applying a matching procedure to our mercantile register data we obtain a database of 286 in-park firms, together with 268 out-park firms. Our results show that in-park firms show greater growth rates and volatility than their counterparts, but we do not find evidence of their capacity to obtain larger long-term debts.

Keywords: science and technology parks, firm location, firm growth

JEL codes: L25, O30, R11, R58

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We are very much indebted to participants at XLI International Conference on Regional Science (Reus, 18th-20th November 2015). This paper was partially funded by ECO2013-42310-R, ECO2014-55553-P, ECO2015-68061-R, the "Xarxa de Referència d'Economia Aplicada", the "Xarxa de Referència d'R+D+I en Economia i Polítiques Públiques", and the SGR programmes 2014-SGR-299 and 2014-SGR-1395 of the Catalan Government. We would like to acknowledge research assistance by Verònica Gombau and Magda Lleixà.

1. Introduction

The role of Science and Technology Parks (henceforth STPs) as policy tools for promoting innovation has generated controversy and an intense debate between academics and policy makers. For some, the impacts of STPs are interpreted through a linear model of innovation that assumes that knowledge can be fluently transferred to business. Others are sceptical of the impact of STPs on technological or urban development and regard their link with firm growth as being more complex. For example, Quintas et al. (1992) argued that STPs are not a major source of technological development, and that geographical proximity between a university and a park was unlikely to have much effect in promoting technology transfer. In this context, some authors talk about 'high tech fantasies' (Phillimore, 1999), while others find that in-park firms are no more innovative than out-park firms (Radosevic & Myrzakhmet, 2009).

Because the linkage between in-park location and growth is not simple, there is still a lack of knowledge on how one affects the other. Frequently however, policy makers believe that there is a positive and direct link between the services provided by a park and the growth of its firms. Additionally, STPs are often interpreted as drivers of regional development by fostering innovative activities and regional growth, but the implications are very much larger and include changes in the spatial distribution of economic activities and in the skill composition of the labour force, as well as gains in productivity. Although most of the economic literature is quite optimistic about the positive role of parks, especially Science Parks (SPs), it is important to note that some claimed effects may never have existed, or apply only for some type of firms. Consequently, we take into account the heterogeneity of in-park firms in order to better identify their effects and arrive at a more realistic approach to STPs.

In order to investigate the relationship between firm performance and location inside / outside an STP we use data for 286 firms located inside 12 Catalan parks (in-park firms) and 268 firms located outside these parks (out-park firms). We test whether in-park firms had the same performance in the period 2006–2013 as did out-park firms located at the same geographical area (i.e., at the same municipality, in order to control for external factors), in the same municipality,) and having similar internal characteristics (i.e., size, age and knowledge intensity).

The aim of the present paper is twofold. Firstly, we study the impact of firms located inside the Catalan parks on three relevant dimensions of firms' performance (growth rate in sales and workers, growth rate dispersion and long-term liability). Secondly, in the econometric estimation, we use quantile techniques in an attempt to observe the effects of the park's location on Catalan firms. Despite the heterogeneous performance of firms involved in growth and financial sources in the empirical studies on the impacts of the location inside the parks, few papers use quantile regression techniques. We are strongly of the opinion that this is a relevant approach since the empirical evidence regarding the role played by STPs on a firm's performance is quite inconclusive (Colombo & Delmastro, 2002).

This paper is organized as follows. The second section offers an overview of the main literature on STPs and presents the hypotheses of the empirical analysis. The third section shows the main characteristics of the Catalan parks. The fourth and fifth sections present our dataset and the econometric methodology, respectively. The sixth section discusses the main empirical results. The final section highlights the main conclusions and suggests further research.

2. Review of literature

2.1. The impact of Science and Technology Parks on firm performance

Policy makers often consider STPs as drivers of regional economic development (Durão et al., 2005; Garnsey & Heffernan, 2005), through regional growth strategies[1] focused on knowledge creation and the promotion of new technology-based firms (henceforth NTBFs) (Fukugawa, 2006; Ferguson & Olofsson, 2004; Lindelöf & Löfsten, 2003; Siegel et al., 2003b; Löfsten & Lindelöf, 2002; Shin, 2001). At the same time, STPs may enhance innovation (Siegel et al., 2003a; Felsenstein, 1994), R&D intensity (Westhead, 1997), firms' absorptive capacity (Cohen & Levinthal, 1990), R&D cooperation with external partners (Vásquez-Urriago et al., 2016; Fukugawa, 2006); and in-park firms are significantly more likely to have a link with a local university than their counterparts (Löfsten & Lindelöf, 2002; Segarra-Blasco & Arauzo-Carod, 2008).

New firms benefit from locating in STPs since they may act as incubators (Phan et al., 2005; Colombo & Delmastro, 2002) providing them with an appropriate environment that makes survival less costly, especially for NTBFs.[2] Consequently, in-park firms achieve higher survival rates (Ferguson & Olofsson, 2004) than out-park firms, although it should be noted that there are entry screening processes that may reduce mortality inside parks (i.e., for managed STPs), and that, since less efficient firms do not consider locating inside STPs, there is also a potential problem of sample selection (Dettwiler et al., 2006)

In terms of their role in firms' performance, it is assumed that interactions inside an STP fosters a firm's productivity (Liberati et al., 2015; Díez-Vidal & Fernández-Olmos, 2015; Vásquez-Urriago et al., 2014; Dettwiler et al., 2006; Fukugawa, 2006; Siegel et al., 2003a; Westhead & Storey, 1994). Nevertheless, as these agglomeration effects are not confined within a park's boundaries and may spill over into neighbouring areas, out-park firms may also benefit from them if they have some linkages with in-park firms.[3] However, as Audretsch et al. (2005) show

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[1] See Dettwiler et al. (2006) for an analysis of the Swedish case in which local authorities play a leading role in promoting the more active involvement of universities in local economic development by means of their participation in STPs.

[2] In terms of survival likelihood, for a sample of UK knowledge-based firms located in SPs Westhead and Storey (1994) found that in-park firms that cooperate with universities have a higher survival rate (72%) than in-park firms that do not cooperate (53%).

[3] Among these benefits we may include supply side ones (e.g., specialized labour pooling, availability of intermediate inputs or knowledge spillovers) and demand side ones (e.g., pool of users from the same or different industries), as reported by Baptista and Swann (1998).

using a large German dataset of publicly listed high-tech start-ups, spillover mechanisms are quite heterogeneous. As in-park firms accessibility to research infrastructures and knowledge spillovers is generally stronger, there is empirical evidence (Siegel et al., 2003a) suggesting that in-park firms have higher research productivity levels than similar out-park firms. In any case, it is important to be aware that higher productivity does not necessarily imply higher growth capacity.

Another aspect of STPs effects is whether firms' internal or external characteristics do matter as drivers of firm performance. Here, Díez-Vidal and Fernández-Olmos (2015) use data for Spanish SPs and conclude that cooperation strategies with universities, research institutions and other firms may enhance firms' performance. This is a key result that helps in understanding some important policy implications. Concretely, Díez-Vidal and Fernández-Olmos (2015, p. 81) recognize that it is not reasonable to "(…) expect all on-park firms to benefit from their location, so we need to promote behaviour that allows firms to take advantage of it". This is a critical point that suggests that being in an STP is not enough *per se* and must be accompanied by other measures / actions taken by a firm in order to ensure it benefits from the decision to locate inside a park.

2.2. The impact of STPs on firm growth

There is an extensive literature covering both internal and external determinants of firm growth (see, among others, Coad et al., 2016; Coad, 2009; Davidsson et al., 2002; Audretsch, 1995; Storey, 1994), but much less is known about the effect of being located inside an STP. As we have seen previously, there are frequent but inconclusive debates between scholars on the benefits of locating in STPs. In any case, empirical evidence points to the existence of higher growth rates for in-park firms (Lindelöf & Löfstern, 2003; Monck et al., 1988), although sectoral composition may play a role as most of these firms belong to intensive knowledge sectors with already higher growth rates.

The main argument as to why in-park firms may show larger growth rates is that STPs are a tool to support both the innovation activities and the growth of innovative firms. First, STPs may ensure and facilitate the interaction among firms and between firms, universities and other research organizations. Second, STPs may provide firms with a high-reputation location that may contribute to firms' legitimacy. Consequently, STPs may attract more customers and create tighter networks relationships (Ferguson & Olofsson, 2004). Another reason may be that in-park firms may have received stronger university spillovers and may benefit from face-to-face communication (Acs et al., 1994). Additionally, the location of firms inside STPs may reduce transaction costs since it may increase the knowledge of the R&D capabilities of firms and reduce the obstacles to cooperation in R&D projects. A lower level of transaction costs reduces market uncertainty and fosters growth.

Apart from the direct benefits of locating in an STP, there are also some indirect impacts on growth. Salter and Martin (2001), for example, find that the direct impacts of in-park location on firm growth are small and fuzzy. However, they consider that there are some other indirect impacts such as the provision of skilled workers, the R&D facilities and the ability to solve complex problems. In a similar vein, Nightingale and Coad (2014) revise the accepted view that in-park firms grow and innovate more than out-park firms. According to these authors, the main sources of innovation for firms are customers and suppliers since universities affect the capacity to create spin-off firms and the training of future employees.

In addition to the doubts regarding the positive impact of STPs, some evidence points to in-park firms being younger and smaller than out-park firms (Lindström & Olofsson, 2002; Löfsten & Lindelöf, 2001; Fergusson, 1999; Westhead and Storey, 1994; Olofsson & Wahbling, 1993). Differences in firm size may cause higher growth rates in order to overcome the "liability of newness" and to achieve a minimum efficient size (see, for evidence, Coad et al., 2013). Therefore, higher performance of firms in STPs may be the consequence of a spurious relationship, although this could be easily be addressed through an accurate process of sample selection of in- and out-park firms.

Nevertheless, it is also necessary to take into account the skill composition of in-park firms. Lindelöf and Löfstern (2003) point out that in-park firms are mainly founded by academics, which implies that these firms are biased towards a skilled workforce and may result in these firms underperforming in terms of employment growth.

Finally, one key factor that influences firm growth is the access to long-term debt, in particular for high-tech small young firms. In-park firms may have the easiest accessibility to external financial sources since they may have better knowledge of their technological viability and, consequently, reduced financial risk. Additionally, in-park firms may be closer to venture-capital initiatives, business angels and public agencies that may facilitate the external finance. Furthermore, in-park young firms are typically involved in public funding programs that allow them to obtain larger shares of public R&D subsidies[4].

2.3. Criticisms regarding the impact of STPs on firm performance and growth

The previous subsections present some contributions highlighting positive effects by STPs over different dimensions of firm performance (e.g., sales, reputation, etc.) and firm growth. Nevertheless, there are some authors that are not only less optimistic about role taken by these STPs but are quite critical (Massey et al., 1992), and even consider that they may negatively affect firms located there. In any case, it seems that previous optimistic assumptions about the role played by STPs may be partially explained by a selection bias when comparing in- and out-park firms and because public policies fostering NTBFs have allocated more resources for in-park programs than for out-park firms (Löfsten & Lindelöf, 2002).

[4] Colombo and Delmastro (2002) using a sample of 17 Italian science parks found 51% of in-park firms received public subsidies compared to 33% for a sample of out-park firms.

Even though it is widely assumed that, generally speaking, STPs benefit local and regional economies, in recent years policy makers of several countries have increased expectations of their capacities to drive growth[5] and, consequently, public support to STPs has expanded considerably. Unfortunately, some of these new parks do not really correspond to what is in fact an STP, a business park managed by professionals, that fosters knowledge generation and diffusion inside the park's borders. Surprisingly, STPs may also have negative externalities over innovation activities carried out in the same areas by other agents, as they may absorb these activities (Spence, 1974), and not all firms may be able to capture positive externalities arising from universities and research centres and transform them into innovations, as they need skilled workers and R&D departments (Pinto et al., 2015).

Some of the previous concerns relate to whether STPs may carry out the same role, no matter what the institutional environment in which they are located. At this point, it seems that the answer is clearly "No", as geography and institutions matter. In view of the success achieved by some STPs in developed countries, policy makers of less developed countries have considered STPs as potentially successful tools, but some case studies (e.g., Rodríguez-Pose & Hardy, 2014) suggest that what is appropriate for a developed country is not necessary appropriate for a less developed one. Concretely, they argue that in terms of achieving success it is important to take into account the national context, the proximity to urban areas and consistency of national policies, which tend to differ as between developed and developing countries.

Even for parks located in core countries, uncertainty about their effectiveness is still a major concern. Here, the empirical evidence is unclear, as some findings suggest that there is not a direct link between being located in a park and, for instance, achieving higher innovation performance (Siegel at al., 2003b;

[5] In line with excessively optimistic approaches to STPs, Appold (2004) considers that STPs do not help to the formation of R&D agglomerations in the areas where they are located but, on the contrary, they simply locate where there these premises are already in place.

Felsenstein, 1994). Additionally, there are some examples of STPs (specially in Southern European countries) that do not fulfil neither the functions not the results of a successful park. Among potential explanations for such failures, one may highlight that some parks are not capable to generate (and maintain) sufficient linkages with local economic environment, as firms, public administrations, universities and research centers.

Apart from previous points about STPs inefficiencies, it is necessary to consider typical arguments about the negative effect of excessive agglomerations (Arauzo-Carod & Manjón-Antolín, 2004; Glaeser, 1998) such as congestion, strong competition, and pressures on the cost of local inputs or land costs, even if these diseconomies only apply for bigger and more dense STPs.

2.4. Hypotheses

Taking the aforementioned literature as a point of departure, in this paper we analyze the way in which being inside an STP influences firm behaviour in terms of growth patterns and accessibility to external funding. In order to do that, we compare performance of our sample of in-park firms with a sample of out-park firms (see Section 4 for technical details) of the same municipality. Accordingly, three main hypotheses are tested:

- **Hypothesis (1)**: In-park firms have, on average, higher growth rates (measured in terms of employment and sales) than out-park firms.
- **Hypothesis (2)**: Dispersion in growth rates (measured in terms of employment and sales) is higher for in-park firms than for out-park firms.
- **Hypothesis (3)**: Financial barriers are lower for in-park firms than for out-park firms.

Previous hypotheses assume that STPs provide in-park firms a business environment that enhances their growth capabilities (Hypothesis (1)), especially for NTBFs (Dettwiler et al., 2006). Furthermore, we assume that growth variation for in-park firms is larger than for out-park firms as STPs tend to host upper outliers (i.e., high-performing firms), as shown by Ferguson and Olofsson (2004) for a sample of Swedish science parks (Hypothesis (2)). Previous STPs advantages are partially explained in terms of better (Phan et al., 2005), and more diversified (Monck et al., 1988)[6] accessibility to external funding for in-park firms, since being located inside an STP helps them to send market signals that may attract external capital (Hypothesis (3)), and because in some countries there are public policies promoting science parks that include financial support to in-park firms (Liberati et al., 2015; Siegel et al., 2003b). Nevertheless, there is also empirical evidence showing that significant differences do not exist between in- and out-park firms in terms of access to capital sources (Lindelöf & Löfsten, 2002).

3. The Catalan park network

In 2002, the International Association of Science Parks defined a Science Park as an organization managed by skilled professionals, whose main aim is to increase the wealth of its territory by promoting the innovation, the R&D cooperation and the competitiveness of its associated businesses and knowledge-based institutions. In view of this generic definition it should not be surprising to found a wide range of identifiers for STPs (Fukugawa, 2006). For instance, "Science Park" is used in the United Kingdom; "Technopole" or "Technopolis" in France; "Technology Centre" or "Technology Park" in Germany; "Science and Technology Park" in Spain; and "Research Park" is mainly used in the U.S.A., among others.

According to the driving institutions of the Catalan park network there are two kinds of parks, Science Parks (SPs) and Technology Parks (TPs). On the one hand, an SP is the result of an initiative from one or several universities and the Catalan government. Its main purposes are to facilitate the creation of spin-offs and NTBFs and to promote the link between high-tech firms and research university groups.

[6] Monck et al. (1988) maintain that in-park firms have wider sources for funding related to out-park ones as they may access to funds coming from universities, local authorities, government development agencies, standard private sector institutions, and tenant firm themselves.

Public universities often provide human research resources and create a wider environment that favours innovation and R&D cooperation between new firms and scientific partners. In these initiatives, public universities contribute to basic research and facilitate location of knowledge intensive firms. On the other hand, TPs are generated by the initiative of local public agents, the Catalan government, and clusters of innovative firms. Furthermore, in TPs technological centres and universities ensure the technology transfer between research institutions and local firms through formal agreements. The main purpose of TPs is to promote the local relations between firms and the territorial innovation system.

The first Catalan technological park was *Parc Tecnològic del Vallès*, created in 1987 by the Consortium of the Zona Franca of Barcelona and the Catalan Government, aiming to strengthen relations between Catalan universities, public research centres, financial institutions and innovative firms. Ten years later, in 1997, the University of Barcelona created the *Parc Científic de Barcelona*, the first Spanish Science Park. Its main purpose was to consolidate an appropriate environment to foster the development of start-ups in biotech and medical sciences, and to promote the relationship between research groups and start-ups.

Catalonia has a network integrating 20 STPs, known as *Xarxa de Parcs Científics i Tecnològics de Catalunya* (henceforth XPCAT). Currently, XPCAT has 13 shareholders and seven associated agents. In this paper, we focus on twelve of these parks (see Table 1).

[Insert Table 1 about here]

The institutions that promoted the formation of a network of Catalan parks are diverse (municipalities, universities, clusters of firms and the Catalan government). Furthermore the governance of the XPCAT has developed to a more decentralized design since the beginning of this century, especially since the founding of TPs in Girona, Lleida and Tarragona-Reus. During the last decade, the traditional and centralized STP network has bypassed the metropolitan area of Barcelona and adopted a more spatially dispersed dimension.

4. Database and descriptive statistics

4.1. Database and selection procedure

Our data is compiled from the *Sistema de Análisis de Balances Ibéricos* (SABI). This database contains exhaustive information at firm level about balance sheets from the Spanish Mercantile Register. We collected detailed information for manufacturing firms covering the period 2006–2013.

In order to carry out comparative analyses between in-park and out-park firms, we identify those firms having a relationship with one of our twelve STPs. The information is compiled through the XPCAT[7] but also complemented with data from the Spanish STPs network (*Asociación de Parques Científicos y Tecnológicos de España*, henceforth APTE) in order to identify the in-park firms.

We applied the following filtering process. Firstly, from the SABI database we selected firms located in those municipalities where there is an STP. Secondly, we selected firms that were operating in the same industry as those in-park firms in order to get a comparable group of out-park firms. Thirdly we considered only in-park firms located in Catalonia. Finally, to control for outliers of growth rates, when the annual mean growth rate was greater than 50% or smaller than -50%, we calculate the average between the previous and the next year growth rate. Finally, our database contains 69,553 observations of 12,025 out-park firms and 1,871 observations of 299 in-park firms.

[7] XPCAT includes a large number of centres and groups for university research, technological centres, big companies and their associate R&D centres, companies focusing on innovation as well as new knowledge based companies, all of them engaged in research, development and innovative activities in a wide range of areas and economic activities.

Since in-park firms may differ systematically from out-park firms, this can give rise to a selection bias problem. Thus, we consider that the probability of a firm located in an STP is not a random process and one must control for the factors that make firms more likely to be recruited by a park manager. These factors also affect the potential firm growth and therefore require an appropriate control mechanism.

Following previous literature (Liberati et al., 2015), we control for the selection bias by matching treated and untreated firms according to the sector where firm operates (high-tech or knowledge intensive sectors), if the firm is located in Barcelona (85% of our firms), firm size (number of employees) and firm age. These four characteristics may condition the probability of locating in an STP and, in consequence, help us to control for selection bias and to obtain two homogeneous groups of firms. We apply a Mahalanobis matching procedure, which is more robust than other alternative methods (Zhao, 2004). Firstly, the matching procedure leads us to control for these individual characteristics that in-park firms may have and may result in a different propensity to be in an STP, and to find a homogenous group of comparison between in-park and out-park firms. Secondly, after controlling for the selection bias of in-park firms by using a propensity score matching technique, our final sample has 286 in-park firms and 268 out-park firms.

4.2. Descriptive statistics

Table 2 shows the mean tests of characteristics between the finally selected in-park and out-park firms (see Table A-1 and A-2 for some descriptive statistics and correlations, respectively). Out-park firms show some significantly differences in the mean test. In-park firms have a higher propensity to export, and high-tech manufacturing sectors and knowledge intensive services are overrepresented. Regarding the financial structure, in-park firms have a higher long-term debt to asset ratio but a lower profit to asset ratio. Furthermore, a lower proportion of firms is located in Barcelona. Regarding those variables closely related with a firm's performance, in-park firms do not show statistically different growth patterns, but the standard deviation of the firm growth is lower among out-park firms. One explanation for this behaviour is that firms located in an STP are developing new projects and may have larger expected growths. However, given the innovative nature of their projects and the inherent risk of their projects, the standard deviation may be higher than out-park firms.

[Insert Table 2 about here]

Table 2 confirms that in-park firms are not significantly different in age and size in terms of employees from their out-park counterparts. However, there are significant differences between firms located in SPs and those located in TPs. The difference-of-means tests shows that firms located in TPs are older and larger than firms located in SPs. Furthermore, the results show that firms in SPs operate more in high-tech manufacturing sectors and KIS. Hence, it seems that they are more similar to NTBFs, which are characterized by being young, small and operating in high-tech sectors. Furthermore, firms in SPs show a lower propensity to export and have a higher long-term debt to asset ratio and a lower productivity. Finally, firms in SPs have higher sales growth and also a higher standard deviation of sales growth.

[Insert Figure 1 about here]

A key variable in our analysis is firm growth. An analysis of the firm growth distribution sheds light on the firm performance of in-park firms and out-park firms. Figure 1 shows firm growth distribution in terms of sales and employees for our matched sample. We observe that there are differences between in-park firms and out-park firms. In terms of sales and employment growth, the density in the modal growth of in-park firms is smaller, while their density is larger in the right tail for the employment growth and in the left for the sales growth. Additionally, Figure 1 highlights the unequal distribution of growth rates and also the fact that the dispersion of the in-park firms is larger than out-park firms. Finally, the figure also reports the Kolmogorov–Smirnov test results, which show that the null hypothesis of equality for the growth distributions is rejected.

5. Econometric methodology

After the matching procedure, we test whether in-park firms perform differently from out-park firms. For this, we estimate the following equations:

$$GrSales_{i,t} = \alpha_{10} + \alpha_{11}Parks_{i,t} + \alpha_{12}\, Controls_{it-1} + \varepsilon_{1it} \quad [1]$$

$$GrEmpl_{i,t} = \alpha_{20} + \alpha_{21}Parks_{i,t} + \alpha_{22}\, Controls_{it-1} + \varepsilon_{2i,t} \quad [2]$$

$$sdGrSales_{i,t} = \alpha_{30} + \alpha_{31}Parks_{i,t} + \alpha_{32}\, Controls_{it-1} + \varepsilon_{3i,t} \quad [3]$$

$$sdGrEmpl_{i,t} = \alpha_{40} + \alpha_{41}Parks_{i,t} + \alpha_{42}\, Controls_{it-1} + \varepsilon_{4i,t} \quad [4]$$

$$LTdebtAssetst_{i,t} = \alpha_{50} + \alpha_{51}Parks_{i,t} + \alpha_{52}\, Controls_{it-1} + \varepsilon_{5i,t} \quad [5]$$

where α_i are the coefficients to be estimated and ε_{it} are the usual error termS for firm *i* at time *t*. Our dependent variables differ depending on our hypothesis. Equations [1] and [2] estimate the determinants of firm growth. Firm growth rates are measured in terms of alternative growth indicators: sales growth (*GrSales*) in Equation [1] and employment growth in (*GrEmpl*) in Equation [2]. Firm growth rates are calculated by taking log-differences of size (as in Coad, 2009 and Tornqvist et al., 1985). Equations [3] and [4] estimate the determinants affecting the standard deviation of sales growth (*sdGrSales*) and the standard deviation of employment growth (*sdGrEmpl*), respectively. Finally, Equation [5] estimates the determinants affecting the capacity of the firm to obtain long-term financial resources, where *LTdebtAssets* corresponds to the ratio of long-term debt to assets.

We include two sets of explanatory variables according to the nature of the variable (see Table A-3). Firstly, we include one dummy that identifies firms that are located in STPs (*Parks*). Second, we include some control variables of firms' characteristics such as firm size, measured in log employees (*lnLab*) or log sales (*lnSales*); firm age measured in log firm age (*lnAge*), and its quadratic value (*lnAgesq*); a dummy variable indicating whether the firm exports (*Export*); a dummy variable indicating if the firm belongs to a high-tech manufacturing sector or to knowledge intensive sector (*HtecKis*); the ratio of long-term debt to asset ratio (*LTdebtAssets*); the ratio of the profits to assets (*ProfitsAssets*); the productivity ratio measured and the log of the sales to workers ratio (*SalesLab*). Finally, we include sector and time dummies in order to control for specific industrial characteristics and different time periods.

In order to capture the different effects that the determinants may have on firm performance, we estimate Equations (1)-(5) using quantile regressions (Koenker and Bassett, 1978). Quantile regressions are preferable to other techniques for several reasons. First, the standard least-squares assumption of normally distributed errors does not hold for our data, because firms' growth rates follow a Laplace distribution. Second, quantile regressions describe the distribution of the dependent variable. And third, quantile regression is more efficient at treating outliers and heavy-tailed distributions.

In view of the characteristics of firms included in our dataset (i.e., innovative firms with higher volatility), quantile regression seems to be the more appropriate methodology as it allows us to explain the influence of the location in STPs on firm performance, for both those firms that are successful and those that are less successful. To this end, we present results for the quantiles $\theta = 0.05, 0.10, 0.25, 0.50, 0.75, 0.90$ and 0.95.

6. Results

Our results support Hypothesis (1) and Hypothesis (2), while Hypothesis (3) is not rejected. Additionally, another important outcome arising from our results points to firms' heterogeneity in terms of their capacity to benefit from being inside an STP, as there are substantial differences among them. These differences hint that although STPs may increase firms' profitability, growth, and knowledge creation, among other positive effects, it is not reasonable to expect the same impact on all types of firm. Accordingly, not all firms may be interested in locating inside an STP nor should public administrations promote parks for no matter what kind of firm. This is an important outcome as a large strand of academic literature has enthusiastically favoured STPs as key drivers of regional development, suggesting an incontestable role for STPs regardless of a firm's profile.

[Insert Table 3 about here]

[Insert Table 4 about here]

[Insert Table 5 about here]

Our results are in line with previous literature that addresses the effects of the services of STPs on the behaviour of in-park firms (Rodríguez-Pose & Hardy, 2014; Radosevic & Myrzakhmet, 2009). We are strongly of the opinion that they provide some clear insights about public policies related to STPs as our results capture in a more precise way the real effects of these parks. Nevertheless, when discussing empirical evidence about role played by STPs, it is important to properly take into account the institutional settings of the areas where these parks are located (i.e., type of public institutions, existence of common research infrastructures, etc.) as well as the industries in which in-park firms operate. On this subject, firms included in our data set are clearly less knowledge intensive than in some Northern European countries, where STPs have been considered as being important drivers of regional economies. Although this point may explain some of previous differences, using quantile regressions allows us to control for firm heterogeneity in order to precisely identify whether parks' effects may differ across firms, as seems very likely.

After describing our results in general terms, we next discuss specifically if Hypotheses (1), (2), and (3) hold. Firstly, in terms of whether in-park firms have higher growth rates than out-park firms, Table 3 shows that the role played by STPs on growth differs slightly when considering sales or employment growth. In this sense, while being in an STP enhances employment growth, in terms of sales the effect of being in an STP is only significant for more dynamic firms (i.e., those for upper quantiles in terms of sales growth). Overall, previous results indicate that being in an STP explains employment growth, but not the sales growth of all firms. This is a key point as it indicates that being in an STP may be a necessary condition for growth but it is not sufficient, as no firm will experience growth just because of its location in an STP, but will require additional determinants. At this point, we may suggest absorptive capacity as one potential explanation of these asymmetrical effects, since not all firms have the same capacity to internalize external effects arising from being inside STPs. Our results corroborate previous evidence supporting STPs as institutions that foster employment and sales growth (Liberati et al., 2015; Dettwiler, et al., 2006; Fergusson & Olofsson, 2004).

Thus, even if public policies supporting STPs are needed in order to foster growth of more dynamic firms, this may not be viewed as an optimal strategy for all types of firm. The asymmetrical STP effect raises the question of whether it is necessary to have rigorous selection criteria before locating in an STP.

Secondly, in terms of whether dispersion in growth rates is higher for in-park firms than for out-park firms, the empirical evidence from Table 4 corroborates Hypothesis (2). The only exception is the upper quantiles of employment growth, which show a significant negative impact. Generally speaking, being located inside an STP increases the dispersion of sales and employment growth for lower dispersion levels,[8] but increases the dispersion of sales growth and decreases the dispersion of employment growth for upper dispersion levels. Although it is neither easy nor evident to explain what underlies this result, our sense is that it is closely linked with our previous findings regarding Hypothesis (1). In this regard, the effect of being located inside an STP is not the same for all kind of firms, since for some of them it does not affect the dispersion of growth rates, while for others it increases the dispersion. Specifically, this behaviour is consistent for the standard deviation of the employment growth rate.

Thirdly, in terms of whether financial barriers are lower for in-park than for out-park firms, our results do not find support for Hypothesis (3). Results from Table 5

[8] A similar result was found by Ferguson and Olofsson (2004) but over the whole range of firms.

indicate that debt levels are not affected if firms are located in an STP. Consequently, our results do not corroborate previous empirical evidence supporting financial advantages for in-park firms, as in Lindelöf and Löfsten (2002) for NTBFs in a sample of Swedish parks or in Colombo and Delmastro (2002), for a sample of 17 Italian SPs.

Finally, our results illustrate some other interesting features. Firm age shows a significant non-linear relationship with firm growth. In particular, this variable shows a U-shaped pattern, so growth rate decreases over time, however those firms that have been operating over a long period in the market may enjoy learning economies. In line with the literature, firm size is negatively associated with firm growth (regardless of the measure); small firms grow more than larger firms. Regarding the impact of firm size in Table 4, firm size exerts a positive impact on the standard deviation of employment growth but a negative one on the standard deviation of sales growth. Regarding Table 5, firm size shows a negative impact on the long-term debt ratio. Concerning international activity, firms that export show a larger sales growth from quantile 0.50 up to the upper ones, while this impact is only significant for the lower quantiles on the employment growth. Regarding the financial variables, the ratio of long-term debt shows a negative impact for the upper quantiles of the growth rates of employment while the ratio of profits shows a negative impact also for the upper quantiles of the growth rates of sales. Finally, the lagged productivity level shows a significant negative impact on the sales growth rate, but a positive one on the employment growth rate. This result may be justified by the fact that high labour productive firms will have incentives to increase the number of employees the following period, while the increase in the sales growth rate may not be temporarily so immediate.

7. Conclusions

Based on a sample of 286 firms located in Catalan Science and Technology Parks, we explore whether location in STPs impacts a firm's performance. The empirical analysis controls for the potential selection bias applying a matching procedure between in-park firms and an extensive sample of out-park firms according to the industry each firm belongs to, the municipality where the firm is located, the firm size and the firm age. Having controlled for this potential selection bias, we apply a quantile regression estimation in order to obtain the impact of locating in STPs on firm growth, the dispersion of firm growth and the access to long-term debt.

Our main results may be summarized in three different points. First, being located in an STP does not guarantee larger growth rates and steady growth trajectories. Concretely, location in an STP positively affects firm growth but the effect is non-significant among low-growing in-park firms (as measured by sales). The quantile method used allows to observe that in-park location positively affects firm growth in terms of employees. However, when firm growth is measured in terms of sales, location in an STP only has a significant positive impact on fast-growing firms, without affecting low-growing firms. Positive effects of in-park locations imply that, on average, these firms register an annual growth rate of 15.3% in terms of sales and 7.8% in terms of workers. Certainly, young and small firms find STPs a suitable environment to reduce their productivity gap with their out-park counterparts.

Second, in line with our initial expectations, in-park firms show a larger dispersion of growth rates than do out-park firms. For low-levels of growth dispersion, in-park firms register higher growth rates dispersion. This evidence shows that in-park firms, especially in SPs, have less stable growth trajectories than out-park firms. The higher dispersion of growth rates, mainly in terms of sales, among in-park firms manifests the existence of selection process where spin-off and NTBFs are located initially inside SPs.

Third, our results show that location in an STP does not affect debt levels. Hence, our results do not give support to the financial advantages that in-park firms are supposed to have in comparison with out-park firms. These results show that after the simple correction for firm size, firm age and individual strategies, there is not a direct relation between park location and the advantages of access to external funds.

Finally, our results provide some useful insights in terms of policy implications and we explore two of these. The first insight is of the unequal effects of STPs over firms' performance. We have demonstrated how the effects of STPs are not the same across the whole range of in-park firms, suggesting that not all firms benefit in the same way from belonging to an STP (i.e., a park environment may be a good impetus for the efficient firms that are able to adapt to the market, but this environment does not guarantee positive and additional support between inefficient firms with moderate growth trajectories). This result implies that public policies supporting STPs should be restrictive in terms of the firms that enter into these parks. The second insight is closely related to the first one, as the previous unequal effects suggest that policy makers should not only control the type of firms inside STPs but also revise public policies related to promotion of STPs, noticeably in some Southern European countries where policies have imitated those of Northern European countries. Concretely, STPs promoted by policy makers have expanded considerably and this may not be an optimal strategy given that STPs may not be the best choice for some low-performance firms, or some knowledge-lagged geographical areas. In Catalonia, the promotion of STPs during the last two decades has facilitated the growth and access to external financial sources for in-park firms. However, STP's contributions differ between firms; in particular, high-growing in-park firms registered an additional growth support, while low-growing in-park firms were not positively affected by their privileged location.

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Tables

Table 1. Selected Science and Technology Parks				
	Firms	**Location**	**Year of creation**	**Type of park**
Parc Científic de Barcelona	123	Barcelona	1997	Science
Parc Científic i Tecnològic Agroalimentari de Lleida	123	Lleida	2005	Science
Parc Científic i Tecnològic de la Universitat de Girona	176	Girona	2001	Science
Parc de Recerca UAB	105	Bellaterra	2007	Science
la Salle Technova Barcelona	110	Barcelona	2001	Technology
Parc de Recerca i Innovació de la UPC	33	Barcelona	2005	Technology
Parc Tecnològic del Vallès	209	Cerdanyola	1987	Technology
TecnoCampus Mataró-Maresme	12	Mataró	1999	Technology
Tecnoparc, Parc Tecnològic del Camp	19	Reus	2004	Science
Barcelona Advanced Industry Park	39	Barcelona	2015	Technology
b_TEC Barcelona Innovació Tecnològica	40	Barcelona	2006	Technology
Esade Creapolis	114	Barcelona	2005	Technology
TOTAL	1.103			

Table 2. Mean test. Differences between in- and out-park firms and between Science and Technological parks.

	Out-park firms	In-park firms: All	In-park firms: Science Parks	In-park firms: Technological parks	Wilks' lambda F (Prob>F): Out-park firms vs. in-park firms	Wilks' lambda F (Prob>F): Science vs. Technological parks
Sales growth	0.116	0.096	0.153	0.047	0.41 (0.5217)	7.10 (0.0079)
Labour growth	0.043	0.060	0.078	0.046	0.52 (0.4712)	1.26 (0.2615)
Standard deviation Sales	0.375	0.489	0.545	0.443	31.44 (0.0000)	14.31 (0.0002)
Standard deviation Labour	0.274	0.333	0.327	0.337	18.59 (0.0000)	0.26 (0.6087)
Age (years)	9.03	9.12	7.56	10.43	0.03 (0.8727)	18.42 (0.0000)
Labour (employees)	37.62	25.84	14.19	35.08	0.85 (0.3574)	3.23 (0.0728)
Sales (thousands Euros)	4122.01	6884.04	3000.44	10114.73	0.14 (0.2852)	3.37 (0.0669)
Productivity (sales over workers)	150.12	170.27	112.92	215.76	0.73 (0.3919)	30.59 (0.0000)
Export (% firms)	5.75	23.84	14.69	31.44	81.37 (0.0000)	33.31 (0.0000)
HtechKis (%firms)	23.38	37.42	45.40	30.79	30.42 (0.0000)	19.38 (0.0000)
Long-Term debt over assets (%)	10.66	12.49	14.70	10.65	2.72 (0.0990)	9.15 (0.0026)
Profits over assets (%)	7.60	3.10	4.29	2.11	10.34 (0.0013)	1.57 (0.2110)
Barcelona (%firms)	36.55	29.68	25.20	33.41	7.10 (0.0078)	6.75 (0.0095)
Firms	268	286	127	159		

Source: own elaboration

Table 3. Quantile regression for growth in log terms (sales and employees)

	GrSales							GrEmpl						
	5%	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**
LnAge	-0.0493	-0.0361	-0.133***	-0.167***	-0.208***	-0.268***	-0.400***	-0.171***	-0.0682	-0.0559*	-0.0539***	-0.174***	-0.210***	-0.336***
	(0.0541)	(0.0463)	(0.0366)	(0.0308)	(0.0292)	(0.0522)	(0.0834)	(0.0638)	(0.0511)	(0.0331)	(0.0206)	(0.0268)	(0.0316)	(0.0510)
LnAgesq	0.0066	0.0061	0.0221**	0.0267***	0.0367***	0.0530***	0.0787***	0.0442***	0.0208	0.0112	0.0070	0.0267***	0.0291***	0.0507***
	(0.0142)	(0.0122)	(0.0096)	(0.0081)	(0.0077)	(0.0138)	(0.0220)	(0.0170)	(0.0136)	(0.0088)	(0.0055)	(0.0071)	(0.0084)	(0.0136)
LnSales	0.0259*	0.0141	0.0082	-0.0086	-0.0300***	-0.0570***	-0.0708***							
	(0.0148)	(0.0127)	(0.0100)	(0.0084)	(0.0080)	(0.0143)	(0.0228)							
LnLab								-0.0012	-0.0192	-0.0214**	-0.0098*	-0.0333***	-0.0427***	-0.0461***
								(0.0172)	(0.0138)	(0.0089)	(0.0056)	(0.0072)	(0.0085)	(0.0138)
Parks	-0.0298	-0.0156	0.0276	0.0683***	0.0719***	0.0730*	0.101	0.129**	0.0727*	0.0371	0.0403**	0.0940***	0.0751***	0.153***
	(0.0437)	(0.0374)	(0.0296)	(0.0249)	(0.0236)	(0.0422)	(0.0675)	(0.0524)	(0.0420)	(0.0272)	(0.0169)	(0.0220)	(0.0260)	(0.0419)
LTdebtAssets	-0.0704	0.0108	-0.0531	-0.0051	0.0226	0.0567	0.0100	-0.0971	-0.101	-0.0699	-0.0479*	-0.105***	-0.172***	-0.202***
	(0.0674)	(0.0577)	(0.0456)	(0.0383)	(0.0364)	(0.0651)	(0.104)	(0.0822)	(0.0658)	(0.0426)	(0.0265)	(0.0345)	(0.0407)	(0.0657)
ProfitsAssets	-0.0056	-0.0171	-0.0036	-0.0465	-0.118***	-0.179***	-0.131	0.153**	0.0796	0.0341	0.0379*	0.0138	-0.0004	-0.0627
	(0.0562)	(0.0481)	(0.0380)	(0.0319)	(0.0303)	(0.0542)	(0.0867)	(0.0679)	(0.0544)	(0.0352)	(0.0219)	(0.0285)	(0.0336)	(0.0543)
SalesLab	-0.0508**	-0.0434**	-0.0666***	-0.0588***	-0.0298**	-0.0431**	-0.0901***	0.0602***	0.0814***	0.0511***	0.0217***	0.0451***	0.0518***	0.0409**
	(0.0224)	(0.0192)	(0.0152)	(0.0127)	(0.0121)	(0.0216)	(0.0346)	(0.0213)	(0.0171)	(0.0110)	(0.0069)	(0.0089)	(0.0106)	(0.0170)
Export	-0.0312	-0.0243	0.0423	0.0517*	0.0916***	0.120***	0.232***	0.0451	0.0574	0.0385	0.0070	0.0466*	0.0503*	0.0585
	(0.0476)	(0.0407)	(0.0322)	(0.0271)	(0.0257)	(0.0460)	(0.0734)	(0.0574)	(0.0460)	(0.0298)	(0.0186)	(0.0241)	(0.0285)	(0.0459)
HtechKis	0.167	0.446	-0.0253	-0.109	-0.0170	-0.105	0.386	-0.0588	-0.0285	0.0366	0.0639	0.238	-0.252	-0.186
	(0.337)	(0.288)	(0.228)	(0.191)	(0.182)	(0.325)	(0.519)	(0.396)	(0.317)	(0.205)	(0.128)	(0.166)	(0.196)	(0.317)
Constant	-0.449	-0.351	0.417**	0.623***	0.647***	1.164***	1.602***	-0.319	-0.488*	-0.234	-0.0876	-0.0796	0.433**	0.556**
	(0.299)	(0.255)	(0.202)	(0.170)	(0.161)	(0.288)	(0.461)	(0.351)	(0.281)	(0.182)	(0.114)	(0.147)	(0.174)	(0.281)
Pseudo-R2	0.2530	0.1916	0.1282	0.1250	0.1934	0.2862	0.3953	0.2910	0.2316	0.1279	0.0603	0.1858	0.2526	0.3267
Observations				2,052							2,023			

Standard errors in parentheses. Time and sectoral dummies are included.
*, **, *** significant at 1%, 5% and 10%.

Table 4. Quantile regression of standard deviation of growth (sales and employees).

	sdGrSales							sdGrEmpl						
	5%	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**
LnAge	-0.0005	0.0077	-0.0110	-0.0210	-0.0389	-0.117	0.0131	0.0149*	0.0172	0.0214	0.0087	0.0005	-0.0783***	-0.0756***
	(0.0112)	(0.0084)	(0.0167)	(0.0208)	(0.0386)	(0.0790)	(0.0563)	(0.0078)	(0.0134)	(0.0144)	(0.0189)	(0.0177)	(0.0303)	(0.0193)
LnAgesq	-0.0020	-0.0079***	-0.0051	-0.0088	-0.0050	0.0062	-0.0157	-0.0011	-0.0036	-0.0106***	-0.0094*	-0.0117**	-0.0006	-0.0069
	(0.0029)	(0.0022)	(0.0044)	(0.0055)	(0.0102)	(0.0208)	(0.0148)	(0.0021)	(0.0036)	(0.0039)	(0.0051)	(0.0048)	(0.0081)	(0.0052)
LnSales	0.0028	0.0064***	-0.0027	-0.0158***	-0.0233**	-0.0191	-0.0058							
	(0.0031)	(0.0023)	(0.0046)	(0.0057)	(0.0106)	(0.0216)	(0.0154)							
LnLab								0.0299***	0.0202***	0.0073*	0.0009	0.0043	0.0145*	0.0214***
								(0.0021)	(0.0037)	(0.0039)	(0.0051)	(0.0048)	(0.0082)	(0.0052)
Parks	0.0565***	0.0617***	0.0505***	0.0853***	0.158***	0.270***	0.274***	0.0560***	0.0745***	0.0673***	0.0663***	0.0705***	-0.0023	-0.0542***
	(0.0090)	(0.0068)	(0.0135)	(0.0169)	(0.0312)	(0.0638)	(0.0455)	(0.0063)	(0.0109)	(0.0117)	(0.0153)	(0.0143)	(0.0245)	(0.0156)
LTdebtAssets	0.0047	0.0027	-0.0011	0.0184	0.0100	0.0412	0.0055	-0.0032	-0.0100	-0.0043	-0.0079	-0.0108	-0.0255	-0.0417*
	(0.0139)	(0.0105)	(0.0208)	(0.0260)	(0.0481)	(0.0985)	(0.0702)	(0.0097)	(0.0168)	(0.0180)	(0.0236)	(0.0221)	(0.0379)	(0.0241)
ROA	-0.0067	0.0034	-0.0119	-0.0318	-0.0133	-0.0344	-0.0051	0.0074	0.0045	0.0021	-0.0012	-0.0080	-0.0267	-0.0224
	(0.0116)	(0.0087)	(0.0174)	(0.0217)	(0.0401)	(0.0820)	(0.0585)	(0.0083)	(0.0144)	(0.0154)	(0.0202)	(0.0189)	(0.0324)	(0.0206)
SalesLab	-0.0109**	-0.0229***	-0.0317***	-0.0211**	-0.0260	-0.0069	0.0041	-0.0123***	-0.0086*	-0.0082*	-0.0043	0.0021	0.0087	0.0085
	(0.0047)	(0.0035)	(0.0069)	(0.0086)	(0.0160)	(0.0327)	(0.0233)	(0.0026)	(0.0045)	(0.0048)	(0.0063)	(0.0059)	(0.0101)	(0.0064)
Export	0.0014	0.0182**	0.0486***	0.0135	-0.0231	-0.0032	-0.0035	-0.0066	0.0367***	0.0400***	0.0082	-0.0009	0.0458*	0.110***
	(0.0098)	(0.0074)	(0.0147)	(0.0183)	(0.0339)	(0.0695)	(0.0495)	(0.0070)	(0.0121)	(0.0129)	(0.0169)	(0.0159)	(0.0272)	(0.0173)
HtechKis	-0.268***	-0.273***	-0.280***	-0.245*	0.0465	0.0411	-0.0609	-0.0401	-0.0164	0.0411	0.0551	0.122	0.107	0.217*
	(0.0696)	(0.0524)	(0.104)	(0.130)	(0.240)	(0.492)	(0.350)	(0.0483)	(0.0834)	(0.0893)	(0.117)	(0.110)	(0.188)	(0.120)
Constant	0.381***	0.415***	0.543***	0.541***	0.562***	0.470	0.167	0.143***	0.113	0.135*	0.139	0.129	0.282*	0.366***
	(0.0617)	(0.0464)	(0.0922)	(0.115)	(0.213)	(0.436)	(0.311)	(0.0429)	(0.0741)	(0.0793)	(0.104)	(0.0975)	(0.167)	(0.106)
Pseudo-R2	0.3033	0.3008	0.2970	0.3506	0.4086	0.4885	0.5388	0.3125	0.3290	0.3044	0.3204	0.3966	0.4576	0.5287
Observations				2,052							2,040			

Standard errors in parentheses. Time and sectoral dummies are included.
*, **, *** significant at 1%, 5% and 10%.

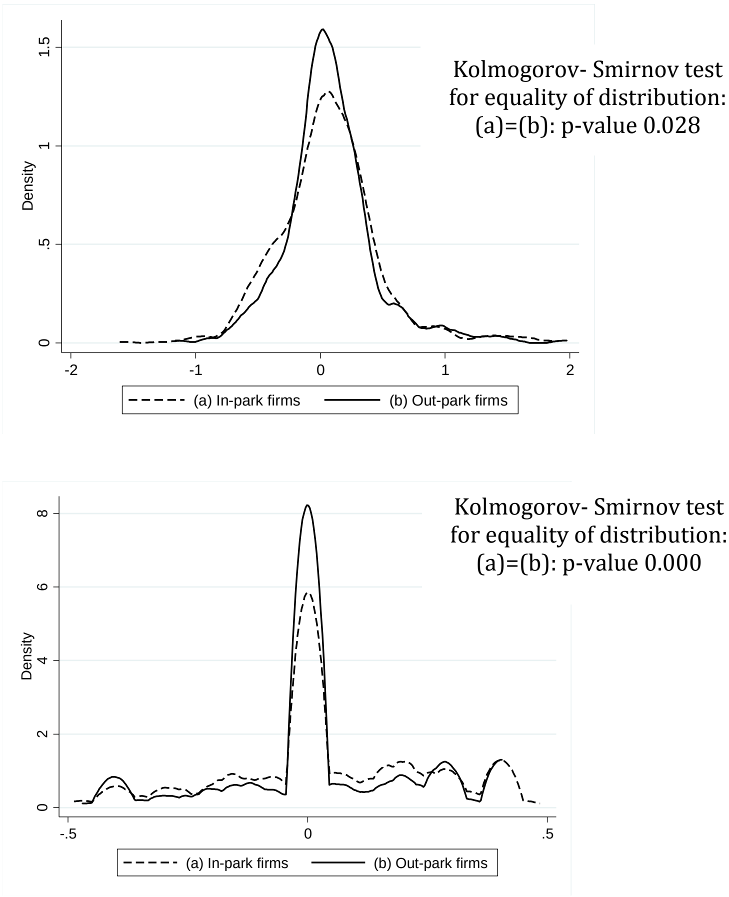
Table 5. Quantile regression of long-term debt to assets

	Sales determinants							Employment determinants						
	5%	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**
GrSalesi,t-1	0.0501*	0.0274	0.0338	0.0138	0.0184	0.0151	0.0045							
	(0.0256)	(0.0304)	(0.0276)	(0.0179)	(0.0316)	(0.0795)	(0.189)							
GrLab i,t-1								-0.0511*	-0.0326	-0.0576	-0.0346	-0.0378	-0.0667	-0.0856
								(0.0300)	(0.0389)	(0.0399)	(0.0300)	(0.0452)	(0.105)	(0.252)
LnAge	0.125***	0.0871	0.0475	0.0679**	-0.0018	-0.0141	0.0228	0.0634	0.0461	0.0290	0.0500	-0.0268	-0.0241	-0.0110
	(0.0469)	(0.0557)	(0.0505)	(0.0327)	(0.0579)	(0.145)	(0.346)	(0.0425)	(0.0552)	(0.0566)	(0.0426)	(0.0642)	(0.149)	(0.358)
LnAgesq	-0.0221*	-0.0156	-0.0127	-0.0227***	-0.0082	-0.0023	-0.0030	-0.0142	-0.0043	-0.0102	-0.0190*	-0.0022	-0.0012	0.0039
	(0.0114)	(0.0135)	(0.0123)	(0.0079)	(0.0141)	(0.0354)	(0.0842)	(0.0102)	(0.0132)	(0.0136)	(0.0102)	(0.0154)	(0.0357)	(0.0857)
LnSales	-0.0768***	-0.0634***	-0.0410***	-0.0318***	-0.0435***	-0.0493	-0.0521							
	(0.0107)	(0.0127)	(0.0115)	(0.0075)	(0.0132)	(0.0332)	(0.0791)							
LnLab								-0.0688***	-0.0590***	-0.0361***	-0.0292***	-0.0414***	-0.0533	-0.0545
								(0.0095)	(0.0123)	(0.0126)	(0.0095)	(0.0143)	(0.0332)	(0.0797)
Parks	0.0517	0.0235	0.0105	0.0106	-0.0052	-0.0207	-0.128	0.0619**	0.0179	0.0466	0.0138	-0.0077	-0.0497	-0.164
	(0.0319)	(0.0379)	(0.0344)	(0.0223)	(0.0394)	(0.0991)	(0.236)	(0.0283)	(0.0368)	(0.0377)	(0.0284)	(0.0428)	(0.0992)	(0.238)
SalesLab	0.0243	0.0099	-0.0143	0.00437	-0.0226	-0.0418	-0.0489	-0.0569***	-0.0668***	-0.0560***	-0.0317***	-0.0770***	-0.105***	-0.0905
	(0.0162)	(0.0193)	(0.0175)	(0.0113)	(0.0201)	(0.0504)	(0.120)	(0.0112)	(0.0145)	(0.0149)	(0.0112)	(0.0169)	(0.0391)	(0.0939)
Export	0.0970***	0.0253	-0.0138	-0.0442*	-0.0666	-0.264**	-0.371	0.0618**	0.0330	-0.0346	-0.0564*	-0.0678	-0.277***	-0.385
	(0.0332)	(0.0395)	(0.0358)	(0.0232)	(0.0410)	(0.103)	(0.245)	(0.0289)	(0.0375)	(0.0385)	(0.0289)	(0.0436)	(0.101)	(0.243)
HtechKis	-0.419*	-0.431	-0.460*	-0.323**	-0.325	-0.629	-0.619	-0.413**	-0.421	-0.395	-0.0058	-0.346	-0.612	-0.582
	(0.220)	(0.262)	(0.237)	(0.154)	(0.272)	(0.684)	(1.628)	(0.203)	(0.263)	(0.270)	(0.203)	(0.306)	(0.710)	(1.706)
Constant	-0.0663	0.0254	0.141	0.317**	0.630***	1.071*	1.147	0.0480	0.137	0.0986	0.0338	0.695**	1.185*	1.171
	(0.193)	(0.229)	(0.207)	(0.134)	(0.238)	(0.597)	(1.422)	(0.183)	(0.237)	(0.243)	(0.183)	(0.276)	(0.639)	(1.535)
Pseudo-R2	0.2918	0.2800	0.2568	0.1963	0.2480	0.4106	0.5379	0.2909	0.2789	0.2573	0.2000	0.2569	0.4214	0.5473
Observations				1,632							1,584			

Standard errors in parentheses. Time and sectoral dummies are included.
*, **, *** significant at 1%, 5% and 10%.

Figures

Figure 1. Kernel density of sales logaritmic growth (up) and employment logaritmic growth (down).



Source: own elaboration

Appendix

Table A-1. Statistical descriptive

	Observations	Mean	Std. Dev	Min	Max
Out-park firms					
GrSales	708	0.1164	0.4731	-1.1612	3.4311
GrEmpl	661	0.0432	0.3253	-0.9162	1.8191
sdGrSales	973	0.3749	0.3277	0.0016	2.0448
sdGrLab	950	0.2741	.02116	0	1.0221
Age	973	9.0371	11.5600	0	111
Lab	921	37.62	293.19	1	3995
Sales	973	4122.01	26776.73	2.7131	350531.3
SalesLab	921	150.12	565.8604	0.6794	9095.02
Export (% firms)	973	5.75	23.30	0	1
HtechKis (%firms)	973	23.38	42.36	0	1
LTdebtAct (%)	973	10.66	21.06	0	99.88
ROA (%)	973	7.60	25.56	-1.1827	1.7763
Barcelona(%firms)	973	36.55	48.20	0	1
In-park firms					
GrSales	1533	0.0956	0.5170	-1.6095	4.2969
GrEmpl	1426	0.0600	0.3484	-1.7047	2.3513
sdGrSales	1819	0.4890	0.3928	0.0147	3.0384
sdGrLab	1712	0.3327	0.2581	0	1.3367
Age	1819	9.1299	9.7364	0	85
Lab	1712	25.84	160.5561	1	2606
Sales	1819	6884.04	55994.6	0.0971	935971.4
SalesLab	1712	170.27	261.27	0.0486	2831.01
Export (% firms)	1819	23.84	42.63	0	1
HtechKis (%firms)	1819	37.42	48.42	0	1
LTdebtAct (%)	1819	12.49	19.42	0	1
ROA (%)	1819	3.10	25.17		
Barcelona(%firms)	1819	29.68	45.71	0	1

Source: own elaboration

Table A.2. Matrix of Person correlations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) GrSales	1.000												
(2) GrEmpl	0.392*	1.000											
(3) sdGrSales	0.398*	0.120*	1.000										
(4) sdGrLab	0.137*	0.251*	0.379*	1.000									
(5) Age	-0.204*	-0.130	-0.250*	-0.071*	1.000								
(6) Lab	-0.000	0.006	-0.074*	-0.055	0.255*	1.000							
(7) Sales	-0.008	-0.012	-0.074*	-0.057*	0.392*	0.796*	1.000						
(8) SalesLab	-0.008	-0.040	-0.045	-0.002	0.103*	0.015	0.088*	1.000					
(9) Export	-0.030	-0.031	0.028	-0.061*	0.166*	0.170*	0.150*	0.221*	1.000				
(10) HtecKis	0.051	0.078*	0.057*	0.133*	-0.089*	0.067*	-0.003	-0.020	0.055*	1.000			
(11) LTdebt	0.049	-0.045	0.098*	0.062*	-0.005	0.027	0.019	-0.047	-0.031	0.064*	1.000		
(12) ROA	0.078*	0.000	-0.157*	-0.087*	-0.024	-0.023	-0.003	0.048	-0.030	-0.046	-0.115*	1.000	
(13) Barcelona	0.038	0.072*	0.001	0.063	-0.082*	0.120*	0.087*	0.012	-0.016	0.022	-0.022	0.026	1.000

** Significant at 5%*
Source: authors

Table A-3. Variables and description.	
	Description
Dependent variables	
GrSales	Annual growth rate of sales (in log, log ($sales_t$) –log ($sales_{t-1}$))
GrLab	Annual growth rate of employees (in log, log ($size_t$) –log ($size_{t-1}$))
sdGrSales	Standard deviation of the annual growth rate of sales
sdGrLab	Standard deviation of the annual growth rate of employees
$LTdebtAssets_{it}$	Ratio of long term debt over assets
Independent variables	
Technological environment	
Parks	Dummy identifying firms located in a Science or a Technology Park
Firm characteristics determinants	
$LnSales_1$	Total sales (in log, one year lag)
$LnLab_{it-1}$	Total employees (in log, one year lag)
$LnAge_{it-1}$	Firm age (in log, one year lag)
$LnAgesq_{it-1}$	Quadratic firm age (in log, one year lag)
$Export_{it}$	Dummy = 1 if the firm exports
$HtechKis_t$	Dummy = 1 if firm belongs to a high-technology sector (high-tech manufactures and Knowledge Intensive Services)
$LTdebtAssets_{it-1}$	Ratio of long term debt over assets (one year lag)
$ProfitsAssets_{it-1}$	Ratio of profits over assets (one year lag)
$SalesLab_{it-1}$	Labour productivity measured as sales per employees (one year lag)
Barcelona	Dummy variable identifying if a firm is located in Barcelona city
Source: Own elaboration	