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“Are science parks and incubators good “brand names” for spin-offs? The case-study of Turin”

Abstract: In recent years there has been an increasing focus on universities’ entrepreneurial orientation and their ability to exploit and transfer scientific knowledge to the commercial sector. Spin-off firms are recognised as an important opportunity for universities. This paper aims to examine the university spin-off firm context, with particular attention to the relationship with science parks-incubators and their importance as brand names. Evidence is taken from Turin case-study. Turin has a consolidated university framework: the University and the Polytechnic are examples of success all around Europe. A particular characteristic of Turin is given by the presence of two science and technology parks and two incubators.

JEL Codes: O3; L2

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

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1. Introduction

“There is much to be learned about science parks, in general, and their influence on university activity, in particular” (Link, Scott, 2003, p. 1350) and *“more generally, the place of university research parks in a national innovation system is not yet well understood”* (Link, Scott, 2007, p. 662). In order to provide a contribution towards this direction, the present paper aims to highlight whether science parks and incubators can be considered as good “brand names” for a particular kind of firm like the research spin-off one. Evidence is taken from Turin and the Province research spin-off firms context. Turin is located in Piedmont Region in the North of Italy. According to the European Innovation Scoreboard 2006 (ProInnoEurope, 2006), Piedmont is the third Italian Region in the final classification of European Regions. Piedmont Region, the Province, the Chamber of Commerce, banks, foundations, incubators and science parks are establishing partnerships with the aim to support and foster the creation of start-up and spin-off companies. With more than 860,000 inhabitants Turin has a well known and consolidated university framework: the University and the Polytechnic are examples of success all around Europe. Given this strong scientific background, since the 1990s the Region has focused on policies aimed to sustain initiatives like incubators and science and technology parks. The pressure exerted by the Internet bubble since 1996 has pushed further the founding of incubators (Serazzi, 2005). The existence of a formal structure such as an incubator inside the university indicates importance to spin-off activity (O’Shea *et al.*, 2005). In this context, Turin is an important case-study, not only because it has prestigious and consolidated universities, but also because it has two university incubators, I3P and 2I3T, and two science and technology parks, the Environment Park and the Bio-Industry Park.

In this paper we provide original evidence on research spin-offs located in Turin. Our empirical investigation is based on subjective data based on perceptions and judgements of a questionnaire respondents and on objective data taken from balance sheets. Therefore, we made use of primary data sources that captured data directly from the spin-off firm as well as of secondary data obtained from Aida data bank. Given the general difficulty of obtaining useful and reliable data on research spin-off companies (Zhang, 2009; Clarysse *et al.*, 2007; Shane, 2004), we decided to focus on the results coming from an empirical investigation on self-evaluation by research spin-off firms and to complete this survey with a comparison between a sample of spin-offs with a matched sample of start-ups.

Turin research spin-offs are micro firms but they deal on the international markets and they work in the most crucial sectors for regional development plan. These firms do not show a rapid growth (Autio, 1997), but there is a perception of growth aspirations. Personal and family capital and public money are the most used funding sources. The actual problem is that an institution monitoring the several funding sources at public level does not exist. According to the results of this survey, the hypothesis to be examined in this paper is that science parks and incubators can play the role as brand names for spin-offs, but an effective aid more oriented to the needs of spin-offs is required. The completeness of the section dedicated to the incubator-science park and spin-off relationship and the recurrence in answers of the positive role of these structures are key insights in order to confirm our assumption. Nonetheless, the lower performance of spin-offs compared to start-ups highlighted a need for improvement. Given the growing role of science parks in helping universities balance their 21st century missions in education, research and commercialization (Wessner, 2009), one of the key challenges is to address the issue of how to align the needs of the tenants with the objectives of the university as well as of the science park-incubator. We can add to this assertion that according to the statistical results of Link and Scott (2007; 2003, p. 1348) *“the organizational nature of the university-park relationship is important”*. With this in mind, the establishment of a “task force” comprising university and science park-incubator staff, specifically dedicated to tackle funding problems and to monitor the improvement of management competence and the achievement of spin-off credibility on the market, could be an advisable solution.

The paper is divided in two parts. In the first one, the university attitude towards this phenomenon (Section 1) and a brief survey on science parks and incubators and their role as “brand names” (Section 2) are presented. The second part is focused on a description of the methodology applied in order to analyze the spin-off universe (Section 3) and on the illustration of the main results coming from the questionnaire (Section 4). Section 5 completes the survey with a regression model aimed to compare a sample of spin-off respondents with a matched sample of start-ups. A discussion of these results follows (Section 6). Finally, Section 7 highlights our conclusions.

2. The University attitude towards spin-off firms

Regional policies regard spin-off firms as an important mechanism of development of university-industry relationships and creation of employment and wealth. Universities, as well, regard spin-off firms as a pivotal tool for valorization of research results (European Trend Chart on Innovation, 2002; Wright, Vohora, Lockett, 2004; Shane, 2004). The positive attitude of universities towards spin-offs is a recent phenomenon (Clarysse *et al.*, 2002; Degroof, Roberts, 2003, 2004; Wright, Vohora, Lockett, 2004; Piccaluga, Balderi, 2006), and it is due most of all to the influence of the US Bayh-Dole Act of 1980 and to the change in the traditional mission of universities towards a more active participation in regional economic development (Benneworth, Charles, 2004; Stuart *et al.*, 2007; Gupte, 2007). In 2003 in a communication on the role of universities in the Europe of knowledge the European Commission underlined the importance to intensify effective and close cooperation between universities and industry: “...it is vital that knowledge flows from universities into business and society. The two main mechanisms through which the knowledge and expertise possessed and developed by universities can flow directly to industry are the licensing of university intellectual property, and spin-off and start-up companies.” (Commission of the European Communities, 2003, p.7; Verspagen, 2006).

In recent years the research spin-off phenomenon has been considerably intensified (Benneworth, Charles, 2004; Piccaluga, Balderi, 2006), also because of lack of funds in university and because of greater autonomy of universities in the establishment of spin-off firms (Chiesa and Piccaluga, 2000; Clarysse *et al.*, 2002; Baldini *et al.*, 2007). Universities are more business oriented and engaged with commercialization of research discoveries (O’Shea *et al.*, 2005; Powers, McDougall, 2005; Wright, Birley, Mosey, 2004; Goktepe, Etzkowitz 2005; Piccaluga, Balderi, 2006; Stuart *et al.*, 2007; David, 2007). Rather than “ivory towers” devoted to the pursuit of knowledge for its own sake, universities are now regarded as instruments for knowledge-based economic development and change (Mowery, Sampat, 2005). Shane (2004) underlined the pivotal importance of the university support. A lasting relationship with the parent institute is very often useful for the success and growth of the firm. The transfer of technology from universities to the market has historically been dominated by licenses, but this is not the only solution available for universities and academics that want to have the best benefits from the exploitation of university discoveries¹. In recent years the increasing attention devoted to research spin-off firms (Wright, Birley, Mosey, 2004; Benneworth, Charles, 2004; Landry *et al.*, 2006), which are one of the alternatives to licenses on the one hand (Druihe, Garnsey, 2004; Degroof, Roberts, 2003) and a useful tool to utilize patents on the other hand, has produced consequences also on public policy strategies. In the mid-1990s a policy for the introduction of acts like the Bayh-Dole one in the US and for financial support to professionalize technology transfer services in order to support the creation of spin-offs was set up by European universities (Mowery, Sampat, 2005). This led to an immediate boost of spin-offs (Wright *et al.*, 2007). Given the results reached by these companies, one of the first findings was that financial support programmes were not enough. Researchers were not able to build a business plan. Since the end of the 1990s, several programmes to help researchers in the start-up stage were introduced by governments. Furthermore, policies to support the establishment of spin-offs include legislation on IP and initiatives to bridge the knowledge and finance gaps, like national incubator programmes to provide active coaching to start-ups and increasing attention devoted to professionalize the organisation of Technology Transfer Offices (TTOs). If we consider public support initiatives of incubation and spin-off incentive activities, competitions to incentivate the establishment of spin-off firms were introduced in most of the European countries, both at regional and national level (Wright *et al.*, 2007). In this context, incubator and science park structures are important policy tools to support start-ups evaluated as the most promising, including also spin-offs (O’Shea *et al.*, 2005; Link, Scott, 2007). According to Wright *et al.* (2007), following the creation of science parks in the 1980s, incubators have become a key instrument used by universities in the 1990s with the aim to promote the setting up of start-ups. These incubators are mainly financed by public money and have strong links with authorities at regional and local level (Hackett, Dilts, 2004b). Notwithstanding, “while much attention has been devoted to the description of incubator facilities, less attention has been focused on the incubatees...” (Hackett, Dilts, 2004b, p. 74).

¹ On this topic see: Lockett *et al.*, 2003; Lockett *et al.*, 2005; Moray, Clarysse, 2005; Wright, Birley, Mosey, 2004; Thursby and Thursby, 2002; Balconi, Breschi, Lissoni, 2002; Goktepe, Etzkowitz, 2005; Wright, Vohora, Lockett, 2004.

3. Science parks and incubators as “brand names” for spin-offs

Science parks are an innovation that diffused throughout the second half of the twentieth century (Link, Scott, 2003). There is no generally accepted definition of a science park (Link, Scott, 2003; Link, Link, 2003; Wessner, 2009). A number of definitions of a science park have been proffered in recent years (Link, Scott, 2006). The emphasis is on technology transfer from the university, on the knowledge flow and on regional economic growth. The term “science park”² is usually used to describe a property based initiative that has formal and working links with a university or other higher education institution or research centre. A science park 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, 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).

The earliest parks were established in North America in the 1950s (Cesaroni, Gambardella, 1999; Colombo, Delmastro, 2002; Link, Scott, 2003; Link, Link, 2003; Wessner, 2009). Park formations increased sharply in the late 1970s and early 1980s in all countries also under the stimulus of the Bayh-Dole Act and the passage of several technology initiatives in the early 1980s (Link, Scott, 2007, 2006, 2003). In Europe, science parks are concentrated in France and the United Kingdom (Sancin, 1999). In Italy the first science parks were established in the 1980s. Area Science Park of Trieste has been the first Italian experience in this field, dated 1982. Tecnopolis Novus Ortus of Bari founded in 1985 was the second one. Several other examples followed in the coming years. Since the end of the 1990s, almost every Italian Region has at least a science park (Sancin, 1999). In the absence of an agreed and clear policy, the Italian science park context is characterized by particularities such that every science park denotes distinctive and almost unique characteristics, not only due to regional needs. Diversity is an important characteristic of science parks well underlined in the literature (Wessner, 2009). According to Link and Scott (2003, p. 1325) and to Link and Link (2003, p. 81), “*The definition of a research or science park differs almost as widely as the individual parks themselves*”. In Italy it is possible to find science parks of huge dimensions, like Bioindustry Park of Canavese and Environment Park of Turin, as well as less consolidated structures, in particular in the South of Italy. Notwithstanding their dimension and heterogeneity, the rationale for the creation of science parks may be considered proximity to university laboratories and research centers, the presence of an incubator, the creation of networking opportunities, the role as bridging institution providing tenant firms with suitable accommodations and technical and business services (Colombo, Delmastro, 2002; Link, Scott, 2003, 2006, 2007). The presence of an incubator is a pivotal factor. Since the 1960s (Hackett, Dilts, 2004b), structures providing a supportive environment and shared facilities for helping the establishment of young firms as well as their development and maximization of their growth and rate of survival, were established in the industrialized countries. These structures are referred to as “incubators”³. The concept of incubation evolved over the years and there are three current generations of incubators, characterized by differences in business support services. The first generation incubators provided physical space and basic shared facilities. The second generation provided more specialized business support services, like counselling. The third generation, referred to as networked knowledge incubators, appeared at the end of the 1990s, with availability of networking for the sharing of knowhow and the promotion of best practices among entrepreneurs. The incubation process was accelerated by the Internet revolution and its positive feedback on high-tech businesses. Thanking to the ICT revolution and the emergence of the Internet (Benghozi *et al.*, 2009), incubator projects began spreading first in the US and second in Europe. The growth since 1980 in the number of US business incubators suggests that it was desirable to try to help “weak-but-promising” firms to avoid failure by incubating them (Hackett, Dilts, 2004, 2004b).

The incubator model is frequently developed within a science park structure, of which an incubator is an important cornerstone. In our case-study, I3P and 2I3T are not located in a science park, but they are structures developed near university laboratories and departments⁴ (see Appendix).

The question whether science parks are really effective in supporting young firms is still without an agreed answer.⁵ In general, the growth in science parks has fostered an academic debate concerning whether

² The term “science park” is more prevalent in Europe, while the term “research park” is more prevalent in the United States and the term “technology park” is more prevalent in Asia (Link, Scott, 2007, p. 661).

³ An extensive review of the literature on incubators and a list of definitions culled from the literature is provided by Hackett, Dilts (2004b).

⁴ For a comprehensive discussion on the distance between the science park and the university campus and the importance of proximity, see Link, Scott, (2007), Link, Scott (2006), Link, Scott (2003), Wessner, ed., (2009).

such initiatives directly enhance the performance of corporations, universities and economic regions over time (Link, Scott, 2007). A specific interest in identifying best practices in the formation and operation of such parks emerged. “*Unfortunately, few academic studies directly address these issues*” (Link, Scott, 2007, p. 662). In Italy a few years ago Colombo and Delmastro (2002) tried to provide a contribution through an empirical investigation on the Italian context. Their findings proved that science parks are an important tool of a technology policy fostering the development of new technology-based firms. This paper tries to contribute to the debate on the effectiveness of science parks and incubators that work as “brand names” for research spin-offs. The selection criteria applied by I3P and 2I3T tend to filter good entrepreneurial projects, but the potential success of these business ideas cannot be given for granted. The lack of managerial and business competences and the lack of credibility of a particular kind of firm like the research spin-off need to be supplemented by the aid of a structure like an incubator or a science park, that may serve a function of “certification” for spin-offs (Akerlof, 1970) and may help develop management competence. The knowledge potential of a research spin-off firm is not enough. It has to be linked to a structure that works as a solution to the needs of the single spin-off firm, taking into consideration that these particular firms suffer a lack of information on potential funding sources. An important initiative is given by the agreements initialed by Michelin Foundation, SanPaolo IMI and Unicredit Banks, Unionfidi and I3P incubator. These agreements are significant examples of partnerships between public and private actors at regional level with the aim to create wealth and employment. The agreement with Michelin foundation, founded in 2003, and Unionfidi has been introduced in 2007 and it provides forgivable loans at favourable conditions for spin-off firms hosted within I3P incubator (a similar agreement is in progress with 2I3T incubator) and that create new workplaces in a period of 3-5 years. Another bank and Unionfidi agreement introduced in 2006 with I3P and in 2007 with 2I3T gives start-ups the possibility to obtain financing without guarantees and with a favourable interest rate. The aim of these initiatives is to provide effective aid in the start-up stage of high-knowledge companies coming from the Polytechnic and the University. These actors are not able to evaluate the quality of a spin-off project and, therefore, they rely on the judgement of a structure like an incubator-science park, which works as a “brand name” for tenant companies.

4. The empirical investigation: the methodology applied

The empirical analysis is based on a comprehensive survey of research spin-off firms established in Turin and the Province. The idea to investigate the case of Turin to prove the importance of incubators and science and technology parks as brand names for spin-offs has been due first of all to the presence of two incubators, I3P and 2I3T, and two science parks hosting start-ups and spin-offs, the Environment Park and the Bio-Industry Park (see Appendix). Second, Turin has both a University and a Polytechnic. Turin is located in Piedmont Region in the North of Italy. According to the European Innovation Scoreboard 2006 (ProInnoEurope, 2006), Piedmont is the third Italian Region in the final classification of European Regions and it is listed at 73rd position, just after Lombardy Region (71st position) and not so far from Lazio (44th position). This result is a crucial evidence of the importance of Piedmont Region and it makes Turin an interesting case-study. Furthermore, in 2004 started the reform of cohesion policy to deliver the Lisbon Strategy (2007-2013) with the aim to foster structural interventions according to Lisbon and Gothenburg goals. The two aims for Regions ex objective 2, like Piedmont, are “Regional competitiveness and employment” and “European territorial cooperation”. Both these aims highlight the importance of “Innovation and knowledge-based economy” as well as the exploitation of university and business entrepreneurship and the creation of financial tools and incubators. Piedmont Region has considered these goals as key strategic policy objectives. Piedmont is characterized by a strong and wide industrial sector. The assets of the re-launch of Lisbon Agenda, approved by the European Council in 2005, find correspondence in Piedmont socio-economic context and are at the base of the regional development plan. Piedmont, Lombardy and Lazio are the first Italian regions for R&D expenses. Furthermore, Piedmont is characterized by a strong specialisation in aerospace technologies, ICT and transports (Piedmont Regional Council, 2006). These particularities make Turin an interesting case-study in terms of exploitation of scientific results and thus in terms of spin-off firms.

The main problem was to identify the actual number of spin-off firms founded in Turin and the Province, because there is no official, complete and updated list at the regional or national level. In the

⁵ See Rowe (2002), ANGLE Technology (2003), Parry, Russell (2000); Siegel *et al.* (2003) for the UK; Mian (1996) and Rothaermel, Thursby (2005) for the US; Colombo, Delmastro (2002) for Italy.

absence of such a list, it is also impossible to identify how many spin-offs have been established and how many of them are still working. In this context, each university adopts an autonomous policy. Piedmont Industrial Liaison Office (ILO) is in charge of supporting spin-off firm initiatives. The first step was to look at ILO, Turin university and the Polytechnic websites for a list of spin-offs and the second step was to verify the completeness and updating of this list. Another problem was due to the fact that the university takes care only of spin-offs participated by the university itself. Because of the fact that we decided to adopt a large definition of spin-off including also spin-offs not participated by the university, the university list had to be completed with the science park and incubator tenants list. A final problem was due to the fact that science parks and incubators do not make any difference between start-ups and spin-offs. Telephone and e-mail contact with University staff as well as science park and incubator personnel were pivotal in filling this gap and in excluding start-ups from the final list.

The universe of spin-off firms⁶ we identified in Turin and the Province was 45. This paper is the result of face-to-face interviews carried out between September and October 2007 in Turin university spin-off firms selected as case-studies and of a questionnaire sent to all the universe of spin-offs. The response rate was 70%: 30 spin-offs accepted to answer to the questionnaire, 2 refused because of lack of time and privacy, while 13 did not reply at all to the e-mail with the questionnaire attached. We can reasonably consider this sample as representative. The questionnaire was sent by e-mail to spin-offs between January and March 2008 with information about the purpose and details of the survey. An e-mail reminder was sent to spin-offs that did not reply to the first e-mail within a month.

The idea of a questionnaire as a method of analysis was introduced because of the difficulties in collecting face-to-face interviews in the universe of spin-offs and because of the necessity to have a standard set of questions for a comprehensive investigation. Furthermore, spin-off founders expressed preference for a written questionnaire instead of an interview because of lack of time and agenda organization. A written and standard questionnaire has the key advantage of giving standard answers available for an overall analysis and it helped obtain a high response rate, that gave us the possibility to overcome the limits of subjectivity in some answers. Main disadvantages of this tool of analysis are linked to the difficulty of highlighting specific particularities of each spin-off firm beyond the structure of the questionnaire, but this gap was partially filled through previous face-to-face interviews with selected case-studies. Some interviews were undertaken before drawing up the questionnaire as a crucial tool in order to understand the general context and check the main aspects of examination. The face-to-face interviews were based on open questions divided into two sections: the first one gathered data on the history of the spin-off firm and the links with the university and the incubator. The second one was more oriented towards specific questions on funding sources used step by step during the life of the firm and the difficulties encountered. In general, the interviews lasted forty minutes-an hour. The limits of a standard questionnaire were supplemented also by further information obtained through Internet searching. This approach enabled us to understand the most important features of this kind of firms and thus to draw up a questionnaire as much as possible linked to the particularities of spin-offs. Taking into consideration the results of the face-to-face interviews and the Internet searching, the final questionnaire was divided in the following sections:

- a) general characteristics of the spin-off firm;
- b) funding sources;
- c) university and spin-off firm relationship;
- d) incubator/science park and spin-off firm relationship;
- e) patents;
- f) industrial partnership;
- g) geographical location of the spin-off firm.

The first section contains a general description of the firm: year of creation, capital, number of shareholders, number of employees, turnover, field of activity, motivations for the creation of the firm, and so on. The second section investigates the funding sources during the start-up stage and during the growth one, and the difficulties encountered during management activities, the relationship with venture capitalists and banks. The third section analyses the relationship between the spin-off and the university: the university attitude towards the spin-off initiative, the spin-off interest in having the university as a shareholder of the firm, advantages and disadvantages of the university participation. The fourth section comprises deep questions concerning the incubation of the spin-off firm. The section analyses advantages and services used

⁶ In this paper we include in the category all spin-offs coming from the research world with or without a university share and a patent, but established by university members and aiming to exploit research results.

as well as the gaps in the facilities provided. The fifth section investigates whether the spin-off has one or more patents. The sixth section is about the industrial partnership and the reasons that fostered this agreement and its implementation. The last section is devoted to the geographical location of the firm: where the spin-off was born, which are the main advantages and disadvantages of the location.

All these sections are linked and useful as a means of having a general and comprehensive framework of how a spin-off firm works and how important are the relationships with the parent institute and an incubator-science park. The respondents were invited to complete the questionnaire by filling in the space provided for open questions or by submitting answers to the multiple choice questions. In the following analysis we will focus on A, B and D sections: results relating to the other sections will be mentioned only when they are pertinent to the aim of the analysis. We provide descriptive tables with data useful for understanding the overall characteristics of the sample and for highlighting the main significant answers emerged from the multiple choice questions.

5. Main results from the questionnaires

We now focus on the 30 questionnaires. The estimation of the results of many questions is based on self-evaluation by the respondents. This was considered as the most reliable indicator given the difficulty in obtaining useful data on the Italian research spin-off phenomenon. And this way of analysis was followed also by the questionnaire investigation undertaken by Autio and Lumme (1998) as well as by Autio (1997). Similarly, Franklin *et al.* (2001) used a questionnaire to gather data on the perceived advantages and disadvantages of using academic and surrogate entrepreneurs in UK research spin-off companies and Ferguson and Olofsson (2004) analysed information provided by Swedish respondents on their perception of the science park location benefits they were receiving.

Turin spin-off firms are relatively young companies. Most of the spin-off firms analysed were established between 2005 and 2007 (see table 1). All but two are limited companies, one is a joint-stock company and another one is a limited partnership.

Table 1: Year of establishment

<i>Year</i>	<i>Spin-off firms</i>	<i>%</i>
1997	1	3.33
1999	1	3.33
2000	2	6.67
2002	1	3.33
2003	1	3.33
2004	1	3.33
2005	7	23.33
2006	6	20.00
2007	7	23.33
2008	3	10.00
Total sample	30	100.00

Initial and present capital is low (between 10,000 and 20,000 euro) with few exceptions (see table 2 for more details). Almost all the spin-offs with an initial capital exceeding 15,000 euro are product companies.

Table 2: Initial and present capital

<i>Initial Capital</i>	<i>Spin-off firms</i>	<i>%</i>	<i>Present capital</i>	<i>Spin-off firms</i>	<i>%</i>
1,291	1	3.33	10,000	11	36.67
10,000	12	40.00	10,400	1	3.33
10,400	1	3.33	10,500	1	3.33
10,500	1	3.33	11,000	1	3.33
11,000	1	3.33	12,000	2	6.67
12,000	1	3.33	13,000	1	3.33
13,000	1	3.33	15,000	3	10.00
15,000	3	10.00	35,000	1	3.33
35,000	1	3.33	40,000	1	3.33
40,000	1	3.33	50,000	1	3.33

50,000	1	3.33	51,646	1	3.33
51,646	1	3.33	64,000	1	3.33
64,000	1	3.33	100,000	4	13.33
70,000	1	3.33	387,893	1	3.33
100,000	3	10.00			
Total sample	30	100.00	Total sample	30	100.00

The number of employees is between 2 and 4. This finding is consistent with the literature. Mustar (1997) underlined that major successes of French research spin-offs in terms of job creation are rare, and Pérez Pérez and Sánchez (2003) underlined in the empirical investigation from university of Aragón's case studies that this kind of firm is not a significant source of employment. Also Zhang (2009) in an exploratory analysis on US venture backed companies found that research spin-offs are significantly smaller than other venture-backed start-ups in terms of employment. Clarysse *et al.* (2007) in an empirical investigation on European research spin-offs, which included Italy, found that the firms were overwhelmingly very small at start-up in terms of employees, with mean employment of 1.6 people.

The number of shareholders is about 4 or 5 and only in 7 cases⁷ at least one shareholder left the university to work full time in the spin-off firm. And this confirms the literature evidence that in general academics do not choose to leave the university job (Lockett *et al.*, 2003; Wright, Vohora, Lockett, 2004; Shane, 2004). 20 spin-off firms describe themselves as service companies while the other 10 declare to be product firms. The conceptual distinction between service and product orientated spin-offs has been confirmed in various empirical studies (Wright *et al.*, 2007; Mustar *et al.*, 2006).

The industry sectors (Figure 1) are most of all biotechnology and chemical-pharmaceutical (34%), aerospace and transport (23%), informatics and telecommunication (20%), environment (13%). These sectors are the ones in which Piedmont region is most specialised. More specifically, the majority of product firms work in the biotechnology and chemical-pharmaceutical industry and in the aerospace and transport one, while service companies highlight a similar distribution among the different sectors (Figure 2). Shane (2004) underlined that research spin-offs are concentrated in only a few industries, of which the most common are biopharmaceutical and ICT. Mustar (1997) found that 28% of French spin-offs were in biotechnology and 27% in ICT. Gupte (2007) found a prevalence of ICT (37.4%) and biotechnology (20.6%) fields in German spin-offs.

Figure 1: Spin-off companies: industry sectors

⁷ 3 product spin-offs and 4 service spin-offs.

Figure 2: Service and product spin-off companies: industry sectors

An interesting point is the international attitude of Turin spin-off firms: the answers revealed that 70% of the sample analysed deals on the international market, while 30% works on the national market and no-one is limited to local or regional market (Table 3). This is a pivotal confirmation of the importance of Piedmont region in Italy. All but two of product spin-offs deal on the international market. Therefore, we can argue that even if these companies are small and young, they have a high international attitude and they are strongly not limited to local-regional level. This high efficiency in the market focus may probably be due to the fact that, according to Autio and Yli-Renko (1998), small firms have strengths that cannot easily be replicated by a large firm, including entrepreneurial dynamism, internal flexibility and specialised expertise. Nevertheless, it is important to underline that in the case of research spin-offs these particularities are linked to a knowledge gap in management and business administration. According to Chiesa and Piccaluga (2000), that found a similar international focus in their empirical investigation on an Italian sample of spin-offs, this can be explained with the technology intensity of the businesses where spin-offs deal. Such contexts are often international by definition and there is nearly no room for purely local markets. And McDougall and Oviatt (1996) identified the phenomenon of companies which are international in focus from their founding date. Our results are also coherent with the findings of Harrison and Leitch (2007) highlighting that for the most part UK spin-offs appear to start and remain small, even when they are dealing on international rather than local and national markets.

Table 3: The spin-off firm deals on the market

Possible answers	Spin-off firms	%
1-local/regional	0	0.00
2-national	9	30.00
3-international	21	70.00
Total sample	30	100.00

It was difficult to obtain useful data on the performance because of the young age of these firms. More than half of the sample did not report any turnover in 2005 and 2006, while very different are the answers for 2007 and 2008 turnover expectations: see table 4 for more details. There are no significant differences between product and service spin-offs. Nevertheless, we can assume from these data that even if they do not highlight a strongly positive performance, there is a subtle difference that enables to deduce a trend towards positive and not negative results in the following years, also in terms of expectations. In short, these are “micro” firms rather than SMEs, according to the general classification of the European Union, but they deal on the international market and they have a positive expectation of growth. This result is a key confirmation of the literature evidence that in general new technology-based firms do not show a rapid growth (Autio, 1997). Nonetheless, in this case there is a perception of willingness to growth.

Table 4: Turnover

Limits	2005 turnover		2006 turnover		2007 turnover		2008 turnover	
	Spin-off firms	%	Spin-off firms	%	Spin-off firms	%	Spin-off firms	%
No turnover	20	66.67	15	50.00	9	30.00	2	6.67
Till 20,000 euro	2	6.67	2	6.67	3	10.00	1	3.33
Till 50,000 euro	1	3.33	2	6.67	4	13.33	6	20.00

Till 100,000 euro	2	6.67	1	3.33	3	10.00	2	6.67
Till 250,000 euro	0	0.00	4	13.33	4	13.33	5	16.67
Till 500,000 euro	1	3.33	1	3.33	0	0.00	2	6.67
Till 1,000,000 euro	3	10.00	2	6.67	3	10.00	2	6.67
Over 1,000,000 euro	1	3.33	1	3.33	1	3.33	2	6.67
No answers	0	0.00	2	6.67	3	10.00	8	26.67
Total sample	30	100.00	30	100.00	30	100.00	30	100.00

This sample of spin-off firms was asked to say which were the two most important motivations for the establishment of the firm. Contrary to what highlighted by Fini *et al.* (2009), the enhancement of academic status and personal prestige are not perceived as the most important incentives to foster the creation of a research spin-off firm. The answers revealed that the desire to transfer research results to the market and to work in a business way and with independence were the pivotal motivations. The independence attitude is a characteristic highlighted by recent studies (O'Shea *et al.*, 2005; Shane, 2004). The possibility to exploit research results plays an important and crucial part in deciding to establish a spin-off firm (see table 5 for more details). A consequent key problem is therefore the necessity to develop and learn management competence (Lockett *et al.*, 2003; Wright, Vohora, Lockett, 2004; Shane, 2004; Roberts, 1991).

Table 5: Reasons for the creation of the firm

<i>Possible answers</i>	<i>First choice</i>	<i>%</i>	<i>Second choice</i>	<i>%</i>
1-Lack of job in the University	3	10.00	2	6.67
2-Desire of independence	5	16.67	7	23.33
3-Desire to work in "a business way"	2	6.67	6	20.00
4-Use research results	10	33.33	6	20.00
5-Go from the idea to the market	9	30.00	4	13.33
6-Personal prestige	0	0.00	1	3.33
7-Other	1	3.33	2	6.67
No answers	0	0.00	2	6.67
Total sample	30	100.00	30	100.00

The answers to the solution adopted for the lack of managerial competence highlighted the importance of the link with a structure like a science park-incubator. A significant number of spin-off firms underlined "aid by the incubator" and "self-training" as key solutions for managerial incompetence (see table 6). This is an important evidence of the role that a science park-incubator with efficient and effective services could play in sustaining this kind of firms.

Table 6: Solutions for lack of managerial competence

<i>Possible answers</i>	<i>Spin-off firms</i>	<i>%</i>
1-External manager	3	10.00
2-Aid by the incubator	10	33.33
3-Self-training	9	30.00
4-Aid by the industrial partner	1	3.33
5-No lacks	7	23.33
Total sample	30	100.00

The 7 spin-off firms that reported no lack of managerial competence, specified that they benefited from the aid and support of a venture capital or an industrial partner or at least one shareholder had previous managerial experience and business development competence.

Another important finding is the one about the sources of finance used by this kind of firms in the start-up phase and in the development one. According to the questionnaire results the most used tools of finance are personal and family capital and the possibility to obtain regional, national or European grants through calls for competition (see table 7). The Start-Cup⁸ competition, the National Innovation Prize and the

⁸ Start-Cup competition has the goal to foster and support the creation of high knowledge companies, to promote regional economic development and to stimulate the entrepreneurial orientation of researchers. The outcome is in form

MIP initiative⁹ are well applied for funding sources. The use of the “3F” as a finance tool is a well known solution underlined in the literature (Roberts, 1991), but it would be interesting to understand also why this is one of the most diffused solutions for financing needs. According to the results of the interviews and the questionnaires, we can assume that personal and family capital is a common source of financing for spin-offs because of the difficulty of raising money from potential financiers due in most of the cases to lack of credibility and to the so-called liability of newness (Ferguson, Olofsson, 2004; Schwartz, 2009; Sofouli, Vonortas, 2007).

Table 7: Financial resources

<i>Possible choices</i>	<i>Yes</i>	<i>%</i>
1-Personal and family capital	21	70.00
2-Bank loans	3	10.00
3-Regional, National, European grants; Start-Cup; National Innovation Prize; MIP	24	79.99
4-VC/Business Angels	4	13.33
5-Support of credit	1	3.33
9-Other	2	6.67

This kind of firm is not interesting for a venture capitalist and spin-off firms themselves are not interested in obtaining a venture capital participation. Only 5 spin-off firms in the sample of 30 are participated by a venture capital society: they are all product companies. 3 of these 5 firms said that a “faster growth” has been the first benefit from a venture capital participation while the other 2 chose “competence improvement” as the second advantage. The remaining 25 spin-off firms are not participated by a venture capitalist and the most recurrent answers to the question “first and second reasons for lack of a venture capital participation” were as follows: desire of independence, lack of quality improvement, lack of interest by spin-off firms, lack of interest by venture capitalists, (see table 8 for more details). We can assume from these considerations that the independence attitude has a high influence in the absence of a partnership between a spin-off firm and a venture capital society, but it did not emerge a negative opinion on venture capital. Similarly, the empirical investigation undertaken by Mustar (1997) highlighted that in France the creation of research spin-offs relied much more heavily on public funding than on the availability of venture capital.

Table 8: Reasons for lack of venture capital participation

<i>Possible answers</i>	<i>First choice</i>	<i>%</i>	<i>Second choice</i>	<i>%</i>
1-Lack of interest by VC	4	13.33	1	3.33
2-Lack of interest by spin-off firm	5	16.67	1	3.33
3-Fear to lose the spin-off control	2	6.67	0	0.00
4-Desire of independence	2	6.67	5	16.67
5-Lack of VC standard requirements	0	0.00	1	3.33
6-Lack of agreement on growth goal	0	0.00	1	3.33
7-Negative opinion of VC	1	3.33	0	0.00
8-Lack of quality improvement	4	13.33	3	10.00
9-Risk aversion	2	6.67	2	6.67
10-Other	2	6.67	3	10.00
No answers	3	10.00	8	26.67
Not relevant	5	16.67	5	16.67
Total sample	30	100.00	30	100.00

The relationship with banks is another field of investigation. Half of the spin-off firms analysed highlighted the absence of any difficulties, while the others underlined the lack of competence by their own or by banks and the pivotal role played by the incubator (see table 9). According to Colombo and Delmastro

of awards, cash, training and advice services. The best business plans are awarded with cash prizes of 20,000 euro (first prize), 15,000 euro (second prize) and 10,000 euro (third prize). Additional prizes and grants are available.

⁹ Mettersi in Proprio (Start up your own business) is a support service to enterprise creation. It is made up of several integrated actions, with the aim to spread a culture of entrepreneurship, to stimulate new business ideas and to foster the start-up and development of successful companies. Mettersi in Proprio is a free service of the Province of Turin, funded by the European Union (European Social Fund), the Italian State (Ministry for Labour and Social Policy) and Piedmont Region.

(2002) banks generally lack the technical expertise necessary to assess the quality of a new technology-based firm, whereas new firms do not have track records on which banks may base their decisions.

Table 9: Relationship with banks

<i>Possible answers</i>	<i>Spin-off firms</i>	<i>%</i>
1-Difficult for lack of competence by spin-off firm	4	13.33
2-Difficult for lack of competence by banks	3	10.00
3-Pivotal aid of the incubator	4	13.33
4-Pivotal aid of the University	1	3.33
5-No difficulties	15	50.00
6-No relationship	1	3.33
No answers	2	6.67
Total sample	30	100.00

An important finding that highlights that this kind of firm is not very well aware of the opportunities available for raising finance is given by the answers to the question “Does it exist an agreement with more favourable conditions for spin-off firms hosted within the incubator?”. To this question 60% of the sample analysed said “no, it does not exist” and only 30% was aware of the existence of an agreement, with no significant differences between product or service spin-offs (see table 10).

Table 10: Agreement benefiting spin-off firms hosted within the incubator

<i>Possible answers</i>	<i>Spin-off firms</i>	<i>%</i>
Yes	9	30.00
No	18	60.00
No answers	3	10.00
Total sample	30	100.00

Section D analyses the relationship between the spin-off firm and the incubator or the science park. 26 spin-off firms in the sample of 30 benefited or are benefiting from the hospitality in one of the incubators-science parks. This high percentage enables us to investigate the perceptions of tenant companies on the importance of these structures. Table 11 provides a summary of the hosting period. Only 7 spin-off firms have finished their period of incubation, the other 17 spin-off firms are still in an incubator-science park. All but two of product spin-offs are incubator-science park tenant companies.

Table 11: Period of incubation

<i>Time period</i>	<i>Spin-off firms</i>	<i>%</i>
1999-2002	2	6.67
2000-2002	1	3.33
2001-2004	1	3.33
2003-2005	1	3.33
2003-2007	1	3.33
2004-2008	1	3.33
2005-	4	13.33
2006-	3	10.00
2007-	7	23.33
2008-	3	10.00
No answers	2	6.67
Not hosted	4	13.33
Total sample	30	100.00

The most important advantages coming from the hospitality are the possibility to use the services provided by the structure, the rent less expensive than on the market, the greater visibility (see table 12). And this is consistent with the findings by Squicciarini (2008) gathered through the questionnaire sent to a sample of on-park and off-park Finnish companies. Therefore, research facilities provided by the hosting structure are a crucial point, as yet highlighted by Link and Scott (2007). This is also a confirmation of the finding of the empirical investigation undertaken by Ferguson and Olofsson (2004) on on-park and off-park companies: science park locations were more often perceived to offer an image benefit to tenant firms. From these

considerations, we can assume that effectively science parks and incubators could be considered as a “brand name” for tenant companies.

Table 12: Advantages coming from the hospitality in an incubator or a science park

<i>Possible answers</i>	<i>First advantage</i>	<i>%</i>	<i>Second advantage</i>	<i>%</i>
1-More visibility	5	16.67	5	16.67
2-Prestige	0	0.00	1	3.33
3-Use the services provided	13	43.33	10	33.33
4-Rent less expensive	6	20.00	6	20.00
5-Guarantee of reliability	1	3.33	1	3.33
6-More easiness in finding clients	1	3.33	0	0.00
7-Other	0	0.00	1	3.33
No answers/not hosted	4	13.33	6	20.00
Total sample	30	100.00	30	100.00

In the literature, critical issues concern what incubators and science parks offer besides physical space (Mustar *et al.*, 2006). We tried to investigate which kinds of facilities are most utilized by tenant companies and which ones are lacking. The questionnaire results show that “meetings organised by the incubator-science park with business personalities” and “open spaces for meetings” are the most appreciated, followed by “tutorship” and “consulency” services (Table 13). Thus, initiatives by the hosting structure are more diffused than network activities among tenant companies.

Table 13: Science park-incubator services utilized

	Yes	%	No	%	not hosted	%	total	%
Tutorship	14	46.67	12	40.00	4	13.33	30	100.00
Consulency	14	46.67	12	40.00	4	13.33	30	100.00
Network of private investors	3	10.00	23	76.67	4	13.33	30	100.00
Networking with other firms	12	40.00	14	46.67	4	13.33	30	100.00
Networking with university departments	8	26.67	18	60.00	4	13.33	30	100.00
Meeting organized by incubator	20	66.67	6	20.00	4	13.33	30	100.00
Conference room and common spaces	19	63.33	7	23.33	4	13.33	30	100.00
Other (secretary, use of scientific tools)	4	13.33	22	73.33	4	13.33	30	100.00

For the purposes of this analysis, section E is important for the link between the number of firms with a patent and the number of these firms that are also science park or incubator tenants. 10 spin-off firms investigated have one or more patents and 8 spin-off firms of this group have benefited or are benefiting from the hospitality in an incubator-science park. Furthermore, 8 of 10 spin-offs with patents are product companies. The most important advantages coming from the patents are more visibility and prestige on the market and more defence against competitors. The reasons for which the other 20 spin-off firms do not have a patent are related to the lack of a patentable product, high expenses, difficulties of patent defence.

6. Turin research spin-offs and start-ups: a comparison

In order to analyse the research spin-off phenomenon in Turin we decided to start from a questionnaire investigation. We obtained interesting answers from the respondents and we had a confirmation of the fact that these are in reality all research spin-off firms. The questionnaire description suggested us how to build a comparison between this sample of spin-offs with a matched sample of start-ups. Therefore, given the young age of these firms we investigated if time on the market was a significant factor and given the poor success in terms of employment we used total assets as a size variable. Finally, the strong national and international attitude of research spin-offs notwithstanding the small size, the desire to transfer research results to the market and the availability of public funds, suggested us to investigate potential differences in the performance between spin-offs and start-ups. We organized these variables and we built the regression model as follows.

The aim of the comparison was to highlight whether there have been any differences in added value between research spin-offs and start-ups in the year 2007. According to McDougall and Oviatt (1996), to Gupte (2007) and to Rothaermel and Thursby (2005), measuring the performance of organizations is always

a complex problem, and it is especially thorny for new ventures. Therefore, given these constraints and the difficulty of obtaining reliable data on a particular kind of firm like the research spin-off, we decided to limit the comparison in terms of added value levels. Starting from our questionnaire investigation, we decided to compare the sample of 30 spin-off respondents with a similar sample of start-up firms, which means firms not created by university personnel and therefore not linked to the academic world. According to the criteria followed by Colombo and Delmastro (2002), that resorted to Rita data bank to build the control sample, in order to undertake the analysis on the comparison between the sample of spin-offs with a sample of start-ups we identified similar firms in terms of sector of activity, age and geographical location. In order to find firms that complied with the above mentioned criteria, we resorted to Aida data bank¹⁰. The matching strategy was successful as concerns all the criteria. Given the difficulty of obtaining data on Turin research spin-offs, we were able to find 20 research spin-offs (68%) starting from our original sample of 30, and we compared these firms with 91 start-up firms. We did not find the other 10 research spin-offs on the data bank Aida because 3 companies established in 2008 as well as 5 of the firms created in 2007 had not yet deposited the balance sheet at the time of our investigation; 1 spin-off in the form of limited partnerships was not available on Aida, because this data bank takes account only of capital firms; finally 1 firms created in 2006 was not yet available on Aida, probably because of the low level of capital. Nonetheless, according to the sample size we may consider this sample as reasonably representative. In order to build the control sample, we proceeded as follows. In order to compare the sectors of activity we used the Ateco 2007 classification¹¹; in order to compare the age we considered the same year of creation of the firm. Finally, we identified start-ups established in the same city of the original sample of spin-offs. More specifically, we identified firms with the same Ateco code of the sample of spin-offs, established in the same year and with the same geographical location of our original sample of research spin-off firms. Starting from 20 research spin-offs we identified 91 start-ups. Therefore, the final dataset included 111 firms. We provided a cross-sectional analysis on the year 2007, which was the latest year available on Aida and it is coherent with the period of investigation through questionnaires (January-March 2008). An important advantage relative to our data is that Aida has a record of every company included in the data bank. As a result, Aida data is free from survivor bias, a sample selection problem that is endemic to studies of young companies (Shane, Stuart, 2002). All the firms of our dataset were still active at the date of investigation. At best, the evidence suggests that start-up firms performed better than research spin-offs in 2007 in terms of added value.

6.1 Dependent and independent variables

We decided to use “added value” as dependent variable in this analysis. The independent variables we employed were as follows: “flagspinoff” for spin-off and start-up; “total assets” as a variable for firm size; “time” measured as the number of years on the market.

We measured the variable “flagspinoff” by using a binary variable which took the value 1 if the firm was a spin-off and 0 otherwise. We decided to measure the firm size in terms of “total assets”¹², because it has been not possible to have enough and reliable data on the number of employees. As it was mentioned in the description of the questionnaire answers, research spin-offs are not a success in terms of employment: the questionnaire investigation revealed that in most of the cases the number of employees is between 2 and 4, but the respondents made no difference among full employee, part-time employee, and the different kinds of contracts. Furthermore, in many cases spin-off staff is paid by the university in the form of fellowship, for example, but it is considered as a spin-off employee. Finally, the balance sheets are not helpful to this aim,

¹⁰ AIDA is a databank that provides company accounts, ratios, activities for 950,000 Italian companies; ownership and management for the top 20,000 companies. Consolidated accounts are available for over 3,800 companies. AIDA also incorporates a database of scanned images of the year end reports and accounts for over 300,000 companies. The accounts are in a detailed format and include 50 ratios as standard. News relating to companies is also included. AIDA offers personal data with a description of the company’s activity and it allows access to the detailed balance sheet of every Italian company following the complete scheme of the IV EC Directive 78/660/EEC of 25 July 1978. The balance sheets are available in historical series till 10 years. The search and analysis programme is developed by Bureau van Dijk Electronic Publishing.

¹¹ Since the 1st of January 2008 a new classification of economic activities called Ateco 2007 is in force as the single rule of classification for public administration. This new classification in Italy is published by Istat (National Institute of Statistics) and it is the national version of the European nomenclature NACE Rev. 2, established by the Regulation EC n. 1893/2006 of the European Parliament and the European Council, published on the Official Journal on the 30th of December 2006.

¹² This variable has been calculated as total assets minus fixed assets.

because the number of employees is not required by law. We measured the variable “time” starting from 0 if the firm was created in 2007; 1 if it was established in 2006; 2 if it was founded in 2005, and so on.

Descriptive statistics of the continuous variables are shown in table 14. More specifically, table 15 and table 16 provide descriptive statistics respectively of the spin-off sample and of the start-up sample. The average level of added value for the total sample in 2007 was Euros 358,866, while the average research spin-off firm had a level of added value of Euros 84,028, and the average start-up firm had a level of added value of Euros 419,270. The average total assets of the overall sample was Euros 970,220, while the average total assets of a spin-off firm was Euros 528,621 compared to Euros 1,067,274 of the start-up firm. Finally, the average age of the firms of the overall sample was 4.4 years. The average age of a spin-off firm was 2.9 years while the average age of a start-up firm was 4.7 years. From this data we can assume that research spin-off firms are smaller and younger than the matched start-ups.

Table 14: Descriptive Statistics: total sample

Variable	Observations	Mean	Std. Dev.	Min	Max
Added value 2007	111	358866	957838	-455639	6182017
Total assets 2007	111	970219.8	2812488	14343	2.76e+07
Time	111	4.369369	2.648938	0	10

Table 15: Descriptive Statistics: Spin-offs

Variable	Observations	Mean	Std. Dev.	Min	Max
Added value 2007	20	84027.85	286997.7	-455639	1060162
Total assets 2007	20	528621.4	1021006	14343	3522320
Time	20	2.9	2.826566	0	10

Table 16: Descriptive Statistics: Start-ups

Variable	Observations	Mean	Std. Dev.	Min	Max
Added value 2007	91	419270	1040898	-204955	6182017
Total assets 2007	91	1067274	3065119	62789	2.76e+07
Time	91	4.692308	2.510831	1	10

6.2 Method adopted and main results

The regression model with added value as dependent variable was estimated using ordinary least squares (OLS) regression analysis. Table 17 presents the correlations among the continuous variables. The total assets and the added value are the only variables significantly correlated. The high positive correlation between these two research variables suggests that firms with a high total assets had also more added value.

Table 17: Correlation Matrix

(obs=111)	Added value 2007	Time	Total assets 2007
Added value 2007	1.0000		
Time	0.2294	1.0000	
Total assets 2007	0.8113	0.1893	1.0000

We now discuss the regression results. Our aim was to verify whether research spin-offs had higher or lower levels of added value than start-ups in the year 2007. We tested a regression model that was highly significant. The equation was strongly significant the results of which are presented in Model 1 table.

In Model 1 we found a $Prob>F = 0.0000$, a $R\text{-squared}$ of 0.6674 and two significant coefficients. More specifically, there is strongly significant coefficient ($P<0.01$) relating to the total assets variable and a weak significant coefficient ($P<0.10$) relating to flagspinoff. According to the results of Model 1, research spin-off firms in 2007 had a lower level of added value compared to start-ups of Euros 148,427 in average. Furthermore, the firms with a higher level of total assets had also a higher level of added value of Euros 0,27 in average. Therefore, the impact is very low. The number of years on the market was not a statistically significant variable in this model, which means that time on the market had no impact on the level of added value.

Number of obs = 111
F(3, 107) = 9.06
Prob > F = 0.0000
R-squared = 0.6674
Root MSE = 5.6e+05

Added value 2007	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
Time	22876.91	15870.06	1.44	0.152	-8583.63	54337.46
Total assets 2007	.2706989	.0563141	4.81	0.000***	.1590628	.382335
Flagspinoff	-148426.9	82696.81	-1.79	0.076*	-312363.7	15509.83
Constant	23014.49	66523.46	0.35	0.730	-108860.5	154889.5

*** Significant at 1% statistical level

* Significant at 10% statistical level

7 Discussion

According to Link and Scott (2007; 2006; 2003), science parks are not well understood and attendant research on them is just beginning to burgeon. We tried to provide a contribution through an investigation on a sample of research spin-offs located in Turin and in most cases tenants of these structures.

Turin spin-offs are young firms, with a low capital and with few employees. These are most of all service firms rather than product ones. The main sectors of activity are biotechnology and chemical-pharmaceutical, aerospace and transport, informatics and telecommunication, environment. These are the sectors in which Turin incubators and science parks (see Appendix), as well as the Polytechnic and the University, are most specialized. Furthermore, they are the pillars of Piedmont development plan. In particular, the automotive district (Calabrese, Erbetta, 2005) and the ICT district promoted by Turin Wireless Foundation¹³ prove to be of key importance in the establishment of research spin-offs in these sectors. These spin-offs are micro firms but they deal most of all on the international market: “internationalisation” is one of the main strategic objectives scheduled by Piedmont Region in the Docup¹⁴ 2000-2006 (Piedmont Region, 2004). The turnover results allow us to believe that all is going in the direction of a growing performance in the following years. Therefore, this investigation confirmed the literature assumption of an absence of rapid growth potential, but not of an absence of growth aspirations (Autio, 1997). Similarly, Link and Scott (2006; 2007) highlighted that just over one-half of all parks they surveyed had incubators within the park and the results of the model they applied showed that research parks with incubator facilities grew nearly 3% slower per year than parks without. The reason is linked to the fact that incubator facilities assist with the growth of small companies, but success and rapid growth for these small companies may come only after they leave the park and lose research synergies with park tenants.

The literature on research spin-offs underlines the pivotal role of the researcher that becomes manager (Lockett *et al.*, 2003; Murray, 2004). The interviews and the answers of the questionnaire highlighted that in general academics choose not to leave university job. Nonetheless, even if the inventor does not run the new firm day by day, he is usually involved in technical activities of the innovation to the detriment of business aspects (Lockett *et al.*, 2003; Wright, Vohora, Lockett, 2004). According to the literature, spin-off founders are influenced by a desire of autonomy and independence (O’Shea *et al.*, 2005; Shane, 2004), and the possibility to exploit research results. One of the key problems is that they lack business experience and management competence (Lockett *et al.*, 2003; Wright, Vohora, Lockett, 2004; Shane, 2004). With regard to this issue, incubator aid and self-training were the solutions most diffused. This is one of the most evident proofs of the role played by incubators in the first phase of start-up and growth of a new firm. If the tutoring service is effective, a spin-off firm can benefit from the incubator help and survival problems are reduced. And another important evidence of the key role of an incubator or a science park is given by the aid provided in the relationship with banks. We can add to these reflections that, according to Hackett and Dilts (2004b, pp. 70-71), from a transaction cost economics (TCE) and market failure perspective, incubators and science parks “are a systematic approach to controlling resources and reducing costs during the early stages of a venture’s development”.

¹³ Turin Wireless Foundation was established in December 2002 with the goal to promote the growth of the ICT District in Piedmont, in synergy with other local players.

¹⁴ Docup is the “programming single document” of every Italian Region.

If we look at funding sources, personal and family capital and grant initiatives at regional and national levels are the most common sources of financing for spin-offs. These firms find difficulty of raising money from potential financiers due in most of the cases to lack of credibility. Schumpeter (1934) believed that credit could be created in a variety of ways, but he gave more importance to the role of the commercial bank in generating new purchasing power and making it available to entrepreneurs (O'Sullivan, 2005). Notwithstanding, bank credit is still not a source of finance deeply utilized by research spin-off firms. Spin-off founders are usually not able to write a business plan, because they are scientists and not managers, and potential financiers have difficulties of evaluating such kind of firm, because they do not have specific competences pivotal for such an evaluation. Furthermore, our investigation proved that funding opportunities at regional or national levels, like Start-Cup and MIP, exist and are utilised. According to Clarysse *et al.* (2007, p. 610) the availability of public funds aimed at addressing the so-called “*financing and knowledge gap*” is one of the factors that have accelerated the rise in number of research spin-offs in recent years. Also Siegel *et al.* (2007) argued that extensive financial support is now available in many countries to fund the creation and nurturing of research spin-offs. Nevertheless, all these initiatives are not monitored and coordinated by a specific organization. A lack of information on funding opportunities particularly at private level emerged. If this information gap is due to spin-off founders unwillingness to be fully informed or to lack of precise information by universities, incubators and science parks is still to be deeply understood.

A crucial role is played by Foundations and Banks. One of the main missions of Michelin foundation is to help businesses and one of the key elements in SanPaolo IMI and Unicredit bank strategies is to promote business initiatives linked specifically to regional territory. The same vision is shared by Unionfidi¹⁵. Each of these actors alone could do little, but together they are able to share the risks and to provide favourable conditions in order to foster the establishment of high-technology companies and to support the tricky phase of start-up. In particular, the condition that the firm has to be hosted within the incubator to have access to these agreements is due to the fact that the previous evaluation procedure from which the firm has been accepted by the incubator is a pivotal guarantee for Michelin foundation, banks and Unionfidi. These last ones, in fact, are not able to evaluate a very particular kind of firm, like the spin-off one, because they do not have the specific scientific background that, instead, the university and incubator evaluator staff has (Colombo, Delmastro, 2002). Furthermore, the admission criteria are very selective: incubatee selection processes is an incubator variable associated with incubatee success (Hackett, Dilts, 2004b). In short, if a spin-off firm is hosted within an incubator it has more probabilities to have more success than other start-ups, because it has the favourable approval of university and incubator staff and it has access to services and facilities that can be of greater help in order to survive in the critical start-up stage and pass to the development one, but to this aim it is vital to fill the gaps in management competence and credibility on the market.

Our regression model highlighted that, in general, in the year 2007 Turin research spin-off firms showed a lower level of added value compared to the control sample of start-up firms. This result on Turin research spin-offs, if confirmed by further studies, is not consistent with the findings of Shane (2004) highlighting that research spin-offs perform better than start-ups. And it highlights the need to improve the role as brand name of science parks and incubators. Furthermore, it confirms the findings showed by Link and Scott (2007, p. 669), that “*localized spillovers from parks are not as great as they could be*”.

Given these considerations we can assume that if incubators improved the effectiveness and the quality of the facilities provided and introduced services more linked to specific needs of every kind of spin-off firm, they could improve the performance of tenant firms. In fact, Hackett and Dilts (2004b) claim that scholars stress the importance of having a good “fit” between incubatee needs and the services provided by the science park-incubator. Positive results reached by spin-off firms hosted within an incubator are proven by the fact that 8 firms in the sample of 10 that have one or two patents are spin-off firms coming from an incubator-science park and 4 of the 5 spin-off firms that registered an increase in capital after the start-up stage benefited from the hospitality in an incubator-science park. These 4 spin-off firms have shown a substantial increase in turnover in recent years and 3 of these 4 spin-off firms have yet concluded their period of incubation in 2002 or 2005. Finally, 3 of the 5 spin-off firms with a venture capital participation are incubator-science park tenants. But this is not enough compared to the performance of start-ups. If in the market for lemons by Akerlof (1970) the question is “trust” by the point of view of the buyers, in the spin-off mechanism the problem is “credibility” by the point of view of potential financiers, suppliers, clients. Spin-

¹⁵ Unionfidi was established in 1975 with the aim to facilitate the access to credit by associate SMEs through the granting of guarantees and through managerial and financial assistance.

offs must show to be credible on the marketplace. To counteract the effects of quality uncertainty Akerlof (1970) illustrates several institutions, such as guarantees, brand names good, licensing practices. In the case of spin-offs, credible signals like the presentation by an incubator-science park work as brand names and licences for this kind of firm. Incubators and science parks could be the key means of a spin-off working “well” in order to reduce the so called “liability of newness” (Ferguson, Olofsson, 2004; Schwartz, 2009; Sofouli, Vonortas, 2007). Liability of newness relates to the high failure risk young firms face in the first years of their life. Start-ups and young firms do not have stable business relationships and they do not possess any reputation and need some time to gain legitimacy in the market. Therefore, newly founded firms need to demonstrate that they are reliable and trustworthy business partners towards the market (Schwartz, 2009). Incubators and science parks are perceived as useful solutions, because they can work as “brand names” for tenants. A brand is widely known as a name, a logo, a symbol or a combination of these that identifies something, enhances its value and makes it different from competitors (Fan, 2002; Crimmins, 2000; Kohli, LaBahn, 1997). If “*a good brand name should be simple, distinctive, meaningful and indicative of the product benefits*” (Fan, 2002, p. 181), similarly a structure like a science park or an incubator should develop a policy of rigid selection criteria, transparency and equality of treatment, clear and simple rules for potential tenants, regular evaluation procedure. In other words, a science park or an incubator could be a good brand name for tenant spin-offs in front of potential financiers and clients if and only if it is able to issue a set of perceived quality, distinctive and meaningful rules applied since the beginning of the selection call to the end of the hosting period. This could benefit tenant companies in terms of an indicative certificate of their competences and potentialities of development and growth. If “*the essence of a brand is that it is a name in the memory of consumers. Brand creates meaning and identification*” (Fan, 2002, pp. 185-186), a science park or an incubator can work as a network of positive and favourable associations for tenant companies willing to grow. It is usually impossible for a potential financier, supplier, client, to tell the difference between a “good” and a “bad” research spin-off (Akerlof, 1970), because of a lack of technical expertise of assessment (Colombo, Delmastro, 2002). Only the parent institute and the science park or incubator could know this difference, because they have more knowledge about the quality of a spin-off initiative. Turin incubators and science parks are very selective: in 2006 I3P incubator received 122 business ideas, of which 32 developed a business plan and 15 have been established. The relationship “8: 2: 1” is the exemplification of the selection policy undertaken by I3P (Cantamessa, 2007). Start-Cup competition has a key role in selecting the best business plans that will become I3P and 2I3T tenants. Furthermore, at the end of the examination process, if positive, an operational feasibility study of the investment is realised by the Bioindustry Park of Canavese technical experts in order to arrive at a formal approval by the Park and to the signature of the contract.

But this is not enough. The questionnaire answers highlighted the recurrent choice of the aid provided by science park and incubator structures, but the results in terms of growth and performance seem to be poor. The regression model underlined a lower performance of spin-offs compared to start-ups. Therefore, an effective and efficient control over the various funding initiatives at the regional and national level should be introduced. According to Link and Scott (2003, p. 1333), “*public policy can have a large impact on the formation of science parks*” and according to Link (2009, p. 118), “*universities are not known to be good managers [of research parks]*”. In order to promote entrepreneurial activity, intersector interaction and partnerships, the IIT Madras Research Park has instituted a system of credits that tenants have to earn to remain in the park (Ananth, 2009) and in measuring success Manchester Science Park tenant companies are asked to fill out a questionnaire annually (Davies, 2009). In our opinion, a monitoring activity undertaken by a specific “task force” comprising university and incubator-science park staff, dedicated to tackle funding problems and to monitor constantly the improvement of management competence and the achievement of spin-offs credibility on the market, could be a useful solution. Banks finance could become more used by spin-offs thanks to the agreements signaled by Foundations and banks with science parks and incubators and, thus, thanks to the brand name (Fan, 2002; Crimmins, 2000; Kohli, LaBahn, 1997) and positive evaluation of these actors and to the advertising of these initiatives to spin-off founders. Furthermore, if incubators and science and technology parks improved the communication channels and fostered more network activities, as illustrated in the incubator-incubation concept defined by Hackett and Dilts (2004b), spin-offs could have more advantages not only by the point of view of finance incentives but also by the point of view of the firm management. The empirical investigation highlighted the absence of a negative opinion on venture capital, even if only 5 spin-offs are participated by a venture capital society. The support provided by a structure like a science park-incubator could be an important intermediary in order to foster a higher level of venture capital participation. We can add to this assertion that Phan (2009, p. 67) argue that

“Another feature that characterizes the more successful park development efforts is access to risk capital”. All these initiatives prove to be of pivotal importance for the start-up stage of a spin-off company. All these links between incubators, banks, foundations, and so on, are clear evidence of the more easiness for a spin-off firm to survive and develop better than other start-ups if it is sustained and helped from this kind of initiatives.

Following the question suggested by Link and Scott (2007, p. 671) if science parks have a unique place within a national innovation system, we can assume from the results of our survey that if it is true that “[science parks] *should not a priori be considered a primary element of a nation’s innovation system...*[they] *are not a sine qua non of the knowledge flow...*[science parks] *fall under the broader category of an effective educational system*”, it is also true that an improved and more effective role as brand names could warrant a higher status and contribute to include these structures in the elements of a national innovation system.

8 Conclusions

Notwithstanding plenty of scientific production on spin-offs, an agreed and a precise definition of research spin-off does not exist (Pirnay *et al.*, 2003; Degroof, Roberts, 2003; 2004; Piccaluga, Balderi, 2006 a). The difference and heterogeneity in the definitions highlights how the spin-off phenomenon is interesting for its own complexity. According to Schumpeter (1934) research spin-offs can be defined “innovative firms” if they devote time to research with continuity. Research spin-offs are innovative firms that aim to commercialize research results starting from R&D and reaching the market and the consumers. Our empirical investigation confirmed the desire to transfer research results to the market, but many weaknesses emerged as well as the necessity to improve the role as brand names of science parks and incubators.

The analysis on 30 questionnaires coming from the case of Turin spin-offs revealed that in general these are micro firms rather than SMEs but dealing on the international market and in the most important sectors for the regional development plan. These spin-offs are influenced by a “growth myopia” (Autio, 1997), but they show growth aspirations in the near future. Main difficulties faced by these firms are lack of funding support and lack of managerial experience. According to the questionnaire answers, the most common solutions adopted are aid by the incubator and learning by doing. The hospitality within an incubator or a science park is pivotal and this is proved by many answers to the sections of the questionnaire. The presence of a tutorship service available for tenant companies is most of the times a very helpful solution for lack of business competences. One of the key problems highlighted by the questionnaire is that Turin spin-offs are not well aware of the opportunities available for raising finance. They do not know the existence of agreements among banks, foundations and incubators. As a consequence, they usually use personal and family capital as the first source of financing and they benefit from favourable conditions available from banks and so on only if the incubator itself suggests to utilise them. In short, the problem is linked to a sort of lack of information due to lack of precise and clear advertisements and/or to the scarce attitude of these firms to look at information on funding sources. Start-Cup competition is one of the most used and known sources of funding support because it is very well advertised through channels of communication like Internet website, printed brochure available in universities, research centres, incubators, science parks and advertising posters around Turin. Other sources of funding are advertised only through informal communication, not easily available. If spin-off firms had more information on the overall framework of possibilities for raising finance, they could reduce substantially one of their most crucial obstacles in succeeding in the start-up stage. Furthermore, the aid provided by a structure like an incubator or a science park is proven to be of key importance, because not only it provides tutorial services and facilities but it is also a guarantee of reliability in front of potential clients and in front of banks that are more inclined to give loans to firms positive evaluated by a university incubator. Nevertheless, the result of the comparison between Turin spin-offs and a matched sample of start-ups highlighted a lower performance of spin-offs and the consequent need to improve the role as brand name of science parks and incubators. As affirmed by Phan (2009, p. 67), *“You can’t just “build [a park] and they will come” – you have to make it attractive in the first place”*.

In conclusion, policy choices made not only by the parent institute as affirmed by Wright *et al.* (2007), but also by the hosting structure can affect the number, the type and the success of a spin-off. McMahan (2009) highlighted the importance of a policy environment that is patient, adaptable and focused on commercialization. And Hackett and Dilts (2004b) in their review of business incubation note the importance of the value-added component of network relationship building. As evidenced from the questionnaire answers, characteristics of the incubator organization and the forms of support provided are of pivotal

importance. The positive evaluation of a spin-off initiative by the science park and the incubator may serve a function of “certification” for spin-offs, indicating the attainment of certain levels of proficiency (Akerlof, 1970). The questionnaire answers revealed that funding initiatives exist and are utilised. The actual problem is that it does not exist a single organization monitoring the overall framework of public funding opportunities. From these considerations we can assume that an alternative to the introduction of an external manager suggested in the recent literature (Lockett *et al.*, 2003; Wright, Vohora, Lockett, 2004; Shane, 2004; Mustar *et al.*, 2006) could be the establishment of a specific “task force”. An official synergy between the parent institute and the incubator-science park with the aim to monitor the research spin-offs “after” their formal creation could be an advisable solution. Particular attention should be devoted to resolve the specific needs and gaps of every spin-off firm through courses, seminars and information initiatives. This solution could also incentivate the establishment of more product spin-offs rather than service ones, and the importance of incubator and science park role as brand names could produce more advantages and positive results in terms of exploitation of scientific results as well as of creation of wealth and employment in the following years. In order to support our suggestions, it is significant to underline that according to the survey undertaken by Link and Scott (2003) there is more agreement than disagreement that involvement with a science park positively affects the research output and extramural research funding of universities, and according to the model built by Hackett and Dilts (2004) an incubator is a means to an end and not an end in itself.

We are perfectly aware of the limited empirical evidence under analysis, but we think that our questionnaire investigation and the regression model with a comparison between the questionnaire respondents and a matched sample of start-ups are an important contribution to the literature on the research spin-off phenomenon. According to Zhang (2009), empirical investigations on this topic are continuously constrained by the limited availability of data. Therefore, if confirmed by further research, we believe that the role as “brand names” of science parks and incubators should be enhanced in order to improve the performance of tenant companies and to safeguard the potential of research spin-off firms.

Appendix: Turin incubators and science and technology parks

Since 1999 Turin has established two incubators: I3P (Innovative Enterprise Incubator of the Polytechnic of Turin) and 2I3T. Furthermore, Turin has two science parks¹⁶. The Environment Park is near the city centre and the Bio-Industry Park of Canavese is located in the province of Turin and precisely in Colletterto Giacosa (Ivrea).

I3P is a non-profit joint-stock consortium (S.c.p.a.) constituted by Turin Polytechnic, the Province, the Chamber of Commerce, Finpiemonte¹⁷, Turin Wireless Foundation, and the City of Turin. I3P was established in 1999 with an area of nearly 3,000 sq.m. and with the goal to promote the creation and growth of new, knowledge-based enterprises that can benefit from the incubator's close ties to Turin Polytechnic, and its capacity to catalyse, stimulate and drive cutting-edge business initiatives. Services provided include scouting of ideas, preincubation and incubation for a maximum of three years. Main sectors of tenant companies are automation and electronics, information technology, telecommunication, mechanic.

2I3T is the society that manages the incubator of Turin University, constituted by the Province, the City of Turin, Finpiemonte and Turin University. 2I3T was established in 2007 with an available area of 1,800 sq.m. It promotes the creation of new businesses, stimulating the technology transfer to valorize by an economic point of view scientific and technological research results. 2I3T has two thematic locations: the biotechnology one inside the MBC (Molecular Biotechnology Centre) in the city centre, and the chemical-pharmaceutical one in the suburbs. The services provided are the same as for I3P.

The Environment Park was founded in 1996, through an initiative of Piedmont Region, the Province, the City of Turin and the European Union. It represents an original experiment in the field of European Scientific and Technological Parks because it combines technological innovation and eco-efficiency. Environment Park also constitutes a centre of excellence for Information and Communication Technology companies. The Park's goal is to provide SMEs with advanced solutions and innovative technologies in the fields of energy and environment, through partnerships, special projects, specific training activities and the

¹⁶ From this list we exclude the “Virtual Reality and Multi Media Park” of Turin, because it does not host spin-off firms.

¹⁷ Finpiemonte spa was established in 1976 as a tool of the regional planning, with the goal to contribute to the regional economic development plan.

organisation of thematic events. It is located in Spina 3, one of the main development areas in the city of Turin, just near the city centre, and it covers an area of about 50,000 sq.m. of which 35,000 consisting of laboratories, offices and service centers.

The Bioindustry Park of Canavese is a science and technology park located in Colletterto Giacosa, near Turin, with an area of 70,000 sq.m. equipped for production activities and 16,000 sq.m. of laboratories, offices and pilot production plants. It was established in 1998 and it has as shareholders public institutions and private companies. The project of the Park was adopted by Piedmont Regional Authority as a priority in the regional industrial policy. The Bioindustry Park has been realized in the context of European Union Structural Funds, with contributions from the European Fund for Regional Development, and is jointly financed by the State and the Regional Authority, who granted a total investment of 52 million Euro. The Park promotes and develops research in biotechnologies and life sciences, hosting enterprises of chemical, pharmaceutical, diagnostic, bioengineering and information science fields. It offers research facilities, scientific and support services, such as technology transfer, patent support, tutoring/mentoring of start-ups and spin-offs.

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