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► **To cite this version:**

Ilaria Mariotti, Elisa Salvador. On-park and off-park research spin-offs: some insights from an empirical investigation on Italy. *International Journal of Entrepreneurship and Innovation Management*, Inderscience, 2015, Special Issue on Inspired by Silicon Valley: a Cheap Copy or a Masterpiece?, 19 (5/6), 10.1504/IJEIM.2015.073217 . hal-02265373

**HAL Id: hal-02265373**

**<https://hal.archives-ouvertes.fr/hal-02265373>**

Submitted on 9 Aug 2019

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*This article has been accepted for publication by the International Journal of Entrepreneurship and Innovation Management*

*It can be cited as follows:*

*Mariotti I., Salvador E. (2015) “On-park and off-park research spin-offs: some insights from an empirical investigation on Italy”, International Journal of Entrepreneurship and Innovation Management, Special Issue on Inspired by Silicon Valley: a Cheap Copy or a Masterpiece?, vol. 19, n. 5/6, pp. 405-422.*

***“On-park and off-park research spin-offs: some insights from an empirical investigation on Italy”***

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**ABSTRACT**

The literature on research spin-off firms has flourished in the last decade. Research spin-offs are recognized as an important opportunity for universities, and for enhancing entrepreneurship and economic growth. Several analyses and empirical investigations have been published in this field in recent years. Notwithstanding, many aspects of information regarding the activities of research spin-off firms are missing, including fragmented data. In this context, the debate on the relationship between research spin-offs and science parks/incubators is still open. The present paper aims at contributing to this debate through an investigation of the role played by these structures for the growth and development of research spin-offs. The empirical analysis – descriptive statistics and econometric estimation – focuses on 155 respondents in a questionnaire investigation. It shows that on-park research spin-offs are smaller than off-park firms, and are more oriented to deal in the international market, and they are specialised in the biopharmaceutical sector. The analysis reveals that on-park research spin-offs are less prone to develop patents compared to off-park ones. On-park research spin-offs seem, therefore, to be high value-added and innovative, but they require huge investments in equipments and laboratories in order to develop and grow: these facilities can be offered by structures like science parks and incubators.

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**JEL Codes:** O3; L2

**Keywords:** research spin-offs; science parks; incubators; technology transfer

*This article is a revised and expanded version of a paper entitled “The location of Italian research spin-offs: which factors do really matter?” presented at Ersu (Barcelona, Spain, 30 August-3 September 2011) International Conference and of a paper entitled “Location decisions of research spin-off firms in Italy” presented at Aisre (Turin, Italy, 15-17 September 2011) International Conference.*

*Although the paper is the result of a joint work of the authors, the sections may be attributed as follows: section 2 to Salvador E.; section 4 to Mariotti I.; sections 1,3,5 are the result of common reflections equally distributed between the two authors.*

## **1. Introduction**

In recent years we have seen a greater emphasis on the research spin-off (RSO) phenomenon (Mustar *et al.*, 2006, 2008; Miner *et al.*, 2010). RSOs can be considered as one of the main tools for the external transmission of knowledge developed in universities, and for enhancing entrepreneurship and economic growth. Nonetheless, several are the open issues surrounding this particular kind of firm. RSOs are an example of entrepreneurship, but they come from the university world, therefore, they are linked to university rules and procedures. Furthermore, spin-off founders are predominantly scientists and not managers: a gap of finance and management competence as well as of credibility on the market usually emerges (Mustar *et al.*, 2008; Wright *et al.*, 2004).

Several analyses and empirical investigations have been published in this field. Among the wide range of investigations on RSOs we can cite the following three branches: (a) understanding the heterogeneity of RSOs, (b) investigating the impact of RSOs in the local context, and (c) analysing the effectiveness of science parks and incubators for the growth and development of these particular firms. Notwithstanding, information on many aspects of RSOs' activities such as differences between on-park RSOs (firms incubated in a science park or incubator) and off-park RSOs (firms that developed outside these supporting structures) are missing, and most of the data is fragmented (Lockett *et al.*, 2003; Shane, 2004; Lockett, Wright, 2005; Mustar *et al.*, 2006).

Within this context, the present paper aims to analyse to what extent Italian on-park RSOs and off-park RSOs differ (in terms of sector, size, international propensity, patenting attitude, and location), and aims at investigating whether science parks (SPs) and incubators are pivotal for the growth and development of specific typologies of firms like RSOs, that might not survive outside these supporting structures. Understanding the heterogeneity of RSOs has, indeed, implications for the design and implementation of strategies to develop RSOs, and to help design better targeted public policy measures (Mustar *et al.*, 2006). Specifically, in this paper RSOs are defined as those firms

coming from the research world – with or without a university share and a patent – but established by current or former university/research centre members (professors, researchers, technical and administrative staff, PhD candidates).

Data comes from a questionnaire investigation on the universe of Italian RSOs (January-June 2008), and the empirical analysis includes descriptive statistics and a logit estimation, relating the probability to be either on-park or off-park.

The focus on Italy is justified by the fact that RSO is a phenomenon with significant potential for this country, where new firms are mainly concentrated in low-technology mature sectors (OECD, 2005), and where the national innovation system is rather inefficient (Malerba, 1993). Furthermore, Italy is among the most active European countries that have recently issued policy tools to promote the development of RSOs: (i) spin-off regulations, following the Legislative Decree n. 297/1999, have been issued by many Italian universities since 2002 (Salvador, 2009); (ii) Technology Transfer Offices (TTOs), patent offices and Industrial Liaison Offices (ILOs) have been created following the law 262/2004 (Nosella, Grimaldi, 2009; Muscio, 2010; Conti et al., 2011; Bianchi, Piccaluga, 2012); (iii) SPs and incubator structures have been developed. Nonetheless, an agreed and clear policy is still missing, and the Italian SPs denote distinctive and almost unique peculiarities, not only due to regional needs.

The analysis highlights that on-park RSOs are more oriented to deal in the international market, they are more specialised in the biopharmaceutical sector, they are born small (lower capital at the time of foundation than off-park ones), they are less prone to develop patents compared to off-park RSOs, and are mainly located in the north west of Italy.

The paper is structured into five sections. The introduction is followed by the theoretical framework where the research hypotheses to be tested are presented. Data and methodology are described in section 3, while the empirical analysis with the descriptive statistics and the results of discrete choice modelling is presented in section 4; concluding remarks and policy implications follow.

## **2. Theoretical framework**

### **2.1. RSO firms and science parks and incubators in Italy: a brief overview**

The growing interest towards the RSO phenomenon is nowadays a “matter of fact” in the US and in Europe. Notwithstanding the attention given to RSOs, there remain many difficulties and problems characterising these firms, like how to deal on the market, knowledge and management learning gap, and different cultural and mentality aspects between the university and the industry worlds. These problems are observed in several European countries. According to Mustar and Wright (2010), the majority of French and English university spin-offs are very small and with few chances of achieving the stock market listing; the same is found for the Italian case (Chiesa, Piccaluga, 2000). Nevertheless, as highlighted by Balderi et al. (2007), RSOs are a means of knowledge diffusion, and a

policy supporting the creation and development of these particular firms is a way to contribute to local economic development and growth.

Within this context, Italy is among the most active European countries to have recently issued measures, schemes and programs for fostering the creation of RSOs (Mustar, Wright, 2010; Balderi et al., 2007). In particular, the spin-off of high-tech business ideas has gradually increased in recent years as a new strategic orientation of Italian universities, notably since 2001 a pivotal initiative has been undertaken by Italian universities in favour of the establishment of RSOs<sup>3</sup>. The inspiration for the issuing of spin-off regulations was the Legislative Decree No 297/1999, which is concerned with the *'reorganization of the discipline and streamlining of the procedures for the support of scientific and technological research, for the diffusion of technologies, for researchers' mobility'*. Furthermore, the Ministerial Decree of 8 August 2000, No 593, sets out *'procedures for giving support according to Legislative Decree n. 297/1999'* (Salvador, 2009). Furthermore, in recent years a proliferation of structures like technology transfer offices (TTOs), industrial liaison offices (ILOs), business incubators, SPs and patent offices may be observed in many Italian universities (Balderi et al., 2007; Nosella, Grimaldi, 2009; Muscio, 2010; Conti et al., 2011; Bianchi, Piccaluga, 2012), and consequently the diffusion of RSOs has been fostered. Furthermore, since 2005, the reform of Title V of the Constitution in 2001 and its implementation through the Law 131/2003 increased the contribution of Italian regions to the innovation policy formulation process and the management of measures favouring R&D and innovation<sup>4</sup>.

Among the policy measures fostering the growth and development of RSOs, those supporting the creation of SPs<sup>5</sup> and incubators have emerged. SPs and incubators should be considered as a means to reduce the so called "liability of newness" (Ferguson, Olofsson, 2004; Gilbert et al., 2006; Sofouli, Vonortas, 2007; Schwartz, 2009; Schwartz, Hornych, 2010; Salvador and Rolfo, 2011), which relates to the high failure risk young firms suffer in the first years of their life. Indeed start-ups and young firms, in general, may not have stable business relationships and they may not possess any reputation: they need, therefore, some time to gain legitimacy in the market (Schwartz, 2009; Karlsson, Wigren,

<sup>3</sup> Indeed, globalization has made necessary the modernization of Italy, and the elimination of many structural delays (Bianchi et al., 2010). Main challenges for the Italian system are provided by the improvement of technology transfer mechanisms to reduce the existing gap between research and the market, by the innovation financing and mobility of talents. Yet, several policy interventions have been introduced in order to address these challenges.

<sup>4</sup> As it is the case for Italy, also in France and in the UK (Mustar, Wright, 2010) Regions fostered innovation and technology transfer policy.

<sup>5</sup> Although no uniformly accepted definition of SP exists (Lofsten, Lindelof, 2005; Dettwiler et al., 2006), the term SP is usually adopted to describe a property based initiative that has formal and working links with a university or other higher education institution or research centre. A SP is a business support and technology transfer initiative that encourages and supports the start-up, incubation and development of innovation led, high growth, knowledge based businesses; it provides an environment where larger and international businesses may develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit (Parry, Russell, 2000; Ferguson, Olofsson, 2004).

2010). SPs and incubators can work as a network of positive and favourable associations for tenant companies willing to grow. Thanks to the advantages linked to the creation of a stable and effective network of contacts in terms of potential financiers, clients and suppliers, these structures may help to fill the legitimacy gap.

The first SPs were established in North America in the 1950s (Cesaroni, Gambardella, 1999; Colombo, Delmastro, 2002; Sofouli, Vonortas, 2007; Link, Scott, 2003; Wessner, 2009; Bellavista, Sanz, 2009), and in the late 1970s and early 1980s an increasing development of SPs was observed, even under the stimulus of the Bayh-Dole Act and the passage of several technology initiatives in the early 1980s (Link, Scott, 2007, 2006, 2003). It is widely known that Silicon Valley with its Stanford Research Park and Route 128 in Massachusetts were the first successful initiatives.

The presence of an incubator inside a SP is in most of the cases a pivotal factor since it provides a supportive environment and shared facilities for helping not only the establishment of young firms, but also their development, growth and survival (Hackett, Dilts, 2004; Lofsten, 2012). The concept of incubation evolved over the years, and a range of wide and up to date business support services are offered to the hosted firms. While the incubators of the “first generation” provided firms with physical space and basic shared facilities, the “second generation” ones also offered more specialized business support services, like counselling, and the “third generation” – also called “networked knowledge incubators” – fostered the availability of networking for the sharing of knowhow and the promotion of best practices among entrepreneurs. Indeed, networking has become “*one of the important arguments in favour of science parks*” (Lofsten, Lindelof, 2005, p. 1027). The incubation process was accelerated and influenced by the Internet revolution (Benghozi *et al.*, 2009; Grimaldi, Grandi, 2005), and its positive feedback on high-tech businesses. Specifically, ICT are one of the key factors in the emergence of the third generation SPs focusing more on the needs of the hosted tenants and collaboration with universities and research centers.

To sum up, the role of SPs and incubators has clearly evolved over the years and one of the main challenges has been to foster the use of the ICT in order to provide more focused as well as more useful services to the tenant companies. Therefore, network relationship building and an international involvement have recently become some of the key factors in SP-incubator policy strategy (Conicella, Salvador, 2012; Salvador *et al.*, 2012).

In particular, Italy is characterised by a considerable heterogeneity of SPs concerning their size, the nature of the activities performed, and the ability to attract knowledge-intensive businesses (Colombo, Dalmastro, 2002). The first SPs were established in the 1980s with the Area Science Park of Trieste in 1982 (Bigliardi *et al.*, 2006), and the Tecnopolis Novus Ortus of Bari in 1985. Since the end of the 1990s, almost every Italian Region has at least one SP (Sancin, 1999), characterized by distinctive and almost unique peculiarities. Differences are observable also in the distribution of the total number of these structures in all the Italian regions (Salvador, Rolfo, 2011): the northern regions, hosting more SPs and incubators, also register a larger number of RSOs. Specifically, the

concentration in the North of the country may be related to the strong territorial imbalances in Italy that are among the sharpest in the European Union: the territorial distribution of innovation in Italy is concentrated in a very few northern regions, a phenomenon known as the “Italian innovative divide” (Iammarino *et al.*, 2009).

## **2.2 Literature review and research hypotheses**

Among the wide range of issues, the literature on RSOs has focused on understanding: (a) the heterogeneity of RSOs, (b) their impact on the local context, and (c) the effectiveness of SPs and incubators for the growth and development of these companies. The first branch includes three typologies of studies, which have been labelled by Mustar *et al.* (2006) as: (i) resource based studies, focusing on the resources of the firm as a differentiator and a predictor of competitive advantage; (ii) business model studies, underlining sectorial differences, technological regime and product market combinations of RSOs that generate growth; (iii) institutional perspective studies, emphasising the relation which RSOs have with their parent organisation, and how this relation influences their starting configuration and business model. The second one aims at testing the impact of RSOs on local development (see, amongst others, Iacobucci, Micozzi, 2013; Bathelt *et al.*, 2010; Braunerhjelm *et al.*, 2009), the reasons why these firms cluster around the location of their parent institution and linked structures (see, amongst others, Chiesa, Piccaluga, 2000, and Salvador, Rolfo, 2011 for Italy; Egelin *et al.*, 2004, and Lejpras, Stephan, 2008, for Germany; Mustar, 1997, for France; Lofsten, 2012, for Sweden; Shane, 2004 for the US). The third branch investigates the effectiveness of SPs and incubators for the growth and development of the hosted companies (see, amongst others, Rowe, 2002, ANGLE Technology, 2003, Parry, Russell, 2000, Siegel *et al.*, 2003 for the UK; Mian, 1996, Rothaermel, Thursby, 2005 for the US; Colombo, Delmastro, 2002, Barbieri *et al.*, 2008, Salvador, 2011, Salvador, Rolfo, 2011 for Italy; Schwartz, Hornyk, 2010 for Germany; Yang *et al.*, 2009 for Taiwan).

In this section we specifically refer to those lines of analysis that underlined the characteristics of RSOs, in order to frame the research hypotheses that will be tested in section 4.

Several studies have investigated the main sector of activity of RSOs, revealing a prevalence of companies in the ICT and biopharmaceutical sectors (Mustar, 1997; Shane, 2004; Lindelof, Lofsten, 2004; Gupte, 2007; Netval 2010, 2011, 2013). While the Internet revolution has certainly a deep influence on the high number of companies in the ICT industry, according to Shane (2004) and Zhang (2009) possible explanations for the predominance of the biopharmaceutical sector are linked to long product development perspectives and to the universities’ expertise in the creation of biomedical inventions. Young firms in the biopharmaceutical industry usually spend many years on R&D activities before putting the first product on the market. Therefore, we might hypothesize that the condition of tenant companies of a SP-incubator may be important, given the possibility to use resources and laboratories. Therefore, the first hypothesis can be framed as follows:

*H1. On-park RSOs tend to operate in the biopharmaceutical sector.*

Another aspect highlighted by the literature is about the national or international attitude of RSOs. Specifically, Chiesa and Piccaluga (2000) emphasised the international pattern of the Italian RSOs of their sample, which can be explained by the technology intensity of their businesses. Furthermore, Harrison and Leitch (2007) highlighted the small size of English RSOs, even when they were working for international rather than local and national markets. In general, most of the European RSOs are and remain very small in terms of employees, or they grow slowly (Mustar, 1997; Pérez Pérez, Sánchez, 2003; Clarysse et al., 2007; Mustar *et al.*, 2008). Despite this, SPs and incubators are strengthening their international networks and are fostering the international attitude of the hosted companies. Therefore, we expect on-park RSOs to exhibit a stronger international propensity than off-park RSOs thanks to the aid provided by the SP-incubator, and its international networking context. Hence, the second hypothesis is the following:

*H2. On-park RSOs tend to supply the international market.*

Another issue concerns the propensity of RSOs towards patenting. As stated by Breschi *et al.* (2008), in countries like Italy, France, Sweden, Finland and Germany the patent activity has attracted significant attention in recent years, indeed there exists a sizable and growing number of university-invented patents, that is inventions by one or more academic scientists whose intellectual property rights are assigned to business companies, governmental funding agencies or individual scientists. The total number of patents owned by European universities has increased quite dramatically since 2000. The increase is greater for countries with more recently established knowledge transfer infrastructures like TTOs: the number of university-owned patents increased between the mid-1990s and the mid-2000s in Italy and France (Geuna, Rossi, 2011).

Nevertheless, a recent investigation in Germany, undertaken by Fritsch and Krabel (2010), has pointed out that patenting experience is unrelated to scientists' appeal to work in the private sector. Academic entrepreneurs (compared to business entrepreneurs) tend to publish their results rather than to patent research outcome. The result is that patenting activity is hardly related to scientists' intention to become entrepreneurs, but it is positively related to start-up activity.

Thinking specifically about RSOs and SPs-incubators, a recent investigation undertaken in Italy and concerning the Bioindustry Park Silvano Fumero highlighted a scarce attitude to innovate through patents (Salvador *et al.*, 2012), an attitude that might be explained by a companies' young age and the existence of tacit know-how not still finalized in patents. Another element to be noted is the presence of possible patent strategies based on a few strong patents that, only after the review of patent authorities, could then be split into different sub-patents. Furthermore, Lazzeri and Piccaluga (2012)



highlighted that Italian RSOs with less intellectual property rights (IPRs, patents and/or licenses and/or trademarks) grow significantly more in total assets during the first years compared to firms with a great portfolio of IPRs at founding.

Given these assumptions, the third hypothesis can be framed as follows:

*H3. On-park RSOs are less prone to develop patents compared to off-park ones.*

The last consideration concerns the location of RSOs. As argued by Shane (2004), differences in access to capital, locus of property rights and licensing policy, rigidity of the academic labour market, and the industrial composition of the area, are the main factors explaining variation in RSO activity at the national level. Furthermore, Gilbert *et al.* (2006) identified geographic location as a compelling factor influencing new venture growth. Competition for resources that firms have to face in high-clustering locations has an influence on their ability to acquire key resources. In particular, an inability to acquire resources at a local level will have consequences on growth, because new ventures are highly dependent on the local environment for resources. Therefore, “*as there is an inequality of resources available in differing locations, a venture’s geographic location has strong implications for the growth it may be able to realize*” (Gilbert *et al.*, 2006, p. 933). For instance, greater access to financial capital is an advantage for a firm with growth ambition located in cluster regions like Silicon Valley, while inner city or rural firms are at a disadvantage in financial capital availability. Last but not least, given the fact that regions and universities are heterogeneous, according to Mustar *et al.* (2008), the nature of university-industry links may depend on the nature of the region (core and peripheral) in which a university is embedded. According to Lejpras and Stephan (2008, p. 5), “*the potential and quality of the firm’s location*” of spin-offs “*can be viewed as the sum of potential inherent in a variety of locational conditions*” (*i.e. regional availability of skilled labor or support from local government*). Therefore, we expect to find differences depending on location in a country like Italy, characterised by a historically North-South distinction in the innovation system (Iammarino *et al.*, 2009). Furthermore, as stressed by Nosella and Grimaldi (2009) the localisation of universities affects the generation of academic spin-offs, and universities located in the northern and more industrialised part of Italy are more likely to generate spin-offs, confirming the importance of a fertile local context to enhance the creation of new companies. Moreover, according to the Netval annual survey (2010, 2011, 2013): over 50% of the RSOs in the sample of analysis is located in the North of Italy, evidence which is confirmed by the recent descriptive analysis developed by Salvador (2011a) and Salvador and Rolfo (2011).

The validity of these hypotheses is tested in the next sections by means of an empirical analysis using a sample of 155 Italian RSOs.

### 3. Data and methodology

The empirical analysis is based on a comprehensive survey of Italian RSOs through face-to-face interviews and a questionnaire (for a detailed overview, see a previous work by Salvador and Rolfo, 2011). The main problem was to identify the actual number of RSOs founded in Italy, because an official, complete and updated list of RSOs at the regional or national level does not exist. In Italy, indeed, each university adopts an autonomous policy. Thus, the first step was to look at the ILO, the TTO and the university websites to find a list of RSOs, and the second step was to verify the completeness and if it was updated. We decided to adopt a large definition of RSO including companies not participated by the university; therefore, the university list had to be completed with the Italian SP and incubator tenants' list. A final problem was due to the fact that SPs and incubators do not make any difference between RSOs and start-ups. Telephone and e-mail contact with university staff as well as SP and incubator personnel were pivotal in excluding start-ups from the final list.

The universe of RSOs identified in Italy was 419. Nonetheless, 394 firms have been effectively contacted, because 25 RSOs had the positive approval of the university at the time of the survey, but had not yet been established. Face-to-face interviews were carried out between September and October 2007 in some Italian RSOs selected as case-studies, and a questionnaire was sent between January and June 2008 to the universe of Italian RSOs. The response rate was 39.5%: 155 companies accepted to answer the questionnaire. Given the response rate, we can reasonably consider this sample as representative.

As underlined in the previous sections, similarities and differences between on-park and off-park RSOs have been investigated in the analysis undertaken by Salvador and Rolfo (2011), by means of descriptive statistics. The present paper corroborates the first results obtained by Salvador and Rolfo (2011) by means of a logit estimation relating the probability to be either on-park or off-park, and therefore, test the research hypotheses as previously framed.

The probability is expressed as follows:

$$F(x'i \beta) \text{ where } F(.) = \exp(.) / [1 + \exp(.)], \quad (1)$$

where  $\beta$  is the vector of coefficients; for the discrete choice we measure 0 if the firm is off-park, and 1 if it is on-park. The explanatory variables included in the analysis are the following:

- Capital\_Start – capital of the firm at the time of foundation.
- *Incentives<sub>p</sub>* - regional incentives and other facilitations (i.e. tutoring phase, incentives assistance) obtained by the firm (dummy), at the time the questionnaire has been filled.
- Age – the number of years from the foundation.
- Patent – patents developed by the firm (dummy), at the time the questionnaire has been filled<sup>6</sup>.

<sup>6</sup> This variable variable takes the 0 value if off-park firms did not develop any patent, and if on-park ones did not develop any patent in the period they have been hosted inside the SP/incubator. *Viceversa*, the variable takes the 1 value if off-park firms developed at least a patent, and on-park firms developed a patent during the period in the SP/incubator.

- Macroarea – geographical macro-area where the firm is located (dummy).
- Market – firm market orientation (dummy).
- Sector – firm sector (dummy).

The equation suggests that the variables that may influence the probability of an RSO being located in an incubator-SP are: (i) capital of the firm at the time of foundation; (ii) regional incentives and other facilitations obtained by the firm; (iii) firm age; (iv) willingness to develop patents; (v) firm location (macro-area); (vi) market (regional, national, international); (vii) sector.

## 4. Empirical analysis

### 4.1 Descriptive statistics

The present section describes the results of the descriptive statistics carried out on the sample of firms, consisting of 65 on-park RSOs<sup>7</sup> and 90 off-park RSOs. More than half of the sample is settled in the North of the country: the supremacy of the North is confirmed in the two groups of firms, but the North-west macro-area accommodates a more significant number of on-park RSOs (31) compared to off-park firms (14) (Table 1).

**Table 1: The macroarea of location of spin-offs (absolute number and percentage)**

	Centre	North east	North west	South&Islands	Tot.
<b>Off-park</b>	25 (28%)	29 (32%)	14 (16%)	22 (24%)	90 (100%)
<b>On-park</b>	10 (15%)	16 (25%)	31 (48%)	8 (12%)	65 (100%)
<b>Tot.</b>	35 (23%)	45 (29%)	45 (29%)	30 (19%)	155 (100%)

**Table 2: RSOs: sector, market and patent**

	Off-park	On-park
<b>Sector</b>		
<b>Automobile industry</b>	13%	9%
<b>Biopharmaceutical</b>	13%	40%
<b>Engineering</b>	29%	17%
<b>ICT</b>	36%	31%
<b>Other</b>	9%	3%
<b>Missing</b>	0%	0%
<b>Tot.</b>	90 (100%)	65 (100%)
<b>Market</b>		
<b>International market</b>	34%	55%
<b>National market</b>	56%	34%
<b>Regional market</b>	10%	9%
<b>Missing</b>	0	2%
<b>Tot.</b>	90 (100%)	65 (100%)
<b>Patent</b>		
<b>Without patent</b>	72%	75%
<b>With patent</b>	27%	25%
<b>Missing</b>	1%	0%
<b>Tot.</b>	90 (100%)	65 (100%)

In line with the literature, most of the on-park firms operate in the biopharmaceutical (40%) and the ICT sectors (31%), while off-park RSOs are mostly found in the ICT (36%) and engineering sectors (29%), (Table 2). As far as the market is concerned, 55% of on-park RSOs operate in the international

<sup>7</sup> It is defined on-park RSO a firm that has been hosted in a SP/incubator for a certain time in its life (that is before or during the survey has been carried out).

market while only 34% work on the national one (Table 2). It can, therefore, be argued that notwithstanding their small size, Italian RSOs have a high international attitude and they are strongly not limited to the local-regional level. This result is coherent with the literature (Chiesa, Piccaluga, 2000; Harrison, Leitch, 2007). Besides, it seems that, on average, off-park RSOs are slightly more prone to develop patents than on-park firms (Table 2).

**Table 3: Capital of the RSOs**

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<b>On-park</b>					
<b>Capital</b>	64	22148.95	25413.67	516	100000
<b>Off-park</b>					
<b>Capital</b>	88	30811.65	41898.19	2000	300000

**Table 4: Value added and university regulations – NUTS3 provinces**

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<b>Provinces On-park</b>					
<b>VA tot</b>	65	49641.08	4303.6	39606	60450
<i>Univ Re gulat<sub>p</sub></i>	65	1.769231	1.057255	0	5
<b>Provinces Off-park</b>					
<b>VA tot</b>	90	47876.56	5950.196	35069	60450
<i>Univ Re gulat<sub>p</sub></i>	90	1.488889	1.282943	0	5

As far as the size is concerned, on-park firms are on average small, in terms of capital at the time of foundation: they are from 1/4 to 1/3 smaller than off-park ones (Table 3). The last consideration concerns the characteristics of the provinces where the two groups of firms are located. As expected, the provinces hosting the sample of on-park firms show a higher value added, that is they are more competitive, and reveal a larger number of universities that have issued regulations to support RSOs (Table 4).

#### 4.2 Econometric findings

This section aims at corroborating the results of the descriptive statistics by means of an econometric analysis, which investigates the characteristics of on-park and off-park RSOs, and aims to test the hypotheses framed in section 2.2.

We computed a logit estimation to see whether the differences between on-park and off-park RSOs are significantly different from zero. The results can be found in Table 5. We ran four regressions in sequence, including macro-area dummies in models 1, 2, 3, and sector dummies in models 2, 3, 4 to control for fixed effects.

**Table 5: Results of the logit analysis**

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>
<i>Capital_Start</i>	-0.4271*	-0.4381	-0.3949	-0.4829*
<i>Incentives<sub>p</sub></i>	1.1882***	1.0890***	1.3375***	1.0948***
<i>Age</i>	0.1762	0.1892	0.1016	0.2443
<i>Patent</i>	-1.1203**	-1.9091***	-1.8172***	-1.9483***
MA_Northwest	2.0896***	2.1295***		2.286***
MA_Northeast	0.4744	0.4377		0.4364
MA_S&I	0.2970	0.4435		0.1799

Sector_ICT		-1.4704***	-1.8110***	-1.6357**
Sector_Engineering		-1.2139**	-1.6503***	-1.3188*
Sector_Automobile		-0.0314	-0.0617	0.1781
Sector_Other		-0.0842	-0.6140	0.0940
Market_regional			0.5055	1.300
Market_national			-0.9328***	-0.6866
Cons.	2.4618	3.5108	4.6128**	4.1164
Log likelihood	-77.2573	-66.2945	-70.7198	-62.5890
Pseudo R <sup>2</sup>	0.21	0.27	0.21	0.30
N.	143	133	132	132

Notes:

\*\*\*, \*\* and \* mean results are significant at the 1%, 5% and 10% level respectively.

The reference group for MA (macroarea) is the Centre, for Market is the international market, for the sector is the biopharmaceutical one.

The comparison shows that these two sets of firms differ significantly on the following accounts. In all the models on-park companies exhibit a higher probability to be positively affected by incentives/facilitations provided by the region of location probably because they have higher access to public subsidies (Colombo, Dalmastro, 2002), and because, as expected, have a significant higher probability to be located in the northwest area. The North of the country and specifically the northwest offers to RSOs a better access to key resources: skilled labour force, agglomeration economies, knowledge spillover, and infrastructure networks (including universities and SPs-incubators). The North west of Italy, indeed, shows the highest GDP per-capita, accommodates about 57% of the total inward FDI (Mariotti, Mutinelli, 2009), and hosts the most technologically oriented sectors.

As far as the sector is concerned, on-park firms show a higher probability to operate in the biopharmaceutical sector, than in the ICT and engineering sectors, if compared to off-park ones. The predominance of this sector within SPs and incubators confirms the evidence highlighted in the literature by Shane (2004) and Zhang (2009): long product development horizons and several years spent on R&D activities before putting the first product on the market. Therefore, being settled in a SP-incubator, where resources and laboratories are available, might play a fundamental role. These results confirm that H1 is tested:

*H1. On-park RSOs tend to operate in the biopharmaceutical sector.*

Besides, on-park firms exhibit a higher propensity to supply the international market, than off-park ones. The international orientation might be linked to the sector specialisation, which mainly concerns technological intensive industries. Moreover, the propensity of on-park firms to deal internationally may be explained by the affiliation to SPs-incubators, where international networks are more easily available.

Thus, H2 is tested:

*H2. On-park RSOs tend to supply the international market.*

As far as the patent issue is concerned, the investigation contributes to the open debate about RSOs and patents: the results of the empirical analysis confirmed that on-park RSOs are less prone to develop patents compared to off-park ones, thus H3 is accepted.

*H3. On-park RSOs are less prone to develop patents compared to off-park ones.*

Finally, on-park RSOs exhibit a lower capital at the time of foundation, while the explanatory variable Age is positive and not significant.

## **5. Concluding remarks and policy implications**

The aim of the present paper was to investigate similarities and differences among RSOs incubated within a SP/incubator (on-park RSOs) and RSOs that developed outside these supporting structures (off-park RSOs). Understanding the heterogeneity, characteristics, gaps, and needs of these firms is an open debate and has implications for the design of better targeted public policy measures.

To this aim, three main hypotheses have been framed and tested by means of an econometric analysis. The results of the logit model confirmed that Italian RSOs hosted by a SP-incubator operate in the biopharmaceutical sector, they are more internationally oriented, and less prone to develop patents compared to off-park RSOs. Moreover, on-park RSOs benefit from financing and other kind of facilities provided by the Italian regions. Last but not least, the reliability of our model has been proved by the confirmation of the evidence found in the literature about the Italian innovative divide: the results highlight that on-park RSOs tend to be located in the northwest of Italy.

The predominance of the biopharmaceutical sector is related to the need for this industry to be supplemented by the use of expensive equipment and laboratories, since it usually spends many years on R&D activities before putting the product on the market (Shane, 2004; Zhang, 2009). The technology intensity of RSOs makes them “international oriented”, and on-park RSOs even more if compared to off-park ones, because the hosting structures facilitate and foster the development of international networks. Besides, on-park companies tend to be smaller than off-park ones in terms of capital at the time of foundation, and less involved in patenting activities. These two aspects are very much related: on the one hand, smaller firms are more willing to benefit from incentives and location in advanced structures; on the other hand, RSOs may be more prone to develop a patent after the incubation period.

What can we assume from these results? They seem not only to confirm the evidence found in the literature, but also to add some significant insights, that might be useful for future improvements in SPs-incubators policy strategy. SPs and incubators provide, indeed, a good ground of development for those firms smaller in size, specialised in a sector requiring investments in equipment and laboratories (i.e. the biopharmaceutical one), and more willing to operate on the international market. These firms are expected to be high value added and innovative, and they are a means of knowledge diffusion, contributing to local economic development and growth (Balderi et al., 2007). Therefore, fostering

their growth and development must be advocated, although it requires huge public investments in financing structures like SPs and incubators. The establishment of such structures is pivotal in a country like Italy where most new firms are in the mature low-technology industries (Bianchi et al., 2010), and where the national innovation system is rather weak. SPs and incubators, indeed, aim to deal with market failures relating to the knowledge gap and other inputs of the innovative process (i.e. firms' innovative activities such as technical, financial, and other business services, access to external financing), (Colombo, Delmastro, 2002).

Further research might focus on the differences in size and age of on-park RSOs compared to off-park ones, and on the related consequences for firm performance, in order to shed more light on such an intriguing and unexplored aspect. SPs and incubators may become “decisive” factors for the hosted companies (Salvador, Rolfo, 2011), and, as stated by Salvador (2011), they “could” be good brand names for RSOs. However, as highlighted by the empirical analysis of the present paper, there are still some gaps that need to be filled. To this aim, the performance characteristics, the needs and more generally the point of view of the incubated companies should be the starting point for future policy strategy improvements. SPs and incubators should enhance activities internationally oriented as well as networking initiatives with personnel in similar structures abroad in order to help on-park RSOs to reach qualified goals after the incubation period.

Nonetheless, it is important to highlight that this study suffers from some limitations and potential biases. The population of Italian RSOs did not cover the universe, and the study focused on the Italian context, thus, not providing a cross analysis with other European countries. Furthermore, this analysis relied on data covered in a given time period, not providing an analysis able to monitor the characteristics of on-park and off-park firms within a broader time frame. However, many of these shortcomings are common to most recent empirical investigations in this field. Notwithstanding these limitations, given the difficulty of obtaining reliable official data, this analysis highlighted interesting findings. Specifically, the results served for better understanding the main characteristics of Italian RSOs located in a SP-incubator, and the pivotal role of these structures in the development and growth of such firms. Moreover, these results contribute to the steps in progress for better understanding the potentialities and usefulness of SPs and incubators for RSOs' survival and growth and they stimulate further research along this line.

### **Acknowledgements**

Financial support from the Italian National Research Council (CNR) award under the ‘Promotion of Research 2005’ programme, Project for young researchers (Elisa Salvador, grant number 263/229), is gratefully acknowledged.

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