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Abstract

We assess the effectiveness of technology incubators in Turkey in supporting small and new firms. Information on 48 on-incubator and 41 off-incubator firms is gathered through face-to-face interviews to compare and to contrast those that benefit from incubators with those that do not. Our findings indicate differences between on- and off-incubator firms regarding their economic performance, highly in favor of on-incubator firms, but the same cannot be put forward concerning innovative output. We found financial support mechanisms and incubator support services important in explaining these performance differentials. We further argue that the impact of entrepreneur characteristics, business networking and interaction with universities are not strong enough.

Keywords: Technology incubators, SMEs, university industry links

1. Introduction

It is widely accepted that small and medium enterprises (SMEs) are important in creating income and employment. Their flexible structure enables them to adapt quickly to changes in economic environment and technology. Many politicians believe and economists have the intuition that new possibilities for growth, innovation and job creation will come from small and new firms (Thurik and Wennekers, 1999). They can play vital role in achieving economic growth especially in the developing countries. However SMEs have several disadvantages. They are generally unable to obtain benefits from economies of scale both from the output and input side. Small size is an important constraint for process and product innovations, which are the core of recent competitiveness (European Commission, 2001). They also have various problems in gaining access to resources and in the development of R&D initiatives possibly because of their limited access to scientific knowledge.

In dealing with the above difficulties and to serve for such means, incubators provide an attractive framework. They can be considered as a remedy for the disadvantages that SMEs encounter by providing numerous business support services and they are useful in fostering technological innovation and industrial renewal (Similor and Gill, 1986; Mian, 1994a, 1994b, 1997). Incubators are also important for universities to set links with the commercial world that enables commercialization of research and transfer of technology (Phillips, 2002). They can be viewed as a mechanism for new venture creation and technological entrepreneurship (Mian, 1994a, 1996, 1997); an initiative to deal with market failures relating to knowledge and other inputs of innovative process (Colombo and Delmastro, 2002); and a mechanism to support

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regional development (Allen and Levine, 1986; Mian, 1997). For such goals and reasons many countries have increasingly been engaged in establishing incubators.

Last decade has showed that, Turkey is one of the countries that also followed this trend. This movement started in the early-1990s with a particular interest in technology business incubators (TBIs). We made an attempt in this paper to discuss the basic characteristics of the early phase of Turkish experience in technology business incubation. To achieve our task, we collected information on 48 on-incubator and 41 off-incubator firms through face-to-face interviews to compare and to contrast the firms that benefit from incubator services with those that do not. The information in our data set also reflects basic characteristics of 78 on-incubator and 61 off-incubator entrepreneurs that established these firms.

Our contribution rests on three aspects. An important condition behind the success of incubators is the existence of effective assessment of the services of incubators. Such assessments provide invaluable feedback for the different parties involved in an incubator, however they have hardly been employed in Turkey.¹ One of the goals of this paper is to contribute in this aspect. Second, studies evaluating the value-added impacts of incubators are generally conducted in developed countries.² Different from the existing literature this paper reflects the experience of a developing country that suffers from macroeconomic instability and a weak national system of innovation (NSI). Lastly, we suggest that our questionnaire and fieldwork might provide helpful insights on how to conduct related studies in other developing countries.

The discussion proceeds as follows. The following section gives brief information on incubators in Turkey. We will describe our methodology in section 3 by putting special emphasis on our questionnaire design and fieldwork. Section 4 investigates the performance of the incubator firms. Then we try to answer what makes incubator firms more successful. Section 6 concludes the paper with further remarks and policy implications.

2. SME support policies and incubators in Turkey

Considering the fact that 99 percent of all companies are SMEs in Turkey, it is clear that SMEs possess an important place in Turkish economy. Having realized this fact the government authorities have employed various policy tools to assist SMEs such as, direct financial support, R&D subsidies and tax allowances.³ The policy option of establishing incubators is rather new for Turkey and it is still in the development phase. This section presents brief information regarding the role of incubators in Turkey. But before reviewing the Turkish incubation experience we will provide a concise definition of the term “incubator”.

The literature on incubators provides various definitions for the concept. These definitions more or less coincide and share the same characteristics. In this paper we employ an internationally accepted definition. National Business Incubation Association (NBIA) defines *business incubation* as “a dynamic process of business enterprise development which (i) nurture young firms, help them to survive and grow during the start-up period when they are most vulnerable; (ii) provide hands-on management assistance, access to financing and orchestrated

¹ For instance, OECD suggests that the evaluation process of science and technology policy tools in Turkey represents major weaknesses calling for policy adjustments (OECD, 1998: 31). Another OECD document argues that it is hard to assess the effectiveness of policy tools in Turkey mainly because of the reason associated with lack of statistical information (OECD, 2004: 8).

² There are numerous studies that assess science park and incubator impact in developed countries. For science parks see Monck et. al. (1988), Quintas et. al. (1992), Westhead (1997) for United Kingdom; Löfsten and Lindelöf (2002a, 2002b, 2003) for Sweden; and Phillimore (1999) for Australia. For incubators see Mian (1994a, 1994b, 1996a, 1996b, 1997), Phillips (2002) for United States; and Colombo and Delmastro (2002) for Italy. For a recent study on incubators in the EU see European Commission (2002).

³ For recent studies on SMEs in Turkey see OECD (2004), and Taymaz (1997).

exposure to critical business or technical support services; *(iii)* offer entrepreneurial firms shared office services, access to equipment, flexible leases and expandable space — all under one roof.”

Incubators provide services generally for a limited period (in most cases 3 to 4 years) and they offer assistance only for newly established small firms. The primary goal of a “traditional” incubator is to facilitate economic development by promoting entrepreneurship, innovation, employment opportunities and growth. Especially after the 1990s incubators are established mainly for differentiated special purposes. At this point we should devote our attention to TBIs since Technology Development Centers (TEKMERS) in Turkey share common characteristics with TBIs. TBIs are not very different from other incubators. Main objectives of TBIs are, *(i)* to facilitate new high-tech firm creation and development; *(ii)* to improve technology transfer between higher education institutions and industry; *(iii)* to facilitate transfer of scientific research into commercial applications; *(iv)* to facilitate new opportunities for the university graduates both in terms of entrepreneurship and employment; *(v)* to benefit from agglomeration economies.

The concept of incubators as a policy tool is appealing for Turkey for several reasons. First, as has been underlined, incubators can be viewed as an important element of SME policy since they not only provide numerous ordinary incentives (such as government financial support and R&D support) but also assist small firms during their vulnerable start-up period by taking tenant companies in the body of incubator and by providing hands-on assistance (for instance by facilitating office spaces, and administrative and technical support). Second, they serve as a node of network integrating high-tech industries, universities, public organizations and other related actors. Given that interaction between and within different institutions is low in Turkey, the policy of establishing incubators might help to stimulate these links. Another feature is that, in addition to the ordinary problems that are present in any other developed country, Turkish SMEs face an unstable macroeconomic environment. This instability, mainly in the form of economic crises, introduces extra difficulty for small companies to reach financial resources. Therefore the presence of incubators that provide a protective environment is important. Fourth, developing countries have limited resources both in terms of technology and human capital. Incubators can assist SMEs in the use of their resources in more efficient ways. For example many incubators have machinery and equipment for the use of all tenant companies. So firms will not have to direct resources towards these provided services. This facilitates firms to use their available funds in more productive means. Finally, Turkey is one of the countries that suffer from brain drain. Every year many well-educated technical and scientific personnel move to other countries for reasons associated with better opportunities. Incubators may be at the very least an attempt in suspending this situation by enabling these people to implement their knowledge and skills within the borders of Turkey.

Unfortunately it is not easy to assess the assertions on incubators’ impact because of three reasons. First, since different parties with different objectives are involved as partners, there could be various (sometimes conflicting) criteria for “success” (Monck, et. al., 1988). In the case of Turkey, there are at least four partners: Small and Medium-size Industry Development Organization (KOSGEB), universities, incubators and the firms. A high survival rate can be considered as a success criterion from the side of KOSGEB and incubators themselves. However if that happens without an increase in the employment of graduates of the university in which the incubator is located, it may be considered as a failure from the university’s point of view. Second, it may be difficult to identify the effects because of self-selection biases. For instance, it may be the case that incubated firms interact more with the university just because of the reason that incubators are located within university campuses, or it may be the case that incubated firms perform better regarding economic or technological indicators because entrepreneurs of these firms might be more qualified.⁴ Lastly, the lack of data could create problems in impact evaluation. For example, though incubators in Turkey may prevent migration

⁴ For example, Colombo and Delmastro (2002) states that, “...Italian technology incubators appear to attract educated individuals with quite sophisticated technological and managerial skills...” (p. 1115).

of skilled workers, it is not easy to assess their performance in this particular issue at least in the short run.

Table 1
KOSGEB Technology Development Centers (TEKMERS) in Turkey.

Name of University	Location	Date of establishment	Number of firms ^a	Number of firms interviewed
Ankara University	Ankara	1996	5	4
Middle East Technical University (METU)	Ankara	1990	21	18
Bosphorus University	Istanbul	1996	9	8
Istanbul Technical University (ITU)	Istanbul	1990	21	14
Yıldız Technical University	Istanbul	1998	5	3
Gebze Institute of Technology	Kocaeli	2000	10	1
Total			71	48

^aThe figures represent the number of firms that are physically present in an incubator building.

Note: We collect data from 48 firms in 6 different incubators. There are five other, which are not covered by this study: Istanbul University (Istanbul), Dokuz Eylul University (Izmir), Erciyes University (Kayseri), Blacksea Technical University (Trabzon) and Pamukkale University (Denizli). Apart from that there are 28 enterprise development centres.

Incubators in Turkey have been established by KOSGEB. KOSGEB is a non-profit, semi-autonomous organization (under the Ministry of Industry and Trade) established with the objective of improving the conditions of SMEs and enhancing their competitive capacity by providing financial support and technical and managerial assistance. Within the body of KOSGEB, there are three different schemes that can be identified as an incubator: *Enterprise development centers* that function as a traditional incubator, *incubators without walls* and *technology development centers (TEKMERS)*. This paper's central concern is the TEKMERs because our study is focused on the impact of incubators on technological activities.

TEKMERS recruit entrepreneurs/firms after an assessment of their projects mainly on the basis of whether the project involves any (technological) innovative activity. Therefore the incubator firms are usually high-tech firms specialized in computer, software and electronics. TEKMERs aim; (i) to help people that are trained in scientific and technological fields to become entrepreneurs, (ii) to foster the creation of new technology-based enterprises, (iii) to support the activities of existing SMEs, (iv) to foster commercialization of R&D efforts, (v) to help efforts aiming development and diversification of regional economic activities, (vi) to strengthen university-industry cooperation. As of June 2003, a total of 128 firms are graduated from TEKMERs, and 149 firms are still being supported. Our field study involves only the firms that are physically present within a TEKMER. These firms are provided an office space and necessary supplies and equipment. Moreover firms can benefit from diversified financial assistance initiatives. These include (i) a support (in the form of loan) up to 70.000 euros for supplies, equipment and prototype development, (ii) initiatives ranging from professional consultancy support to rent support, without repayment up to a total of 23.000 euros. Apart from these support schemes, firms can take advantage of the facilities provided by the universities where the incubator is located.

3. The methodology and data sources

In order to evaluate the impact of technology incubators, we conducted a survey of two different samples of firms: firms that are located in an incubator (the "on-incubator" sample) and firms located elsewhere (the "off-incubator" sample). The fieldwork involved visiting firms and making face-to-face interviews with the entrepreneurs. In some cases that the company is relatively large both in terms of employment and sales revenue, the questionnaires were

answered by an authorized employee, usually a manager. The data was collected in the first half of 2003. Our data set contains information on 48 on-incubator and 41 off-incubator firm, and 78 on-incubator and 61 off-incubator entrepreneurs. Although at the time of the study there were 10 technology incubators, the study covers six incubators, because others have been established very recently and do not have available buildings and infrastructure. After forming the on-incubator sample, we matched these firms with their counterparts located outside an incubator on the basis of three indicators: (i) main business activity, (ii) geographical location, (iii) employment size.

There are two caveats of the method we employ in this study. First, observed differences between on- and off-incubator firms could reflect the motivations of the firms as well as the benefits of an incubator (Löfsten and Lindelöf, 2002a). Second, firms, which perform well, could be more willing to exchange information so that the samples might not represent the population truly (Colombo and Delmastro, 2002). We devote considerable attention to form the samples; unfortunately it is not easy to say that our sample is not affected from such biases. However we managed to get high response rates from the on-incubator firms so we are quite confident that the on-incubator sample can be regarded as a representative of the population.

We used three databases to form the off-incubator sample: the TOBB database, KOBINET, and the TTGV database for computer and software companies.⁵ The questionnaire comprises questions about basic firm characteristics, innovative output, evaluation of the services provided by incubators (for on-incubator sample only), importance of interaction with universities and other firms and finally the profile of entrepreneurs. When designing the questionnaire we relied heavily on the *Oslo Manual* and other surveys that were previously employed.⁶ We also took advice from KOSGEB.⁷ However, it was difficult—and sometimes not possible—to use questions designed for developed country firms. Therefore regarding information on some variables we made minor changes.⁸ The major difficulty that we faced during the interviews was that some firms were unwilling to share information on some firm specific variables, which they consider *sensitive*. During the interviews we have clearly underlined that the data provided will be kept confidential and will not be shared with third parties. Unfortunately, the firm owners hesitated to answer our questions on sales revenue and employment figures and as a result, despite our enthusiastic effort, we are not able to present full sample information regarding these variables.⁹

⁵ TOBB is the abbreviation of Union of Chambers and Commodity Exchanges of Turkey. KOBINET is a network of small and medium enterprises established with the initiatives of KOSGEB. We would like to thank Tolgahan Oysal for providing information on Technology Development Foundation of Turkey (TTGV) database.

⁶ For instance the questionnaire designed for evaluating the incubators in the EU. See European Commission (2002).

⁷ We would like to thank Mustafa H. Çolakoğlu (KOSGEB) and Ömer Öz (METU-TEKMER) for useful comments.

⁸ For example it was very hard to gather information on sales revenue and employment so we asked the question in three steps. First we try to get the exact figures. If it is not possible we demanded approximate values. If the interviewee did not respond to both questions we asked whether sales or employment numbers increased, stayed constant or decreased during the last two years. Likewise questions designed to assess co-operation between firms and between firms and universities were asked in different manner. We asked the *importance* of co-operation and interaction—not whether they have actual links—since almost none of our target firms had formal links and co-operation agreement with other firms or with universities.

⁹ Face-to-face interview is an essential element of this study. We found it practical and useful for several reasons. First, it would have been very hard to complete this research by employing other surveying methods such as, mailing and telephone surveys since the response rates would have been very low especially if one considers that Turkey is a developing country. We can assert that face-to-face interviews enabled high response rates. Second, no matter how clear the questions are, there is always a possibility that the interviewees are not able to understand the questions fully. Such cases will either result in incomplete questionnaires or imprecise answers that led misleading evaluations. In a face-to-face interview the interviewer can supply further explanations if needed so that he/she would be sure that the respondents have correctly understood the question. Another feature of the face-to-face interview is that informal information extracted during the interviews, which would have been impossible to gather in other ways, may be quite important. The interviews made for this study not only produced data but also provided exchange of

We have employed two different tests to evaluate the differences between on-incubator and off-incubator firms: independent sample t-test (for continuous variables) and chi-square test of independence (for discrete variables). In cases that we have performed chi-square tests the null hypothesis states that the variable in question is independent of location, i.e., there is no difference between on- or off-incubator firms. If the null hypothesis is rejected then it means that the difference between categories is statistically significant and the *variable in question* is not independent of location, i.e., being in on- or off-incubator category does affect the *variable in question*.

4. Are firms in incubators more successful?

This section investigates whether on-incubator firms display better performance compared to those that are established elsewhere. We start by presenting basic characteristics of our sample. The majority of the on-incubator sample composes of computer and software, electronics and medical (specialized on electronics component) firms, although there are few firms that belong to other sectors such as automotive, energy and chemical industry. The off-incubator sample composes of these three main sectors: computer and software, electronics and medical. Almost all firms in both samples are individual companies, i.e., they do not belong to any business group. In the on-incubator sample the majority of the firms are limited liability companies, whereas in the off-incubator sample 51% of the firms are limited liability companies and 39% of the firms are joint stock companies. There are no significant statistical difference between two samples regarding the size (number of employees), mean age and geographical location.

Table 2
Main business area and number of employees: On- and off-incubator firms

		On-Incubator					Off-Incubator				
		Sectors				Total	Sectors				Total
		Computer / Software	Electronics	Medical	Other		Computer / Software	Electronics	Medical		
Number of Employees	1-4	8	6	3	5	22	2	8	1	11	
	5-9	10	3	1	1	15	8	1		9	
	10-24	5	1	1		7	9		2	11	
	25-49	1	1		1	3	6		1	7	
	50-99	1				1	2	1		3	
Total		25	11	5	7	48	27	10	4	41	

In line with the existing literature, we initially focus on two indicators to assess the “incubator effect”. First, it is claimed that incubated firms display better records in terms of sales revenue and employment when compared to other firms. An early assessment of this assertion shows that there is no significant difference in performance in terms of employment between on- and off- park companies (Monck et al., 1988). However the recent literature is in consensus regarding the positive incubator impact on sales and employment performance (see for instance, Colombo and Delmastro, 2002; Löfsten and Lindelöf, 2002b). Second, incubators are generally established with the expectation of contributing to R&D, innovation and product renewal so it is expected that incubated firms are more likely to develop new products and services. The evidence on this issue is ambiguous. For example Monck *et al.* (1988) argue that incubated firms employ more R&D personnel and invest more on R&D relative to other firms located elsewhere. On the contrary, Westhead (1997) reports no significant difference regarding such

valuable informal information. The outspoken entrepreneurs and employees gave important information on firm behavior and on the evaluation of the policy tools concerning SMEs. Finally, if the sample is small, it is better for one interviewer to make all the interviews. In this way the stock of (informal) knowledge resides in one person, which is useful in making an overall assessment. In this paper the first author made all the interviews.

indicators and further states that on- and off-park firms are not different in performance on new product development, patents and copyrights. Recent studies support the evidence provided by Westhead. Colombo and Delmastro (2002) found that neither innovative output nor R&D intensity differ between the two samples. Similarly Löfsten and Lindelöf (2002a) found no statistically significant difference between on- and off-park samples concerning indicators such as, patents, licenses and new products.

Table 3
Change in employment in on- and off-incubator firms, 2000-2002

	On - Incubator		Off – Incubator	
	Frequency	%	Frequency	%
<i>Total Employment</i> °				
Increased	17	39.5	13	34.2
No change	20	46.5	13	34.2
Decreased	6	14.0	12	31.6
Total	43	100	38	100
<i>University Graduates</i> **				
Increased	18	41.9	11	28.9
No change	23	53.5	16	42.2
Decreased	2	4.7	11	28.9
Total	43	100	38	100
<i>R&D personnel</i> *				
Increased	16	37.2	10	26.3
No change	24	55.8	18	47.4
Decreased	3	7.0	10	26.3
Total	43	100.0	38	100.0
<i>PhD</i> °				
Increased	4	28.6	1	7.1
No change	10	71.4	12	85.7
Decreased	0	0	1	7.1
Total	14	100.0	14	100.0
<i>Source of labor</i> ***				
Local	41	85.4	23	57.5
National	7	14.6	17	42.5
Total	48	100	40	100

Note: For 17 firms in the on-incubator sample change in employment represents the difference between 2001 and 2002.

° No statistical difference between the two samples. *** Significant at the 1% level, ** Significant at the 5% level,

* Significant at the 10% level.

We measure economic performance by two variables: changes in sales revenue and changes in employment. We had difficulty in obtaining these figures due the reasons mentioned earlier.¹⁰ Table 3 presents the data on employment change between 2000 and 2002. Our findings indicate an important difference between the on-incubator and off-incubator firms. Majority of the on-incubator firms has stated an *increase* or *no change* in employment. On the contrary employment decreased in 32% of the off-incubator firms. This discrepancy takes a different form when only university graduates are taken into consideration. The proportion of firms that stated an increase in employment of graduates widens between on-incubator and off-incubator sample in favor of on-incubator sample. Another aim of establishing incubators is to foster local employment. Our questionnaire involved a question asking whether the firms rely on local or

¹⁰ The lack of full sample data in sales revenue and employment is partially because of this difficulty and partially due lack of information on newly established firms since they cannot provide full figures for succeeding years. We carried out the analyses by converting all sales revenue figures into US dollar terms. Change in sales revenue and employment represents the difference between 2000 and 2002 in both samples. In the on-incubator sample in cases when the establishment year is after 2000 it is the difference between 2001 and 2002.

national labor market. As expected on-incubator firms heavily rely on the local labor market, especially on the graduates of the university, where the firm is located in.

In a similar vein we can assess incubators in terms of their function as a facilitator of new opportunities for university graduates both in terms of employment and entrepreneurship. Employment by incubator firms can take two forms: regular employment and employment of student trainees. Mian (1996a and 1996b) indicates that “student employees” is one of the major value-added contributions of a university incubator. Our data shows that, 36 firms (75%) have stated that there is at least 1 employee (including entrepreneurs who founded the firm) graduated from the university where the firm is located in. Amongst all the university graduates, 36% are graduated from the university that the firm is located in. The firms in the incubators serve also as a model for entrepreneurs. Amongst 48 incubator firms 29 (60%) of them have at least one entrepreneur (founder of the firm) graduated from the university in which the firm is located.

Nearly 60% of the firms revealed the data on their sales revenue. There is an important difference between on- and off-incubator firms concerning sales revenue: 62% of the on incubator firms have stated that their sales revenue has increased; whereas this ratio is much lower in the off-incubator sample. Our findings show that on-incubator firms display a better record both in terms of sales revenue and employment.

Table 4
Change in sales revenue in on- and off-incubator firms, 2000-2002

	On - Incubator		Off – Incubator	
	Frequency	%	Frequency	%
<i>Sales Revenue</i> ***				
Increased	18	62.1	5	20.0
No change	1	3.4	5	20.0
Decreased	10	34.5	15	60.0
Total	29	100	25	100

Note: For 6 firms in the on-incubator sample change in sales represents the difference between 2001 and 2002.

*** Significant at the 1% level.

The second criterion for evaluation is innovativeness.¹¹ It is suggested that incubators encourage technological performance of new high-tech firms. Several indicators can be used to evaluate this assertion. Table 5 reports the data related to innovation. Our data reflects interesting results regarding ownership of intellectual property rights. For instance, nearly 40% of the off-incubator firms have its own trademark, whereas this ratio is about only 15% in the on-incubator sample. This difference is statistically significant at the 5 percent level. The questionnaire also comprised a question to gather information on whether the firms have introduced a new product or a process innovation in the past three years. 32% of the off-incubator firms stated that the product they produced is at least partially new for the world. This ratio is slightly lower in the on-incubator sample. More than half of off-incubator firms claimed that they have introduced a product new for Turkey in the last three years whereas the same proportion is about 42 percent for on-incubator firms. 15% of the incubator firms have stated that what they produce is new to the firm, which might be an expected result in the sense that on-incubator firms are rather younger, and what they produce may be a known technology in the industry but they have just made it on their own. Overall, our findings do not provide clear evidence to support the assertion that on-incubator firms display better records in innovative output.

¹¹ Firms in both samples are generally involved in either experimental development or applied research. Only two firms in the off-incubator sample stated that they do not have any R&D activities.

Table 5
Indicators on innovation and technology in on- and off-incubator firms

	On - Incubator		Off - Incubator	
	Frequency	%	Frequency	%
<i>Ownership of patent, trademarks etc. *</i>				
Yes	11	22.9	17	41.6
No	37	77.1	24	58.4
Total	48	100	41	100
<i>Firms introduced a new product or service **</i>				
Not introduced new product or service	9	18.8	5	12.2
New for the firm	7	14.6	0	0
New for Turkey	20	41.7	23	56.1
New for the World	12	25.0	13	31.7
Total	48	100.0	41	100.0

** Significant at the 5 % level, * Significant at the 10 % level.

Change in the number of R&D personnel can be used as an indicator for the accumulation of technological capability. Table 3 shows that on-incubator firms have better performance than their off-incubator counterparts regarding employment in R&D related activities. The number of firms indicating a rise in R&D personnel in the on-incubator group is more than the off-incubator sample. About 26% of the firms in the off-incubator sample indicated a decrease in R&D personnel, whereas this is only 7% in the on-incubator sample. To conclude this section, in terms of indicators related with employment and sales revenue, incubator firms seem to have a better record than their off-incubator counterparts on average. However, incubator firms are not more innovative than off-incubator firms but they tend to accumulate technological capability at a faster rate. Thus, low-level of innovativeness of on-incubator firms can be explained by the fact that they are yet at the early phase of their innovative activities/R&D projects.

5. What makes incubator firms more successful?

After showing that there are differences between on- and off-incubator firms with regards to their performance, this section identifies the underlying factors that determine these differences. We will analyze three sets of factors. First, we consider the differences between the characteristics of entrepreneurs. It might be the case that on-incubator entrepreneurs are more qualified both in terms educational background and prior working experience, which makes the firms they establish more successful. Second, incubator firms are more likely to interact with other firms and universities. On-incubator firms can benefit more from business networking and interactions with universities which enable them to transform their resources into productive means more easily than the off-incubator firms. Third, financial opportunities made available by the incubator may determine the success. Incubators in Turkey provide various kinds of financial support mechanisms and these supports might explain the performance differences between on- and off-incubator firms.

Concerning entrepreneurial characteristics, there is a common belief that entrepreneurs that locate their businesses in an incubator are more qualified both in terms of education and prior working experience. In Turkey, entrepreneurs are accepted to an incubator only after an assessment of their projects. It could be the case that the entrepreneurs in the incubators are more qualified than their off-incubator counterparts just because of the reason that they are found to be successful with regards to their characteristics and ability. This process may lead to a self-selection bias in comparing on- and off-incubator firms. However, as Colombo and Delmastro (2002) suggest, incubators serve as a point of attraction for better-qualified entrepreneurs who can fully realize their potential with the support provided by incubators.

Table 6 presents information on entrepreneurial characteristics. There seems to be no significant difference between on-and off-incubator entrepreneurs. We cannot reject the hypothesis that the mean age between two samples is equal. 50% of the on-incubator and 45% of the off-incubator entrepreneurs started their business before 30. There are minor differences in educational background between two samples. On-incubator sample is slightly more educated in the sense that the proportions of both PhD and masters degrees are higher in the on-incubator sample as opposed to the off-incubator sample. However the difference is not statistically significant. This is interesting in the sense that similar studies for other countries suggest that there are significant differences in terms of education between the two samples. (Colombo and Delmastro, 2002 and Löstfen and Lindelöf, 2002b).

Although the educational level is the same, undergraduate fields are rather different for on-and off-incubator entrepreneurs. The proportion of entrepreneurs that hold an undergraduate degree in science (mathematics, chemistry, etc) are significantly higher in the on-incubator sample than the off-incubator sample. Interestingly about 22% of the entrepreneurs in the off-incubator sample hold a social science degree, against only 4% in the on-incubator sample.

Table 6
Entrepreneurs profile: On-incubator versus off-incubator firms

	On - Incubator		Off – Incubator	
<i>Mean Age</i> ^a	33.1		32.4	
	On - Incubator		Off – Incubator	
	Frequency	%	Frequency	%
<i>Education level</i>				
PhD °	16	20.5	10	16.4
Masters °	25	32.1	16	26.2
Undergraduate °	35	44.9	29	47.5
High School or lower than high school °	2	2.6	6	9.9
Total	78	100.0	61	100.0
<i>Area of Undergraduate Degree</i>				
Engineering °	58	77.6	39	70.9
Science **	15	18.4	3	5.5
Social science ***	3	3.9	12	21.8
Other °	0	0	1	1.8
Total	76	100.0	55	100
<i>Prior Working Experience</i>				
First experience *	9	11.7	2	3.3
Owns a business **	7	9.1	14	23.0
Private firm °	51	66.2	36	59.0
Government °	5	6.5	4	6.6
Academic °	5	6.5	5	8.2
Total	77	100.0	61	100.0

^a t-test. No statistical difference between two samples. Age is defined as “age of the entrepreneur when starting the business”.

° No statistical difference between the two samples. *** Significant at the 1% level, ** Significant at the 5% level,

* Significant at the 10% level.

Another characteristic that differs between the two samples is the entrepreneur’s prior working experience. As it is mentioned earlier, incubators enable new opportunities for both students and academic personnel. So at least it may be expected that the proportion of entrepreneurs that have prior academic career is higher in the on-incubator sample. Though not statistically significant it is interesting to see just the opposite. A further interesting finding is that 12% of the on-incubator entrepreneurs have no prior working experience, while this is only 3% in the off-incubator sample. In conjunction with this only 9% of the on-incubator entrepreneurs

owned a business previously, whereas this goes up to 23% in the off-incubator category. The proportion of entrepreneurs who have prior working experience in a private company is very high in both samples (66 % on- and 59% off-incubator). This finding indicates that spin-offs are the dominant source of start-ups /see also Sung, Gibson and Kang, 2002). There is weak evidence that indicated that off-incubator entrepreneurs have better records in terms of management capability than their on-incubator counterparts. Although it is a subjective remark, during the interviews it is observed that one of the main deficiencies of the on-incubator entrepreneurs is their lack of experience on handling the management of the firm.

Incubators enable firms to benefit from business networking and on-incubator firms are expected to interact intensively with other firms and the university where the incubator is located. We test this hypothesis by asking the firms to rate the importance of networking and interaction they have with other firms and universities. Responses are ranked in a 5-point scale (1 the highest and 5 the lowest degree of importance).

Table 7
Degree of importance attached to networking and interaction by on-and off-incubator firms (averages)

	On-Incubator	Off-Incubator
<i>Interaction with other businesses</i>		
R&D collaboration °	0.604	0.600
Commercial relations °	0.729	0.750
Social interaction °	0.521	0.600
<i>Interaction with universities</i>		
R&D collaboration*	0.667	0.475
Analysis, testing and evaluation of company's products °	0.396	0.425
Collaboration on projects (other than R&D) °	0.625	0.450
Employee education and training **	0.500	0.275
Recruitment of staff °	0.500	0.475
<i>Contact with universities</i>		
Contact with academic personnel ***	0.771	0.500
Using the available infrastructure at the university ***	0.813	0.300

Note: We combined the first two levels of importance and labeled it as “important” and combined the remaining three levels of importance and labeled it as “not important”. Importance level: 1=important and 0=not important.

° No statistical difference between the two samples. *** Significant at the 1% level, ** Significant at the 5% level,

* Significant at the 10% level.

The results reveal interesting patterns. First, companies in both samples rank R&D collaboration and commercial relations with other businesses more or less at the same level, contrary to the expectation that incubator firms engage in cooperation relatively more than the other firms. A detailed investigation displays even more surprising results. The percentage of off-incubator firms that attach the highest level of importance to networking with similar business are significantly higher than the on-incubator firms in all three categories of interaction.¹² Interestingly social interaction is not so much important for on-incubator firms as opposed to off-incubator firms. We further asked incubator firms to rank the importance of interaction with incubator firms. It is expected that the interaction within incubator should be at least ranked more important. Surprisingly, social interaction is less important within the incubator firms, when compared to social relations between an incubator firm and an off-incubator counterpart. During the interviews it is observed that the main reason for low levels of business networking is the lack of confidence. Incubator firms do not trust others because they are afraid that other firms could “plagiarize” their own projects. Moreover they are also uncomfortable about transfer of employees to other firms. Incubator firms are small in size and many entrepreneurs stated that

¹² There is no consensus among researchers on this issue. Mian (1996a) states that the services provided by the incubator regarding business networking are found to be the ones that firms mostly receive benefit from. However Löfsten and Lindelöf (2003) suggest that there is not a significant added value of networking with similar business.

employees have perfect information on every aspect concerning the company and transfer of an employee to another competitor means simply transfer of the firm's own project.

Another result is that incubator firms give more importance to every type of interaction with universities as opposed to their off-incubator counterparts. This is an expected result since technology incubators are all located in a university campus and it should be easier for firms to contact with universities on these issues. However except interaction with universities on R&D collaboration and on employee education and training the differences between the two samples are not statistically significant. Firms are also asked to rank the importance for contact with universities, which we separated into two forms: contact with academic personnel and using the available infrastructure of the university. On-incubator firms tend to attach more importance to contact with academic personnel and use of the infrastructure of the university. Geographical proximity can be an explanatory factor. Moreover, younger and smaller on-incubator firms are perhaps in more need of tools and equipment as well as advice from the academics. To sum up, our findings reveal that on- and off-incubator companies share similar characteristics concerning the cooperation and collaboration with similar businesses, but interaction with universities seems to be more important for on-incubator firms.

An important function of incubators is that through the services they provide, tenant companies have better opportunities to access financial support. Indeed financial support schemes are very important especially in the start-up phase and availability of venture capital is crucial. To show this, entrepreneurs were asked to indicate their source of funding when establishing their businesses and whether their capital was sufficient. Table 8 indicates that there is not a difference between the two samples regarding the source of funding. Most of the entrepreneurs in both on- and off-incubator samples stated that the main source of funding was their own accumulation. Entrepreneurs were also asked whether their financial capital was sufficient in the start-up phase. Interestingly, nearly half of the on-incubator entrepreneurs have stated that their capital was sufficient, and the ratio is even higher in the off-incubator case reaching up to 67%. The difference between the two samples is found to be statistically significant. Contrary to our expectation, these ratios are quite high.¹³ But still, the ones that are relatively in need of funding are the entrepreneurs that located their businesses in an incubator.

Table 8
Entrepreneurs' source of funding

	On - Incubator		Off - Incubator	
	Frequency	%	Frequency	%
<i>Source of funds in the start-up period? °</i>				
Own accumulation	67	87.0	52	96.30
Bank credit	4	5.2	-	-
Friends and relatives	12	15.6	8	14.81
Other	4	5.2	7	12.96
Total ^a	77		54	
<i>Was your capital enough? **</i>				
Yes	34	44.2	36	66.7
No	43	55.8	18	33.3
Total	77	100.0	54	100.0

^a Since some entrepreneurs have multiple responses, percentages do not sum up to 100.

[°] No statistical difference between two samples. ^{**} Significant at the 5 % level.

To evaluate our third argument we employ several indicators related with the financial supports that are available through three different institutions: KOSGEB, TUBITAK-TIDEB¹⁴

¹³ An important factor that may cause a bias here is that many entrepreneurs that own a software company stated that a software company could easily be established with little capital (even only with a computer). So in such cases it might be the reason that they have stated that their capital was sufficient.

¹⁴ TUBITAK is the abbreviation of Scientific and Technological Research Council of Turkey.

(TUBITAK- Technology Monitoring and Evaluation Board) and TTGV. Both TIDEB and TTGV support a definite proportion of the R&D incentives for similar aims. They provide financial assistance for the research that aims to create a new product or to improve the competitive position of an existing product. The supports are up to 50-60% of the total project expenses and include expenditures on personnel, tools, materials, software, consultancy and even expenditures for registration of a patent, industrial design etc. The important difference is that, the support of TTGV has to be repaid within a time interval but without an interest, however the support of TIDEB is in the form of grant. KOSGEB has also incentives in supporting R&D on the project basis. The firms outside the incubator building can also apply for the KOSGEB support as well as the firms that locate their business in a technology incubator. The support can either be in the form of a grant or with repayment. As mentioned before, this financial support scheme covers diversified set of activities such as, prototype development, consultancy support and rent support.

To assess whether on-incubator firms have better opportunities to access financial support, we have asked several questions (see Table 9).¹⁵ It seems that almost all firms in both samples have information on the support programs. Around 40% of the firms in both samples have at least one supported project. However the origin of support shows a discrepancy between the two samples. It is inclined towards TIDEB and TTGV in the off-incubator sample, and towards KOSGEB in the on-incubator sample. Since TEKMERs are centers established and operated by KOSGEB, it may be easier for incubator firms to access KOSGEB supports. Unfortunately, especially the incubator firms indicated several difficulties in reaching financial assistance for R&D projects regardless of the source. Nearly all firms stated that the application process is rather complicated and time consuming. Moreover, firms do not have special personnel to deal with the application and it is hard for an employee (generally an engineer) to handle both R&D and administrative tasks at the same time.

Table 9
Evaluation of supports of KOSGEB, TIDEB and TTGV

	On – Incubator		Off – Incubator	
	Frequency	%	Frequency	%
<i>Has information about supports?</i> [°]				
Yes	47	97.9	39	95.1
<i>Taken supports?</i> [°]				
Yes	21	43.8	17	41.5
N	48		41	
<i>Origin of Support</i> ***				
TIDEB	9	42.8	11	64.7
TTGV	2	20.0	8	47.0
KOSGEB	14	66.6	1	5.9
N ^a	21		17	
<i>Importance of supports</i> [°]				
Very important-critical	14	66.7	4	36.4
Important	6	28.6	6	54.5
Not Important	1	4.8	1	9.1
Total	21	100.0	11	100.0

^a Percentages do not sum up to 100 because there are multiple responses.

[°]No statistical difference between two samples. *** Significant at the 1% level.

We conclude this section by presenting an overall evaluation of the incubators in Turkey. In the first place, as underlined previously, incubators are believed to facilitate new high-technology firm creation. We can evaluate this claim in four ways. First, our data reflects that incubators display strong start-up character. There are 23 start-up firms in the on-incubator sample, which

¹⁵ For a detailed evaluation of the various financial support mechanisms in Turkey see Taymaz (2001).

constitutes about 48% of all firms. However one can easily extend this by adding the 7 firms that are established outside the incubator but moved into an incubator within a year, which makes a total of 63% of all on-incubator firms. Second, the questionnaire included a question on the behavior of the on-incubator entrepreneurs if they had not located their business in an incubator. 6 have stated that the company might still exist but it would have been struggling to survive and would have been inefficient. 2 of them have stated that the company might have not existed and interestingly 3 entrepreneurs stated that they would have immigrated to another country. The results show that at least 23% of the firms might have not been established if they were not located in an incubator. When only start-ups are taken into consideration, this ratio goes up to 28%. Third, 20% of the firms stated that the infrastructure and available office spaces provided are amongst the most important reasons behind locating their business in an incubator. Moreover, 27% of the firms attached first degree of importance to this. This is a clear indication of the importance of the facilities that incubators provide.¹⁶ Finally, our analysis indicates that 54% of the firms that did not receive any kinds of financial support¹⁷ consider the facilities provided by the incubators as critically important for the company's development.

In addition, firms stated three reasons for locating their business in an incubator¹⁸. Firms are also asked to rank the realizations (whether they are satisfied with the services provided) and the sufficiency levels (whether the facility is sufficient or not) for the three reasons they select. Four factors found to be the most important of all: opportunity to interact with university, available infrastructure and office space, favorable location and image, and government. Furthermore, the findings reveal that administrative and technical supports are not important at all. It is evident that on-incubator firms are satisfied with the location and image of incubators, and they as well rank the sufficiency level highest of all.¹⁹ Firms are also quite satisfied with the office spaces and infrastructure provided. However they ranked the sufficiency levels for these factors slightly lower.

Table 10
Reasons behind locating the firm in an incubator

Reasons			Realization level		Sufficiency level	
	% of Firms	% of firms that stated first choice	Average	% of firms that attach first two level	Average	% of firms that attach first two level
Opportunity to interact with the university	22.5	22.9	2.48	31.3	2.45	31.3
Available infrastructure and office space	19.7	27.1	2.11	37.5	2.30	33.3
Favorable location and image	19.0	18.8	1.96	41.7	1.85	39.6
Government Support in all kinds	15.5	25.0	2.64	20.8	2.36	25.0
Opportunity to network with similar business	9.2	-	2.92	10.4	2.46	16.7
Technical support made available by incubators	8.5	6.3	2.55	12.5	2.27	14.6
Administrative support made available by incubators	5.6	-	2.50	8.3	2.13	10.4

N = 48

Realization level: 1 to 5, being 1=Totally satisfied, 3=Average satisfaction, 5=Not at all

Sufficiency level: 1 to 5, being 1=Very good, 3=Average, 5=Not at all

¹⁶ Studies by Mian (1996a, 1996b) report similar finding that is the rent breaks – cheaper office spaces- is an important value-added for many firms.

¹⁷ Such a constraint is imposed because the firms that are not supported financially are the ones that highly use other facilities such as infrastructure and office spaces and we suppose that it is these firms that have benefited the most.

¹⁸ In this question we supplied 7 possible reasons for locating the business in an incubator. We asked firms to rank three reasons according to their level of importance (for example, reason X is the first important, reason Y is the second important etc.) Then we have asked the realization and the sufficiency levels for these factors.

¹⁹ See Westhead and Batstone (1998) and Mian (1996a) for similar findings.

Table 11 presents further evidence on the importance of incubators. Only one firm has stated that the impact of incubator is not important. Nearly 60% of the firms have stated that the facilities and opportunities made available by the incubators were critical for firm's survival and development. In order to identify the characteristics of on-incubator firms that have ranked the importance of incubator facilities as critical, we divided the on-incubator sample into two and carried out a similar analysis. 28 firms that have attached critical importance to incubator facilities are compared with remaining 20 firms in the on-incubator sample. 70% of the firms that have found the services provided by incubators critical are start-ups. Furthermore half of these firms have taken a direct R&D support from one of the three sources and nearly all stated that the R&D support was also critical for the development of the firm. Moreover, these firms that consider incubator facilities as important achieved a better record in terms of economic and technological performance as opposed to the remaining 20 firms in the on-incubator sample. 75% of these firms have stated an increase in sales revenue, whereas this is only 53% in the remaining sample. 30% of these firms own a patent or a trademark as opposed to 15% of the remaining 20-firm sample. Finally, 41% of these firms have produced a product or a service, which they consider as *new to the world* in the past three years. This ratio is only 17% in the remaining 20-firm sample. These results once again provide evidence for our main argument that the TEKMERs in Turkey are quite important in providing assistance for micro firms (especially for start-ups) and help them to survive them in their vulnerable stages.

Table 11
Overall evaluation of TEKMERs by on-incubator firms

	Frequency	%
Very important - critical to firm development	28	58.3
Important	19	39.6
Not important	1	2.1
Total	48	100.0

6. Concluding remarks and policy implications

In this paper we presented detailed information regarding the early stage of Turkish experience in establishing technology incubators. 48 incubator firms were compared with 41 off-incubator firms on the basis of their basic characteristics. Our findings show that technology incubators in Turkey have played quite an important role in supporting start-ups in their vulnerable stages and helped them to survive. There are significant differences between on- and off-incubator firms regarding their economic performance, highly in favor of incubator firms. On-incubator firms have had a better performance record, both in terms of employment growth –especially R&D personnel and local employment - and output growth. However there are not any profound difference in innovativeness. We found financial support mechanisms and various incubator support services important in explaining these performance differentials. 67 percent of the firms that have received financial support stated that the support was critical to firm development. Moreover, nearly 60 percent of the incubator firms evaluated the overall incubator impact as very important (Table 11). We further argue that the effect of entrepreneur characteristics, business networking and interaction with university are not strong enough in explaining the performance differentials between on- and off-incubator firms.

Absence of venture capital initiatives, low levels of business networking, lack of marketing and inadequate business support mechanisms appear to be major problem areas that drive down the positive impact of incubators in Turkey. It is found that the main source of funding at the start-up stage is own resources of the entrepreneurs. Venture capital markets are not developed in Turkey and there should be some attempts for improvement. This is important in the sense that, venture capital and spin-off process are vital for long-term success of incubators and science parks. However one should keep in mind that macroeconomic stability is a prerequisite for developing a well-functioning venture capital market.

Low level of business networking and interaction is one of the main weaknesses of incubators in Turkey. Only 10% of the on-incubator firms stated that the reason for locating the business in an incubator is to network with similar businesses and none of them attached the highest level of importance to this factor. The long-term benefits of incubators depend on the impact of incubator on the behavior and capability of its tenants. Business networking might be an important tool in this respect. Unfortunately, improvements in business networking in incubators in Turkey may be slow because firms do not consider networking as an essential strategy. Apart from the existing weakness in individual level interaction between firms, incubators themselves should be integrated into a wider framework. Incubators should not be stand-alone entities but rather work along side other organizations and schemes to promote broader strategies (European Commission, 2002).

Table 12
Main findings of the study and weaknesses of the incubators in Turkey

<i>Main Findings</i>	
Economic performance	On-incubator firms seem to display better records both in terms of employment growth – especially local employment and R&D personnel - and output growth. An important part of the labor force of on-incubator firms are graduates and student employees from the university where the firm is located in.
Innovative output	Our data do not support the hypothesis that firms in incubators perform better than their off-incubator counterparts regarding new product and service development.
Interaction with similar businesses and universities.	Importance of networking with similar businesses does not differ between on- and off-incubator samples. Incubator firms are better linked to universities, although most of the interaction is in the form of informal contacts.
Information networks & financial supports	Being in an incubator does not affect opportunities to access financial support but supports are more critical for on-incubator firms. Support mechanisms seems to be sufficient for a developing country, however unwillingness and disabilities of firms, complexity of application procedure and deficiencies of the implementation process hinders the full impact of the financial support mechanisms. Incubators can make this process easier by offering extensive help in the application procedure, which is welcome by most of the firms.
Entrepreneurs	Although it is not confirmed statistically on-incubator firm entrepreneurs appear to be slightly better educated. More than 95% of the on-incubator firm entrepreneurs are either engineer or hold a science a degree, which is significantly more than the off-incubator counterparts. However the difference in entrepreneur profile is not strong enough to explain the performance differentials between on- and off-incubator firms.
Overall evaluation	Technology incubators in Turkey have quite an important role in supporting start-ups in their vulnerable stages. 60% of the firms found the services provided critical to firm development.
<i>Main Weaknesses</i>	
Lack of marketing initiatives	The policies aiming to increase the innovativeness and creation of new products and processes should best be supported by policies that aim to improve marketing opportunities - both national and international- as well as policies that aim to create domestic demand.
Low levels of business networking and interaction	The long-term benefits of an incubator depend on the success of business networking and interaction that have impact on the behavior and capability of its tenants.
Lack of risk capital initiatives	Risk capital mechanisms are vital for the success of the incubation process, however it should be kept in mind that macroeconomic stability is prerequisite for this.
Business support functions	The success of an incubator rests on the quality of the services provided rather than the quantity. There should be improvements in the quality of the business support mechanisms.

Our findings provide evidence that technology incubators in Turkey encourage new-firm creation and provide important facilities to support start-ups in their vulnerable stages. However, it seems that technology incubators should be well-integrated with other institutions and

technology development programs. In designing and implementing technology and innovation policies, policy makers should take into account the fact that incubator policy and other programs (education and training, R&D support, techno-parks, etc.) are complementary policies. The benefits of incubators could be augmented by adopting comprehensive and consistent policies.

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