Technology Parks versus Science Parks: does the university make the difference?

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Abstract

Although the notion of Science and Technology Parks (STPs) has become fairly widespread, however, the level of university involvement in these parks differs hugely. At the extremes, there are parks that are owned and managed by universities, and parks with no formal links of any kind with a university. We use data from the Community Innovation Survey (CIS) for Spain and a survey of STP park managers to analyse how the level of involvement of a university in the STP affects the innovation outputs of its tenants and their links with universities. We find that higher involvement of a university in the STP negatively affects tenant's innovation sales and positively affects the number of patent applications. We find no robust evidence of the involvement of a university in the propensity for park firms to cooperate with a university or to purchase external R&D services from the university.

1. Introduction

Science and Technology Parks (STPs) agglomerations that are policy-driven (Huang et al., 2012) with management teams engaged actively in fostering the creation and growth of innovative on-site firms. The International Association of Science Parks (IASP, 2002) definition states that STPs aim at facilitating and managing flows of knowledge and technology amongst universities, R&D institutions, companies and markets, and stimulating the creation and growth of innovation-based companies through incubation and spin-off processes.

In reality, the different development patterns and wide variety of shareholders and founders of STPs (Phan et al., 2005) have contributed to the formation of very heterogeneous organizations (Westhead, 1997), with an important different being the level of involvement of a university in the park. For example, all STPs in the UK are university initiatives (Westhead and Storey 1995; Siegel et al., 2003a). However, in most countries (e.g. the US (Link and Scott, 2007), Australia (Phillimore, 1999), China (Wright et al., 2008), Japan (Fukugawa, 2006), France (Chorda, 1996), Portugal (Ratinho and Henriques, 2010), Spain and Italy (Albahari et al., 2013a) the level of university involvement in national STPs varies hugely[1]. It is possible to identify two types of organizations: *Technology Parks* (TPs) in which there is no university shareholding, and *Science Parks* (SPs) in which there is university shareholding.

TPs tend to follow a rationale of spatial proximity (Albahari et al., 2013b) in which firms benefit from Marshallian agglomeration externalities. Park location allows access to specialized inputs including labour, the benefits derived from knowledge spillovers (Prevezer, 1997), and reduced consumers' search costs (McCann and Folta, 2008). Spatial proximity is believed to be important for innovation because smaller geographical distances facilitate the establishment of links (Hervas-Oliver and Albors-Garrigos, 2009) and the transfer of knowledge, especially tacit knowledge (Howells, 2002), which tends to be locally bounded (Sonn and Storper, 2008) because its transfer requires face-to-face interactions. TPs also engender institutional, organizational, cultural, social and technological proximity, which are believed to be important for the innovation process (Boschma, 2005).[2] Finally, TPs provide a supportive environment, enhance entrepreneurs' networks and facilitate access to credit (Storey and Tether, 1998b; Westhead and Batstone, 1998; Heydebreck et al., 2000), alleviating the problems associated especially with new technology based firms (Storey and Tether, 1998a).

[1] E.g., Albahari et al. (2013a finds that the founders and promoters of 37% of Italian STPs and 56% of Spanish STPs do not include a university; Link and Scott (2005) in a sample of 51 American STPs found that 69% were not operated by a university.

[2] For a review of proximity types see, e.g., Knoben and Oerlemans, 2006.

In addition to the benefits provided by TPs, SP firms gain from the externalities due to proximity to a university. The importance of universities as external sources of knowledge for firm innovation has been widely recognized since the 1980s (Bozeman, 2000) and is emphasized in Etzkowitz and Leydesdorff's (1997) triple helix notion and by open-innovation (Chesbrough, 2003) approaches. The effects of proximity to a university on firm innovation have been studied in depth (Lawton Smith, 2007). Location close to a university allows firms to take advantage of knowledge spillovers, which are geographically localized (Feldman and Kogler, 2010) due mainly to the localized nature of tacit knowledge transfer (Gertler, 2003). SPs aim at institutionalizing this proximity between their tenant firms and the university, while universities are interested in developing SPs to facilitate commercialization of academic research, to internalize financial returns (Storey and Tether, 1998b; Link et al., 2007) and to legitimize their knowledge transfer activities related to their commitment to contribute to society (Monck et al., 1988).

However, some are critical of the role played by universities in parks. In particular, Hansson et al. (2005) claim that the model of a SP as an intermediary between university and industry institutionalzes distance rather than proximity, and results in low levels of interaction. The university's role as a bridging institution may not be legitimate since the interests of the SP and those of the university and the park firms may be different[3] (Foray and Lissoni, 2010).

Despite the popularity of STPs around the world, and the research attention they have attracted (Albahari et al., 2010), to our knowledge, there are no empirical studies that investigate the effect of university involvement in a STP.

The present paper has two main objectives: to fill this gap in the literature by analysing whether the degree of involvement of universities in a STP influences its tenants' innovation performance, and to analyse how this involvement affects university-industry relationships.

First, we contribute to the ongoing debate on STPs' effectiveness (Albahari et al., 2010). Some authors question the STP model (Macdonald, 1987; Massey et al., 1992; Hansson et al., 2005) while others claim that STPs provide a supportive environment for firms (Siegel et al., 2003a; Hommen et al., 2006) – a debate that has been stoked by empirical work. Some authors find a positive effect of STP location on firms' performance (Siegel et al., 2003b; Yang et al., 2009 Squicciarini, 2008, 2009), while others find no significant differences between on-park and off-park firms (Westhead, 1997; Colombo and Delmastro, 2002). We contribute by analysing the different effects of TPs and SPs on firms' innovation outcomes.

[3] E.g. to maximize their income, STPs are keen to rent all available spaces, which can result in less rigid admission criteria.

Second, fostering knowledge and technology transfer between universities and industry is one of the stated objectives of a STP (Storey and Tether, 1998b). However, the evidence is contrasting. On the one hand, there is some consensus about the positive effect of informal links established between tenant firms and universities (Felsenstein, 1994; Westhead and Storey, 1995; Vedovello; 1997; Löfsten and Lindelöf, 2002). On the other hand, very few studies (Colombo and Delmastro, 2002; Fukugawa, 2006) show that STPs encourage the establishment of formal links. A high level of involvement of universities in SPs should *a priori* improve knowledge flows between academia and industry. We contribute by analysing empirically whether this is the case.

Our study is based on the Spanish case because it includes great variety of university involvement in STPs making it an appropriate context for this investigation. We use two main data sources: the 2009 *Community Innovation Survey* (CIS) for Spain (available since 2011), and the *Survey 2009 on the Characteristics and Results of Science and Technology Parks* conducted by the former Department of Science and Innovation of the Spanish government.

The remainder of this paper is organized as follows. Section 2 specifies the empirical framework for the study. Section 3 presents the results and Section 4 concludes and suggests some directions for future research.

2. Empirical framework

2.1. Empirical model

We want to estimate the effect of type of STP (based on level of university involvement) on firms' innovation results and linkswith universities. The empirical model can be written as:

$$Y = \alpha + \beta STP_{type} + \gamma FirmControls + \lambda STPControls + u$$

where *Y* is the dependent variable and *STPtype* is a vector of variables for STP type. Since the objective is to analyse the effect of different STP types on firms' innovation results and firms' links with universities, it is crucial to account for potential confounding factors. On the one hand, we expect that firm characteristics differ across STP types (e.g., SP firms are likely to be more science oriented than TP firms). Thus, we need to control adequately for firm characteristics in order to obtain unbiased estimates of β. On the other hand, we expect STP characteristics will differ across STP types (e.g. SPs may be smaller). Again, controlling for STP characteristics is crucial to obtain unbiased estimates of β.

2.2. *Data*

We combine firm-level data from the 2009 Spanish CIS with park-level data from the Survey 2009 on the Characteristics and Results of Science and Technology Parks.[4] The 2009 CIS for Spain (published in 2011) is managed by the Spanish National Statistics Institute (INE). The CIS collects very detailed information on the characteristics of firms' innovation processes and, since 2007 has included a question about possible on-park location. The 2009 CIS covered 37,201 firms representative of the Spanish business structures, 849 of which were on-park firms involving 25 STPs[5] in 12 different Spanish regions. The survey data allow use of a wide set of covariates and enable high levels of heterogeneity across STPs than previous studies. Since the Spanish CIS is modelled on the European CIS, it allows comparisons to be made with other studies using CIS.

Other secondary data sources are INE national accounting and INE population census data.

2.3. *Variables definition*

2.3.1. *Dependent variables*

In this subsection we describe the variables used to measure the innovation performance of tenant firms and their relations with universities. We also report empirical evidence from previous work on STPs that employs the same or similar variables.

Innovation outputs

lnewmerl

The first indicator of on-park firms' innovation performance is sales from new to the market products. We have data for each firm in the CIS survey. This indicator is used in several studies of innovation (for a review see e.g. Vásquez-Urriago et al., 2011). It is argued that it overcomes problems associated with other indicators such as patents, R&D expenses and number of innovations (Griliches, 1998).

Previous empirical studies have compared the outcomes of on-park and off-park firms and show contrasting results. Monck et al. (1988), Westhead (1997) and Löfsten and Lindelöf (2002) find no differences between on- and off-park firms for number of new products launched onto the market, while Siegel et al. (2003b) finds that on-park firms slightly outperform off-park firms.

[4] Although central government is not directly involved in any STP initiatives, response to this survey is required in order for STPs to access government funding. In a few cases, missing data for a particular park required direct contact with the relevant park manager.

[5] Our STP sample includes only those STPs that were *full members* of the Association of Science and Technology Parks of Spain (APTE) for at least two years before 2009.

In a recent working paper, Vasquez-Urriago et al. (2011), using the indicator of sales obtained from new to the market products, find a strong and positive impact of on-park location.

Operationally, the dependent variable *lnewmerl* is the logarithm of the sales obtained from new to the market products per employee, for products introduced in the period 2007-2009.

lpatnuml

Number of patents granted is a widely used indicator of innovation performance in previous work (Griliches, 1998 and there is a body of evidence on the effect of on-park location on the patenting activity of firms. In their pioneering work on STPs, Monck et al. (1988) find that patenting activity is not affected by on-park location, a result supported by Westhead (1997), Löfsten and Lindelöf (2002); Colombo and Delmastro (2002). However, others find a positive effect of on-park location on the likelihood of patenting (Squicciarini 2008, 2009; Huang et al., 2012)[6].

The variable *lpatnuml* is the logarithm of number of patent applications per employee.

Links between tenants and universities

A large part of the literature on STPs is concerned with the role played by the STP supporting the establishment of links between academia and industry. With some exceptions,[7] there is a view that STPs facilitate the establishment of informal links with universities, but more evidence on the establishment of formal links is needed. Felsenstein (1994) reports that low-level interactions (i.e. recruitment of local university graduates, use of university facilities) are more common than high-level interactions (i.e. joint research, industry funding of university research), and that on-park firms are more likely to report the former type of interactions. These results are confirmed by Westhead and Storey (1995), Vedovello (1997) and Löfsten and Lindelöf (2002) who find that STPs facilitate the establishment of informal links, but that there is mostly no influence on establishment of high-level (more formal) links with universities or other higher education institutions. On the other hand, Colombo and Delmastro (2002) and Fukugawa (2006) find that on-park firms are more likely also to engage in formal agreements, such as joint research with universities than firms in an off-park sample. A working paper by

[6] Also Siegel et al. (2003b) find a positive effect on number of patents, although the magnitude of this effect is quite small when they control for endogeneity bias.

[7] The findings in Monck et al. (1988) from a study of STPs in UK are very similar for propensity for establishing links with local universities between on- and off-park firms. These results are confirmed by Quintas et al. (1992) and Malairaja and Zawdie (2008), who find no statistically significant differences between the on- and off-park samples.

Vásquez-Urriago et al. (2012) concludes that on-park location has a strong and positive effect on firms' propensities to cooperate[8] on innovation activities.

We proxy the link between a university and an on-park firm using two indicators: *coopuni* is a dummy variable that takes the value 1 if the firm cooperates[9] with a university or some other higher education institution; *lRDboughtl* is the amount of external R&D bought from a university, defined operationally as the logarithm of total expenditure on R&D services sourced from a university per employee.

2.3.2 Independent variables

Our main objective is to show the effect of different levels of university involvement in the STP on tenant firms' innovation outputs and links with universities. As already mentioned, the variety of STP experience in relation to level of involvement of a university makes Spain a good case study. This experience ranges from parks wholly or partly owned and managed by a university, which we describe as Pure Science Parks (PSPs) to parks with no formal links to a university, which we describe as Pure Technology Parks (PTPs). Between these extremes are STPs where a university is a minority shareholder, described as Mixed Parks (MPs) and parks where a university (although not a shareholder) has some research facilities located in the STP, which we describe as Technology Parks with University (TPUs).

Using data on the percentage share of each park shareholder, and information on the presence of university facilities in the STP, we define four dummies variables (Table 1), according to the degree of university involvement. *PSP* takes the value 1 if the park is a pure science park, that is with more than 50% university ownership, and 0 otherwise. *MP* takes the value 1 if the park is a mixed park, that is, there is a minority (less than 50%) university shareholding, and 0 otherwise; *TPU* takes the value 1 if the park is a technology park hosting some university research facilities, and 0 otherwise; *PTP* takes the value 1 if the park is a pure technology park, that is no university presence.[10]

TABLE 1 APPROX. HERE

In our sample, five parks are PSPs, five are MPs, eight are TPUs and seven are PTPs. The number of firms per park type is respectively, 112, 206, 260 and 271.

[8] Not exclusively with a university.
[9] The CIS refers to cooperation as active participation with other organizations on innovation activities; this does not include subcontracting.
[10] Managers of PTPs were contacted by phone or email, to confirm this categorization.

2.3.3 *Control variables – firm level*

Previous studies using CIS data show the importance of general firm characteristics (i.e. total turnover, exports, industry sector, firm age) and innovation-specific characteristics (i.e. innovation effort, percentage of employees with a PhD, perceived obstacles to innovation) as determinants of innovation outputs (for a review see Vásquez-Urriago et al., 2011) and links with universities (for a review see Veugelers and Cassiman, 2005). The list of covariates used in the present study is shown in Table 2

Table 3 shows that these covariates seem to be related also to park type. PSP and MP firms are younger, smaller and more R&D intensive. The more scientifically-oriented the park, the higher the percentage of knowledge intensive firms. We need to control for these covariates such that estimates of β capture the effects of different types of STPs, and do not confuse them with firm characteristics.

TABLE 2 and 3 APPROX. HERE

2.3.4 *Control variables – park level*

Albahari et al. (2013b) show that the characteristics of the STP significantly affect tenants' innovation results. We distinguish between two types of STP characteristics: structural characteristics (age and size), and managerial characteristics (size of the management entity, and provision of services) (Table 4). Table 5 shows that park characteristics are related also to park type. Spanish PSPs are the youngest and smallest type of park; they have larger management teams and provide more services. We include park's structural characteristics as control variables to avoid biases in the estimations of β. We also include managerial characteristics. However, these could be interpreted in different ways since different types of parks might adopt different management styles, which might contribute to their differing results. For example, one indication of the university effect might be via better provision of services to tenants (Table 5).

TABLE 4 APPROX. HERE

STP age (*age*, number of years since park establishment) is included in its quadratic form (*ageq*).

lnfirms is the log of number of park tenants at the end of the year previous to the survey (2008), and proxies for park size.

The independent variables related to the characteristics of park management are: a) *lstaffr*, number of full-time equivalent employees in the park's management company per 100 tenants; b) *international*, a dummy variable that takes the value 1 if the park management provides services to foster internationalization of its tenants, and 0 otherwise; c) *consult*, a dummy variable that takes the value 1 if the park management provides legal, commercial and/or fiscal consulting services to its tenants, and 0 otherwise.

TABLE 5 APPROX. HERE

Table 6 presents descriptive statistics for the variables used in our models for the 849 sample firms. Descriptive statistics for the same variables per park type are presented in the Annex.

TABLE 6 APPROX. HERE

3. Results

3.1. *Influence of park types on innovation outputs*

The effect of park type on innovation is shown in Table 7. Column I provides a crude view of the effect of park type on sales of new products per employee; it shows no differences because park types are related to different firm and park characteristics. Column II includes the set of firm covariates, but does not control by park characteristics; there are no significant differences across park types. Column III includes measures for parks' 'structural' characteristics (age and size). These characteristics have been shown to be relevant for explaining the performance of tenant firms (Albahari et al., 2013b) and, as previously shown, are correlated with park type (see Table 5). They should be included in the regressions to avoid omitted variables bias. When the effect of these variables is controlled for, we observe that firms located in pure science and in mixed parks perform worse than firms in other types of parks with no university presence. These results hold when the variables capturing park management, management team size, and provision of internationalization and consultancy services, are included (Column IV). The magnitude of the effects is quite large, 122 log points for PSPs, and 96 log points for MPs (roughly 70% and 62% fewer sales of new products per employee, respectively).

Among the covariates, our results are in line with studies showing the importance of innovation efforts (Czarnitzki and Hottenrott, 2009; Frenz and Ietto-Gillies, 2009; Tsai, 2009) and firm age (Czarnitzki and Hottenrott, 2009) for explaining sales of new to the market products, and the insignificant influence of industry when other factors are accounted for (Frenz and Ietto-Gillies, 2009; Faems et al., 2005). In addition, we found no significant effect for size, exports or obstacles to innovation.

TABLE 7 APPROX. HERE

Columns V-VIII present the four specifications for the dependent variable *lpatnuml,* all of which provide very similar results. Firms in PSPs perform much better than firms in other park types for numbers of patents. Again, the differences are large in magnitude, between 135 and 144 log points (approximately four times more patents per employee).

Among the covariates, innovation effort is again the most significant. We also find a positive effect of exports, but no significant effect of size, industry technology level or obstacles to innovation. Therefore, park characteristics do not explain firm patenting.

These results show clear output specialization for different park types. Firms in PSPs show the highest performance in patenting, but perform worst for sales of new products, while PTP firms (no university presence) show the opposite pattern. Firms in MPs and TPUs are somewhere between these two extremes.

We include in the specifications a large set of firm covariates in order that the effect of park type is not confounded by the influence of orientation of firms' innovation processes. These covariates may capture some degree of the heterogeneity of the innovation processes, but it could be argued that the firm's specific innovation orientation (more scientific related or more product related) is not adequately captured. This is important because it might be expected that more scientifically oriented firms might focus more on patenting, and more product oriented firms might achieve higher returns from sales of new products. Tables 8 and 9 include the covariate, *PhDs*, to proxy for the percentage of R&D employees with a PhD degree. However, we can include this covariate only for those firms with a formal R&D department,[11] which reduces our sample of on-park firms to 667 (78.6% of the 849 firms in the full sample).[12] We

[11] Around 50% of Spanish innovative firms do not have an R&D department. They achieve new products and processes from the development of other innovation activities, e.g. design (Barge-Gil et al., 2011a).
[12] Based on park type, firms with formal R&D functions are101 out of 112 firms (90.2%) in PSPs, 167 out of 206 (81.1%) in MPs, 213 out of 260 (81.9%) in TPUs and 186 out of 271 (68.6%) in PTPs.

deal with reduction in numbers in two ways. First, Table 8 assumes that firms with no R&D department are product oriented and, accordingly, we assign them zero percentage of PhDs[13] in the R&D team. In this case, we include an additional covariate, *int_R&D*, which is a dummy variable that takes the value 1 if the firm conducts R&D and zero otherwise. Second, Table 9 estimates the model on the smaller sample.

The main results do not change significantly in any of these estimations, despite the percentage of PhDs showing a positive effect on patents and a negative (non-significant) effect on products. In addition, when our preferred specifications, controlling for the whole set of park characteristics (Tables 8 and 9, Columns II and IV) are examined, the magnitude of the effects is very similar to those presented in Table 7. Accordingly, it seems that the different performance of firms located in different types of parks are, at least to some extent, a consequence of the role played by the university rather than differences in the firms located in them. This result is not surprising. Spanish universities traditionally have suffered from an inability to transform knowledge into new products (Testar Ymbert, 2012) and it would seem that parks with a high university presence (pure science and mixed parks) have the same problem. Thus, we can conclude that PSPs do not help to overcome this drawback.

However, PSPs seem able to foster higher levels of firm patenting. This result can be interpreted in different ways. On the one hand, patenting could be regarded as a first step towards more marketable results. On the other hand, most patents never materialize into new products; a great deal of effort is required to transform a patent into an economic success (Chesbrough, 2003).

TABLE 8 and TABLE 9 APPROX. HERE

3.2. *Influence of park type on links with universities*

A different and interesting question is whether the relationships between firms and universities are stronger for firms in SPs. One of the main objectives of SPs is to foster firm-industry relationships. We analyse two dependent variables: existence of cooperation, and purchase of university R&D. Table 10 presents the first set of results. Columns I and V provide a comparison across park types, showing a higher likelihood of cooperation with universities for MPs compared to PTPs, and no significant differences regarding bought-in R&D. The specifications in Columns II and VI include firms' characteristics and show no significant

[13] As expected, we find that firms in PSPs have a higher share of R&D personnel with a PhD degree. The mean values for this variable according to park type are: 0.25 for PSPs, 0.14 for MPs, 0.08 for TPUs and 0.08 for PTPs.

differences across STPs types for cooperation with universities, but higher levels of externally sourced R&D for SPs than PTPs. Columns III and VII include park age and size, but show no statistically significant differences across park types, although the coefficient of PSPs is still large. Finally, columns IV and VIII include park's management characteristics; again, there are no statistically significant differences across park types.

To sum up, we find no evidence that SPs fostering cooperation with universities. When external R&D is analysed, the coefficient of PSPs is always positive and quite large, although it is significant only in column VI which does not account for park characteristics.

Regarding the covariates, we find a significant effect of innovation effort, industry technological level and level of development in the province. This last effect is negative, indicating that firms in more developed provinces are less likely to cooperate with universities, and less likely to buy in university R&D.[14] No significant effect is found for size, exports or obstacles to innovation, while age shows a positive effect, which is significant in the cooperation equation, but not in the equation for external R&D.

TABLE 10 APPROX. HERE

Similar to the results for innovation outputs, these results could be biased if the specific orientation of the firms' innovation processes is not captured adequately by the covariates. The composition of the R&D team and, more specifically, the percentage of PhDs in total R&D employees have been shown to influence the relative weight of universities in partner portfolios (Barge-Gil and Conti, 2013). Table 11 includes this indicator, and assumes that firms with no R&D department are product rather than science oriented and accordingly, are assigned zero for percentage of PhDs. Table 12 presents the regression excluding these firms. The results are similar to those in Table 10. No difference is found across park types for likelihood of cooperation with universities, and there is a positive, non-significant effect of PSPs for external R&D. Finally, as expected the percentage of PhDs in the R&D team has positive coefficients, although they are significant only for the results for external R&D in Table 11.

Overall, the results suggest that the decisions of firms regarding the existence and extent of their relationships with universities are not affected by the type of park in which they are located. If one of the reasons why universities develop SPs is to encourage more cooperation between firms and universities than occurs with other types of park firms, then the Spanish experience would seem to show that the effort is wasted.

[14] This is probably due to the fact that more developed provinces have more varied supply of R&D partners that also includes private companies. Also, technology institutes are important providers of external R&D to firms and they have a high presence in some richer provinces, such as those in the Basque Country and Navarra (Barge-Gil et al., 2011b).

TABLE 11 and TABLE 12 APPROX. HERE

4. Discussion and conclusions

STPs are the subject of debate over their effectiveness for supporting business innovativeness and encouraging the establishment of links between firms and universities. However, how much the level of involvement of universities in parks affects park firms' innovation outcomes and links with universities has not so far been addressed.

We investigated this by studying how different levels of involvement of a university in a STP affects firms' innovation outputs measured as sales of new to the market products and numbers of patent applications, and links between STP firms and universities measured as cooperation and purchase of university R&D services. To this end we have distinguished four types of park: pure science parks where the university is a major shareholder; mixed parks in which a university is a minority shareholder; technology parks with university where there is no university shareholding, but some university research facilities are located in the park; and pure technology parks in which the university has no formal involvement.

We exploited firm level data from the Spanish CIS and park-level data the Survey 2009 on the Characteristics and Results of Science and Technology Parks.

Our results for innovation output show clear specialization according to park type: PSP firms show highest patenting performance and lowest product innovation levels, while PTP firms perform best for sales of new to the market products and worst for patenting. For cooperation with a university and the amount of R&D services bought from a university, we found no robust evidence of an influence of type of the park.

It could be argued that these results might be biased by the different orientation of the firms' innovation processes – more scientific or more product-oriented – in different types of parks, and by other park characteristics. To account for these factors, we included a large set of firm level covariates to capture, at least to some degree, the heterogeneity of firms' innovation processes, and we controlled for different park characteristics. We find that, to some extent, the different innovation performance of firms is attributable more to their location on different types of parks than to differences among firms.

Our research has implications at different levels. For university managers it indicates that involvement in park ownership/management allows firms to benefit from the knowledge created in the university, but that more effort is needed to transform this knowledge into commercial outputs. Our research suggests also that firms on parks managed by universities do not

cooperate more with universities than those located in other types of parks. For firms' managers deciding about on-park or off-park location, this research suggests that they need to be aware that different types of parks (more scientific- versus more technology-oriented) have different effects on tenant firms' innovation. Although it would require large amounts of data, it would be interesting for future research to analyse the relationship between firms' characteristics and type of STP. It would also be informative to replicate this study in other countries, such as the US where universities tend to be more entrepreneurial than in Spain. Future research could also assess how the quality of the academic research affects park tenants' innovation. Finally, other less formal indicators of technology transfer between universities and park firms could be employed.

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Tables

Table 1. Park types' definition and number of parks and firms in the sample.

	Park type	**Characteristics**	**# of parks**	**# of firms in the sample**
Science Park (SP)	*PSP - Pure Science Park*	STP with more than the 50% of shares owned by the university	5	112
	MP - Mixed Park	STP where the university is a minority shareholder	5	206
Technology Park (TP)	*TPU - Technology Park with University*	STP where the university is not a shareholder, but it locates some of their research facilities inside the STP	8	260
	PTP - Pure Technology Park	STP where the university is not a shareholder nor locates some of their research facilities inside the STP	7	271

Table 2. Firms' Covariates

Characteristic	Label	Description
Turnover	lsales07 lsales07_2	Turnover in 2007 (log) Turnover in 2007 (log, quadratic)
Exports	x_s07	Exports over turnover in 2007
Industrial sector	high mediumhigh mediumlow low kis nkis restact	Technological level of industrial sector (0,1) (according to OECD Science, Technology and Industry Scoreboard) 7 dummies: high-tech manufacturing, medium-high-tech manufacturing, medium-low-tech manufacturing, low-tech manufacturing, knowledge intensity service, no-knowledge intensity service, other sectors
Age	lfirmage	Firm age (years) (log)
Innovation effort	rdexpen_emp	Expenditure on innovation activities in 2007 per employee (thousand euros)
Location	lprovGDPpp	Provincial GDP per capita (log)
Cost obstacles to innovation	costobst	Perceived average importance of the following factors as a barrier to innovation during 2007-2009: - lack of internal funds - lack external funds - high costs of innovating - risk costs due to uncertain demand of innovative products and services (scale: 1 – 4; 1 very important; 4 unimportant)
Information obstacles to innovation	infobst	Perceived average importance of the following factors as barriers to innovation during 2007-2009: - lack of qualified personnel - lack of information on technology - lack of information on the markets - difficulty to find cooperation partners (scale: 1 – 4; 1 very important; 4 unimportant)

Table 3. Control variables – firm level per type of park. Means.

	PSP (112 obs.)	MP (206 obs.)	TPU (260 obs.)	PTP (271 obs.)
firmage	9.11	11.45	13.06	14.59
sales07	2.03e+07	9867963	1.24e+07	1.81e+07
x_s07	0.02	0.03	0.04	0.04
rdexpen_emp	52069.72	42728.68	27853.12	22280.33
provGDPpp(*)	28.21	23.28	24.96	24.38
low	0.04	0.02	0.03	0.06
mediumlow	0.00	0.02	0.04	0.05
mediumhigh	0.03	0.07	0.06	0.12
kis	0.76	0.67	0.66	0.55
nkis	0.07	0.10	0.07	0.10
restact	0.02	0.05	0.04	0.05
costobst	0.57	0.54	0.55	0.55
infobst	0.39	0.39	0.40	0.39

(*) thousands of Euros.

Table 4. Control variables – Park level

	Characteristic	Label	Description
Structural characteristics	Age	age	Age of the STP (years)
		ageq	Age of the STP (quadratic)
	Dimension	lnfirms	Number of tenant organizations in 2008 (log)
Managerial characteristic	Management	lstaffr	Number of full-time equivalent employees in the park's management company per 100 tenants
		international	1 if the park provides services to foster internationalization of firm, 0 otherwise
		consult	1 if the park provides advice on legal, commercial and fiscal issues, 0 otherwise

Table 5. Control variables – park level per type of park. Means.

	PSP	MP	TPU	PTP
age	8.97	19.42	15.91	15.11
nfirms	150.29	206.55	290.42	205.26
staffr	93.11	14.99	14.40	23.23
international	0.87	0.89	0.42	0.56
consult	0.87	0.18	0.08	0.26

Table 6. Descriptive statistics (849 observations).

	Mean	Std. Dev.	Min.	Max.
Dependent Variables				
newmerl	14387.06	43567.13	0	607684.4
patnuml	520.1189	1920.806	0	26000
coopuni	.3451119	.475685	0	1
RDboughtl	755.1109	2782.416	0	34352.5
Independent variables – STPs' characteristics				
age	15.59246	5.116911	6	24
nfirms	224.4016	218.0987	2	1436
staffr	27.74644	68.32535	0	1550
international	.6372203	.4810854	0	1
consult	.2650177	.4416028	0	1
Control variables – firms' characteristics				
firmage	12.63604	12.00347	1	152
sales07	1.46e+07	6.98e+07	0	1.02e+09
x_s07	.0337759	.1212245	0	.9519433
rdexpen_emp	32878.32	68140.92	0	915000
provGDPpp(*)	24.79523	5.332709	17.08	34.49
low	.0365135	.1876747	0	1
mediumlow	.0341578	.1817415	0	1
mediumhigh	.0789164	.2697671	0	1
kis	.6442874	.4790109	0	1
nkis	.0895171	.2856569	0	1
restact	.0424028	.2016252	0	1
costobst	.551005	.2036635	.25	1
infobst	.3940897	.126744	.25	1

(*) thousands.

Table 7. Influence of park type on innovation outputs. Main specification

	(I) lnewmerl	(II) lnewmerl	(III) lnewmerl	(IV) lnewmerl	(V) lpatnuml	(VI) lpatnuml	(VII) lpatnuml	(VIII) lpatnuml
PSP	-0.116	-0.526	-0.772*	-1.223**	1.873***	1.352***	1.434**	1.399**
	(0.408)	(0.432)	(0.359)	(0.385)	(0.340)	(0.328)	(0.383)	(0.409)
MP	-0.275	-0.512	-1.009**	-0.957**	0.283	0.073	-0.055	0.115
	(0.601)	(0.497)	(0.353)	(0.286)	(0.264)	(0.274)	(0.304)	(0.331)
TPU	-0.233	-0.559	-0.531	-0.328	0.240	0.014	0.001	-0.034
	(0.441)	(0.387)	(0.318)	(0.252)	(0.353)	(0.336)	(0.316)	(0.307)
lsales07		0.118	0.131	0.127		0.010	0.012	0.010
		(0.101)	(0.099)	(0.100)		(0.059)	(0.059)	(0.058)
lsales07_2		-0.005	-0.006	-0.006		-0.004	-0.004	-0.004
		(0.007)	(0.007)	(0.007)		(0.003)	(0.003)	(0.003)
x_s07		1.253	1.183	1.278		2.467*	2.449*	2.483*
		(1.105)	(1.145)	(1.171)		(1.089)	(1.090)	(1.076)
restact		-1.613	-1.588	-1.718		0.329	0.322	0.281
		(1.336)	(1.330)	(1.305)		(0.505)	(0.507)	(0.483)
low		-0.628	-0.840	-0.638		0.170	0.154	0.118
		(1.023)	(1.021)	(1.043)		(0.612)	(0.629)	(0.637)
mediumlow		-0.534	-0.545	-0.590		0.608	0.640	0.624
		(1.416)	(1.407)	(1.402)		(0.517)	(0.507)	(0.515)
mediumhigh		-0.614	-0.683	-0.621		0.081	0.093	0.055
		(0.908)	(0.899)	(0.901)		(0.428)	(0.427)	(0.421)
kis		-1.019	-1.053	-1.126		0.163	0.158	0.146
		(0.770)	(0.757)	(0.760)		(0.234)	(0.232)	(0.226)
nkis		-0.518	-0.590	-0.593		-0.148	-0.167	-0.210
		(0.851)	(0.867)	(0.867)		(0.307)	(0.305)	(0.299)
rdexpen_emp		0.387***	0.391***	0.389***		0.169***	0.170***	0.167***
		(0.043)	(0.042)	(0.042)		(0.015)	(0.015)	(0.014)
costobst		1.065	1.045	1.021		-0.125	-0.142	-0.177
		(0.862)	(0.842)	(0.860)		(0.398)	(0.389)	(0.401)
infobst		0.824	0.589	0.583		-0.136	-0.149	-0.149
		(1.276)	(1.248)	(1.256)		(0.693)	(0.690)	(0.721)
lfirmage		0.856**	0.835**	0.830**		0.094	0.090	0.075
		(0.229)	(0.227)	(0.228)		(0.137)	(0.135)	(0.142)
lprovGDPpp		-0.480	-1.073	-1.263**		0.297	0.175	0.340
		(0.831)	(0.566)	(0.448)		(0.480)	(0.720)	(0.611)
age			-0.493**	-0.716***			-0.036	-0.070
			(0.140)	(0.115)			(0.157)	(0.154)
agec			0.016**	0.022***			0.002	0.002
			(0.005)	(0.004)			(0.005)	(0.005)
lnfirms08			0.345**	0.462**			0.061	0.112
			(0.119)	(0.130)			(0.102)	(0.107)
lstaffr				0.472***				0.040
				(0.106)				(0.135)
international				0.338				-0.304
				(0.207)				(0.252)
consult				-0.668				-0.076
				(0.376)				(0.301)
N	849	849	849	849	849	849	849	849
r2	0.001	0.116	0.125	0.130	0.041	0.131	0.132	0.135

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Influence of park type on innovation outputs (Includes Phd. Full Sample)

	(I) lnewmerl	(II) lnewmerl	(III) lpatnuml	(IV) lpatnuml
PSP	-0.540	-1.048**	1.167**	1.193**
	(0.340)	(0.353)	(0.371)	(0.379)
MP	-0.938*	-0.856**	-0.128	0.002
	(0.353)	(0.271)	(0.311)	(0.343)
TPU	-0.544	-0.315	0.064	0.014
	(0.313)	(0.241)	(0.299)	(0.293)
lsales07	0.133	0.131	-0.000	-0.004
	(0.097)	(0.098)	(0.058)	(0.056)
lsales07_2	-0.007	-0.007	-0.002	-0.002
	(0.007)	(0.007)	(0.003)	(0.003)
x_s07	1.385	1.499	2.174	2.200
	(1.143)	(1.179)	(1.101)	(1.091)
restact	-1.611	-1.748	0.384	0.352
	(1.312)	(1.283)	(0.505)	(0.485)
low	-0.806	-0.587	0.112	0.070
	(1.022)	(1.053)	(0.659)	(0.671)
mediumlow	-0.556	-0.578	0.750	0.719
	(1.452)	(1.451)	(0.516)	(0.527)
mediumhigh	-0.651	-0.578	0.067	0.027
	(0.912)	(0.920)	(0.449)	(0.445)
kis	-1.009	-1.085	0.126	0.120
	(0.743)	(0.742)	(0.238)	(0.235)
nkis	-0.558	-0.569	-0.241	-0.271
	(0.845)	(0.842)	(0.307)	(0.304)
rdexpen_emp	0.402*	0.411**	0.282***	0.275***
	(0.145)	(0.145)	(0.064)	(0.064)
PhDs	-1.763	-1.883	2.153**	2.164**
	(1.092)	(1.104)	(0.681)	(0.688)
int_R&D	0.092	-0.016	-1.429*	-1.367*
	(1.479)	(1.460)	(0.573)	(0.576)
costobst	0.996	0.958	-0.070	-0.091
	(0.891)	(0.910)	(0.383)	(0.393)
infobst	0.560	0.575	-0.076	-0.095
	(1.257)	(1.256)	(0.775)	(0.806)
lfirmage	0.826***	0.822**	0.149	0.137
	(0.220)	(0.221)	(0.140)	(0.147)
lprovGDPpp	-1.046	-1.228**	0.015	0.150
	(0.589)	(0.405)	(0.660)	(0.578)
age	-0.486**	-0.720***	-0.052	-0.075
	(0.144)	(0.103)	(0.147)	(0.147)
agec	0.016**	0.023***	0.002	0.002
	(0.005)	(0.003)	(0.005)	(0.005)
lnfirms08	0.351**	0.497***	0.058	0.080
	(0.115)	(0.125)	(0.100)	(0.105)
lstaffr		0.503***		0.015
		(0.093)		(0.124)
international		0.297		-0.230
		(0.201)		(0.249)
consult		-0.579		-0.151
		(0.331)		(0.288)
N	849	849	849	849
r2	0.129	0.135	0.158	0.160

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9. Influence of park type on innovation outputs (Includes Phd. Restricted Sample)

	(I) lnewmerl	(II) lnewmerl	(III) lpatnuml	(IV) lpatnuml
PSP	-0.954	-1.404**	1.006*	1.086*
	(0.468)	(0.409)	(0.423)	(0.410)
MP	-1.465***	-1.275***	-0.232	-0.159
	(0.380)	(0.280)	(0.395)	(0.431)
TPU	-0.709	-0.506	0.094	-0.002
	(0.416)	(0.302)	(0.339)	(0.352)
lsales07	0.182	0.185	-0.045	-0.050
	(0.104)	(0.103)	(0.063)	(0.062)
lsales07_2	-0.009	-0.009	0.001	0.001
	(0.007)	(0.007)	(0.003)	(0.003)
x_s07	0.017	0.231	2.007	2.047
	(1.586)	(1.635)	(1.376)	(1.357)
restact	-1.333	-1.446	0.974	0.963
	(1.824)	(1.771)	(0.769)	(0.757)
low	0.838	0.992	0.317	0.311
	(1.476)	(1.492)	(0.955)	(0.969)
mediumlow	-0.660	-0.704	1.333*	1.290
	(1.662)	(1.666)	(0.639)	(0.663)
mediumhigh	-0.763	-0.744	0.517	0.453
	(1.053)	(1.054)	(0.542)	(0.539)
kis	-0.766	-0.831	0.356	0.356
	(0.919)	(0.922)	(0.287)	(0.287)
nkis	-0.415	-0.421	-0.176	-0.189
	(1.273)	(1.284)	(0.505)	(0.506)
rdexpen_emp	0.591**	0.579**	0.574***	0.563***
	(0.174)	(0.173)	(0.084)	(0.085)
PhDs	-1.739	-1.863	1.836*	1.885*
	(1.043)	(1.052)	(0.691)	(0.718)
costobst	0.378	0.374	-0.045	-0.060
	(1.132)	(1.147)	(0.550)	(0.555)
infobst	0.767	0.756	-0.126	-0.166
	(1.320)	(1.340)	(0.953)	(0.982)
lfirmage	0.997*	1.000*	0.182	0.171
	(0.362)	(0.359)	(0.177)	(0.179)
lprovGDPpp	-2.024**	-1.994***	-0.383	-0.272
	(0.706)	(0.497)	(0.774)	(0.674)
age	-0.721***	-0.949***	-0.120	-0.143
	(0.150)	(0.106)	(0.164)	(0.160)
agec	0.024***	0.030***	0.004	0.004
	(0.005)	(0.004)	(0.006)	(0.005)
lnfirms08	0.409*	0.592**	0.095	0.081
	(0.184)	(0.159)	(0.131)	(0.141)
lstaffr		0.552***		-0.020
		(0.135)		(0.177)
international		0.167		-0.194
		(0.268)		(0.288)
consult		-0.757		-0.260
		(0.383)		(0.350)
N	667	667	667	667
r2	0.071	0.077	0.135	0.137

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10. Influence of park type on links with universities. Main Specification

	(I) coopuni	(II) coopuni	(III) coopuni	(IV) coopuni	(V) lRDboughtl	(VI) lRDboughtl	(VII) lRDboughtl	(VIII) lRDboughtl
PSP	0.096	0.026	-0.006	-0.034	1.227	0.957*	0.902	1.078
	(0.080)	(0.057)	(0.057)	(0.067)	(0.609)	(0.435)	(0.447)	(0.596)
MP	0.120*	0.056	0.048	0.026	0.454	0.070	0.109	-0.200
	(0.048)	(0.040)	(0.039)	(0.036)	(0.308)	(0.257)	(0.466)	(0.458)
TPU	0.051	-0.006	0.010	0.031	0.263	0.006	0.053	0.078
	(0.049)	(0.043)	(0.031)	(0.030)	(0.302)	(0.240)	(0.224)	(0.215)
lsales07		-0.001	-0.002	-0.002		0.008	0.002	-0.002
		(0.011)	(0.011)	(0.011)		(0.069)	(0.070)	(0.069)
lsales07_2		0.001	0.001	0.001		0.001	0.002	0.002
		(0.001)	(0.001)	(0.001)		(0.004)	(0.004)	(0.004)
x_s07		0.054	0.054	0.056		1.769	1.778	1.724
		(0.153)	(0.154)	(0.152)		(1.061)	(1.090)	(1.091)
restact		-0.195*	-0.184*	-0.188*		-0.818	-0.786	-0.727
		(0.075)	(0.075)	(0.075)		(0.442)	(0.446)	(0.442)
low		-0.166	-0.178	-0.157		-0.449	-0.456	-0.404
		(0.089)	(0.092)	(0.089)		(0.478)	(0.486)	(0.489)
mediumlow		-0.238*	-0.263*	-0.265*		-1.178*	-1.254*	-1.283*
		(0.108)	(0.103)	(0.102)		(0.492)	(0.455)	(0.469)
mediumhigh		-0.289***	-0.305***	-0.295***		-1.252**	-1.293**	-1.246**
		(0.054)	(0.056)	(0.054)		(0.361)	(0.371)	(0.380)
kis		-0.057	-0.053	-0.056		-0.591	-0.570	-0.542
		(0.059)	(0.058)	(0.058)		(0.396)	(0.402)	(0.404)
nkis		-0.219**	-0.209**	-0.203**		-1.107**	-1.066*	-0.983*
		(0.059)	(0.058)	(0.059)		(0.394)	(0.400)	(0.394)
rdexpen_emp		0.041***	0.041***	0.041***		0.216***	0.214***	0.220***
		(0.004)	(0.004)	(0.004)		(0.030)	(0.029)	(0.028)
costobst		0.098	0.100	0.103		-0.118	-0.113	-0.032
		(0.079)	(0.081)	(0.081)		(0.657)	(0.656)	(0.646)
infobst		-0.096	-0.110	-0.111		-0.355	-0.364	-0.421
		(0.132)	(0.128)	(0.126)		(0.665)	(0.649)	(0.640)
lfirmage		0.051**	0.053**	0.055**		0.017	0.026	0.058
		(0.018)	(0.017)	(0.018)		(0.125)	(0.123)	(0.128)
lprovGDPpp		-0.212**	-0.276**	-0.316***		-1.897**	-2.026**	-2.356**
		(0.065)	(0.079)	(0.073)		(0.514)	(0.698)	(0.663)
age			-0.034	-0.046*			-0.034	0.002
			(0.019)	(0.017)			(0.152)	(0.138)
agec			0.001	0.001*			0.001	0.000
			(0.001)	(0.001)			(0.006)	(0.005)
lnfirms08			-0.029	-0.029			-0.146	-0.282
			(0.016)	(0.022)			(0.148)	(0.191)
lstaffr				0.031				-0.050
				(0.018)				(0.129)
international				0.074**				0.637*
				(0.024)				(0.239)
consult				-0.048				-0.297
				(0.056)				(0.531)
N	849	849	849	849	849	849	849	849
r2	0.010	0.166	0.174	0.179	0.016	0.122	0.125	0.131

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11. Influence of park type on links with universities. (Includes Phd. Full Sample)

	(I) coopuni	(II) coopuni	(III) lRDboughtl	(IV) lRDboughtl
PSP	-0.031	-0.050	0.664	0.890
	(0.059)	(0.070)	(0.526)	(0.655)
MP	0.040	0.016	0.042	-0.303
	(0.039)	(0.037)	(0.506)	(0.495)
TPU	0.009	0.027	0.099	0.113
	(0.029)	(0.030)	(0.242)	(0.227)
lsales07	-0.002	-0.002	-0.007	-0.013
	(0.011)	(0.011)	(0.070)	(0.069)
lsales07_2	0.001	0.001	0.003	0.003
	(0.001)	(0.001)	(0.004)	(0.004)
x_s07	0.035	0.037	1.541	1.468
	(0.149)	(0.147)	(1.077)	(1.076)
restact	-0.183*	-0.186*	-0.738	-0.667
	(0.075)	(0.074)	(0.421)	(0.417)
low	-0.181	-0.162	-0.493	-0.450
	(0.092)	(0.089)	(0.504)	(0.512)
mediumlow	-0.267*	-0.269*	-1.175*	-1.211*
	(0.106)	(0.105)	(0.462)	(0.488)
mediumhigh	-0.309***	-0.300***	-1.319**	-1.274**
	(0.056)	(0.054)	(0.386)	(0.401)
kis	-0.058	-0.061	-0.603	-0.569
	(0.057)	(0.058)	(0.386)	(0.387)
nkis	-0.211**	-0.204**	-1.125**	-1.034*
	(0.057)	(0.058)	(0.396)	(0.387)
rdexpen_emp	0.033***	0.035***	0.290**	0.301**
	(0.006)	(0.006)	(0.083)	(0.083)
PhDs	0.179	0.176	1.895*	1.980*
	(0.097)	(0.096)	(0.888)	(0.888)
int_R&D	0.056	0.042	-1.008	-1.063
	(0.059)	(0.061)	(0.566)	(0.565)
costobst	0.104	0.109	-0.052	0.044
	(0.081)	(0.082)	(0.653)	(0.640)
infobst	-0.109	-0.112	-0.307	-0.377
	(0.131)	(0.128)	(0.645)	(0.633)
lfirmage	0.051**	0.054**	0.069	0.108
	(0.016)	(0.017)	(0.128)	(0.134)
lprovGDPpp	-0.272**	-0.315***	-2.143*	-2.509**
	(0.080)	(0.074)	(0.803)	(0.713)
age	-0.034	-0.045*	-0.047	-0.001
	(0.019)	(0.016)	(0.170)	(0.147)
agec	0.001	0.001*	0.001	0.000
	(0.001)	(0.001)	(0.006)	(0.005)
lnfirms08	-0.030	-0.033	-0.149	-0.313
	(0.016)	(0.022)	(0.159)	(0.207)
lstaffr		0.027		-0.075
		(0.019)		(0.141)
international		0.077**		0.701**
		(0.022)		(0.247)
consult		-0.057		-0.369
		(0.055)		(0.556)
N	849	849	849	849
r2	0.179	0.184	0.142	0.150

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12. Influence of park type on links with universities. (Includes Phd. Restricted Sample)

	(I) coopuni	(II) coopuni	(III) lRDboughtl	(IV) lRDboughtl
PSP	-0.038	-0.034	0.541	0.951
	(0.069)	(0.084)	(0.570)	(0.692)
MP	0.025	-0.013	-0.046	-0.515
	(0.054)	(0.048)	(0.692)	(0.640)
TPU	0.004	0.025	0.051	0.061
	(0.043)	(0.037)	(0.324)	(0.268)
lsales07	-0.007	-0.008	-0.051	-0.059
	(0.012)	(0.013)	(0.089)	(0.089)
lsales07_2	0.001	0.001	0.008	0.008
	(0.001)	(0.001)	(0.006)	(0.006)
x_s07	-0.100	-0.106	1.844	1.669
	(0.212)	(0.211)	(1.192)	(1.227)
restact	-0.238*	-0.237*	-0.762	-0.682
	(0.105)	(0.104)	(0.662)	(0.671)
low	-0.083	-0.077	0.354	0.316
	(0.164)	(0.160)	(0.906)	(0.926)
mediumlow	-0.255	-0.264	-1.094	-1.200
	(0.138)	(0.138)	(0.571)	(0.602)
mediumhigh	-0.298***	-0.286***	-1.222*	-1.158*
	(0.075)	(0.075)	(0.490)	(0.520)
kis	-0.044	-0.048	-0.559	-0.557
	(0.078)	(0.078)	(0.463)	(0.468)
nkis	-0.259*	-0.253*	-1.474*	-1.418*
	(0.095)	(0.094)	(0.530)	(0.531)
rdexpen_emp	0.071***	0.074***	0.565**	0.588**
	(0.011)	(0.011)	(0.159)	(0.160)
PhDs	0.154	0.154	1.627	1.752
	(0.093)	(0.093)	(0.887)	(0.896)
costobst	0.132	0.140	-0.039	0.032
	(0.096)	(0.096)	(0.867)	(0.852)
infobst	-0.140	-0.146	-0.265	-0.350
	(0.182)	(0.178)	(0.835)	(0.818)
lfirmage	0.068**	0.072**	0.021	0.054
	(0.021)	(0.021)	(0.175)	(0.180)
lprovGDPpp	-0.399***	-0.459***	-2.921**	-3.481***
	(0.093)	(0.096)	(1.028)	(0.862)
age	-0.045*	-0.049*	-0.118	-0.018
	(0.020)	(0.020)	(0.210)	(0.176)
agec	0.001*	0.002*	0.003	0.001
	(0.001)	(0.001)	(0.008)	(0.006)
lnfirms08	-0.039	-0.051	-0.171	-0.441
	(0.025)	(0.033)	(0.206)	(0.263)
lstaffr		0.021		-0.170
		(0.027)		(0.195)
international		0.115***		0.947**
		(0.026)		(0.310)
consult		-0.074		-0.497
		(0.064)		(0.634)
N	667	667	667	667
r2	0.112	0.119	0.116	0.130

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Annexes

Table A1. Descriptive statistics for Pure Science Parks (112 observations)

Variable	Mean	Std. Dev.	Min	Max
Dependent Variables				
newmerl	7802.071	16807.96	0	104470.1
patnuml	1309.76	3438.015	0	26000
coopuni	.3839286	.4885267	0	1
RDboughtl	1619.849	4763.997	0	34352.5
Independent variables – STPs' characteristics				
age	8.973214	1.890993	7	12
nfirms	150.2946	70.99697	2	209
staffr	93.11475	168.3715	15	1550
international	.8660714	.3421062	0	1
consult	.8660714	.3421062	0	1
Control variables – firms' characteristics				
firmage	9.107143	8.243323	1	39
sales07	2.03e+07	1.12e+08	0	1.02e+09
x_s07	.0255383	.0941319	0	.5853816
PhDs(*)	.254427	.2900657	0	1
int_R&D	.9017857	.2989417	0	1
rdexpen_emp	52069.72	71839.91	0	581847.7
provGDPpp(**)	28.20955	2.993663	18.94	30.23
low	.0357143	.1864109	0	1
mediumlow	0	0	0	0
mediumhigh	.0267857	.1621823	0	1
kis	.7589286	.429656	0	1
nkis	.0714286	.2586969	0	1
restact	.0178571	.1330273	0	1
costobst	.5673622	.2087513	.25	1
infobst	.3866511	.1276362	.25	1

(*) 101 observations.
(**) thousands.

Table A2. Descriptive statistics for Mixed Parks (206 observations).

Variable	Mean	Std.Dev.	Min	Max
Dependent Variables				
newmerl	19239.16	57624.3	0	542121
patnuml	309.9504	1222.031	0	14285.71
coopuni	.407767	.4926166	0	1
RDboughtl	946.8914	3249.854	0	30000
Independent variables – STPs' characteristics				
age	19.41748	4.815674	8	24
nfirms	206.5485	102.1768	30	336
staffr	14.98841	24.28875	7.738095	116.6667
international	.8883495	.3157032	0	1
consult	.1796117	.3847988	0	1
Control variables – firms' characteristics				
firmage	11.4466	10.08958	1	64
sales07	9867963	3.14e+07	0	3.31e+08
x_s07	.0278694	.1086076	0	.7647692
PhDs(*)	.141093	.2355709	0	1
int_R&D	.8106796	.3927173	0	1
rdexpen_emp	42728.68	105366.6	0	915000
provGDPpp(**)	23.28442	6.248539	17.08	30.34
low	.0194175	.1383232	0	1
mediumlow	.0194175	.1383232	0	1
mediumhigh	.0728155	.2604664	0	1
kis	.6747573	.4696067	0	1
nkis	.1019417	.3033088	0	1
restact	.0485437	.2154356	0	1
costobst	.5447968	.1980654	.25	1
infobst	.3911716	.1179434	.25	.8

(*) 167 observations
(**) thousands.

Table A3. Descriptive statistics for Technology Parks with University (260 observations).

Variable	Mean	Std.Dev.	Min	Max
Dependent Variables				
newmerl	13062.02	34082.59	0	290812.7
patnuml	462.365	1667.769	0	13333.33
coopuni	.3384615	.474099	0	1
RDboughtl	622.1162	2123.337	0	15000
Independent variables – STPs' characteristics				
age	15.91154	3.638578	7	22
nfirms	290.4192	328.0653	15	1436
staffr	14.40331	12.48315	2.715878	68.75
international	.4230769	.4950002	0	1
consult	.0769231	.2669833	0	1
Control variables – firms' characteristics				
firmage	13.06538	12.32411	1	89
sales07	1.24e+07	5.33e+07	0	6.84e+08
x_s07	.0389088	.1292199	0	.8
PhDs(*)	.0823416	.1757204	0	1
int_R&D	.8192308	.3855691	0	1
rdexpen_emp	27853.12	49005.91	0	551461.5
provGDPpp(**)	24.95604	5.025551	17.89	31.38
low	.0269231	.1621708	0	1
mediumlow	.0423077	.2016784	0	1
mediumhigh	.0653846	.2476801	0	1
kis	.6653846	.4727659	0	1
nkis	.0730769	.2607647	0	1
restact	.0384615	.1926786	0	1
costobst	.5509438	.197088	.25	1
infobst	.398087	.132639	.25	1

(*) 213 observations.
(**) thousands.

Table A4. Descriptive statistics for Pure Technology Parks (271 observations)

Variable	Mean	Std. Dev.	Min	Max
Dependent Variables				
newmerl	14691.47	46605.63	0	607684.4
patnuml	408.9418	1618.174	0	12000
coopuni	.2878229	.4535858	0	1
RDboughtl	379.5431	1464.231	0	12800
Independent variables – STPs' characteristics				
age	15.11439	4.559668	6	19
nfirms	205.262	170.4959	25	430
staffr	23.23026	17.93033	0	62.80992
international	.5571956	.4976369	0	1
consult	.2619926	.4405322	0	1
Control variables – firms' characteristics				
firmage	14.58672	13.83336	1	152
sales07	1.81e+07	8.16e+07	0	8.68e+08
x_s07	.0367454	.1320954	0	.9519433
PhDs(*)	.0783154	.1840451	0	1
int_R&D	.6863469	.4648356	0	1
rdexpen_emp	22280.33	36936.75	0	304282.4
provGDPpp(**)	24.3783	4.998281	20.21	34.49
low	.0590406	.2361367	0	1
mediumlow	.0516605	.2217502	0	1
mediumhigh	.1180812	.3233013	0	1
kis	.5535055	.4980487	0	1
nkis	.103321	.3049409	0	1
restact	.0516605	.2217502	0	1
costobst	.5490226	.2125276	.25	1
infobst	.3955471	.1275556	.25	1

(*) 186 observations.
(**) thousands.