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SCIENCE AND TECHNOLOGY PARKS IN ITALY: MAIN FEATURES AND ANALYSIS OF THEIR EFFECTS ON THE FIRMS HOSTED

by Danilo Liberati*, Marco Marinucci* and Giulia Martina Tanzi†

Abstract

We analyse the results of a survey conducted by the Bank of Italy in the spring of 2012 on Italian science and technology parks. First we describe the main features of science parks in Italy. Then we investigate whether they have been effective in improving the economic performance and innovative capacity of the firms located within them. We find a pronounced heterogeneity between science and technology parks, whose cooperation with public research institutions is characterized by physical proximity. Although the business situation of firms located in science and technology parks tends on average to be better than that of similar "non-park" firms, a difference-in-differences estimation shows that entering a science and technology park did not generally improve firms' business performance and their propensity to innovate compared with external counterparts.

JEL Classification: C31, L25, O31.
Keywords: Scientific and Technology Parks, matching, difference in differences.

Contents

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1 Introduction[1]

In the last decades there has been an increasing interest from academics and policy-makers toward the improvement and the fostering of the innovation activity of both public and private institutions. Such interest has been particularly high in Italy, where the weakening competitiveness of the national economy with respect to other countries raised strong concerns.
Among the possible policies adopted to promote the economic growth there is the creation and the reinforcement of Science and Technology Parks (SPs). In general terms, a Science Park is a geographical area in which firms, R&D laboratories, universities and research centres have a common location in order to exploit proximity advantages, knowledge spillovers and agglomeration economies (Capello and Morrison, [6]). The rationale behind the promotion of SPs is twofold. First, SPs offer to firms several services (advisory on project management, legal support, provision of logistic infrastructures, training on employees, advisory on R&D and patenting activities, ...) that may affect the firms' income performance, their profitability and their financial conditions. Secondly, the role of SPs is to foster links between hosted firms and universities, to encourage the creation of knowledge based businesses and to transfer technologies and skills.
As shown in Section 2 many papers have investigated, in several countries and with different empirical strategies, whether SPs have been actually successful in promoting innovation, high skill activities and economic performances among the resident firms. Results found have been mixed and the role of SPs on firms remained doubtful.
This paper contributes to this literature by investigating the activity of Italian science parks and their effect on their hosted firms (SP firms in the following). We base our analysis on a survey of the Italian SPs made by the Bank of Italy in spring 2012 where it is provided a detailed information on 25 Italian SPs (out of 39), as well as an updated list of the firms hosted (if any) in these parks. Starting from this survey we perform several analyses that allow us to address three main issues.
The first one arise from the limited knowledge that we have on these institutions: previous studies on Italian SPs either focused on specific case studies (Bigliardi et al. [4]), were concerned more about the effectiveness

[1]We are grateful to the Science Parks that participated to the survey. We wish to thank Raffaello Bronzini, Matteo Bugamelli, Luigi Cannari, Guido De Blasio, Alessandro Fabbrini, Luigi Infante, Francesca Lotti, Giovanni Marin, Andrea Orame, Davide Revelli and the anonymous referees for their insightful comments and suggestions. We are also grateful to the participants in the workshops on innovation held at the Bank of Italy (26-27 September 2012 and 19 March 2013) and the Università "G. d'Annunzio", Pescara . We are also indebted to Luca Missori for his invaluable assistance in creating the questionnaire and collecting data and to our colleagues of the regional research offices for helping us in collecting the list of science parks. The opinions expressed in this paper are those of the authors and do not necessarily represent those of the Bank of Italy.

of incubators instead of SPs (Capello and Morrison, [6]) or they looked at both of them (Colombo and Delmastro [8]).[2] However, no paper tried to get a general picture of Italian science parks namely about their nature, cooperative strategies or services provided to the hosted institutions (firms, universities etc.). Thanks to the above mentioned survey, we try to fill this gap by providing a detailed overview of Italian science parks according to their year of creation, their ownership, their financial conditions, the kind of services provided to firms, the degree of cooperation with universities and research centres.[3]

We find that Italian SPs are strongly heterogeneous in terms of size, performance, strategy and specialization. SPs show a quite low dependence from public direct funds together with an increasing turnover and staff in the last years. This result seems to confirm a growing activity. Interestingly, all SPs have their main partnering university in the same region, often in the same province, suggesting a significant cooperative activity with other local knowledge institutions.

Given the nature of a science park and the services provided, firms operating in a specific sector or involved in a particular research project may actually be more attracted than others to enter/born in a SP. Therefore, it may be that firms in a SP may somehow differ from their outer counterparts. For this reason, the second aim of this paper is to check whether SP firms show peculiar features in term of balance sheet indicators and innovative performance with respect to others similar but located outside the parks. Data shows that SP firms are actually better performers with respect to their counterparts (in terms of business size, investments and profitability indicators), a result that partially confirms the findings of Colombo and Delmastro [8].

The third issue that we address in our paper is linked with the latter finding. As a matter of fact, SP firms may perform better than out-of-park firms (henceforth NSP firms) either because they actually get a significant benefit from being located inside SPs or because they were already better before deciding to locate inside SPs. In the former case, SPs is undoubtedly an effective tool to increase firms' competitiveness while in the second case the answer is less clear: even though SP firms were ex-ante better, they may or may not get a benefit from being in a SP. To answer this question we study only those firms that decided to enter in the SP (i.e. not born in it)

[2]For example, the latter study the effectiveness of 17 SPs and 25 BICs (Business Innovation Centers) on the propensity to innovate of the incubated firms. However, focusing also on BICs, which may actually have different goals with respect to SPs, makes their analysis on science parks' activity biased. Furthermore, their study was performed more than 10 years ago, when many of the Italian SPs were just born.

[3]To the best of our knowledge, the only paper that tries to make a similar overview, but for the Spanish science parks is Barge-Gil et al. [2]. See the next section for further details.

and we look for a difference in their performance related to their staying in the park.
After a matching process that allow us to correclty compare the hosted (i.e. treated firms) with non-hosted firms, we run a difference in difference estimation to test whether being located in a SP actually increases SP firms' performances. Such check is made using different firms' indicators in 2011 like sales, value added, profitability indexes, investment and patents. The analysis shows no significant effects of the SPs for those firms that moved inside a park apart from a positive effect on production performance, measured with sales and added value (even though for the latter the effect is not particularly robust).
These results are robust to different years of analysis, sample of parks, and estimation strategies.
Since SP firms perform better than similar firms located outside, but their competitive advantages seem not to increase after having moved inside the parks, one may think that these results seems to support the findings made by other papers like Felsenstein [9]: SPs are actually used by firms for "reputation" reasons. However, there are some aspects that suggest a less conclusive statement. First, a distinction according to the age of the parks shows that their positive effect on the business performance of the hosted firm occur only for the oldest SPs. This seems to suggest that science parks may need time, namely experience, to be really effective on improving the hosted firm performance.
On the other hand, differentiating the sample according to some firms' features, we find that the effect of science parks on sales is significant on the oldest and the smallest firms, mainly settled in the centre-south of Italy.
Even though we are aware of the drawbacks existing in our analysis, it is worth point out that, to the best of our knowledge, we are the first to address the effectiveness of Italian SPs through a quantitative approach by considering firms settled in a great number of SPs at the same time. Further investigations are therefore needed to understand which factors (services provided, SP organization etc.) could contribute to foster SP firms' performance and to improve the effectiveness of the SP in their support of the firms' activity.
The paper is structured as follows. The next section reviews the empirical literature on SPs while section 3 describes the data used. Section 4 provides a detailed description of the main features and differences among Italian SPs while 5 gives a first overlook of the main balance sheets data of the resident firms, compared to not resident ones. Section 6 study the performance of SP firms compared to NSP firms. Finally, section 7 concludes.

2 Literature review

Looking at the literature on SPs it is straightforward to see that all the articles are empirical and based on two main approaches. The first approach is basically made of case studies on one (or few) science parks where the authors get some information on the SP's activity or about the success of the firms that used the SP services. The aim is therefore limited to the actual contribution of the single park to the creation and the growth of their in-SP firms and to explore what instruments they adopt, the internal organization of the SP, the rules that firms must follow to get access to the benefit etc. Examples of these kind of papers are Chan and Lau [7] and Zhang [30]. In the former, the authors try to see which factors (like free rents, access to laboratories, networking, information sharing etc.) have a positive effect on the performance of the firms incubated in a Hong Kong's science park. The authors find that networking and information sharing with other in-SP firms do not provide benefits to firms while SPs services, like free access to laboratories and buildings, are beneficial. In the second paper, Zhang surveys 21 managers of firms operating in 4 Chinese SPs finding that the effectiveness of a SP is determined by several factors like the existence of areas where in-SP firms can settle after their incubation period as well as the local proximity to ITC firms and/or operating in the same sector of the in-SP firms.

The second approach is more quantitative and it aims to empirically test the effect of SPs on either the in-SP firms or the territory nearby the SP (i.e. higher economic growth, employment R&D spillover etc.).[4] Examples of papers focused on last issue are Felsenstein [9], who question whether SPs are seedbeds or enclaves of innovation, Wallsten [26] and Hu [15][5] while the question about SP effect on hosted firms is usually pursued throughout a counter factual analysis on the performance of the in-SP *versus* out-SP firms. Up to now the results provided on this issue are mixed: it is still doubtful whether SPs have been successful in promoting innovation and high skill activities among firms. In fact, some analysis do not find relevant differences in term of innovative activities between firms located within SP and NSP firms (Westhead and Storey [28]). At the same time, other works support the positive and important role of SPs for the development of those firms joining them (e.g., Ferguson and Olofsson [10]; Squicciarini [23] [24] and [25]).

A good survey on the empirical works about this topic is proposed by Barge-

[4] Actually some recent contributions by Link and Scott [18] and [19] are also trying to see which factors, like university proximity, may influence the performance of SPs.

[5] In particular Wallsten [26] study whether the clustering effect of SPs in UK have a positive effect on the employment and the venture capital in the areas close to the science parks (with a negative answer). Hu [15] instead analyses whether the chinese SPs provide some benefit in terms of higher productivity, finding that this is actually the case.

Gil et al. [2]. Moreover, in this work they employ different methods in order to evaluate the impact of the location of more than 39,000 Spanish firms in 22 Spanish SPs by using data from the 2007 Spanish Technological Innovation Survey. Their main results are that the location in a SP positively affects the level of product innovation and sales. On the other hand Monck et al. [21] and Westhead [27] find no significant effects of SPs in United Kingdom in terms of several firms' outcomes (patents, new products, R&D expenditure, etc...). In particular, Monck et al. [21] uses 183 and 101 firms resident respectively inside and outside the British SPs in the 1986 whereas Westhead [27] works with 47 firms inside and 48 firms outside during the period 1986-1992. The matches between the firms located in and out the Parks' samples are done by considering firms that share similar economic sectors, age, ownership as well as comparable geographical areas. Similar criteria are used by Lindelöf and Löfsten [17] for Swedish SPs in the period 1996-1998. They consider 9 SPs and 134 firms inside the techno-pole (i.e. SP) and 139 outside finding mixed results: only for some variables, as the links between the firms and high education institutes, the location in a SP is an advantage for the hosted firms whereas, for others variables, as the number of patents/products launched in the last three years, no statistical significant differences are recorded. Ferguson and Olofsson [10] considers two Swedish SPs with 30 firms located inside and 36 outside of them. They find positive effects of the survival rate of firms and no significant effects on growth in terms of sales and employment.

The contribution of our paper to the economic literature is threefold. First, thanks to our survey we are able to provide a broad and updated snapshot of a relevant number of science parks, a study that is met neither in case-studies (focused on very few SPs) nor in counter-factual analysis (focused on in-SP firms). The second contribution of our paper is linked to the existing literature related to the effects of science and technology parks on their hosted firms (see above). Last but not least, we pay our attention on Italian science parks. As already said in the previous section, there are only few papers that study the Italian science parks. Colombo and Delmastro [8] study a sample of 90 firms equally split between firms within a SP or a business incubator (BIC) and firms outside the SP/BIC. The objective is to make a counter-factual analysis in order to check whether the two sub-samples are different in terms of propensity to innovate and to cooperate with other research institutions. In spite of the fact that they do not find a significant difference between the two groups, the authors find that firms inside SPs or business incubators are endowed with a stronger human capital (hence they should have a larger absorptive capacity), they tend to be more connected with other research institutions and, consequently, they participate to international research projects more than firms outside the parks. More recently, Capello and Morrison [6] study two Italian SPs to check whether SPs actually are able to enhance the networking and the technology trans-

fer (hence the innovative capacity) among their in-SP firms. Taking into account the different purposes of a science park, the authors find that the SPs effectiveness depends on in-SP firms' features. In particular, it is found that only the firms with a high absorptive and relational capacity are able to exploit the SPs' services. On the other hand, Bigliardi et al. [4] study four Italian SPs in order to define some methodological issues related to the SP performance evaluations. In particular, they conclude that SPs are so different in terms of stakeholders, organization and objectives that a deep analysis on the activity made by the science parks is necessary to make a fair evaluation, and it should take into account of these differences (rather than look at one only dimension as done in the counter-factual analysis).
With respect to these papers, our survey provide a broad and updated picture of the current situation of the Italian science parks while our new and updated firm database shed light on the effectiveness of Italian SPs on their hosted firms.

3 Data description

This study uses a survey of the Italian SPs that we made on behalf of the Bank of Italy from February to May 2012. We contacted 39 SPs located in Italy: thirty-one of them belongs to the "Associazione Parchi Scientifici e Tecnologici Italiani" (APSTI).[6] The other parks has been suggested by the local research offices of the Bank of Italy because of their regional relevance.

A first phone contact lead us to exclude three science parks because of their closure or their merge with other non-SP institutions. The remaining 36 parks received a PDF questionnaire via e-mail.[7] Globally, from thirty-six potential SPs, twenty-five parks answered to our survey with a response ratio of almost the 70%; eight of the collaborating parks are located in the North West of Italy, five in the North East, seven in the Center and five in the South. The remaining eleven parks decided not to participate.[8]
The information collected through the questionnaire can be distinguished as follows:

1. **general information:** name, year of foundation, ownership;
2. **financial:** turnover, budget share of public direct funds;
3. **cooperation:** type of cooperation with universities and other public research institutions;

[6] See the website http://www.apsti.it/ for further details

[7] See Appendix C for a translated version of the questionnaire. For whom interested, the original (Italian) version is available upon request to the authors.

[8] Looking at only science parks belonging to the APSTI then 20 over 27 SPs participated to our survey.

Table 1: Original lists of park contacted for the survey

		City	*Province*	*Region*	*Area*
1	***Bioindustry Park del Canavese***	Colleretto Giacosa	TO	Piemonte	North-West
2	***Environment Park***	Torino	TO	Piemonte	North-West
3	***Virtual Reality & Multimedia Park***	Torino	TO	Piemonte	North-West
4	***Tecnogranda***	Dronero	CN	Piemonte	North-West
5	***PST della valle scrivia***	Tortona	AL	Piemonte	North-West
6	***Tecnoparco Del Lago Maggiore***	Verbania	VB	Piemonte	North-West
7	***ComoNExT***	Como	CO	Lombardia	North-West
8	***Kilometro Rosso***	Stezzano	BG	Lombardia	North-West
9	***Parco Tecnologico Padano***	Lodi	LO	Lombardia	North-West
10	***Polo Tecnologico Milano Bicocca***	Milano	MI	Lombardia	North-West
11	***Science Park RAF***	Milano	MI	Lombardia	North-West
12	***Servitec***	Dalmine	BG	Lombardia	North-West
13	***Area Science Park***	Trieste	TS	Friuli-Venezia Giulia	North-East
14	***Friuli Innovazione***	Udine	UD	Friuli-Venezia Giulia	North-East
15	***PST Galileo***	Padova	PD	Veneto	North-East
16	***STAR - Parco Scientifico di Verona***	Verona	VR	Veneto	North-East
17	***VEGA - PST di Venezia***	Marghera	VE	Veneto	North-East
18	***Centuria***	Cesena	FC	Emilia Romagna	North-East
19	***Parma Tecninnova***	Parma	PR	Emilia Romagna	North-East
20	***Trentino Sviluppo***	Rovereto	TN	Trentino Alto Adige	North-East
21	***TIS innovation park***	Bolzano	BZ	Trentino Alto Adige	North-East
22	***Polo Tecnologico di Navacchio***	Navacchio di Cascina	PI	Toscana	Center
23	***Pont-Tech***	Pontedera	PI	Toscana	Center
24	***Toscana Life Sciences Park***	Siena	SI	Toscana	Center
25	***Polo Tecnologico Lucchese***	Lucca	LU	Toscana	Center
26	***PST delle Marche (Tecnomarche)***	Marino del Tronto	AP	Marche	Center
27	***Umbria Innovazione***	Terni	TR	Umbria	Center
28	***Pa.L.Mer.***	Ferentino	FR	Lazio	Center
29	***Parco Scientifico Romano***	Roma	RM	Lazio	Center
30	***Tecnopolo S.p.A.***	Roma	RM	Lazio	Center
31	***Campania Innovazione***	Napoli	NA	Campania	South
32	***Technapoli***	Pozzuoli	NA	Campania	South
33	***Consorzio PST Multisettoriale Magna Grecia***	Crotone	KR	Calabria	South
34	***CalPark S.C.p.a.***	Rende	CS	Calabria	South
35	***Molise Innovazione s.c. a r.l.***	Campobasso	CB	Molise	South
36	***Tecnopolis s.c. a r.l.***	Valenzano	BA	Puglia	South
37	***Cittadella della ricerca***	Brindisi	BR	Puglia	South
38	***PST della Sicilia S.c.p.A.***	Palermo	PA	Sicilia	South
39	***Sardegna Ricerche***	Pula	CA	Sardegna	South

4. **size:** area, total employees of the SP managing institution;

5. **services supplied:** incubation staff, technology transfer staff, type of services provided by the SP;

6. **firms:** year of the first firm established in the park, number of firms settled/born/exit, firms' name.

Since some variables (like area and total SP staff) were missing for a couple of SPs, we integrated them by consulting the science parks' website. The dataset has the obvious limit of being a cross-section, which hampers to make an evaluation of the evolution of SPs during the last years. However, we tried to fill this gap by integrating some information (e.g. turnover, employees) with further questions about the changes occurred during the previous five years.
All the collected information refers to 2010 as a year-base. The only information updated to spring 2012 is related to the name of the firms established in the SP, an information collected for only 20 SPs because five parks do not host firms. Thanks to such list of names we took for each firm some general information and balance sheets data from Infocamere, CeBi and Cerved databases allowing us to collect data for 425 firms located within parks. As a second step, we merged these balance sheet data with PatStat dataset with the aim of capturing the innovative capacity of the SP firms.[9]
Even though this dataset sheds light on SP specialization (see below), it is mainly used to investigate whether in-SP firms are performing better than their out-of park counterparts. Before answering to such question it is however worth to study which are the main features and what are the main differences (if any) among Italian Science Parks. To this purpose, in the next section we give a further look on the main results that come out from our survey.

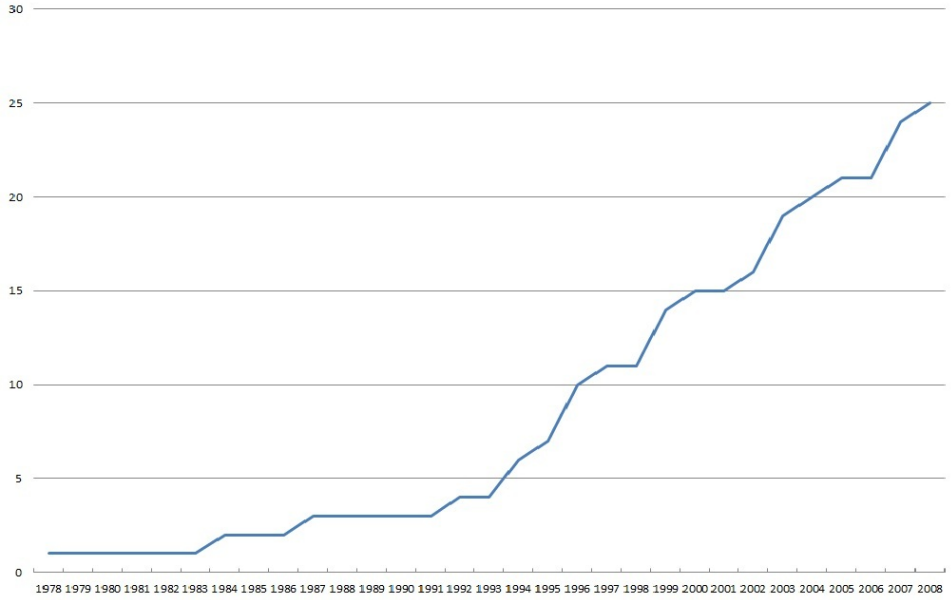
4 Main features and differences among Italian Science Parks: an overview

The first SP created in Italy was "AREA science park" in 1978 followed by two other parks during the '80s (see Figure 1). The creation of science parks actually blossomed in '90s, when eleven parks have been created from 1990 to 1999, and continued during the last decade, with a SP created each year on average. Since all the parks have either a public or a mixed ownership, with the exception of "Kilometro rosso", it seems that policy makers

[9] As a matter of fact, PatStat is a dataset that collects all the patents applied to the European Patent Office. For our purposes, we use the dataset created by Giovanni Marin which merges the firm level data by AIDA Bureau Van Dijk with patents data by the European Patent Office. For further details about PatStat and its merging with AIDA see Lotti and Marin [20].

put a significant effort in pursuing the creation of SPs in Italy. However, as found in our survey, the recent closure of SPs or they merge with other public institutions suggests a possible policy change which deserves a further attention in the following years.

Figure 1: Frequency of Italian Science Parks according to the year of foundation



The turnover of the interviewed SPs is extremely volatile, passing from over 23 million of Euro to less than 100.000 (Table 2, with a mean and a median of $4,28$ and of $2,37$ million of euros respectively). This evidence is quite reasonable if we think that parks may have different operating levels because of their different year of foundation and different objectives.

Table 2: Descriptive statistics of all SPs

	Obs.	Mean	Median	St. Dev.
Turnover (million of euros)	25	4,28	2,37	5,63
Share of direct public funds	24	31,44	22	36,62
Area (thousand metres)	24	36,81	10	89,63
Total SP Staff	25	38,60	12	56,19
Incubation SP Staff	24	2,96	2	3,28
Technology transfer SP staff	24	10,58	3	30,04
Firms within SP	25	28,12	19	26,93
Firms served	24	105,0	40	170,36

An interesting point is that 17 over 25 SPs increased their turnover in the last 5 years (5 decreased), denoting a growing activity of the SPs (Table 3). Such growing activity is also confirmed by the total staff, increased for fifteen SPs. In spite of their recent creation and the public nature of the

Table 3: Financial and staff variation during the last 5 years

	Increased	***Unchanged***	***Decreased***	***Unknown***
Turnover	17	3	5	-
Budget share	5	10	7	3
Total staff	15	2	8	-

Italian SPs, the share of direct public funds has an average and a median of 31% and 22% respectively, showing a good financial independence. Moreover, seven SPs were able to reduce this share in the last 5 years, while ten SPs registered a substantial stationariness. Nevertheless, it is not clear whether this result is due to a higher ability of science parks to be independent (in spite of the economic crisis) or to a higher difficulty of national and local governments to provide such funds (because of the crisis).
High dispersion is also found in both surface and total staff employed by the SP management authority. For example, the surface of a science park passes from less than 1.000 to over $700.000m^2$ while the total staff goes from 3 to 250 employees. However, these two indicators do not provide the same information about the size: some parks should be classified as small if we look at the total staff whereas they become medium, or even big, if we look at their surface.[10] Classifying a SP by its size is therefore quite difficult because it is sensitive to the variable used.
We then tried to use these variables to perform a (hierarchical) cluster analysis in order to group the parks according to their size. However, also in this case the groups formed were very sensitive to the clustering criterion adopted such that the results were not reliable.[11] Therefore, we do not make any descriptive analysis according to the size in order to avoid specious comments.
Also the number of firms established in SPs is quite dispersed. If we consider five science parks without firms in their structures, the average number of firms in the SPs is in fact 28, with a median of 19. Similarly, the number of firms served by SPs, no matter whether they are inside or outside the park, has an average and a median of 105 and 40 respectively. This variability

[10]Even though to a lesser extent, the same occurs even if we consider the turnover of the SP.

[11]In particular, the Ward and Centroid methods, which are the most common clustering algorithms provide different distances, hence different orderings, of the SPs. We also tried to overcome this problem by considering the turnover of the SP in the cluster analysis. Unfortunately, also in this case results were too sensitive to the clustering method adopted.

holds even accounting for the area of the SPs. Furthermore, the time needed for a SP to be able to attract the first firm within its area is around three years.[12]

Looking at the cooperation with universities and other Public Research Institution (PRI), SPs tend to cooperate by participating to joint research projects, especially national ones, as well as by allowing the reciprocal use of the structures (e.g. laboratories, machineries etc.). In general, SPs tend to be more connected with Universities rather than to PRIs (Table 4).

All SPs have the main university partner always within the same region

Table 4: Cooperation with universities and PRIs

	Yes	***No***	***Unknown***
Universities			
Financial (towards Universities)	10	15	-
Financial (from Universities)	8	17	-
National research project links	18	7	-
Foreign research project links	14	11	-
Training/Hiring	14	11	-
Use of SP structures	17	8	-
Use of University structures	18	6	1
PRIs			
Financial (towards Public research institution)	5	18	2
Financial (from Public research institution)	7	16	2
National research project links	15	9	1
Foreign research project links	14	10	1
Training/Hiring	6	18	1
Use of SP structures	12	12	1
Use of Public research institution structures	13	10	2

where they operate, with almost all of them settled in the same province (20 over 25). On the other hand, the "Consiglio Nazionale delle Ricerche" (CNR) is the main principal PRI partner for half of the SPs; but also in this case the main partnering PRIs are localized in the same area of the SP. Such strong physical proximity of the main partners shows a clustering and a complementarity between the SP and local research institutions.[13]

As shown in Table 5, the services provided by SPs to firms settled inside and outside parks are quite numerous, with the exception of legal assistance and the patent support, served by 8 and 15 SPs respectively. The pivotal services of Italian parks are Incubation, R&D, Project management, and

[12]This average does not take into account the five SPs without firms in their area.

[13]Obviously, such close localization of the main partner does not mean that SPs do not cooperate with others settled elsewhere.

Table 5: Services provided to firms inside and outside the Science Parks

	Yes	***No***	***Unknown***
R&S	19	6	-
Partnership	25	0	-
Incubation	19	6	-
Business planning	20	4	1
Training	22	3	-
Project management	23	2	-
Research of financial support	23	2	-
Patenting support	15	10	-
Legal support	8	17	-
SP structures	20	4	1
Do you have a technology transfer office?	17	8	-

Partnership.[14] In an open question, three parks pointed out their activity on promoting the technology transfer.
After this first general analysis, we now study the main characteristics of SPs according to the year of incorporation, ownership, and sectorial specialization.

Year of foundation We sort the SPs under three periods, namely 1978-1989 ("Old" SPs), 1990-1999 ("Recent" SPs) and 2000-2008 ("New" SPs). Using this classification, data suggests that recent SPs are quite different from both Old and New. The main quantitative results are shown in Table 6.[15] First, recent SPs are on average much smaller than others in terms of total area, an outcome that should be more suited for younger SPs. Their share of direct public funds is higher than new SPs, even though they have a similar turnover level and a higher number of employees. It is worth mentioning that five of the seven science parks that declared a reduction in the share of direct public funds are Recent. During the last 5 years Recent are the only to register a reduction of turnover; also the decrease of SP employees mostly involved recent SPs.
Looking at the services provided to firms, Recent shows a lower propensity with respect to their counterparts. Incubation, patent and legal support, and the use of infrastructures are the least services provided. Recent host/serve a lower number of firms, even accounting for the smaller dimension. This

[14]By "Project management" we mean a long term support to the strategy of the project, in according to costs, timing and objectives. We defined "Partnership" service as assistance in joint ventures and other cooperative agreements, support in the relationships with other public institutions etc.

[15]Results on the other qualitative answers (like turnover variation in the last 5 years, number of services provided to firms etc.) are available upon request by the author.

Table 6: Descriptive statistics of SPs **by year of foundation**: mean values (standard deviation in brackets)

	Old	Recent	New
Turnover (million of euros)	10,02	3,50	3,49
	(11,68)	*(3,59)*	*(4,98)*
Share of direct public funds	15,00	35,61	26,50
	(15,00)	*(40,38)*	*(36,27)*
Area (thousand metres)	55,00	15,83	49,47
	(32,79)	*(24,49)*	*(133,09)*
Total Staff	64,67	40,36	29,73
	(69,83)	*(72,96)*	*(31,37)*
Incubation Staff	4,33	2,45	3,09
	(2,08)	*(4,44)*	*(2,12)*
Technology transfer staff	15,67	16,09	3,68
	(21,22)	*(44,46)*	*(2,31)*
Firms within SP	55,33	21,55	27,27
	(25,70)	*(31,24)*	*(19,04)*
Firms served (inside and outside the SP)	357,67	57,09	84,00
	(317,45)	*(84,72)*	*(141,98)*

lower attitude of recent SPs to serve firms' R&D activity is in line with the lower number of service provided, but it looks in contrast with the fact that they have the highest mean of technology transfer staff.
Apart from recent SPs, data show that "New" tend to cooperate more than others with Universities and (to a lesser extent) PRIs, especially in financial, R&D, and education/training partnerships.

Ownership The analysis of SPs according to the ownership lead also to some interesting aspects (Table 7). First, public SPs seem to be larger than the mixed ones: their turnover, surface, and total staff are in fact usually higher. Also the number of firms settled/served is bigger in absolute value for public SPs; however this result does not hold if we take into account the surface.
Direct public funds are on average higher for public science parks, however excluding a public SP created in the last years, the result is reversed. Therefore, mixed SPs seem to be, paradoxically, more dependent from public direct funds. On the other hand, no differences arise in the variation of turnover and public funds in the last 5 years. Concerning the cooperation strategies, mixed SPs tend to be more connected with universities and PRI than their public counterparts. The higher degree of cooperation is more evident in R&D projects and, for PRI partnerships, also in the reciprocal use of infrastructures.

Table 7: Descriptive statistics of SPs **by ownership**: mean values (standard deviation in brackets)

	Mixed	***Public***
Turnover (million of Euro)	2.0	6.9
	(2.2)	(7.1)
Buget share from direct public funds	28.4	31.9
	(33.7)	(40.3)
Area (Thousand meters)	14.0	22.1
	(22.5)	(26.5)
Total staff	18.3	61.3
	(21.6)	(73.1)
Incubation staff	1.7	3.9
	(1.4)	(4.2)
Technology transfer staff	2.5	19.2
	(1.7)	(42.5)
Firms within the park	25	30
	(26)	(29.8)
Firms served (inside and outside the SP)	82	133
	(134)	(208.8)

Finally, even though there is no difference in terms of services provided, three public SPs declared that "Partnership" is their most important activity whereas none of the mixed science parks have such activity as core. The reverse occurs for "Project management" which is core for three mixed SP and none public SP.

Sectors Before continuing SP analysis let us look at Table 8 which lists the frequencies and the percentages of all SP firms operating in each sector. Not surprisingly, the table shows that the main represented sectors among the SP firms are Computer programming and other information services (in which operates the 22.5 per cent of the firms), Research and development (16.5 per cent) and Architectural and engineering activities (11.0 per cent). This confirms the high-tech propensity of SP firms, however we do not know how these sectors are represented within each SP: are science parks focused, namely specialized, in particular industry sectors or they tend to support innovation, no matter the scientific field is? The question is not trivial because the specialization of a SP in one field may, on one hand attract and promote firms in a specific sector, hence the potential creation of industrial districts; on other hand it may hamper the birth and/or the development of worthy businesses/research projects not related to the SP sector of specialization.

Table 8: Number of in-SP firms per sector

Sector	Freq.	Perc.	Cumul.
Manufacture of food products	3	0.75	0.75
Manufacture of coke and refined petroleum products	2	0.50	1.25
Manufacture of chemicals and chemical products	7	1.75	3.00
Manufacture of basic pharmaceutical products and pharmaceutical preparations	5	1.25	4.25
Manufacture of rubber and plastic products	5	1.25	5.50
Manufacture of other non-metallic mineral products	4	1.00	6.50
Manufacture of fabricated metal products, except machinery and equipment	2	0.50	7.00
Manufacture of computer, electronic and optical products	19	4.75	11.75
Manufacture of electrical equipment	7	1.75	13.50
Manufacture of machinery and equipment n.e.c.	11	2.75	16.25
Manufacture of motor vehicles, trailers and semi-trailers	3	0.75	17.00
Manufacture of other transport equipment	3	0.75	17.75
Manufacture of furniture	1	0.25	18.00
Other manufacturing	6	1.50	19.50
Repair and installation of machinery and equipment	7	1.75	21.25
Electricity, gas, steam and air conditioning supply	5	1.25	22.50
Waste collection, treatment and disposal activities materials recovery	1	0.25	22.75
Construction of buildings	2	0.50	23.25
Specialized construction activities	6	1.50	24.75
Wholesale trade, except of motor vehicles and motorcycles	16	4.00	28.75
Land transport and transport via pipelines	2	0.50	29.25
Food and beverage service activities	1	0.25	29.50
Publishing activities	3	0.75	30.25
Motion picture, video and television programme production, sound recording and music publishing activities	2	0.50	30.75
Programming and broadcasting activities	1	0.25	31.00
Telecommunications	4	1.00	32.00
Computer programming, consultancy and related activities	90	**22.50**	54.50
Information service activities	21	5.25	59.75
Financial service activities, except insurance and pension funding	2	0.50	60.25
Activities auxiliary to financial services and insurance activities	1	0.25	60.50
Real estate activities	3	0.75	61.25
Activities of head offices management consultancy activities	22	5.50	66.75
Architectural and engineering activities and related technical consultancy	44	**11.00**	77.75
Scientific research and development	66	**16.50**	94.25
Advertising and market research	2	0.50	94.75
Other professional, scientific and technical activities	5	1.25	96.00
Rental and leasing activities	1	0.25	96.25
Employment activities	1	0.25	96.50
Services to buildings and landscape activities	4	1.00	97.50
Office administrative, office support and other business support activities	3	0.75	98.25
Education	4	1.00	99.25
Libraries, archives, museums and other cultural activities	1	0.25	99.50
Repair of computers and personal and household goods	2	0.50	100.00
Total	400	100	

A possible way to see whether there are SPs specialized in Italy is to look at the economic sectors where the firms inside a SP are operating. To this purpose, we performed a cluster analysis based on the number of firms and the sectors where they operates.[16] Using these variables we can define four groups of SP:

1. **general:** firms are scattered in many sectors (8 SPs)
2. **mixed:** the number of sectors and the concentration of firms is neither high, nor low (6 SPs)
3. **specialized:** featured by a high concentration of firms operating in few sectors (6 SPs)
4. **not-hosting:** characterized by the absence of firms operating in the science park (5 SPs)

First, none of the clusters has a particular ownership structure. On average "specialized" group is made of younger SPs compared to the other clusters. On one hand this may suggest a policy change towards the creation of specialized SPs. On the other hand, "specialized" group may actually reflects the "age" of a SP rather than a real specialization: a young park needs time to attract firms from different sectors. Science parks, like Toscana Life Science and Virtual Reality, seem to confirm the former interpretation. Nevertheless, the second hypothesis is supported by the fact that "general" SPs, which are also the oldest, tends to be larger in area, staff as well as number of firms established (see Table 9).

Consequently, the answer requires time to see whether specialized SP will be so also when they grow up. Keeping in mind this caveat, we will continue to distinguish the SPs according to the clustering definition made above.

Concerning the degree of cooperation with universities and PRIs, specialized and general SPs are on average more cooperative than the other groups. The same occurs about the number of services provided to firms. Surprisingly, not-hosting SPs are the least cooperative with universities and PRIs.

5 SP Firms Descriptive Analysis

In the previous section we had several insightful results about SP activity. We now focus on our second research question, namely whether in-SP firms outperformed with respect to out of park firms and if this can be attributed to their location within the parks and to the use of the services provided.

[16] We do not discuss here the clustering method applied to our data. For whom interested, see Appendix A.

[17] Data about Specialized group is related to four SPs

Table 9: Descriptive statistics of SPs **by sector of specialization**: mean values (standard deviation in brackets)

	General	***Mixed***	***Specialized***	***Not-hosting***
Turnover (million of Euros)	6.6	4.0	1.1	4.1
	(7.8)	(3.5)	(0.9)	(5.9)
Buget share from direct public funds	14.5	23.5	52.0	45.5
	(14.5)	(38.0)	(48.2)	(41.9)
Area (Thousand meters)	89.4	18	1	9
	(149.4)	(13.63)	(0.55)	(8.47)
Total staff	68.0	30	9	33
	(86.1)	(35.47)	(5.52)	(33.18)
Incubation staff	6	3	0	3
	(4.65)	(1.83)	(0.45)	(1.76)
Technology transfer staff	30	3	4	4
	(54.77)	(1.52)	(2.54)	(3.06)
Firms within the park	56	23	-	21
	(27.35)	(8.96)	(-)	(15.67)
Firms served (inside and outside the SP)[17]	175	122	82	17
	(229.63)	(185.77)	(123.62)	(14.45)

In this section of the paper we described the main characteristics of more than 400 SP firms located in 20 Italian SPs in 2011, providing a first descriptive comparison with respect to NSP firms located in the same geographical area and operating in the same sector of business.[18] This allow us to have a first overview of the characteristics of the firms settled into SPs and to understand if these firms show peculiar features. To perform the comparison, we firstly select all the firms located outside the techno-poles that share the same geographical area, and industry sector of the SP firms. From such selection we then create a stratified sample made of around 6,000 firms according to the sectoral and geographical criteria. In Table 10 we display the average values in 2011 of some variables of interest referred to the firms located, respectively, outside and inside SPs.[19]

As can be seen from the two tables, SP firms display higher average values than NSPs firms for all the considered indicators of performance, profitability, investments and number of patents produced between 2009-2011. In order to check whether the average values of the two groups of firms are statistically different, we perform a t-test on the difference between the two means for each of the considered variable (Table 11, second column). However, the t-test is a benchmark insofar as it implies the normality distribution of the considered variable, an assumption that is not usually met for balance sheet and patent data. This is actually what happens: perform-

[18] We did not compare the performance of these firms also in the pre-treatment year because many firms were born in the parks and, moreover, the pre-treatment year is different among firms of different parks, making the analysis less informative.

[19] Data shown in these tables are obtained by keeping the dataset from the 5th to 95th percentiles.

Table 10: Summary statistics about SP and NSP firms. Year=2011

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
		NSP firms			
Sales (th. euros)	5400	596.7	892.9	0	4529
Value added (th. euros)	5134	199.2	285.5	-19	1379
Net worth (th. euros)	5449	236.5	444.8	1	2929
ROA	5009	1.6	5.5	-15.3	17.6
Gross Operative margin / assets	4989	9.9	9.9	-10.9	37.0
Investments/sales	5030	-0.00	0.1	-0.5	0.6
Intangible assets (th. euros)	5399	19.0	38.8	0	215
Number of patents (2008-2011)	6000	0.0	0.2	0	10
Age (years)	6000	11.8	10.6	1	114
		SP firms			
Sales (th. euros)	312	779.1	1,010.9	0	4,385
Value Added (th. euros)	276	282.4	319.5	-19	1,291
Net worth (th. euros)	325	328.6	515.3	1	2,814
ROA	350	1.7	5.2	-14.75	17.57
Gross Operative Margin / assets	339	10.2	10.0	-10.66	36.41
Investments/sales	346	0.01	0.1	-0.5	0.53
Intangible assets (th. euros)	283	36	52.5	0	211
Number of patents (2008-2011)	398	0.13	0.94	0	12
Age (years)	400	12.4	14.6	1	146

ing the one-sample Kolmogorov-Smirnov and the Skewness-Kurtosis tests to asses the normality of the distributions we find that both tests always reject the normality assumptions for all the tested variables in the two groups of firms.[20] In order to circumvent this drawback and properly assess the difference between the two groups, we therefore integrated the analysis by using two other non parametric tests, namely the two-sample Kolmogorov-Smirnov test for equality of distribution functions and the Kruskal-Wallis equality-of-populations rank test (Table 11, third and fourth columns).
Results show that SP firms have statistically higher values as regard the general performance (sales, net worth, value added), the investment profile,[21] and innovative capacity (proxied with the number of patents applied between 2009-2011). On the other hand the two groups of firms do not differ according to the profitability measures (Gross Operating Margin over total assets, ROA).

Table 11: Difference between the 2 samples (p-values in brackets while + means higher average values for SP firms)

Variable	T-test	K-Smirnov	K-Wallis
Sales	yes + (0.0005)	yes + (0.000)	yes + (0.0001)
Net worth	yes + (0.0003)	yes + (0.000)	yes + (0.0001)
Value Added	yes + (0.0000)	yes + (0.000)	yes + (0.0001)
ROA	no (0.7762)	no (0.099)	no (0.5861)
Gross Operative margin / assets	no (0.6090)	no (0.242)	no (0.5114)
Investment/sales	yes + (0.0322)	yes + (0.002)	yes + (0.0498)
Intangible investment	yes + (0.0000)	yes + (0.000)	yes + (0.0001)
Intangible investment/sales	no (0.8291)	yes + (0.000)	no (0.2291)
Number of patents	yes + (0.0000)	no (0.859)	yes + (0.0001)

However, we cannot say whether the better performance of SP firms is due either to the benefits they obtained by being located inside SPs or to

[20] All the p-values of these tests are well below the 1%, for whom interested the tests can be asked upon request to the authors.

[21] Note that the difference in the ratio intangible investment/sales is not clear cut probably because both numerator and denominator are higher for SP firms.

the fact that the best firms chose to locate inside SPs. To address this issue we now provide a counter factual analysis. In the next section we move to explain in details the matching strategy to optimally pair treated and the untreated firms, a necessary step before quantitatively evaluating the impact of the parks on hosted firms.

6 The effects of SPs on resident firms

6.1 The matching

After the descriptive analysis of SPs firms, we study the effect of science parks on the hosted firms performance as a policy evaluation problem in which we assume that the location in a SP and the use of its facilities and services can be interpreted as a treatment.
The first step of the analysis consists of finding a correct group of comparison for the treated firms. As a matter of fact, since entering in the park is usually subject to some rules or judgements by the SPs' management, it is possible that firms located within parks systematically differ from those that are outside with respect to some co-variates. This could generate a problem of selection bias: the different outcomes we would observe between participants in the training and non-participants may be due to pre-existing differences between the two groups rather than to a real effect of the treatment.
In order to minimize this bias and to guarantee the coeteris paribus condition, we match treated and untreated firms according to the sector of activity and the geographical area in which the firm is located and conditioning on those characteristics that were likely to affect the probability to participate in the intervention, namely that influenced the selection process and that incorporate all relevant differences between the two groups before the start of the treatment. Basically, we construct a control sample of firms in which the distribution of the observed co-variates is as similar as possible to those in the treated sample before the treatment started. The co-variates used to perform the matching are a) firms' age, b) annual sales, c) net worth and d) gross operative margin over total assets. The choice of these variables allows us to have similar groups in terms of age, dimension of firms' business (controlling for total sales and net worth), as well as of their income profile, measured with the gross operative margin. These co-variates, in our opinion, well summarizes the status of the firm in the pre-treatment year according to different perspectives. Of course there could have been also unobservable characteristics that influenced the selection process and that could keep alive the selection bias issue (for example the fact the firms hosted in parks may be more motivated than others to perform well), but we will reduce this bias, at least partially, applying in the second step of the analysis the dif-in-dif estimation (see Section 6.2 for details).

Among the different matching methods, we choose the Mahalanobis matching with replacement, in which the association between treated and not-treated firms is done by minimizing a special metric, the Mahalanobis distance, that depends on the covariance matrix of the co-variates.[22] Our choice of the Mahalanobis matching is justified by Zhao [31] who finds that the Mahalanobis matching performs better than the other methods when the sample size is small methods as in our case.
Since treated and not treated firms should have been similar before the beginning of the treatment, we take the values of these co-variates chosen referred to one year before the treatment. The identification of the year in which the treatment begins was not immediate insofar as we do not know the year of settlement in the park for each firm. So, we considered the year of settlement of the first firm in each SP, an information that is available from the survey, as the year of settlement for all firms that are located in that park.[23] We are conscious that we are implicitly assuming that the majority of the firms moved inside the parks in the year of first settlement in the corresponding park or in the subsequent year. In order to reduce the possible distortions that derive from this assumption we select only the firms belonging to the 11 parks whose first firm's establishment date was between 2002 and 2008. On one hand, restricting the analysis to this sample of parks allows us to reduce the differences in the treatment period among firms located in the same park, since these parks are relatively young and the settlement years could not differ too much. On the other hand, this allows us to have a good homogeneity in terms of length of the treatment period also for firms belonging to different parks, since these park have a similar first settlement year. Basically, we drop the oldest Parks, for which the treatment period could have lead to a very heterogeneous treatment period among the firms located in different parks (because of very different years of first settlement among parks) and in the park itself (because of the long period of life of the park). In the exercise, we also drop the most recent parks, for which the treatment on firms could have been too weak to be detected due to their short period of living.
Finally, we restricted our analysis only on those firms that belong to the selected parks but that were established before the year of first settlement of the corresponding park, dropping those firms born in the techno-poles.[24] In this way, we are sure that for the selected treated firms there will be a

[22]Other matching methods employs the propensity score (Rosenbaum and Rubin [22]), that is a synthetic and one-dimensional index based on the co-variates chosen. In our exercise the Mahalanobis matches performed better both in term of number of matched firms that in term of balancing properties of the matched samples. For a detailed overview on the propensity score analysis see also Guo and Fraser [12]

[23]As a matter of fact, the decision of asking only the year of settlement of the first firm is due to keep the questionnaire as light as possible, hence to increase the response ratio.

[24]For example, if the first year of settlement of the science park A is (say) 2005, we (do not) consider for our analysis only the firms created before (after) such year.

pre and a post-treatment period, a necessary condition to implement the dif-in-dif approach.
In the considered 11 parks there are located 90 (not born in SP) firms. For each of the 11 SPs we match the located firms according to the co-variates previously chosen for the Mahalanobis analysis and conditioning to both industry sector and geographical area. Then, we put together all the matched firms in a unique sample in order to perform all the balancing tests. Our matched sample was finally made by 65 treated firms matched with 63 untreated firms. The failing matches for some treated firms are related to the presence of missing values in the balance sheet data.
Table 12 displays the balancing properties of the matching: for each covariate the thresholds of 5 per cent in the bias between the two groups is clearly respected, with an average and median bias of 2.4. Also the t-tests confirms a good balancing in the groups, since no statistical differences among the sample means of the treated and not treated groups is found for any of the co-variates.

Table 12: Balancing tests and matching properties

	Treated	Control	% bias	t-test	p-value
Sales	1,558.3	1,478.5	2.5	0.14	0.888
Gross Operative margin / assets	12,881	13,018	-1.0	-0.06	0.995
Age	13,569	13,73	-2.3	-0.13	0.896
Net worth	300.95	281.25	3.9	0.22	0.824
Observations	65	63			
	Pseudo R^2	LR χ^2	$p > \chi^2$	MeanB	MedB
	0.001	0.15	0.997	2.4	2.4

As in Section 3, we checked the normality assumption of the distributions of the treated and untreated firms.[25] Again, since the normality is rejected for all the variables, we check further the balancing properties of the two sample throughout other tests that are not based on the normality distribution assumption. In table 13 we show the results of mean comparison tests in case of not normality for the selected co-variates. Moreover, we control also the balancing properties for other additional variables, in order to check the reliability of the matching according to other dimensions for which we did not control directly in the match (value added, ROA, investment/sales, intangible assets/sales, intangible assets).[26]

[25]We perform the Kolmogorov-Smirnov and the Kruskal-Wallis tests to which we add the Shapiro-Wilk and the Shapiro-Francia test for normality. We did not used the Shapiro-Wilk and the Shapiro-Francia in the previous section because these tests can be applied only for samples that goes between 4-2000 and 5-5000 observations respectively, a condition that was not met in our general analysis. These results about these tests are available upon request by the authors.

[26]We also reports the results of the t-tests as a benchmark. Moreover, the number of

Table 13: Balancing Statistics (p-values in brackets)

	Treated		Not treated		Difference between the samples means		
	Obs.	Mean	Obs.	Mean	T-test	K-Smirnov	K-Wallis
Sales	65	1,558.3	63	1,478.5	no	no	no
					(0.888)	(0.924)	(0.497)
Gross Operative margin / assets	65	12,881	63	13,018	no	no	no
					(0.955)	(0.935)	(0.849)
Net worth	65	300.95	63	281.25	no	no	no
					(0.824)	(0.929)	(0.647)
Age	65	13,569	63	13.73	no	no	no
					(0.896)	(0.935)	(0.645)
ROA	65	1.8	63	1.20	no	no	no
					(0.696)	(0.980)	(0.821)
Value Added	65	558.29	63	416.55	no	no	no
					(0.402)	(0.135)	(0.344)
Intangible assets	65	118.63	63	54.30	no	no	no
					(0.102)	(0.660)	(0.132)
Investments/sales	43	0.08	39	0.028	no	no	no
					(0.673)	(0.883)	(0.893)
Intangible investments/sales	43	0.065	39	0.0253	no	no	no
					(0.689)	(0.349)	(0.395)

As can be seen, no differences between the two groups is found for all the variables chosen, meaning that the matching performed well. Since in the next section we will extend our analysis to the firms located in 14 SPs as a robustness check, we apply the same matching procedure also to this enlarged sample of firms, getting 79 treated and 77 untreated firms. Also for this case the balancing properties of the sample are fully respected as shown in Table 14.

Table 14: Balancing tests and matching properties for 14 parks

	Treated	Control	% bias	t-test	p-value
Sales	1931,5	1942,3	-0,3	-0,02	0,987
Gross Operative margin / assets	12,337	11,905	2,4	0,15	0,879
Age	15,544	15,753	-2,5	-0,15	0,877
Net worth	319,13	304,12	2,8	0,18	0,859
Observations	79	77			
	Pseudo R^2	LR χ^2	$p > \chi^2$	MeanB	MedB
	0,001	0,15	0,997	2,0	2,5

The good match between treated and untreated firms according to the observables chosen allows to net out compositional differences among the two groups and to move further in identifying the effect of the being located in the park.

matched observations is lower for the investments variables because they are created as the differences between the assets in t and t+1, leading us to built them on a 4 years balanced sample. As a consequence we have a reduction of the number of firms due to the presence of more missing values.

6.2 Diff-in-diff estimation

After the matching, we now analyse the effectiveness of being located within a park by performing a difference in differences estimation. This consists in observing the performances of the treated firms before and after the treatment, and comparing them with the not treated ones. This approach allows to control also for time invariant unobservable characteristics that could have affected the selection process and that could be relevant for our outcome variables, generating systematic differences between the two groups. Our specification is the following:

$$y_{it} = \alpha + \beta_1 \cdot POST_t + \beta_2 \cdot TREATMENT_i + \beta_3 \cdot \mathbf{SPEFFECT_{it}} \quad (1)$$

$$+\beta_4 \cdot SECT_i + \beta_5 \cdot GEO_i + \epsilon_{it}$$

where subscripts i and t correspond to the firm and the year respectively. The POST dummy takes value equal to one in the post treatment year (2011) and zero in the pre-treatment year; the TREATMENT dummy takes value one only for the firms located within a SP while the SPEFFECT variable is given by the product of these two dummies. We are interested to the coefficient of SPEFFECT, namely the interaction term, since it captures the effects of have being located in a Park for the treated firms. We also include industry sector and geographical dummies to control for the core-business of the firm as well as for its location (NorthWest, North East, Centre or South of Italy). No other controls are needed insofar as the two groups have been matched for the characteristics that are, in our opinion, relevant for the treatment and for the outcomes. We study the effects of SPs on several outcomes:

1. **Production performance:** we include the logarithm of both annual sales and the operative value added that may be affected by the favourable environment of the Parks in terms of services provided, knowledge spill-overs and product processing. The choice of using log is due to get an easier interpretation of the coefficients and to smooth the large values typical of the balance sheet variables.

2. **Profitability performance and financial conditions:** we consider the ROA index and the gross operative margin over total assets (EBITDA/Assets) as profitability indexes. These indicators are useful to verify if significant differences exist between the two groups in terms of income profile, that may depend on the supply of services by SPs. Training and project management are some of the typical services supplied by a techno-pole that may lower monetary and time costs for the firms, hence increase their profitability.

3. **Investment propensity:** we look at the ratio between investment and total sales in order to understand whether SP firms invest more than their counterparts.[27]

4. **Innovative capacity:** since one of the goals of the SPs is to promote the technology transfer in terms of knowledge and innovative activities, we exploit the ratio between intangible investment and total assets as a proxy of the firms' innovation capabilities. We also consider the patenting activity of the firm using a dummy variable that takes value 1 if the firm has applied at least for one patent at the European Patent Office. In order to correctly capture the patent stock produced during the treatment period, we cumulated the number of patents starting from three years after the settlement in the Park and going until 2011, which is the last year for which data are available.[28]

As shown in Table 15, the results of the dif-in-dif estimations show that for the majority of the outcome variables the average effect of the training on the treated is not statistically significant. We find a positive effect on sales and on the value added [29], and an impact, even less significant, also on the share of intangible investments over sales. Therefore, moving to a SP seems to provide a better production performance while it does not significantly affect the profitability, the overall investment propensity as well as the innovative capability.
Since the drawback of our approach may be the small number of firms located within parks, we extended our analysis passing from 11 to 14 science parks, namely including three parks born at the end of the '90s and at the beginning of '00s.[30] This allow us to improve the significance of the analysis even though at the cost of an higher variance within firms in terms of treatment period. As already said, even passing from around 128 (in the 11

[27] As regard the investment, we have a smaller number of observations than the other outcomes because we need to have the stock variables in two subsequent years to compute the investment.

[28] The three years delay is justified by the fact that the SP firm needs some time in order to benefit of SP services. To make the comparison possible we then applied the same number of years to the pre-treatment period, going back from the year of settlement in the Park. For example, if the SP firm settled in 2005, we considered its patent application treatment period from 2008 to 2011, hence four years; as a second step we account four years of pre-treatment period (i.e. 2002-2005). Note also that few of the matched firms had a positive patent application stock, generating a very low variability of the dependent variable.

[29] Note that, even though, sales and added value increase respectively of around 83 and 55 per cent due to the treatment; these effects are not particularly strong if we think of the small average values shown for the considered firms.

[30] About the remaining six SPs that we could have included in the counter-factual analysis, three were too old such that balance sheet data of their SP firms in the pre-treatment period were not available; while the others were too young to be included in the analysis such that it is too early SP firms moved inside these parks too recently.

Table 15: Effects of the SPs on firms' performance (11 SPs)

	LnSales	LnAddedVal.	ROA	EBITDA/Assets	Inv/Sales	Intang. Inv/Sales	Patents
training	0.026	0.110	0.677	-0.079	-0.025	-0.046	0.091***
	(0.311)	(0.307)	(1.630)	(2.360)	(0.076)	(0.043)	(0.034)
post	-0.101	0.401**	-2.770	-4.957**	-0.085	-0.067	0.004
	(0.195)	(0.188)	(2.599)	(2.147)	(0.088)	(0.054)	(0.003)
speffect	0.834***	0.555**	2.213	-0.351	0.147	0.152**	-0.050
	(0.252)	(0.264)	(2.973)	(2.986)	(0.097)	(0.074)	(0.037)
geo dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
sectoral dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
N	227	216	244	244	155	156	244
groups	124	121	128	128	83	83	128
R^2	0.326	0.298	0.085	0.172	0.1846	0.0762	0.210

Significance levels : $*$: 10% $**$: 5% $***$: 1%

parks) to around 160 (in the 14 parks) treated and not treated firms, the matched samples are perfectly balanced for each of the covariates (See Table 14).
Also in this sample of firms, as Table 16 shows, the location in a SPs is not responsible, in general, of different performances with respect to those located outside the science parks. The positive effect found on sales and added value within the 11 SPs sample is confirmed only for the first outcome, but with a smaller significance and magnitude. Since the 14 SP analysis may bias our results because of the already mentioned higher variance, we insert in the specification "year" dummies that capture the length of the treatment.[31] These "year" dummies are always equal to zero for not treated firms as well as for treated firms *before* the treatment. However, a "year" dummy takes value equal to 1 in the post treatment period if the firm is settled in a park that has this particular year as year of first settlement. As shown in table 24, results do not change with respect to the basic regression. Coefficients of these dummies are not shown in the table since they are always not significant (but available upon request).
The lack of relevant differences, with exception of sales dynamic, suggests that the services provided by SPs to firms do not improve SP firms performances. This could be partially related to the fact that some SPs firms may be more oriented to pure research and to innovative activities rather than to profitability or economic goals.[32]
Moreover, one should take into account that most of the SPs have been created recently: the absence of SP impact on hosted firms may actually reflect their age, namely lack of experience, rather than their inefficiency. We address this issue in the next section where, among the other things, we perform a difference-in-difference analysis taking into account the age of the park and the treatment period. Before showing these results in the next section, it is worth mentioning that results related to 11 and 14 SPs have been checked also using both the Bootstrap and the Jackknife methods to get an alternative estimate of the standard errors. No significant differences come out with respect to the classical robust variance estimation.[33] Moreover, a further check of our results on 2011 data is made considering 2010 as an alternative post-treatment year; also in this case results do not change in a significant way (see Appendix B, Table 27).
Before continuing, it is worth mentioning that the Difference-in-Difference

[31] Obviously we are not able to control for the exact length of treatment for each firm, but we assume that the length of the treatment is equal for the firms that are settled in each park. Therefore, the length of the treatment for each park is constructed considering the difference between 2011 and the year of settlement of the first firm in it.

[32] Recall that the are also 4 parks that have no firms inside their area, suggesting that they are less business-oriented.

[33] See Tables 25 and 26 in Appendix B to see our results with both Bootstrap and Jackknife methods.

Table 16: Effects of the SPs on firms' performance (14 SPs)

	LnSales	LnAddedVal.	ROA	EBITDA/Assets	Inv/Sales	Intang. Inv/Sales	Patents
training	0.077	0.212	0.169	0.788	0.035	0.099	0.063**
	(0.300)	(0.300)	(1.555)	(2.694)	(0.087)	(0.155)	(0.031)
post	0.168	0.701***	-0.721	-2.857	-0.078	0.842	0.003
	(0.220)	(0.192)	(2.391)	(2.053)	(0.067)	(0.940)	(0.002)
speffect	0.648**	0.316	1.463	-0.488	0.095	-1.274	-0.028
	(0.261)	(0.251)	(2.749)	(3.089)	(0.087)	(1.404)	(0.033)
geo dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
sectoral dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
N	278	261	297	297	210	211	297
groups	151	147	156	156	113	113	156
R^2	0.251	0.237	0.078	0.158	0.133	0.045	0.227

Significance levels : $*$: 10% $**$: 5% $***$: 1%

approach is based in the "common trend" assumption: the underlying trends in the outcome variable must be the same in both treated and control groups. In our framework it is possible to test this assumption because we have balance sheet data before the beginning of the treatment for almost all the firms in our sample. To check the common trend we run two placebo exercises, estimating the baseline regression considering the period that goes from one (two) year(s) before the start of the treatment and the year of treatment itself. We decided not to further increase the time span because we lose an increasing number of observations. As shown in table 23 (see Appendix B) the interaction term is never statistically significant, allowing us to exclude the existence of pre-existing trends in our outcome variables that could have compromised our results.[34]

6.3 Heterogeneous effects of the treatment

The effects of being located in a SP can be different according to the characteristics of the park itself, how it is organized and its experience in serving hosted and not-hosted firms. Moreover, the effectiveness of the SP may depend also on some firms features like size or age.
Therefore, it is quite relevant to see whether our results are valid in general or they can be more related to a particular type of SP and/or firms. As a matter of fact, such a question is important especially for a policy-maker who wants to improve the effectiveness of the science parks promoting specific SP configuration and/or the location in the parks of a particular type of firms.
Therefore, in this part we study the existence of heterogeneous effects of the treatment according to some features of both SPs and their hosted firms. We first check whether the age, the ownership and the degree of specialization (as defined at the end of Section 4) of a park may change its impact on SP firms. Then, we see if and how the effect of the SP changes according to the size, the age and the geographical location of the firms located within the parks.
Our first analysis splits the sample of firms into two groups according to the year of settlement of the first firm in the correspondent park (an information available from our survey). Therefore, we compare "Recent" and "Old" parks, where the former stands for a park that started to host firms after the 2005.[35] With this analysis we are implicitly taking into account

[34]We did not check the common trend assumption for patents because it is a variable with few values different from zero such that it is high unlikely that the common trend assumption is violated.

[35]Note that the different size of the two groups is due to the fact that many parks have the same median year of first settlement i.e. 2005. In order to make the two groups comparable we put these firms to the group of the oldest parks. Clearly, the adjective old is used in a relative sense.

the differences in the length of the treatment period for the firms, and we can argue something about the need of a longer permanence in the parks in order to see valuable effects on the hosted firms.
As can be seen no relevant effects are found for the firms located in the most

Table 17: SP effect on firms' performance according to the SP age (14 SPs)

	LnSales	LnValue added	ROA	EBITDA/assets	Inv/sales	Intang. Inv/sales	Patents
			Recent SP				
speffect	0.064	-0.300	2.198	-4.040	0.252**	-1.377	-0.099
(std. err)	(0.468)	(0.474)	(5.287)	(4.652)	(0.102)	(1.631)	(0.066)
obs.	92	84	107	107	112	112	107
groups	51	49	56	56	61	61	56
R2	0.380	0.477	0.090	0.160	0.169	0.101	0.240
			Old SP				
speffect	0.963***	0.552**	0.593	1.870	-0.014	0.025	0.000
(std. err)	(0.323)	(0.277)	(3.134)	(4.005)	(0.107)	(0.041)	(0.040)
obs.	186	177	190	190	96	97	190
groups	100	98	100	100	51	51	100
R2	0.227	0.225	0.104	0.158	0.241	0.129	0.260

Significance levels : ∗ : 10% ∗∗ : 5% ∗ ∗ ∗ : 1%

recent parks (Table 17, where it is shown only the coefficients of the interaction term) while significant coefficients of SPEFFECT are shown when we look at both sales and added value of the Old group.
Such result suggests that the permanence period in a SP is actually important, even though from a productivity point of view, meaning that more effects of SPs may appear in the future. Obviously, the same reasoning (i.e. the shortness of the length of treatment for many of the considered parks) could be valid for the firms' profitability, investments and innovation measures but in these cases the answer seems to be more clear-cut.
A second distinction we made is to differentiate SPs according to their ownership, dividing the sample between firms settled in public and not-public (i.e. mixed or private ownership) science parks. Results in Table 18 shows that the effects of the treatment on sales and added value is due to public parks, while in the non-public ones there are no significant effects except for a higher propensity to invest with respect to NSP firms.

Table 18: Effects of the SPs on firms' performance according to the ownership (14 SPs)

	LnSales	LnValue added	ROA	EBITDA/assets	Inv/sales	Intang. Inv/sales	Patents
			Pure public parks				
speffect	0.824**	0.729*	3.447	0.594	0.034	-24.804	-0.060
(std. err)	(0.419)	(0.411)	(3.514)	(4.036)	(0.107)	(80.918)	(0.043)
obs.	130	127	134	134	94	97	134
groups	70	69	70	70	51	51	70
R2	0.302	0.306	0.184	0.233	0.281	0.077	0.156
			Non-public parks				
speffect	0.524	-0.074	-0.156	-1.135	0.222**	-1.443	-0.004
(std. err)	(0.336)	(0.298)	(4.361)	(4.724)	(0.101)	(1.678)	(0.051)
obs.	148	134	163	163	114	114	163
groups	81	78	86	86	61	61	86
R2	0.461	0.402	0.091	0.215	0.116	0.119	0.290

Significance levels : ∗ : 10% ∗∗ : 5% ∗ ∗ ∗ : 1%

On the other hand, if we distinguish the science parks according to their

sectorial specialization (Table 19) we find that non-specialized parks (i.e. those who host firms of many different sectors) seem to be more effective than specialized parks in improving the sales performance of the hosted firms. However, it is worth mentioning that specialized parks have a positive effect on the investment of their hosted firms.

Table 19: Effects of the SPs on firms' performance according to the SP industry specialization (14 SPs)

	LnSales	LnValue added	ROA	EBITDA/assets	Inv/sales	Intang. Inv/sales	Patents
			Specialized parks				
speffect	0.511	0.247	3.548	-3.163	0.276**	-1.432	-0.070
(std. err)	(0.438)	(0.493)	(4.465)	(4.389)	(0.107)	(1.714)	(0.048)
obs.	119	109	137	137	106	106	137
groups	67	64	72	72	58	58	72
R2	0.315	0.398	0.088	0.146	0.191	0.89	0.206
			Non specialized parks				
speffect	0.759**	0.302	-0.587	2.425	-0.024	0.020	-0.001
(std. err)	(0.336)	(0.269)	(3.488)	(4.441)	(0.101)	(0.038)	(0.047)
obs.	159	152	160	160	102	103	160
groups	84	83	84	84	54	54	84
R2	0.162	0.253	0.134	0.188	0.212	0.114	0.277

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Moving to analyse the treatment effect according to the firms' characteristics (Table 20), we find that SPs affect positively small firms from both sales and investment viewpoint, whereas no benefit seems to come out for large firms.

Results are quite different when we distinguish among young and old firms (Table 21), where by old firms we mean firms with more than 14 years of activity.[36] In such a case in fact, the SP effect is weaker from a statistical point of view for both groups, but the effect on sales is confirmed only for the oldest firms.

Therefore, a possible interpretation of both Tables 20 and 21 may be that SP has a significant impact on small but experienced firms.
Finally, since the SP effectiveness may be influenced by the territory where they are based, we perform a final exercise creating two sub-samples according to the geographical area.

Splitting the sample between North and Center-South, we find a relevant impact of science parks on the investment of"North" firms and on sales of those located in the Center-South.
Summarizing, the main findings related to our sub-samples analysis are that a) both productivity and investment measure are influenced by SP activity even though the latter to a lesser extent b) the effect is non-homogeneous across the types of SP and firms. This non-homogeneity may actually reflect the strong heterogeneity found in SP features (see Section 4) and it has, in our opinion, a significant policy implications because it allows to

[36] As for the analysis Recent vs. Old parks, the concept of "old" firms is relative and related to the need of building up two comparable sub-samples basing the median value of the firms' age.

Table 20: Effects of the SPs on firms' performance according to the firms' size (14 SPs)

	LnSales	LnValue added	ROA	EBITDA/assets	Inv/sales	Intang. Inv/sales	Patents
			Small firms				
speffect	0.812**	0.321	4.318	-1.894	0.305**	-1.295	-
(std. err)	(0.379)	(0.386)	(4.540)	(4.955)	(0.138)	(1.670)	-
obs.	152	139	169	169	97	98	-
groups	87	84	92	92	56	56	
R2	0.182	0.215	0.087	0.204	0.226	0.091	-
			Large firms				
speffect	-0.110	0.016	-2.048	-0.863	-0.007	-0.005	-
(std. err)	(0.352)	(0.368)	(1.752)	(4.561)	(0.032)	(0.029)	-
obs.	126	122	128	128	111	111	-
groups	64	63	64	64	56	56	-
R2	0.382	0.335	0.180	0.138	0.393	0.105	-

Significance levels : * : 10% ** : 5% *** : 1%

Table 21: Effects of the SPs on firms' performance according to the firms' age (14 SPs)

	LnSales	LnValue added	ROA	EBITDA/assets	Inv/sales	Intang. Inv/sales	Patents
			Young firms				
speffect	0.596	0.372	3.899	-0.263	0.269	0.337*	-0.044
(std. err)	(0.391)	(0.399)	(4.330)	(3.874)	(0.241)	(0.181)	(0.034)
obs.	151	143	167	167	72	77	167
groups	86	84	91	91	43	45	91
R2	0.353	0.364	0.130	0.164	0.323	0.174	0.281
			Old firms				
speffect	0.664*	0.191	-1.728	-0.618	0.064*	-1.192	0.000
(std. err)	(0.357)	(0.317)	(3.183)	(5.308)	(0.033)	(1.260)	(0.063)
obs.	127	118	130	130	136	137	130
groups	65	63	65	65	69	69	65
R2	0.277	0.319	0.113	0.207	0.235	0.061	0.318

Significance levels : * : 10% ** : 5% *** : 1%

Table 22: Effects of the SPs on firms' performance according to the area (14 SPs)

	LnSales	LnValue added	ROA	EBITDA/assets	Inv/sales	Intang. Inv/sales	Patents
			North				
speffect	0.547	0.096	3.950	-2.129	0.170**	-1.486	-0.034
(std. err)	(0.362)	(0.289)	(4.938)	(5.337)	(0.081)	(1.648)	(0.055)
obs.	133	123	139	139	120	120	139
groups	72	71	74	74	65	65	74
R2	0.254	0.259	0.055	0.188	0.131	0.074	0.332
			Center-South				
speffect	0.755**	0.552	-0.340	1.311	0.118	0.138	-0.022
(std. err)	(0.379)	(0.401)	(3.043)	(3.655)	(0.149)	(0.101)	(0.043)
obs.	145	138	158	158	85	85	158
groups	79	76	82	82	45	45	82
R2	0.240	0.268	0.138	0.206	0.216	0.094	0.059

Significance levels: * : 10% ** : 5% *** : 1%

understand which type of park configuration is more effective in supporting firms. Moreover, it raises a non-trivial question to the policy maker: why do SPs seem to have a negligible (if not a null) impact on the firms' innovative capacity. Nevertheless, a note of caution is needed insofar as the results of Recent vs. Old parks seems to suggest that there is still a "learning effect" going on the younger parks such that our results may actually change in the years to come.

7 Concluding remarks

The creation and development of SPs has become one of the interventions used to increase firms' growth and innovative capacity during the last decades because SPs supply, among others, specialized services and foster proximity spillovers that benefit firms who decide to settle in a science park. Thanks to a survey conducted by the Bank of Italy during spring 2012, this paper aims to shed light on the activity of SPs in Italy and their effect on the performance of the hosted firms. To the best of our knowledge this is the first attempt to get a full detailed picture of Italian science parks' activity as a whole, whose number, hence relevance, increased during the last years. Looking at our findings our contribution to the literature on science and technology park is threefold.

First, we provide some stylized facts about the main features and differences between Italian Science Parks. From this point of view, we find a significant heterogeneity between SPs in almost all variables (e.g. turnover, staff, firms established/served etc.), but all SPs have in common a strong cooperation with universities of the same region. Moreover, science parks with mixed ownership tend to be more connected than public ones. A distinction by year of foundation reveals that SPs created during the '90s are, on average, more dependent from direct public funds, less prone to provide services to firms, and more subject to a turnover decrease in the last 5 years with respect to other type of SPs.

Secondly, we tried to understand which kind of firms are settled in the Italian SPs and how they differ from the out-of park firms. For this purpose we compare around 400 SP firms with firms outside the parks that share the same area, age, and industry sector, finding that SP firms are, on average, better with respect to their counterparts in terms of economic performance, investments and profitability indicators.

This comparison lead us to a natural question whose answer represents our third contribution: did Italian SP firms get a benefit from being in a SP with respect to their outer counterparts? Our diff-in diff analysis shows that firms that moved inside the SPs actually show higher sales and added value with respect to out-of-park firms. No other benefits are obtained in terms of profitability or patenting, while results on investment are mixed

not robust. However, a further look at the "treated" firms according to the science park age shows that the effect of scientific parks are stronger for the oldest SPs, suggesting that science parks may need time to affect the hosted firms' performance.
All these results seems to raise further questions and issues that deserve further investigations in the near future. For example, the overall heterogeneity of SPs seems to suggest a not unified vision of the policy maker about the nature and the activities of SPs. This could be a positive aspect because it may reflect the capacity of creating SPs in response to the needs of the time and/or the economic context. On the other hand, the lack of a clear role of SPs makes difficult to understand, evaluate, hence appreciate, their contribution to the national innovative capacity. A second important conclusion that we can draw from our comparison is that science parks are able to attract the best firms but not to significantly improve their performances. This could be due to the relative young age of Italian SPs but it is clear that, from a policy viewpoint, Italian SPs deserve a further investigation in order to understand what characteristics have to be strengthened in order to improve their effectiveness in supporting hosted firms.
Finally, our analysis contributes to the literature on science parks not only because it provides an in-depth analysis of a particular country but also because it helps in explaining the heterogeneity of results found for other countries. Our results, in fact, suggest that science parks need time and experience to deliver an effective service to firms and such effectiveness is strongly affected by some features of the science park like ownership and age. Therefore, the different results found for several countries may be explained by the different features that SPs show among the countries.
Even though our study provide some interesting results one should take into account of its drawbacks, which actually correspond to future research paths. First, due to lack of data, our analysis does not investigate the impact of SPs on the welfare. For example, we do not study how technology transfer between firms as well as firms and universities leads to the introduction of new product or process that may benefit consumers. Moreover, we do not look at the performance of firms born in the SPs: since the difference-in-difference analysis refers to the sub-sample of SP firms that moved into the parks, it would be interesting to extend the performance analysis to those firms that were born in the parks (the incubated firms), even though with different methods. Such study could be also integrated by a survival analysis of firms that left the SPs, which represents another important dimension to broadly evaluate the effectiveness of science parks.
In spite of these limits, it is worth to point out that our updated and detailed analysis of SPs' activity in favour of the Italian firms helps to provide a broad picture on one of the tools used by Italian policy makers, together

with business incubators[37] and industrial districts.[38]
Concluding, this paper tries to shed light to SPs activity but, given their relevance from a policy point of view, further research analysis is needed to better understand what roles they can play to increase the innovative capacity of Italy.

[37]For whom interested on incubated firms, a very recent paper Auricchio et al. [1] sheds light on the role played by Italian Business Incubators on firms' survival capacity with respect to non-incubated firms. Their work is therefore quite complementary to ours not only because of their survival analysis, but also because they look at another tool used by policy makers to improve the entrepreneurship and the competitiveness in Italy.

[38]For a recent analysis on the effect of industrial districts on firms' performance see Bertamino et al. [3].

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A Cluster Analysis

To check the specialization of a SP we used the name of firms provided in our survey to get their information from CeBi/Cerved and Infocamere datasets. For the purpose of this paper we look in particular at their economic sectors according to the ATECO 2007 classification, which corresponds to ISIC rev.4 and NACE rev. 2.
We have been able to get the 2-digit industry sectors of 548 firms out of 609 firms mentioned in the survey[39] covering almost the 90% of the sample. Knowing in which SP each firm is established, then we were able to see which sectors and how many firms-per-sector are present in each SP.
To detect the degree of specialization we then considered two variables. The first one is the number of sectors existing in the park thanks to the presence of a firm: the higher number, the less specialized is the park. However, this variable can be misleading because a SP may have many sectors but almost all the firms operating in a particular one while another could have fewer sectors but firms more uniformly distributed along them. Therefore we also calculated a concentration (Herfindhal) index for each SP according to the number firms per each sector existing in the SP.
We used these two variable in order to perform a cluster analysis. To avoid the sensitivity of results to different variable unit measures, we normalized the data according to the following rule

$$y_i = \frac{Y_i - \min_{1\leq j\leq N} Y_j}{\max_{1\leq j\leq N} Y_j - \min_{1\leq j\leq N} Y_j} \quad \forall\ j \in [1, N] \tag{2}$$

which is suitable for non negative values as in our case. In order to see which group of SPs naturally arise, cluster analysis is based on hierarchical methods.[40] We considered the Ward method as our benchmark because of its large use. To check the robustness of our clustering with respect to the method used we also used Centroid, Average, Weighted average and Complete methods. For all of them, the ordering of the SPs according to the dissimilarity measure is the same. Centroid did not produce a dendrogram so it was not possible to use it. Concerning the other methods, as the dissimilarity measure increases, the number of groups passes from five to three. However, in case of five groups one cluster is made of an isolated SP, a result that is difficult to evaluate. On the other hand, if we consider a higher dissimilarity level to associate the isolated SP with another group, we have three groups that differ according to the method used. Given these drawback and the higher use of Ward algorithm we use the latter.

[39] Actually, the number of firms signalled by the interviewed SP was initially 703, however a first check lead us to drop 96 of them because they were public entities.

[40] There also exists non hierarchical Cluster analysis where it is assumed *a priori* the number of groups that has to be created at the end of the analysis. For further details see Gatingnon [11].

B Tables

Table 23: Common trend assumption (14 SPs)

	LnSales	LnValue added	ROA	EBITDA/assets	Inv/sales	Intang. Inv/sales	Patents
			from t-1 to the start of the treatment				
speffect	0.034	0.0186	-0.611	-2.457	5.255	-1.087	-
(std. err)	(0.176)	(0.176)	(2.477)	(5.534)	(6.954)	(1.061)	(-)
obs.	180	171	199	199	204	204	-
groups	99	96	109	109	114	114	-
R2	0.329	0.211	0.136	0.143	0.973	0.680	-
			from t-2 to the start of the treatment				
speffect	-0.190	-0.134	-5.681**	-4.691	5.063	-1.222	-
(std. err)	(0.177)	(0.203)	(2.301)	(4.750)	(6.614)	(1.083)	(-)
obs.	168	160	186	186	192	192	-
groups	99	96	109	109	114	114	-
R2	0.324	0.208	0.172	0.230	0.973	0.681	-

Significance levels : * : 10% ** : 5% *** : 1%

Table 24: Effects of the SPs on firms' performance **with year dummies** (14 SPs)

	LnSales	LnAddedVal.	ROA	EBITDA/Assets	Inv/Sales	Intang. Inv/Sales	Patents
training	0.081	0.226	0.131	0.721	-0.026	0.032	0.063**
	(0.303)	(0.300)	(1.582)	(2.72)	(0.060)	(0.134)	(0.031)
post	0.163	0.698***	-0.691	-2.87	-0.076	0.828	0.003
	(0.223)	(0.195)	(2.42)	(2.08)	(0.065)	(0.919)	(0.003)
speffect	0.945**	0.439	0.263	2.723	0.110	-1.22	-0.029
	(0.481)	(0.598)	(3.72)	(12.1)	(0.083)	(1.38)	(0.019)
geo dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
sectoral dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
year dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
N	278	261	297	297	210	211	297
groups	151	147	156	156	113	113	156
R^2	0.273	0.271	0.107	0.180	0.130	0.045	0.260

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Table 25: Effects of the SPs on firms' performance **with Bootstrap method** (14 SPs)

	LnSales	LnAddedVal.	ROA	EBITDA/Assets	Inv/Sales	Intang. Inv/Sales	Patents
training	0.077	0.212	0.169	0.788	0.037	0.100	0.063**
	(0.336)	(0.286)	(1.544)	(2.762)	(0.081)	(0.149)	(0.031)
post	0.168	0.701***	-0.721	-2.857	-0.080	0.842	0.003
	(0.194)	(0.235)	(2.403)	(2.501)	(0.074)	(0.978)	(0.003)
speffect	0.648**	0.316	1.463	-0.488	0.083	-0.824	-0.028
	0.257	(0.303)	(2.473)	(3.575)	(0.068)	(1.003)	0.030
geo dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
sectoral dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
N	278	261	297	297	210	211	297
groups	151	147	156	156	113	113	156
R^2	0.251	0.237	0.078	0.158	0.111	0.043	0.227

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Table 26: Effects of the SPs on firms' performance **with jackknife method** (14 SPs)

	LnSales	LnAddedVal.	ROA	EBITDA/Assets	Inv/Sales	Intang. Inv/Sales	Patents
training	0.077	0.212	0.169	0.788	0.037	0.100	0.063**
	(0.315)	(0.315)	(1.562)	(2.712)	(0.086)	(0.138)	(0.037)
post	0.168	0.701***	-0.721	-2.857	-0.080	0.842	0.003
	(0.215)	(0.187)	(2.345)	(2.013)	(0.064)	(0.906)	(0.004)
speffect	0.648**	0.316	1.463	-0.488	0.083	-0.824	-0.028
	(0.256)	(0.247)	(2.695)	(3.030)	(0.090)	(0.910)	(0.033)
geo dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
sectoral dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
N	278	261	297	297	210	211	297
groups	151	147	156	156	113	113	156
R^2	0.251	0.237	0.078	0.158	0.111	0.043	0.227

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Table 27: Effects of the SPs on firms' performance **in 2010** (14 SPs)

	LnSales	LnAddedVal.	ROA	EBITDA/Assets	Inv/Sales	Intang. Inv/Sales	Patents
training	0.071	0.231	-0.064	0.518	-0.046	0.697	0.057**
	(0.272)	(0.279)	(1.630)	(2.782)	(0.074)	(0.675)	(0.028)
post	0.234	0.344*	-0.326	-5.149**	-0.066	-0.205	0.012
	(0.183)	(0.199)	(1.602)	(2.029)	(0.058)	(0.262)	(0.013)
speffect	0.511**	0.437*	-0.865	1.553	0.095	0.483	-0.033
	(0.231)	(0.255)	(2.423)	(3.141)	(0.073)	(0.411)	(0.032)
geo dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
sectoral dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
N	310	288	337	337	237	242	337
groups	167	157	173	173	127	129	173
R^2	0.288	0.219	0.147		0.043	0.082	0.178

Significance levels : $*$: 10% $**$: 5% $***$: 1%

C Questionnaire

Questionnaire for science parks

1. Name

2. Year of incorporation

3. Ownership

4. Since the incorporation, has the ownership changed? If so, what was the initial ownership?

5. Turnover of the science park in 2010 *(Euro)*

6. In the last 5 years, the turnover has

7. Budget share coming from direct public funds in 2010	
	%

8. With respect to the previous 5 years such share has

9. Type of links with universities
Financial (toward universities)
Financial (from universities)
National research projects
International research projects
Personnel training/hiring
Use of park's facilities
Use of universities' facilities
Other (*please, specify*):

10. Name of the main partnering university

11. Type of links with other research institutions	
Financial (toward research institution)	
Financial (from research institution) National research projects International research projects Personnel training/hiring Use of park's facilities Use of research institutions' facilities	
Other (*please, specify*):	

12. Name of the main partnering research institution

13. Surface of the science park
.000 square metres

14. Number of science park staff

15. In the last 5 years the number of science park staff has

16. Number of staff employed in providing incubation service

17. Number of staff employed in providing technology transfer service

18. Services provided by the science park	
R&D	
Partnership	
Incubation	
Business planning	
Training	
Project management	
Fund-raising support	
Patents	
Legal support	
Facilities	
Other (*please, specify*)	

19. Could you specify which is the main service (among the above mentioned)?

20. Do you have a technology transfer office?

21. Year of settlement of the first firm *(If no firm is settled, please go to question n. 23)*

22. Number of firms currently hosted in the park

23. In the last 5 years, what is the number of firms that:	
Used park services	
Were born in the park	
Left the park, while continuing their activity	
Left the park because they stopped their activity	
Left the park because of merger/acquisition	

24. Could you list the name of the firms currently settled in the park?

25. Comments/Notes

26. Contacts
Name
Position
Telephone
e-mail

27. Date

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