How effective are technology incubators?
Evidence from Italy

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Abstract

In spite of the diffusion of science parks in Europe, it is still unclear whether they have been successful in fostering the establishment and growth of new technology-based firms (NTBFs). This paper aims to contribute to answer such question. For this purpose, a sample composed of 45 Italian NTBFs which at the beginning of 2000 were located on technology incubator within a park is compared with a control sample of off-incubator firms. Aspects considered in the study include the personal characteristics of founders of NTBFs, the motivations of the self-employment choice, the growth and innovative performances of firms, propensity towards networking, and access to public subsidies. In the comparison, we use a larger set of indicators than in previous studies. The empirical results confirm the conventional wisdom that input and output measures of innovative activity are only marginally different between on- and off-incubator firms. Nonetheless, they also show that Italian parks managed to attract entrepreneurs with better human capital, as measured by educational attainments and prior working experience. In addition, on-incubator firms show higher growth rates than their off-incubator counterparts. They also perform better in terms of adoption of advanced technologies, aptitude to participating in international R&D programs, and establishment of collaborative arrangements, especially with universities. Lastly, they find it easier to get access to public subsidies. Altogether, such findings support the view that science parks are an important element of a technology policy in favor of NTBFs. This holds true especially in a country like Italy which is characterized by a rather weak national innovation system. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

It is common wisdom among policy makers that a dynamic new technology-based firm (NTBF) sector is a key element to assure innovation and creation of new jobs in the economy. It is also widely accepted that NTBFs face greater obstacles than other firms, and so deserve support from governmental institutions.

The economic literature has provided two rationales for such view. Firstly, it is claimed that there are severe market failures that prevent NTBFs from fair access to key inputs. Such reasoning especially applies to finance. It is argued that banks generally lack the technical expertise required to assess the quality of a new business in a high-technology sector, whereas new firms do not have track records on which banks may base their lending decisions. In addition, banks may simply perceive the projects of high-technology en-
younger firms are relatively more constrained. Therefore, new firms suffer from credit rationing (Siggelkow, 1981); the presence of other financial intermediaries that are more sensitive to the requirements of NTBFs such as venture capital firms, is not sufficient to close the gap. A number of empirical studies have provided evidence consistent with the argument that capital market constraints negatively affect the behavior of entrepreneurs. First of all, the likelihood of entering self-employment is shown to increase with the net worth of an individual and his family (see Evans and Jovanovic, 1989; Evans and Leighton, 1989). Furthermore, changes over time of founders’ net worth, for instance due to receipt of an inheritance (Holtz-Eakin et al., 1994a,b) or to a rise of the value of housing equity (Black et al., 1996), are found to influence new business formation, the amount of capital committed by founders to the new ventures, and business survival. Nonetheless, other studies question the robustness of such results. Cressy (1996) suggests that the correlation between survival and financial capital may be spurious; as assets are explained by human capital, the observed correlation may be indicative of the human capital deficiencies of unsuccessful entrepreneurs rather than of failures of capital markets. According to data provided by Levenson and Willard (2000) on small business in the USA in the 1980s, the extent of credit rationing appears to be fairly limited, even though smaller, younger firms are relatively more constrained.\footnote{Market failures may also relate to other inputs to the activity of NTBFs. In particular, NTBFs generally face difficulties in acquiring the services of external consultants in fields such as technology, business strategy, staff recruiting, marketing, advertising, public relations, and administrative and legal affairs. From the one side, search costs including the opportunity cost of entrepreneurs’ time, are deemed excessive by small young firms in comparison with expected benefits. From the other side, consultant firms often lack focus on the special requirements of NTBFs. Note, however, that the above mentioned difficulties largely remain speculative. For instance, Robson and Bonnet (2001) document that recourse to external advice is now rather widespread among UK small and medium enterprises.}

Secondly, a strong case for public support to NTBFs hinges on the peculiar role they play in promoting dynamism in advanced economies. Advocates of public intervention in favor of NTBFs point out that such firms often are a source of radical innovations based on unconventional technical approaches. Such innovations challenge existing technological paradigms dominated by large, established industry leaders, and have the potential of revolutionizing industries, opening up new industry segments. As the benefits to society arising from the innovative activity of NTBFs largely exceed those that can be appropriated by them, such positive externality justifies governmental support (see for instance Oakley, 1995).

It is important to emphasize that the view that NTBFs deserve favorable treatment by governments is not unanimously shared by the economic profession. While reviewing standard efficiency and equity criteria for the provision of public support to small business and entrepreneurial firms, Holtz-Eakin (2001) casts serious doubts on the presence of positive externalities and capital market imperfections that may justify such supporting measures. In addition, Jovanovic’s (1982) seminal paper highlights that the creation of a new firm may be the result of the subjective erroneous evaluation by the founder of his/her own capabilities. In Jovanovic’s model, new firms entering the market do not exactly know their level of efficiency; they learn it over time observing the profits they make, with competition leading to exit of inefficient firms. It follows that a technology policy that indiscriminately protects NTBFs may slow down the selection effect of market competition, thus negatively affecting economic efficiency. Such effect may be amplified if overconfidence leads to excess of entry on the part of "unfitted" individuals who mistakenly opt for the self-employment choice (see Camerer and Lovallo, 1999); this is likely to happen above all in the early stages of the life cycle of a new industry (see for instance Colombo and Delmastro, 2001). In spite of the controversial nature of governmental intervention in this domain, in Europe, a series of policy measures based on a variety of schemes has been adopted by national governments and the EC to create a supportive environment for NTBFs (see Storey and Tether, 1998). At the same time, such measures have often been considered as a means to revitalize depressed or declining European regions through the development of new high-technology ventures. Among such schemes, a prominent role has been played by the creation of science parks (SPs) and business innovation centers (BICs). In general terms, these can be defined as property-based initiatives, aimed at supporting innovative firms through the provision of
logistic, technological and other business services. More specifically, the presence within a park of a technology incubator is regarded as a crucial factor to nurture the formation and growth of NTBFs. European parks have often been established through a partnership between national and local governmental institutions, private firms and local universities, and were intended to replicate earlier US success stories.

Since the early initiatives in the late 1960s and early 1970s, their number has been growing rapidly in all European countries (see again OECD, 1997; Storey and Tether, 1998). The rationale for their creation can be synthesized as follows (Massey et al., 1992; Quintas et al., 1992; Westhead and Storey, 1994, 1995; Westhead, 1997; Westhead and Batstone, 1998; Storey and Tether, 1998). First of all, proximity to university laboratories and other research centers provides firms located on park with easier access to scientific expertise and research results, thus, facilitating transfer of research into commercial applications. Such argument relies on evidence that in the US, spillovers from university research has favored the innovative activity of local firms. Jaffe (1989) and ACS et al. (1992), using patent and innovation count data, respectively show that there is a positive correlation at the state level between innovative activity and university research, especially when university and industrial research activity within a state are closely located. ACS et al. (1994) find that such spillover effects are more pronounced for small firms. Secondly, the existence of a technology incubator makes it easier for academic personnel to exploit knowledge-based business ideas, thus lowering the barriers that inhibit direct commercial application of the results of university research. Furthermore, park firms benefit from agglomeration economies, due to the fact that numerous high-technology enterprises are clustered in a relatively small area, especially if they operate in the same sector (or in closely connected sectors). The networking opportunities of tenant firms are also widened, basically for the same reason. Lastly, the park acts as a bridging institution providing tenant firms with suitable accommodations on flexible terms and technical and business services which are particularly valuable to new high-growth enterprises. Nonetheless, some authors are critical of the effectiveness of parks. For instance, Macdonald (1987) suggests that the premise that high-technology firms gain competitive advantage through location alongside a university because of the information flows from the university, is flawed. He also questions the existence of the agglomeration economies permitted by on-park location.

Indeed, in spite of the diffusion of parks in Europe, whether they have been successful or not in supporting NTBFs still is unclear. One of the problem is the lack of large scale longitudinal empirical evidence on the characteristics and performances of incubated firms, with the partial exception of the UK. In addition, the few studies which have compared on- and off-park firms through the analysis of matched pairs sample have provided mixed results. First, as concerns input and output innovative measures, there is no clear evidence that independent park firms outperform comparable firms located off park. In an early study of UK firms, Monck et al. (1988) find that the percentage of qualified scientists and engineers out of the total workforce and the R&D intensity, measured by the ratio of R&D expenses to sales, of tenant firms were higher than those of firms in a control sample; however, such results are not replicated in a later study (Westhead, 1997), which finds such differences to be statistically insignificant. Similarly, no

\[ \text{OECD}, 1997 \]

\[ \text{A "technology incubator" is a business incubator with physical facilities and technical and business services (see OECD, 1997). A "technology incubator" is a business incubator specifically oriented towards NTBFs.} \]

\[ \text{The first US parks (the Stanford Research Park around Stanford University and the Research Triangle Park in North Carolina) were established during the 1950s (in 1951 and 1959, respectively). By the end 1990s, firms located on them had about 60,000 employees (see Storey and Tether, 1998).} \]

\[ \text{The Sophia Antipolis park, in Southern France, was created in 1969, while the establishment of the Cambridge Science Park and the Heron-Watt Park in the UK dates back to 1972.} \]

\[ \text{The above reasoning applies in particular to parks that in addition to university research laboratories, are able to attract other knowledge intensive units, such as the research laboratories of established firms not otherwise connected with the park.} \]

\[ \text{Strictly speaking, this argument only holds true for parks that develop a close collaborative linkage with an academic institution.} \]

\[ \text{Such lack of robust empirical findings extends to the US. For evidence of the effectiveness of US technology incubators based on case studies of "success stories", see Mian (1996).} \]
A statistically significant difference emerges between on- and off-park firms as to the number of patents and copyrights (see also Westhead and Storey, 1994). Nor tenant firms outperform firms located off-park as regards the number of new products and services launched to both existing customers and new markets (Westhead, 1997). Conversely, Westhead and Storey (1994) show that over the period 1986–1992, UK independent park firms had consistently higher growth rates than their off-park counterparts. Their results also indicate that parks were able to attract more qualified entrepreneurs. Lastly, whether the establishment of parks contributes to close the gap between NTBFs and the scientific community also is questionable. On the one hand, the available evidence supports the view that in the UK, linkages with academic institutions are more robust for tenant firms than for other firms, with all else being equal. On the other, a closer look at the nature of such linkages shows that they mainly are of informal or practical nature. In particular, there is a remarkable similarity between on- and off-park firms as to the extent of the employment of academic personnel, the sponsorship of research contracts, the use of test and analysis services provided by universities, the employment of graduates, and the launch of student projects. The only notable difference is the larger number of tenant firms that mention having informal contacts with academic personnel and having made use of university facilities such as computers, libraries, and conference premises (see Monck et al., 1988; Quintas et al., 1992; Westhead and Storey, 1994, 1995). Along the same lines see the studies by Felsenstein, 1994 on Israeli SPs and Von Dierendonck et al., 1991 on Belgian and Dutch SPs.

The aim of the present paper is to contribute to ascertain the added value to NTBFs of location on a park’s technology incubator. For this purpose, we compare a sample of 45 Italian independent NTBFs that at the beginning of 2000 were located on technology incubator with a matched sample of 45 similar off-incubator firms. All the firms considered were established after 1980 and operate in one of the following sectors: aerospace, biotechnology, pharmaceuticals, electronics, computers, software, Internet services, and multimedia content. The study tries to extend the above mentioned empirical literature in three respects. First, we explicitly focus on independent NTBFs. Second, we consider a more comprehensive set of indicators than previous studies. In particular, we compare on- and off-incubator firms according to:

- the characteristics of their founders, in terms of educational background, prior working experience, and motivations of the entrepreneurial choice;
- the growth and innovative performances of firms, and their propensity towards networking: again with respect to earlier work we use a wider set of indicators, including adoption of new technologies and establishment of formal collaborative relations with other institutions (both universities and business firms);
- the access to external financing in the form of public subsidies.

Third, for the first time extensive coverage is provided of the park movement in Italy, and of the characteristics of Italian incubated firms. In our opinion, this is an important addition to the literature on this issue. In fact, Italy is a very interesting case. On the one hand, propensity towards entrepreneurship is especially high in Italy (see for instance Blanchflower and Oswald, 1999) and small firms account for a disproportionately high share of total employment. On the other hand, Italy exhibits a poor performance in high-technology industries, with the ratio of research expenditures to GNP being close to 1%, that is less than half the value of France, Germany, the UK and other northern European countries. Creation of new enterprises is heavily concentrated in low-technology mature sectors. In addition, as has been highlighted elsewhere by the authors (see Colombo and Delmastro, 2001), the characteristics of Italian NTBFs

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8 Note that all park firms in our sample either were born on park or moved to the park location in the very early stage of their life.

9 To our knowledge, systematic evidence on Italian parks is almost absent. For an initial attempt to address such issue, see Cesaroni and Gambardella (1998).

10 In 1992, in Italy manufacturing firms with less than 20 employees accounted for 38.7% of employment in manufacturing, a value that is five times as large as that of the US and about three times as large as that of France, Germany and the UK (see OECD, 1998, pp. 10–12; data are from the OECD SME database and Eurostat). As regards total employment in Italy (i.e. employment in agriculture, manufacturing and services), in 1996, the share of firms with less than 20 employees was 58%; that of firms with less than 10 employees was 47% (see Istat, 1996).
differ substantially from the pattern prevailing in the above-mentioned European countries, with Italian high-technology entrepreneurs being less educated and having less prior sector-specific working experience than their European counterparts. As was pointed out above, the establishment of parks and technology incubators aims to deal with market failures relating to knowledge and other inputs of the innovative process (i.e. technical and business services, including real estate services; access to external financing) which negatively influence the formation of NTBFs and their post-entry performances. Accordingly, such initiatives are expected to play a relatively more important role in those situations where such market failures are more pronounced. This is more likely to be the case of Italy, which is characterized by a rather inefficient national innovation system (see for instance Malerba, 1993), than of other technologically more advanced European countries, where the supply of such inputs to NTBFs is relatively more developed.

The remaining of the paper is organized as follows. In Section 2, the characteristics of Italian SPs and BICs are briefly described. In Section 3, the methodology of the field analysis of NTBFs incubated on-park is presented. The empirical evidence on such firms is illustrated in Section 4, which is devoted to the characteristics of firms’ founders, and Section 5, which analyzes the growth and innovative performances of firms, their propensity towards networking, and their ability to obtain public subsidies. A discussion of the results, highlighting implications for technology policy in Section 6 concludes the paper.

2. Science parks and business innovation centers in Italy

We define a “science park” as a property-based initiative which (i) has formal operational links with centers of knowledge creation, such as universities and (public and/or private) research centers, (ii) is designed to encourage the formation and growth of innovative (generally science-based) businesses, and (iii) has a management function which is actively engaged in the transfer of technology and business skills to “customer” organizations. Characteristic of SPs are generally associated with a SP are the presence of a business incubator and the localization on site of research laboratories, that may belong to the park, to partner (academic or non-academic) institutions, to other non-profit organizations, or to business firms. At the end of 1999, there were 17 SPs in Italy that matched the above definition.12

The notion of “business innovation center” is linked to the set-up by the EC, through the DG XVI, in 1984 of the European Business Innovation Network, with the aim of supporting innovation and the creation of new firms, especially in depressed European regions. In spite of the lack of a precise definition, a BIC shares most of the key characteristics of a SP. It is a property-based venture for the establishment and growth of firms, provides customer firms with technical and business services, and is aimed at strengthening the networking capabilities of firms, promoting the establishment of cooperative relations among them and between these and research institutions. However, a BIC differs from a SP in two important aspects. First, it is less focused on innovation and science-based activities, with relatively greater attention being devoted to the creation of new firms in low-technology sectors. Second, the linkage with academic and research institutions is generally weaker than in a SP (or even absent). Our survey found 24 BICs in Italy.

In January 2000, a questionnaire was mailed to the 17 SPs and 24 BICs. The questionnaire was followed by interviews by phone or on a face-to-face basis with SPs’ and BICs’ management. The requested information concerned the year of establishment and a number of characteristics describing the organization of the initiative and the activities performed. The results of the survey are briefly summarized in the next...
two sections, devoted to SPs and BICs, respectively. SPs and BICs also provided the list of companies that (i) at the beginning of 2000 were located on site, and (ii) were in a high-technology industry. We will come back to this list in Section 3.

Fig. 1 shows the evolution over time of the number of Italian SPs and BICs. In comparison with other European countries, Italy has been a laggard in the development of such initiatives. The first Italian SP, the Area science park in Trieste, was created in 1982. Furthermore, the SP movement did not take off until the early 1990s: between 1990 and 1995 the number of SPs rose from 4 to 13, and then continued to grow though at a much lower rate. In spite of a later start (in 1986), the number of BICs grew more rapidly: at the end of the 1980s, there already were 10 of them. Growth continued at fast rate in the first half of the 1990s and leveled off in the second half. As concerns the localization of Italian SPs and BICs, 59% of the former, but only 39% of the latter are situated in northern regions. The higher percentage of BICs in central and southern regions is in line with the view according to which such initiatives are instrumental to the restructuring and rejuvenation of disadvantaged regions.

2.1. The characteristics of Italian Science Parks

There is considerable heterogeneity across Italian SPs as to characteristics such as their size, the nature of the activities performed, and the ability to attract external knowledge-intensive units. In general, the size of Italian SPs is rather small. Altogether, at the beginning of 2000 in the 17 surveyed parks, there were 364 tenant organizations with 4021 employees. Out of these, 198 were independent firms with 1794 employees (see Table 1). There also were 144 research laboratories, almost equally subdivided between the “privately owned”, “State-owned” and “park-owned” categories. The four largest parks (the Area science park in Trieste, the RAF science park in Milan, the VEGA park in Venice, and the Environment park in Turin) accounted for more than 50% of the high-tech industries include the following ones: aerospace, biotechnology, pharmaceuticals, electronics, computers, software, Internet services, and multimedia content.

13 Remember that according to the definition adopted in this work, high-tech industries include the following ones: aerospace, biotechnology, pharmaceuticals, electronics, computers, software, Internet services, and multimedia content.

14 The greater availability of subsidies from the national government (laws 46/82, 64/86, 181/89, 488/92) and the EC (through the European Structural Funds and the European Social Fund) in Central and Southern Italy has obviously influenced the localization of SPs and BICs.

15 The “State-owned” category also includes research labs owned by non-for-profit organizations such as research foundations.
Table 1
Tenant organizations on Italian Science Parks and Business Innovation Centers at the beginning of 2000

<table>
<thead>
<tr>
<th>Science parks</th>
<th>Business innovation centers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Units</td>
</tr>
<tr>
<td>Independent firms</td>
<td>198</td>
</tr>
<tr>
<td>Subsidiaries</td>
<td>22</td>
</tr>
<tr>
<td>Private research laboratories</td>
<td>47</td>
</tr>
<tr>
<td>Public research laboratories</td>
<td>55</td>
</tr>
<tr>
<td>Park-owned research laboratories</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>364</td>
</tr>
</tbody>
</table>

*This category also includes research laboratories owned by non profit research organizations.

Furthermore, there is great heterogeneity as regards the nature of the activities performed by Italian SPs and their ability to attract external research ventures. From this standpoint, a distinction can be made between SPs that have internalized to a substantial extent the R&D function, and have thus equipped with internal R&D staff, and other parks which prevalently emphasize coordination of external (that is, non-park-owned) knowledge-intensive activities. Actually, while more than half of parks’ direct employees were in R&D, seven parks possessed no R&D facilities; moreover, three parks (Tecnopolis, Abruzzo science park and Pastis) accounted for about 75% of parks’ R&D employees. As regards external R&D laboratories, 82 out of the 102 surveyed were situated in two parks (Area and RAF science parks); both such parks had very limited direct involvement in R&D activities.

Lastly, it is quite interesting to analyze the nature of the services provided by the surveyed parks. While all SPs provide services of scientific and/or technical nature (R&D support, technology transfer, promotion of technological collaborations) and most of them provide professional training, quite surprisingly less than 50% provide financial services. The same applies to marketing and other commercial services, while the figure is even lower for administrative and legal services (18%).

2.2. The characteristics of Italian Business Innovation Centers

The characteristics of Italian BICs are relatively more uniform than those of SPs. At the beginning of
In 2000, we found 425 organizations located on BIC, with only 2838 employees. The large majority (390 units with 2536 employees) were independent firms. Only 30% of them were in a high-technology sector. As it was the case for SPs, out of these latter a conspicuous number was in services. We only surveyed four research laboratories, of which only one was owned by a BIC. Italian BICs generally have a very agile organization, with a small number of employees. Altogether, at survey time the 24 BICs had 290 employees and 358 external consultants. These findings witness the large recourse to service outsourcing on the part of Italian BICs, with emphasis being placed on the coordination of activities and services performed by third parties. They also show that in comparison with SPs, BICs are less focused on innovation-led activities and the knowledge creating stages of the corporate value chain.

That BICs are less oriented towards R&D and technology intensive activities is also evident if one considers the services they provide. Actually, 78.3% of BICs provides professional training, 78.3% marketing and other commercial services, and 65.2% internationalization support services. Administrative and legal, financial advisory and fund search services are also more frequent than is the case for SPs: they are provided by 52.2, 69.6 and 56.5% of BICs, respectively. On the contrary, BICs providing scientific and technical services are less numerous than SPs: 52.2% of BICs is involved in technology transfer activities and only 39.1% in R&D services.

3. Methodology of the field analysis on firms located on a technology incubator

The main objective of this paper is to provide original empirical evidence on how effective are Italian technology incubators that are situated within SPs and BICs. For this purpose, we compare along a series of dimensions which will be defined in detail later, a sample of independent NTBFs which were incubated on a SP or a BIC with a similar sample composed of off-incubator firms. The starting point for the analysis was the list of independent high-technology firms which at the beginning of 2000 were located on a SP or a BIC (see Section 2). Such list comprised 232 enterprises.

A questionnaire was mailed to such firms inquiring about their characteristics and those of their founders, their growth and innovative performances, the cooperative agreements they established, and whether they got public subsidies. In particular, firms were asked to provide the following information:

- year of establishment of the firm;
- number of employees at start-up and at the end of 1999;
- whether the firm was a corporate spin-off or not;
- measures of innovative activity: these include traditional input and output measures (number of researchers out of the total workforce in 1999, patents and copyrights granted to the firm in the period 1996–1999). We also measured the skill level of the workforce by the number of graduates out of the total 1999 workforce. In addition, we considered whether the firm had adopted advanced information and communication technologies by 1999, a dimension of innovative activity that has been neglected by previous studies on this issue, and indicators of access to external knowledge resources (i.e. participation in R&D programs promoted by the EC, purchase of the R&D services of universities and research centers);
- measures of relational capabilities: establishment of formal collaborative agreements with other firms and universities, and nature of the agreements concluded;
- whether the firm obtained public subsidies in the course of its life;
- age of each founder, educational attainments, main motivation of the self-employment choice, and nature of the previous working experience in terms of functional activity (R&D, production, sale, etc.), hierarchical position, and characteristics of the firm (or other organization) by which he was employed before becoming an entrepreneur.

The questionnaire was followed by direct and/or phone interviews with firms’ owner-managers conducted by instructed personnel. The aim of the interviews was to complete the questionnaire (if necessary).
Table 2
Industry and geographical composition of NTBFs on and off technology incubator

<table>
<thead>
<tr>
<th>Sector of operation</th>
<th>On-incubator</th>
<th>Off-incubator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>%</td>
<td>Numbers</td>
</tr>
<tr>
<td>Aerospace</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Biotechnology and Pharmaceuticals</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Electronics</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Computers</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Internet (ISP, e-commerce)</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Software</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Multimedia content</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total sample</strong></td>
<td><strong>45</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>Area of firm’s localization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>35</td>
<td>78</td>
</tr>
<tr>
<td>Center/south</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total sample</strong></td>
<td><strong>45</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The sample firms were then matched with 45 independent NTBFs that were not located on technology incubator, but were in similar sectors, in similar geographic areas, and of similar age. In order to find firms that complied with the above mentioned criteria, we resorted to the RITA database. Developed by CIRET-Politecnico di Milano, RITA provides information on a sample of Italian high-technology start-ups established after 1980 and on their founders. The present release of the database includes almost 400 firms and 1000 entrepreneurs. The matching strategy was successful as concerns both industry and geographic area. As was the case in most previous empirical studies on this issue, the only exception was the age criterion, with off-incubator firms being somewhat older than those located on a technology incubator. However, the difference between the average age of the two categories of firms is less than 1 year (5 against 6 years).

Due to the fact that firms in both the on- and off-park samples were surveyed at a particular date (i.e. the beginning of 2000), the question arises whether the data relating to such firms suffer from sample selection problems and what may be the implications for the empirical analysis. For one thing, one may presume that survival rates are higher among on-park firms in comparison with their off-park counterparts, actually the former enjoy a more protected situation, due to the seedbed role played by the park. Furthermore, innovative firms may be more prone to risk taking and may be characterized by higher early mortality rates than other firms if they are not protected. So they may be relatively less numerous in the control sample than in the sample of incubated firms. Note, however that it may be less innovative, under-performing firms that mostly benefit from the protection offered by location on park. Then the sample selection bias would turn in the opposite direction: more innovative firms would be underrepresented in the on-park sample. In addition, a major reason for voluntary abandonment of on-park location is lack of space. Such situation more often applies to successful, innovative, high-growth firms which again may be relatively less numerous in the on-park sample. Altogether, it is fair to recognize that our data are probably affected by sample selection biases. Nevertheless, opposed forces are at work; therefore, we are quite confident that the empirical

\[19\] Note, however that the available evidence seems not to support such presumption. See for instance Westhead (1997, p. 50).
results that are presented in the following sections are largely independent of such biases. Of course, a sounder methodological approach would have been to identify all firms that were ever incubated in a SP or BIC—and not only those located on park at the date of the survey, to draw a sample from such population, and to track them over time up to the year 2000 if they were still on park at that time, or up to exit time, with exit being the consequence of bankruptcy, take over or the decision of the firm to leave the park for another location. Such sample could then be matched with a control sample chosen in accordance with criteria similar to those mentioned above (i.e. same sector, region, year of establishment, and age). Unfortunately, such research design turned out not to be viable in practice, as Italian SPs and BICs did not systematically keep track of the necessary information. An additional problem might arise due to the fact that the on-park sample is likely to be affected by a self-selection bias, and thus, may not be representative of the target population. In fact, incubated firms which are performing well may be more willing to provide information about themselves; so they are likely to be over-represented in the on-park sample. Nonetheless, the same self-selection bias does affect the control sample, as data from the RITA database were collected through a similar survey. It follows that the selection procedure is unlikely to have biased the comparison between on- and off-park firms.

The sample of incubated firms was compared with the control sample along a series of dimensions through statistical tests (t-tests, binomial and multinomial Chi-squared tests). The findings of the statistical analysis are presented in the following two sections. Section 4 is devoted to the characteristics of firms’ founders, while the growth and innovative performances of firms, the establishment of collaborations with other firms and universities, and access to public subsidies are considered in Section 5.

4. Characteristics of founders of NTBFs located on and off technology incubators

This section is devoted to the analysis of the characteristics of founders of NTBFs located on and off incubating structures and 112 are entrepreneurs of firms located off parks.

Table 3 presents evidence on the characteristics of high-technology entrepreneurs in terms of age (at the date of firm’s establishment), educational attainments and prior working experience. In order to evaluate the statistical significance of differences between the two categories of NTBF founders (i.e. the on- and off-incubator categories), we have proceeded to compute t-tests (for continuous and discrete variables), binomial Chi-squared tests (for dummy variables) and multinomial Chi-squared tests (for categorical variables). Overall, results show that founders of NTBFs located on technology incubators have a different education and working profile with respect to other high-technology entrepreneurs. At the date of firm start-up on-incubator entrepreneurs are only marginally younger (35 years old against 36 of other founders), with the difference between the two categories being statistically insignificant. More interestingly, they have a considerably richer educational background.20 As is evident from Table 3, the percentage of founders of tenant firms with a post-graduate degree is significantly greater (at the 1% level) than that of off-incubator entrepreneurs: 10% of the individuals in the former category has a Ph.D. degree against only 1% in the latter category of entrepreneurs. Not only on-park entrepreneurs have a better post-graduate education, but among them the proportion of individuals with a graduate degree also is significantly (at 1%) higher (59% against 40%). In particular, 16% of them has a degree in engineering against 12% of the founders of NTBFs located off incubators, and 29% has a degree in other scientific or technical fields such as computer science, mathematics and chemistry, against 12% of the other category. Italian SPs and BICs seem, therefore, able to attract a more educated category of entrepreneurs, who are relatively more specialized in scientific and technical branches. Given the low propensity of Italian technical graduates towards the self-employment choice (see again Colombo and Delmastro, 2001), our

Note: that there are remarkable differences as regards Italian and European graduate and post-graduate programs. For a more detailed discussion of such issues and for a comparison of the educational attainments of Italian NTBF founders with those of other European high-tech entrepreneurs see Colombo and Delmastro (2001).
findings suggest that technology incubators may play a pivotal role in fostering technological entrepreneurship in a country which is a laggard in science-based sectors. At the very least, they act as a catalyst for technologically educated entrepreneurs.

A (partial) confirmation of this claim comes from data of Table 3 concerning the prior working experience of NTBF founders. Even though the two categories of entrepreneurs under scrutiny do not show significant differences as regards working background by a multinomial Chi-squared test, the only exception regards the percentage of entrepreneurs being previously employed by a university or another research organization: this percentage is as high as 9.3% for the sample of entrepreneurs working on incubators, but is only 3.6% for founders of NTBFs located off parks. Turning to the other categories of working background and focusing only on entrepreneurs of incubated firms, 8% of them had no prior working experience before founding the firm and 40% worked as an external consultant. Of entrepreneurs with a working experience within a business company (43%), some 71% was previously employed by a high-technology firm, and the remaining 29% by a firm operating in a low-technology industry.

In Table 4, we present results on the characteristics of the prior working experience of the NTBF founders that before starting the new enterprise were working in a business organization. The two samples reduce to 56 and 50 founders for the on- and off-incubator categories, respectively. In particular, we concentrate on the founder’s position and function and the size of the firm by which he was formerly employed. Multinomial Chi-squared tests between the two distributions of NTBF founders show that differences always are significant at conventional levels. In particular, among founders of incubated firms those that worked in a medium or large firm (i.e. a firm with more than 100 employees), had a top or middle management position, and were assigned to technological functions.
such as R&D, design and engineering, and information systems are relatively more numerous than in the control sample. Namely, 52% of on-incubator entrepreneurs worked in a firm with more than 100 employees against 34% in the off-incubator category, 36% had a middle or high managerial position against only 18% in the other category, and 61% was previously employed in R&D, design and engineering, and information systems departments against 30%. On the contrary, before the self-employment choice founders of firms located off incubators had mostly low managerial positions within small firms (with less than 100 employees) and were prevalently assigned to commercial functions. So, even though the proportion of founders with working experience in (high-technology and other) firms is quite similar for the on- and off-incubator categories (43.4 and 44.6%, respectively, see Table 3), their profile turns out to be very different one from another.

Finally, the interviewed entrepreneurs were asked to choose out of four kinds of motivations the one which has been the most important to shape the start-up decision. Selected motivations are of the following four types. First, entrepreneurs may be induced to start a new business because of the negative prospect of other alternatives. Following existing literature (see for instance Arrighetti and Vivarelli, 1999), we call this situation as ‘defensive motivation’. Second, the self-employment decision may be mainly driven by psychological factors such as willingness to autonomously manage working time and aversion to hierarchical corporate culture. By following the income choice approach (see for instance Blanchflower and...
Table 5

<table>
<thead>
<tr>
<th>Motivations</th>
<th>On-incubator</th>
<th>Off-incubator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of obs</td>
<td>%</td>
</tr>
<tr>
<td>Belief in introducing an innovation</td>
<td>66</td>
<td>51.16</td>
</tr>
<tr>
<td>Perceive potential for higher income</td>
<td>17</td>
<td>13.18</td>
</tr>
<tr>
<td>Personal motivation</td>
<td>25</td>
<td>19.38</td>
</tr>
<tr>
<td>Defensive motivation</td>
<td>21</td>
<td>16.28</td>
</tr>
<tr>
<td>Total sample</td>
<td>129</td>
<td>100</td>
</tr>
</tbody>
</table>

*a* Multinomial Chi-squared test between the two categories (on- and off-incubators) of NTBF founders.

*b* Significance level greater than 1%.

Oswald (1998), we also include motivations regarding an expected increase in the entrepreneurs’ income by becoming self-employed. Lastly, entrepreneurs may be of a Schumpeterian type, being mainly motivated by the belief in introducing an innovation.

Table 5 reports results for the two categories of NTBF founders. First, the difference between the two distributions of motivations is found to be statistically significant at the 1% level by a multinomial Chi-squared test. Second, while personal and defensive motivations score similar percentages for the two categories of entrepreneurs, economic and innovation factors obtain very different results. In particular, entrepreneurs of incubated high-technology start-ups are mainly motivated by innovation-related factors: 51% of them indicates this motivation as the major determinant of the self-employment choice, while this percentage reduces to 36% for founders of NBFTs located off-incubators.

To sum up, Italian entrepreneurs of firms incubated on SPs and BICs present distinctive characteristics with respect to other Italian high-technology entrepreneurs. First, founders of incubated NTBFs are on average more educated and are more likely to come from universities and other research organizations. Moreover, when their prior working experience is in a business organization they are more likely to come from technological units (such as R&D laboratories). These features are also mirrored by the founding motivation: they are more likely to start-up a new high-technology venture driven by the willingness of introducing a technological innovation. In addition, they usually hold a higher position in the managerial hierarchy of the firm where they were previously employed, and such firm usually is of larger size. We can therefore, conclude that Italian technology incubators appear to attract educated individuals with quite sophisticated technological and managerial skills, who in Italy, for reasons examined elsewhere by the authors (see again Colombo and Delmastro, 2001), are quite unlikely to take the self-employment choice.

5. Characteristics of firms located on- and off-technology incubators

In this section, we compare the characteristics of the sample firms located on SPs and BICs with those of the off-incubator control sample.

Let us start with firm size. In Table 6, we illustrate the estimates of two simple econometric Tobit models, given the left-truncated nature of the dependent variable: start-up size.

Table 6

<table>
<thead>
<tr>
<th>Variables</th>
<th>Start-up size</th>
<th>Size in 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.1467 (0.5743)</td>
<td>0.9680 (0.5783)</td>
</tr>
<tr>
<td>On-incubator</td>
<td>0.0539 (0.1539)</td>
<td>0.3173 (0.1584)*</td>
</tr>
<tr>
<td>Corporate spin-off</td>
<td>0.4787 (0.2245)*</td>
<td>0.3962 (0.2489)</td>
</tr>
<tr>
<td>Start-up size</td>
<td>-0.3016 (0.0721)</td>
<td>0.3616 (0.0721)</td>
</tr>
<tr>
<td>Firm’s age</td>
<td>-0.1156 (0.0494)*</td>
<td>0.0699 (0.0419)</td>
</tr>
<tr>
<td>Number of founders</td>
<td>0.1372 (0.0404)*</td>
<td>0.0699 (0.0419)</td>
</tr>
<tr>
<td>Education</td>
<td>0.0346 (0.0340)</td>
<td>-0.0027 (0.0346)</td>
</tr>
<tr>
<td>Working experience</td>
<td>0.0262 (0.0096)*</td>
<td>0.0030 (0.0096)</td>
</tr>
<tr>
<td>Observations</td>
<td>90</td>
<td>86*</td>
</tr>
<tr>
<td>Log-likelihood</td>
<td>-94.1970</td>
<td>-90.2202</td>
</tr>
</tbody>
</table>

*a* Significance level greater than 5%.

*b* Significance level greater than 1%.

*c* Four firms which were founded in 1999 could not be included in the regression.
dent variables (i.e. logarithm of the number of employees at start-up and at 31 December 1999), one for start-up size and the other for post-entry growth. The aim is to highlight the influence exerted by firm location (i.e. on-park versus off-park) upon the start-up size and the post-entry growth performances of firms, after controlling for the role played by both founders’ skills and constraints due to the lack of financing and other key resources. In particular, “On-incubator” is a dummy variable which is one whenever the firm is located on a SP or a BIC. Control variables include the following ones. “Corporate spin-off” is a dummy which indicates whether the firm at start-up benefited from tangible and/or intangible assets provided by an established firm;22 “Number of founders” is the number of firm’s owners at start-up. The former variable takes into account financial and/or physical support provided by a mother company at start-up, while the latter is a proxy of both the internal financial resources provided by founders and heterogeneities of capabilities. “Working experience” is the average number of years of founders’ working experience before firm’s foundation; such variable provides information not only on founders’ professional skills, but also on their average earnings level at start-up. Turning to entrepreneurs’ competencies, the variable “Education” is the average number of years they spent on educational programs. Finally, in the post-entry growth regression, we also included “Start-up size” and “Firm’s age” as control variables.

Let us firstly consider the size of firms at start-up. As a preliminary remark, note that the average number of employees at firm’s foundation is 4.8 for NTBFs embedded in a technology incubator and 5.7 for those located off such structures. However, the estimates of the start-up size model show that after controlling for factors other than location, such difference vanishes. Indeed, the variable “On-incubator” turns out to have no impact on the number of employees at firm’s foundation. Conversely, the coefficients of variables which provide information on the resources (e.g. financial) that at start-up were at disposal of founders, i.e. “Corporate spin-off” and “Number of founders”, are positive and significant at conventional levels. In this respect, the detected positive and significant (at 1%) impact of “Working experience” would seem to confirm the importance of the role played by financial resources rather than founders’ skills. Accordingly, the variable “Education plays”, no role in affecting firm’s size at start-up.

Let us now turn attention to the determinants of firms’ post-entry growth.23 As was mentioned earlier, in order to assess whether localization on incubator affects growth, we have regressed the logarithm of the number of employees in 1999 on embedness within an incubating structure, controlling for start-up size, firm’s age and a series of variables that capture human capital of firms’ founders and financial resources at start-up time. Again results are presented in Table 6. Location on SPs and BICs turns out to positively influence the post-entry growth of NTBFs: the coefficient of “On-incubator” is positive and significant at 5%. Other things being equal (i.e. with start-up size,24 firm’s age and other explanatory variables being evaluated at their mean value), the average annual growth rate is 55% for incubated firms and 30% for firms in the off-park sample: incubated high-technology firms start with a size which is similar to that of other NTBFs, but thereafter, they tend to grow at a faster pace.25 Note finally that variables that take into account financial

22 It is worth noticing that there are three corporate spin-offs in the two samples: one in the incubated firm sample and two in the control sample. See footnote 18 for the definition of “corporate spin-off” that we have adopted in this work.

23 It is worth mentioning that for some firms, we also have information on turnover at the survey date. However, data on this variable are often missing so that it is not possible to estimate an econometric model using turnover as a proxy of firm size.

24 Note that since the coefficient of start-up size is significantly lower than 1, Gibrat law does not hold for this sample of Italian NTBFs (see Audretsch et al., 1999).

25 Note that the growth model suffers from two shortcomings, related to sample attrition problems (see Section 3). First, we do not take survival rates into account. As has long been highlighted by the literature on the post-entry performances of firms (for a survey, see for instance Sutton, 1997; Caves, 1998), failure to adjust for the likelihood of survival affects growth rates, as we only observe the growth rates of surviving firms. However, as was said earlier, there is no robust evidence suggesting that survival rates should substantially differ between on- and off-incubator firms. Second, there is an additional sample selection problem due to the fact that all else being equal, rapidly growing firms are more likely to abandon their on-incubator location; in that case, they would be missed by our survey. This means that with all else being equal, the on-incubator sample is likely to underestimate firms’ actual growth rates. This however provides further support to our findings.
We further investigated the characteristics of NTBFs by looking at various measures of innovative activity (see Table 7). In order to assess the statistical significance of the detected differences, we have again proceeded to run binomial Chi-squared tests and t-tests between the two categories of firms. In accordance with the studies mentioned in Section 1, we found no significant difference between on- and off-park firms in the share of R&D employees out of the total workforce. However, employees of incubated firms turned out to be on average more educated: 52% of them has a graduate degree against 29% of the workforce of firms located off incubators, with the difference being significant at the 1% level. In addition, incubated firms are more likely to exploit links with universities and other research institutions. Indeed, 24% of them has been involved in EU R&D projects against only 9% of firms off incubators, with the difference being significant at conventional levels and 29% has acquired R&D services from universities and/or other research laboratories (against 13%; the difference is again significant). Furthermore, there is evidence that firms located on SPs and BICs produce (marginally) higher innovation output than firms in the control sample: 18% of them has patented a new product and/or process against 13% of the sample of NTBFs located off incubators and 11% has been granted a copyright against 9%. Nonetheless, such differences are small and statistically insignificant at conventional levels. Lastly, the data presented in Table 7 show that incubated firms are more likely to adopt information and communication technologies than off-incubator firms: the average number of PCs per firm is 11 against 10 of the off-incubator sample, the average number of workstations is 4.6 against 2.2, and the percentage of LAN users is 98% against 80%, with the two latter differences being statistically significant at the 1% level.

To sum up, our findings basically confirm previous evidence that the R&D intensity (an input measure) of firms located on incubator is similar to that of comparable off-incubator firms, and that the former firms have only a slightly greater innovative output than the latter. Nonetheless, our results also show that incubated firms have a more educated workforce, a significantly greater probability of adopting technological innovations, a greater aptitude to participating in international collaborative R&D projects and getting access to R&D output of research centers. This documents a direct and/or indirect positive impact of on-incubator location. From one side, SPs’ and BICs’ staff provides useful technological brokerage services, which increase the capabilities of NTBFs to leverage their internal knowledge resources. From the other, the greater educational achievements and professional skills of both entrepreneurs and employees involved in incubator locations may generate stronger capabilities in managing external knowledge. The data also confirm the presence of spillovers from SPs and BICs on adjacent firms, which are likely to be influenced by the presence of high quality knowledge providers. From the other side, the presence of external knowledge as a result of on-incubator location has a direct impact on the innovative output of the NTBFs. Finally, the differences in the use of ICTs between the two categories of firms highlight the importance of the presence of on incubator locations in driving the innovative activities of NTBFs.

### Table 7

<table>
<thead>
<tr>
<th>Measure of Innovative Activity</th>
<th>On-incubator</th>
<th>Off-incubator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researchers (%)</td>
<td>13.31</td>
<td>14.19</td>
</tr>
<tr>
<td>Employees with graduate degree (%)</td>
<td>52.26</td>
<td>29.51</td>
</tr>
<tr>
<td>Firms involved in EU R&amp;D projects (%)</td>
<td>24.44</td>
<td>8.89</td>
</tr>
<tr>
<td>Firms that have purchased R&amp;D services from universities (%)</td>
<td>28.89</td>
<td>13.33</td>
</tr>
<tr>
<td>Firms with patent activity (%)</td>
<td>17.78</td>
<td>13.33</td>
</tr>
<tr>
<td>Number of PC per firm (%)</td>
<td>97.78</td>
<td>80.00</td>
</tr>
</tbody>
</table>

*Significance level greater than 1%.

---

Unfortunately, due to missing data, we were unable to compute the R&D to sales ratio. So, in order to measure innovative input, we had to rely only on R&D employees. However, it is also worth mentioning that the intensity of R&D expenses has been the subject of much criticism when it is applied to NTBFs (see for instance Hansen, 1992).

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26 We have also measured the average number of patents for the two sample of firms. This value is close to 0.4 for both samples (i.e. 0.38 for incubated firms and 0.42 for off-park firms), and the difference between the two values is found to be statistically significant by a Wilcoxon rank test. Note, however, that given the very low percentage of firms involved in patent activity these values should be taken with caution. Indeed, they are deeply influenced by outliers: in fact, the marginally higher value of the off-park sample is mostly due to the activity of one NTBF which has been granted eight patents.
Table 8
Cooperative activity: firms that have stipulated formal agreements (%)

<table>
<thead>
<tr>
<th></th>
<th>On-incubator</th>
<th>Off-incubator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total* (%)</td>
<td>77.78*</td>
<td>57.78*</td>
</tr>
<tr>
<td>Commercial agreements* (%)</td>
<td>64.44*</td>
<td>51.11*</td>
</tr>
<tr>
<td>Technological agreements* (%)</td>
<td>57.78*</td>
<td>28.89*</td>
</tr>
<tr>
<td>Technological agreements with clients and/or suppliers (%)</td>
<td>24.44</td>
<td>15.56</td>
</tr>
<tr>
<td>Other firms (%)</td>
<td>11.11</td>
<td>8.89</td>
</tr>
<tr>
<td>Universities (%)</td>
<td>48.89</td>
<td>13.33</td>
</tr>
</tbody>
</table>

* Binomial Chi-squared test between the two categories (on and off-incubator) of firms.

Of incubated start-ups clearly increase the "absorptive capacity" (Cohen and Levinthal, 1989) of these firms, thus, leading to the same outcome.

This analysis is confirmed by results on the cooperative activity of firms. Indeed, Table 8 shows that firms incubated on SPs and BICs are significantly more likely to engage in formal agreements with other units: 78% of them has stipulated commercial and/or technological agreements against 58% of the sample of NTBFs located off incubators. This difference is significant even when we look separately at commercial agreements (64% against 51%; the difference is significant at the 5% level) and technological agreements (58% against 29%, significant at 1%). While incubated firms have a higher, but not significantly so, probability of engaging in technological agreements with business partners (both clients, suppliers and other firms), the difference is large and significant (at the 1% level) when we concentrate on agreements with universities: 49% of incubated NTBFs has stipulated a formal agreement with one (or more) university while this percentage declines to only 13% for the sample of NTBFs located off incubators.28

Note that greater recourse to external R&D services and collaborative arrangements on the part of incubated firms may simply substitute for internal R&D, thus, explaining failure of this study (and of most previous studies) to detect any difference in R&D intensity according to firms’ location on and off incubate. Alternatively, closer collaborative linkages with universities and other firms may increase the productivity of incubated firms’ R&D under such circumstances the fact that innovative output is only marginally higher in the on-incubator category might be due to the well known shortcomings of indicators based on patent activity.

Finally, Table 9 shows that NTBFs located on SPs and BICs had easier access to public financial funds: 51% of on-incubator firms received public subsidies compared with 33% of the off-incubator sample, with the difference being statistically significant at 5%. The larger difference concerns subsidies granted by local institutions. Such evidence confirms the enabling role played by on-incubator location. With a few exceptions, empirical studies on new firms (see Section 1) point to the financial constraints to which such firms are subject. In addition, in Italy there are no policy schemes that specifically target NTBFs, and lack of public subsidies is considered by entrepreneurs in high-technology activities as one of the main obstacle to innovation and growth (see Calderini et al., 2000). Therefore, the support offered by SPs and BICs in this domain appears of great value. Note also that the easier access to public subsidies allowed by on-incubator location may have the additional beneficial effect of inducing risk-averse individuals (in particular, older individuals with greater human capital and higher income) to take the self-employment choice. Such argument is coherent with the detected differences between founders of on- and off-park firms illustrated in Section 4.

6. Discussion and policy implications

The main objective of this paper was to contribute to ascertain the added value to NTBFs of location within a SP or a BIC. In fact, in spite of the popularity of such institutions and their rapidly growing number in Europe over the 1980s and 1990s, it is still doubtful whether they have been successful in supporting the establishment and post-entry development.
of NTBFs. For this purpose, we have compared a sample composed of 45 Italian NTBFs that at the beginning of year 2000 were situated in a technology incubator within a SP or a BIC with a control sample of similar off-incubator firms (in terms of age, sector of activity, and geographical location). The comparison concerned the characteristics of firms’ founders (i.e. educational attainments, prior working experience, and motivations of the self-employment choice), the innovative and growth performances of firms, the establishment of cooperative relations with other firms and universities, and the ability to have access to public subsidies.

This work differs from the empirical literature on this issue in two respects. First, a more comprehensive set of indicators was used than in previous studies. Second, the analysis of the Italian case is an interesting addition to the literature, which so far mainly focused attention on northern European countries. On the one hand, the supply of entrepreneurs is larger in Italy than in other European countries. On the other hand, most Italian new firms are in mature industries, the country is a laggard in high-technology sectors, and the national innovation system is rather weak; in particular, the provision of key inputs to firms’ innovative activities such as technical, financial, and other business services, suffers from serious market failures. Under such circumstances, one would expect SPs and BICs to play a relatively more important role in supporting the NTBF movement.

The results of the paper confirm such intuition. From one side, Italian SPs and BICs have been rather successful in attracting entrepreneurs with high quality human capital, thus, playing a positive selection role. On average founders of on-incubator firms have a richer educational background, especially as regards scientific and technical studies, than their off-incubator counterparts: entrepreneurs with a Ph.D. degree and those with a graduate degree in engineering or in other scientific and technical fields account for a significantly higher percentage in the on-incubator category than in the off-incubator one. As concerns prior working experience, a larger number of founders of SP and BIC firms was employed by a university or another research organization. When attention is focused on entrepreneurs that were previously employed by a business firm, those that worked in medium or large firms, had a top or middle management position, and were assigned to a technological function (i.e. R&D, design and engineering, and information systems) turned out to be relatively more numerous in the on-incubator sample than in the control sample. In accordance with such evidence, on-incubator entrepreneurs mention innovation-driven motivations as the main driver of the self-employment choice to a much larger extent than entrepreneurs in the control sample. Our findings also show that on-park firms have easier access to public subsidies. From this standpoint, the selection function performed by SPs and BICs has the beneficial effect of channeling those subsidies to relatively more promising ventures (i.e. those established by individuals with richer human capital). Of course, the question arises whether SPs and BICs have simply promoted the geographical clustering of high quality new technology-based businesses, or they also have encouraged the creation of businesses which otherwise would not have been established. The data we have do not provide any direct evidence relating to such aspect. Its analysis would be an interesting extension of the findings illustrated in the present paper.

From the other side, the post-entry performances of NTBFs turned out to differ according to their location status. The empirical findings illustrated in the paper conform to previous evidence relating to the UK situation in that the R&D intensity of firms, an indicator of innovative input, is not significantly different between the on- and off-incubator categories; the difference as regards innovative output measured by patent activity also is negligible. Nonetheless, the evidence that on-incubator location favors firm’s growth is also replicated. After taking into account a series of control variables (i.e. the number of a firm’s founders, the characteristics of their human capital, their ability to finance the new venture with their own resources, whether the new firm is a corporate spin-off, start-up size and firm age), incubated firms exhibit a significantly larger number of employees at survey date, all else being equal. In addition, the results of the empirical analysis show that SP and BIC firms outperformed off-incubator firms according to a number of other indicators, including the education of the workforce, the adoption of innovative information and communication technologies, participation in research projects sponsored by the EU, and the ability to take advantage of the scientific and technical services provided by research organizations. Incubated
firms also showed a greater likelihood of establishing formal cooperative relations, both of commercial and technical nature; the difference between the on- and off-incubator samples was especially remarkable as concerns technical collaborations with universities. Altogether, the empirical findings illustrated in the paper suggests a more positive view of SPs and BICs than the one offered by most previous studies. A possible explanation may reside in the fact that Italy is a laggard in high-technology activities. In situations where there are substantial market failures as regards the provision of essential inputs to NTBFs (including finance, real estate, technical and other business services), the presence of bridging institutions such as SPs and BICs may be relatively more beneficial than in countries where the national innovation system is more advanced. For technology policy, this is an interesting result which is waiting for confirmations relating to other laggard countries.

Nonetheless, it is fair to recognize that in order to shed new light on the support to NTBFs offered by parks, much remains to be done. In this paper, we have shown that incubated firms have superior post-entry performances than non-incubated ones, especially as regards growth rates. The econometric estimates suggested that such result could not be explained by the superior human and financial capital of the founders of tenant firms. In other words, there seems to be an added value provided by SPs and BICs. However, the small number of observations hindered use of a more robust methodology, capable of disentangling more effectively the effects due to selection biases from those that can genuinely be attributed to location on-park. In addition, we still ignore whether the added value of on-park location illustrated by our findings is attributable to the quality of the services provided by parks to tenant firms, the agglomeration economies associated with such location, or the easier access to external resources, especially in the technical and financial spheres (i.e. collaborations with universities and other knowledge creating institutions, public subsidies). Of course, being able to distinguish between such effects has important policy implications. For this purpose, one needs to specify and estimate a more general growth model than the one considered here, a task which is high in our research agenda.

Furthermore, we mentioned in Section 2 that there is considerable heterogeneity among Italian SPs and BICs; differences concern important characteristics such as overall size, the ability to attract external knowledge creating units, the nature of the sponsoring institutions, the presence of a dedicated manager, and the internalization of the provision of R&D and other technical services. This situation is common to other countries (for the UK, see for instance Massey et al., 1992). So the question of whether there exists a successful organizational model for SPs and BICs naturally arises. Westhead and Batstone (1999) have explored the benefits to NTBFs of location on a managed park, that is a park with a full-time manager on site. They have showed that the impact of a pro-active management function generally is positive. This is an important initial result. The informal and qualitative evidence that we have collected gives some further interesting indications. In particular, it seems to suggest that key success factors for parks include a lean and agile internal organization, and effective coordination of the services provided by third parties, with the emphasis being placed on the brokerage and gate-keeping function carried out by parks. The fact that in the selection of tenant units, especially in the early period after establishment of a park, priority be given to the R&D laboratories of large firms so as to increase the attractiveness to NTBFs of on-park location, also appears to play a crucial role. Unfortunately, the number of incubated firms in our data set is too small to obtain robust quantitative evidence on these issues. More generally, additional data need to be gathered to provide further insights into the drivers of parks’ success and to draw out the consequent implications for technology policy.

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