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Entrepreneurship and the National System of Innovation

What is Missing in Turkey?

Elif Bascavusoglu-Moreau

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Abstract

Although very dynamic and flexible, Turkish SMEs are less innovative than their European counterparts. The analysis undertaken in this paper allows to assess whether this low level of innovative activities is related to a lack of entrepreneurial behaviour and/or to the weaknesses of the Turkish innovation system. Exploring a unique firm level survey realized among 50,000 small- and medium-sized enterprises, we seek to evaluate the impact of firms' behaviour and choices in the presence of entrepreneurial, technological, institutional, and market opportunities, in an emerging country context. Our results highlight the importance of policy measures in building innovative capabilities.

Keywords: entrepreneurship, national systems of innovation, SMEs, innovative capabilities, emerging economies

JEL classification: O01 O33 L26

* Imperial College London, Imperial Business School, email: E.Bascavusoglu@imperial.ac.uk

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UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

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1 Introduction

Small and medium sized enterprises (SMEs) have emerged as important agents of industrial growth since the 1980s. It is now generally acknowledged that SMEs increase overall efficiency: they are considered to be the key to the development of technology and to the knowledge driven economy, bringing innovation to the market. In this context, entrepreneurship appears to be the mechanism that converts knowledge into growth (Acs et al., 2004).[1]

The positive impact of entrepreneurship arises through a number of mechanisms, such as knowledge spill-overs (Grossman and Helpman, 1991; Lucas, 1988; Romer, 1986), enhanced competition (Feldman and Audretsch, 1999; Glaeser et al., 1992; Porter, 1990), or increased diversity. But for these mechanisms to work properly, a set of well connected and interacting institutions is needed. All process of generation, accumulation, adoption, as well as the imitation of new knowledge involve different actors such as firms, the government, research institutions, or labour and trade unions. This brings us to the 'National Systems of Innovation' (NIS) framework, initiated by Freeman (1987). Edquist and Johnson (1997: 14) define a system of innovation as 'all important economic, social, political, organizational and other factors that influence the development, diffusion and use of innovations'.

Even though the notions of NIS and entrepreneurship seem to be interdependent and complementary, the studies that combine these two approaches are rather scarce. There have been very few attempts to conciliate the notions of a national system of innovation and entrepreneurship. By studying the case of Ireland, the Netherlands, and Finland, Golden et al. (2003) assess the impact of the existence of NIS on entrepreneurship, but fail to find any correlation between institutional indicators and entrepreneurship. Radosevic (2007) presents an exhaustive and critical survey of literature on both NIS and entrepreneurship, and proposes a common basis for integrating both notions. In his framework, entrepreneurship is a systemic phenomenon driven by complementarities between technological, market, and institutional opportunities, which are matched through the national system of innovation (Radosevic, 2007: 39).

This paper uses this framework, in order to analyse the impact of entrepreneurship and the national innovation system on the innovative capabilities of Turkish small and medium sized firms. Innovation capabilities are defined as the skills and knowledge required to make independent adaptations and improvements to existing technologies, and ultimately to create entirely new technologies (Romijn and Albaladejo, 2002), and are measured in this paper by innovative outputs.[2] Although very dynamic and flexible, Turkish SMEs are less innovative than their European counterparts; only 31% of Turkish small firms have reported innovative activities between 2002 and 2004, compared to 42% for the Europe-27, and 34% for the new members (Eurostat, CIS4 and Turkish Statistical Institute (TSI), Innovation Survey). The analysis undertaken in this paper would allow to assess whether this low level of innovative activities is related to a lack of entrepreneurial behaviour and/or to the weaknesses of the Turkish innovation system. In this sense, exploring the determinants of innovative capabilities would lead to interesting discussions about the policy issues.

We explore a survey realized among 50.000 small and medium sized enterprises, by the Turkish Small and Medium Sized Industry Development Organization (KOSGEB). Our objective is to evaluate the impact of firms' behaviour and choices in presence of entrepreneurial, technological,

[1] Although several definition of entrepreneurship exist in the economic literature, we refer here to entrepreneur as 'someone who specializes in taking responsibility for and making judgmental decisions that affect the location, the form, and the use of goods, resources, or institutions' following the definition given by Hébert and Link (1989).

[2] Given our measurement of innovative capabilities, the terms 'innovative capabilities', 'innovation activities' and 'innovation performance' are thus used interchangeably throughout the paper.

institutional, and market opportunities, in an emerging country context.

Following Radosevic, we argue that the outcome of successful entrepreneurship, here measured by innovative capabilities, is an evolutionary process of realization and the interaction of different opportunities. The first of these opportunities is technological: It is not possible to fully assess the knowledge creation process without taking technological opportunities into account (Malerba and Orsenigo, 1997; Griliches, 1991). Technological opportunities can be defined as the probability of innovation and/or technological improvement, with a focus on the science and technology level within and between the sectors (Dosi, 1993; Nelson and Winter, 1982). The second one relates to the market: although national systems of innovation involve both market and non-market interactions, market opportunities refer here to market-led innovation, in the lines of Kirzner (1973). Entrepreneurs are motivated by the anticipation of profits, and therefore have to be 'alert' to search the market for opportunities and innovations that bring improved goods to the market place. The third opportunity concerns institutions, which received increasing attention in shaping and driving social change and economic performance. Features identified as creating increasing returns for technologies can also be applied to institutions, representing the institutional opportunities (North, 1990). Finally, entrepreneurship is approximated by both entrepreneurial behaviour and entrepreneurship capital.[3] While start-ups are used to measure entrepreneurial behaviour (Carree and Thurik, 2003), the entrepreneurship index (Pınarcıoğlu and Işık, 2004) reflects the entrepreneurship capital at the district (NUTS 3) level. This approximation of entrepreneurship in two levels allows considering simultaneously firms' behaviour and their environment.

The remainder of this paper is as follows. The next section discusses the SMEs, the national innovation system and entrepreneurship in Turkey. Section 3 will present our database, variables, and estimation method. Results will be discussed in Section 4. Section 5 concludes.

2 SMEs, entrepreneurship, and NIS in Turkey

According to the latest Census of Industry and Business Establishments, the Turkish firms' average size is 3.68 persons and enterprises employing 1-49 persons constitute 99.41% of the total enterprises in Turkey (TSI, 2002). Medium and small sized enterprises contribute significantly to the Turkish Economy in terms of employment (61.1%) and but not much of the value added (27.3%) (OECD, 2002). Growth rates of the last decade relied heavily on the SMEs, whose dynamism comes from a high level of profitability, and a highly flexible labour market (CEPII, 2004). However, compared to other OECD countries, their share in investments, innovation and exports remains rather low (OECD, 2005). As an example, the share of Turkish SMEs in total exports is around 9%, whilst it is around 16% in EU-19, 30% in Hungary, 20% in South Korea, and 40% in India.

This low performance of Turkish SMEs is largely related to the overall economic situation. Turkey's economy has for a long time been characterized by high inflation, high real interest rates and public sector imbalances, leading to repetitive crises, the last one in 2001. Although the new stability programme has resulted by a recovery, with a growth rate of 7.5% between 2002-06, Turkey is only at the 75th position according to the international GDP per capita ranking. Turkey failed to implement adequate productive and technological policies to accompany its export promotion adopted in the early 1980s: it is far below EU average in imports, exports, and especially, high tech exports.

One of the main problems of the Turkish economy is the shadow economy, estimated around 30% between 1990-2003 (Schneider, 2005), a major obstacle to productivity, competition, and inno-

[3]We follow Acs et al. (2004) and define entrepreneurial capital as the capacity for economic agents to generate new firms

vation. This high level of unregistered business creates imbalances between the formal and informal sector, and somehow contributes to the high flexibility of Turkish small and medium sized industry (Taymaz and Ozler, 2004). Although informality reduces firms' costs and provides them with the flexibility to survive under difficult conditions, it also limits their access to capital markets, their investment capacity, and their ability to develop international partnerships, restricting the potential efficiency gains that they could achieve and trapping potential entrepreneurs in low productivity sectors (OECD, 2003).

The high number of unregistered business can also be explained partly by the current tax legislation, which imposes a heavy financial burden on Turkish SMEs. Turkey does not have a tax integration structure to avoid the double taxation of income earned from equity investment: with a corporate tax rate of 33% and a personal tax rate of 45%, the total tax rate can yield to 63% on fully distributed income from equity investments (OECD, 2005). In this context, some entrepreneurs choose to stay in the informal sector in order to avoid excessive taxation, and hence miss the financial and technological opportunities offered to formal SMEs.

The one indicator where Turkey performs above the EU average is the time required to start a new business (Table 1). Starting a business seems to take less time and require less capital than the regional average (WB, 2004). This favorable situation is further improved by the recent laws on administrative requirements on starting companies. In 2005, the year of our empirical analysis, 3676 new firms and 3230 trade names have been established, with an increase of respectively 11.9% and 18.7% compared to 2004 (TSI, 2006), and Turkish entrants are reported to be 40% smaller than the incumbents (Taymaz, 2005). This last evidence strengthens our hypothesis of using start-ups as approximation of entrepreneurial behaviour.

As put by the Global Competitiveness Report, the market efficiency has also benefited from the recent reforms, which aimed to reduce the bureaucracy (WEF, 2005). Turkey has improved its performance, moving to the 53rd rank from the 71st in 2005 and registered the highest rate of dynamism in upgrading competitiveness (WEF, 2008). It is above the EU average concerning the business sophistication subindex, particularly for the quality and quantity of networks and supporting industries. It has sophisticated industrial and service sectors which are already operating at high levels of efficiency, adopting advanced technologies, efficient production processes, and exploiting economies of scale with respect to the new members in Central and Eastern Europe (WEF, 2005: 29). However, there is need for improvement especially in some very basic points: Turkey performs very poorly in macroeconomic and educational issues and in infrastructure quality (See Table 1).

The total entrepreneurial activity in Turkey is below the overall average (WEF, 2007). Education on entrepreneurship is a very recent phenomenon, still quite limited, and the number of consultancy firms serving entrepreneurs is inadequate (TUSIAD, 2003). However, a positive attitude towards entrepreneurship has also been highlighted. 77% of the population considers entrepreneurship to be a desirable choice and 86% value successful entrepreneurs (Harding and Bosma, 2007). Even though being risk-averse in their employment choice, Turkish people show better performance than average in terms of their approach to hard work and innovation, but without expecting a long term positive economic effect from basic research. According to a survey realized by the Turkish Industrialists' and Businessmen's Association, in starting business, Turkish entrepreneurs are mainly motivated by independence (47%), creating employment (38%) and earning more money (34%) (TUSIAD, 2002). Although 56% of the firms participating in this survey were producing new technology, only 23% have been granted a patent. 20% of the firms consider the lack of innovation as a risk in business.[4]

[4]See TUSIAD (2002) for more details about the survey.

Table 1: Comparative indicators between Turkey and new EU member/candidate countries

	Estonia	Czech R.	Slovenia	Slovak R.	**Turkey**	Poland	Romania	Bulgaria	Croatia	Hungary	Latvia	Lithuania	**Average**
GDP growth**	10.47	6.08	4.03	6.04	**7.38**	3.55	4.1	6.25	4.28	4.25	10.6	7.56	**6.21**
GNI per capita	9530	11150	17430	8100	**4750**	7150	3830	3510	8350	10210	6760	6910	**8140**
Population growth**	-0.21	0.27	0.18	0.08	**1.29**	-0.04	-0.23	-0.53	0.01	-0.2	-0.53	-0.62	**0.15**
Gross capital formation*	35.25	26.06	26.05	29.19	**24.77**	19.24	22.63	27.44	30.98	23.63	34.39	25.06	**27.06**
Industry VA*	28.51	38.29	34.08	31.66	**23.69**	30.79	35	30.89	30.41	30.09	21.58	33.87	**30.74**
Agriculture VA*	3.73	2.9	2.53	3.85	**11.85**	4.64	10.14	9.41	6.9	4.32	3.97	5.6	**5.82**
Services VA*	67.75	58.81	63.4	64.49	**64.45**	64.57	54.86	59.7	62.69	65.58	74.46	60.53	**63.44**
Exports of G&S*	79.95	71.73	64.59	77.28	**27.42**	37.18	32.95	59.6	46.61	66.4	47.85	58.26	**55.82**
Imports of G&S*	86.08	69.82	65.14	82.35	**33.98**	37.53	43.31	75.82	55.21	67.79	62.23	65.3	**62.05**
Hightech exports	17.57	..	4.61	7.28	**1.51**	3.85	3.43	4.68	11.51	24.54	5.29	6.12	**11.39**
Merchandise trade*	130.23	124.71	115.23	142.24	**52.36**	63.03	68.99	110	70.27	117.33	86.39	106.64	**98.95**
Inflation**	6.79	0.68	1.47	2.37	**5.39**	2.58	12.29	3.76	3.19	2.01	10.18	5.77	**4.71**
Market capitalization*	25.42	30.93	22.99	9.26	**44.46**	30.96	20.83	18.71	33.21	29.52	15.75	31.9	**26.16**
Military expenditure*	1.48	1.78	1.67	1.74	**3.23**	1.79	2.11	2.35	1.58	1.31	1.69	1.8	**1.88**
Tertiary school enrol.	65.74	47.99	81.19	40.63	**31.19**	63.41	44.79	43.64	..	65.22	74.36	76.04	**55.62**
Time rq'd to start a business (days)	35	40	60	25	**9**	31	11	32	49	38	16	26	31
Global CI Score	5.12	4.74	4.64	4.55	**4.14**	4.3	4.02	3.95	4.26	4.52	4.57	4.54	**4.59**
Institutions Score	4.7	3.8	4.3	4	**4.05**	3.6	3.4	3.1	3.7	4.2	4.1	3.9	**4.17**
Infrastructure Score	4.66	4.5	4.51	4.08	**3.46**	3.64	3.05	3.41	3.98	4.05	4.33	4.14	**4.28**
Macroeconomy Score	5.31	4.81	5.08	4.37	**3.58**	4.34	3.94	4.92	4.3	3.94	4.93	4.82	**4.62**
Health/Primary Education Score	6.58	6.42	6.83	6.31	**6.28**	6.76	6.38	6.61	6.38	6.39	6.27	6.37	**6.54**
Higher Education Training Score	5.26	5.04	5.07	4.52	**4.15**	4.79	4.34	4.05	4.43	4.93	5.01	4.97	**4.84**
Market Efficiency Score	4.98	4.43	4.17	4.66	**4.35**	4.16	4.03	3.75	4.11	4.61	4.44	4.35	**4.44**
Technological Readiness Score	5.29	4.74	4.51	4.5	**3.56**	3.56	3.59	3.21	3.68	4.17	3.98	3.99	**4.38**
Business Sophistication Score	4.65	4.96	4.64	4.41	**4.58**	4.13	3.89	3.59	4.17	4.34	4.28	4.56	**4.46**
Innovation Score	3.83	3.98	3.71	3.51	**3.35**	3.47	3.14	2.93	3.45	3.82	3.19	3.35	**3.54**

Notes: * % of GDP; ** annual %, *** % of manufactured exports,**** 2000 =100. Cyprus has been removed because of the scarcity of its data.
Source: All the scores are from the Global Competitiveness Index (World Economic Forum). The rest of the indicators is from World Development Indicators (World Bank).

The survey's findings match perfectly with the latest Innovation Survey conducted by the National Institute of Statistics. This latter shows that 22% of enterprises with ten or more employees are product (goods and services) and 22.6% process innovators; while 31.4% of enterprises in Turkey were active in developing or implementing innovations for the period 2004-06. Innovation frequency increases with firm size, with large enterprises with more than 250 employees being more likely to engage in some sort of innovation activity (43.5%) than smaller enterprises (29.7%).

Given the high rates of inflation in the past, combined with the high dependency on foreign technology, the rise of innovation costs appear to be the main obstacle for Turkish innovators. 69.2% of the enterprises report high innovation costs as the main obstacle for innovation, followed by lack of qualified personnel (65.71%) and internal or external funding (65.3%). This is particularly relevant for SMEs, who are not able to reflect the increasing input prices to the selling prices, see their already insufficient equities diminish, leaving them with increasing financial needs. In line with European harmonization, Turkey has recently adopted policy changes in the finance, technology and competitiveness areas, where improving SMEs and entrepreneurship stands out as one of the main objectives.[5] Investments in innovation are promoted through tax incentives, matching grants and reimbursable loan schemes. There are four main fiscal provisions to support R&D in Turkey, although fiscal incentives often do not benefit SMEs, which have insufficient profits to use the tax benefits and do not record R&D expenses separately on financial statements (WB, 2004).

The last European Trend Chart Report reckons that Turkey has almost every element that makes up a national innovation system: a broad policy mix, with a wide range of instruments and measures in almost all areas of innovation policy, as laid down in the European Union Action Plan of 1996 (EU, 2005). The major weakness of the Turkish innovation system lies in the lack of cooperation and linkages between different actors. The number of research collaborations between university and industry are relatively low compared to most EU and Asian countries (WEF, 2007). It has been reported that 'most of the firms in Turkish manufacturing industries do not work with any research center or university in Turkey or abroad in acquiring knowledge or in developing new technologies' (Taymaz, 2005: 12), and the main reason for this lack of cooperation is the lack of information. Furthermore, potential intermediaries between research institutions and industry are rather scarce. Even though there is a recent increase in the number of incubators, technology parks, and technology transfer offices, especially after the 'Law on Technology Development Zones' in 2001, the number of intermediaries remain unsatisfactory given the size of the country. Moreover, the industrial and social heterogeneity of Turkish regions suggest a more decentralized approach of the national innovation system. In this context, the recently established regional development agencies become a crucial part of the national innovation system, but it is still in the early stages to evaluate its impact.

Overall, the national innovation system, as well as entrepreneurship capital present a mitigated picture in Turkey. Despite some recent policy reforms, there is still room for improvement in many areas. Turkish firms, particularly small and medium sized firms lag behind their European counterparts. This paper attempts to explore this poor performance of Turkish SMEs from two different perspectives: entrepreneurship and NIS.

[5] 'SME Strategy and Action Plan' and 'Industrial Policy for Turkey' in 2003, 'European Chart for Small Enterprises'.

3 Database, variables, and methodology

We use a unique firm level survey data collected by KOSGEB in 2005.[6] Our database covers 50.436 SMEs, and gives information about the firm characteristics such as size, age, educational level, as well as its productive, exporting, and innovative behaviour.

After removing outliers that could bias the estimation results, and all the observations with missing variables, 46.54% of the remaining firms are microsized (1-9 employees), and only 9.5% of the whole database employs more than 150 people. Although firms employing up to 250 person are considered as SMEs in both international and Turkish classifications, given their small number in our sample, we remove firms employing more than 150 person, due to their small number in our sample and the possible bias it could introduce. Almost 88% of the firms have been founded after 1980, the same period where a major liberalization process has been adapted in Turkey.

53.76% of the Turkish SMEs performs in low tech industries, followed by 26% in middle low tech and 19% in middle high tech industries.[7] All the sectors, regardless of their technological intensity, are included in the sample, as this paper does not aim to assess knowledge-based entrepreneurship. We consider that innovation can happen in every level, particularly in the context of an emerging country. Given Turkey's overall economic situation and SMEs' characteristics briefly discussed above, it is more likely to have improvements and/or innovations with small technological content.

This last argument is reflected by the choice of the dependent variable. We approximate the innovative capability by an output measure; a dummy variable which equals 1 if the firm holds a patent, utility model, or trademark. Following this definition, 37.4% of our sample have a certain level of innovative activity, whilst only 8% hold a patent. Unlike patents, utility models are granted without a prior research to establish novelty and inventive step. Therefore, they are cheaper and easier to obtain and present an alternative to patenting for smaller firms. 9% of our sample have a utility model, and less than 4% of the sample with innovative capabilities hold both a utility model and a patent. Although noisy, patents and utility models have been widely used as an innovation indicator in the previous literature. However, the choice of including trademarks in our innovative capability indicator might need further explanation. Trademarks are the outcome of establishing recognizable designation as well as firms' identity (Mendonca et al., 2004) and have been used as a complementary indicator in empirical innovation studies (Greenhalgh and Rogers, 2007; Mendonca et al., 2004). Innovative firms are found to use the trademarks more than less innovative ones, and trademarks are used more than patents among the innovative firms (Mendonca et al., 2004; Schmoch, 2003). Moreover, firms in developing countries tend to invest more in brands than in new technology (Baroncelli et al., 2004), as registration fees for trademarks are much lower than patents (Malmberg, 2005). Finally, we argue that the use of a composite indicator, that takes into account different aspects of innovation is more accurate, particularly in an emerging country context.

The independent variables are firm age and size, the average educational level of the employees, R&D, technology outsourcing, the use of technology intensive equipment in the production process[8], use of information and communication technologies, the possession of quality labels, and export behaviour. We also control for the firms' capital level: although we do not know the firms' net

[6]The lack of longitudinal data does not seem to be a major problem, since the entry and exit of small Turkish firms are mostly conducted by the sake of tax corruptions. In fact, most of the small Turkish firms prefer to exit the market, and to re-enter with a new name ant tax number in order to benefit from the tax incentives.

[7]See Appendix Table 1 for the sectoral distribution of the whole sample and the entrepreneurial firms.The definition and classification of the sectors according to their technology level are from Hatzichronoglou (1997).

[8]We consider that a firm is technology-intensive if it uses either programmable logic controller (plc), numerical controller (cnc) or robots in its production process.

current assets, we have the information about their relative size. Our sample is categorized into four classes according to net current assets. In order to test the impact of this latter, we introduce in our estimation 3 class, taking the middle one as the reference category.[9]

3.1 Entrepreneurship

In this paper, entrepreneurship is measured at both firm and region level, as we aim to take into account simultaneously the entrepreneurial behaviour and the entrepreneurship capital.

Entrepreneurship is not synonymous with small business, but small firms represent an outstanding vehicle for individuals to channel their entrepreneurial ambitions (Carree and Thurik, 2003). Although individuals in large firms, i.e. corporate entrepreneurs, can also undertake entrepreneurial actions, in this paper we are interested in persons starting or operating in innovative small firms. Studies evaluating the impact of entrepreneurship on economic performance on the level of firm or establishment use self-employment rates or the firm characteristics such as firm size and/or age. As our sample is solely composed from small and medium scale enterprises, we choose to approximate entrepreneurial behaviour by start-ups. This variable has been widely used in the previous literature to measure entrepreneurship (Audretsch and Thurik, 2001; Fonseca et al., 2001; Blanchflower, 2000; Carree et al., 2000). We consider that a firm is 'entrepreneurial' if the firm age is equal or inferior to five years, and we only consider new firms, hence, family firms or purchased firms have not been taking into account.

To test the robustness of the entrepreneurship variable, we refer to the KOSGEB survey, where managers/entrepreneurs have been asked to evaluate broadly the performance of the firm, according to three basic criteria (increasing/stable/decreasing). Appendix Table 2 gives the answers to this question, both for the whole sample and the start-ups. It shows that start-ups perform better than the whole sample in almost every performance measure, as the increase in their performance is greater than the whole sample.[10] We can hence conclude that start-ups provide an adequate measure for entrepreneurship in Turkey.

We also take into account entrepreneurs' educational level: 40.8% of the SMEs in our database have a manager with at least a university degree. This ratio is around 19% for the start-ups. The average enrolment year of the overall employees is 10.47 years, which indicates a rather high level of education in the Turkish SMEs.

Finally, in order to measure the entrepreneurship capital, we introduce an exhaustive entrepreneurship index at district (NUTS 3) level. Developed by Dr. Melih Pınarcıoğlu, this index accounts for districts' entrepreneurial capacity by taking into account 15 different indicators such as export growth rate and its variety, innovativeness, firm turnover, and subventions among others.[11]. The index varies between 0 and 1, the lowest score being 0.182 (for Bitlis) and the highest, 0.607 (for Istanbul). It points the high level of internal disparities in Turkey, where the eastern part accounts for 37% of population and 22% of GDP, whereas the western part accounts for respectively 63% and 78% (Reeves, 2005).

[9] For the description and summary statistics of independent variables, see Appendix tables 3a and 3b.

[10] The only two indicators where the start-up companies did not perform better is the capital size and the number of export countries, two areas where young firms risk to struggle more than established ones. While access to capital is a major problem for all SMEs in Turkey, to find trade partners and new markets are processes that requires some time and experience, advantaging hence the older firms versus the younger ones.

[11] The indicators that contributed to the entrepreneurship index are listed in Appendix Table 3c. For more details on the construction of the Entrepreneurship index, as well as an exhaustive evaluation of regional inequalities in Turkey, please see Pınarcıoğlu and Işık (2004).

3.2 National innovation system

Technological opportunities are reckoned to be localized and geographically bounded (Fagerberg, 2003). We will therefore approximate the technological opportunities at NUTS 3 level, measuring the industrial structure of the region where the firm is located, by the total capacity of power equipment and the per capita electricity consumption in the manufacturing industry. The spatial distribution of the industry in Turkey is reported to have slightly changed in recent years (Pınarcıoğlu and Işık, 2004). The service sector begins to take over on industrial activities in traditionally industrial regional centers, and the decentralized industry is beginning to concentrate in the rural provinces that are neighbours to traditional regional centres (Ozaslan et al., 2006). Furthermore, some provinces located in different regions of Anatolia appear now as new industrial districts by specializing in certain sectors exploiting local endogenous resources. Our two variables aim to take into account these trends. We also introduce a firm level clustering variable which equals to 1 if the firm is localized in a particular cluster, i.e. in a small or organized industrial zone. 22% of the whole sample is located in a small industrial estate and 20%, in an organized industrial zone. In order to account fully for the technological opportunities in a national/regional innovation system, we introduce this location variable interacted by the number of plots in industrial estates at NUTS 3 level.

Market opportunities are approximated by the location quotient and the urbanization rate imputed at a regional level. The location quotient measures the proportion of an activity in a particular area, compared to the proportion of the aggregated activities in this area at NUTS 3 level. The more concentrated the region/sector is, the more profit firms should have, hence we would expect a higher entry rate, and a greater market opportunity. The urbanization rate reflects the demographic structure of the city where the firm is located. A higher urbanization rate should reflect a greater market and therefore increase the innovative capacity.

Institutional opportunities stand for institutions, norms and rules that affect the innovation process (Radosevic, 2007). In Turkey, both small and large enterprises view high innovation costs and lack appropriate finance as main factors hampering innovation activities (Napier et al., 2004). Furthermore, previous literature has shown that the smaller the enterprise, the bigger their financial problems. We introduce several variables which approximate the financial facilities and support available for SMEs. The first one of these variables is the consolidated budget revenue per capita at NUTS 3 level, in order to account for regional disparities in public investments. However, public investments could not be adequate for the SMEs' needs. Hence we consider investment incentives and private (bank) loans. These two variables are introduced as interactions: firms with an incentive certificate interacted with per capita amount of incentives (granted with incentive certificate)[12] and firms benefiting from a loan with the per capita amount of credits, both at NUTS 3 level.

3.3 Methodology

Our empirical specification is based on the knowledge production function (Griliches, 1979), which models the 'functional relationship between the inputs of the knowledge production and its output that is economically useful new technological knowledge'.[13] The basic assumption states that the output of the innovation process (Q) is a result of the resources invested in inventive activity (R),

[12] In Turkey, in order to qualify for an investment incentive, it is necessary to obtain an incentive certificate before the investment is initiated. An investment must meet a minimum equity ratio of 20% and minimum value of 600.000 YTL (USD420.000) for the developed regions, 400.000 YTL (USD285.000) for the normal regions and 200.000 YTL (USD140.000) for priority development regions.

[13] Acs et al. (2002: 1074)

usually R&D capital or investment, and that the patents (P) are a good measure of this economically valuable knowledge. The patents do not play any explicit economic role in Griliches' model. They are just an indicator of innovative activity, based on the assumption that some random fraction of Q gets patented.

Following Griliches, we assume that Q_i is an index of innovative output of the firm i, and the stock of R&D is the main input in the innovative activity. The production of Q_i can then be expressed by a standard knowledge production function $Q_i = f(R_i, X_i, \upsilon_i)$ where X represents the other variables that may affect the innovative activity, such as firm size, type of activity, and/or sector specific effects and R stands for R&D. As mentioned in the previous section, we adopt a broad definition of knowledge production, and take into account patents, utility models, and trademarks to measure Q_i. The basic specification to be estimated in order to evaluate the determinants of Turkish SMEs' innovative capabilities is therefore:

$$q_i = \alpha_1 + \alpha_2 R_i + \alpha_3 X_i + \varepsilon_i \tag{1}$$

Following Audretsch and Keilbach (2004), we consider that entrepreneurship involves a number of different legal, institutional, and social factors: an entrepreneurship capital, measured in this paper by the entrepreneurship index (E_j). We also introduce firms' behaviour, approximated by being a start-up (E_i) and entrepreneurs' educational level (ED_i). This second specification is given below :

$$q_i = \alpha_1 + \alpha_2 R_i + \alpha_3 X_i + \alpha_4 E_i + \alpha_5 E_j + \alpha_6 ED_i + \varepsilon_i \tag{2}$$

The subscripts i and j stand respectively for firm and regional levels. Following Radosevic (2007), national systems of innovation are approximated by technological (T), institutional (I), and market (M) opportunities, as following:

$$q_i = \alpha_1 + \alpha_2 R_i + \alpha_3 X_i + \alpha_4 T_j + \alpha_5 M_j + \alpha_6 I_j + \varepsilon_i \tag{3}$$

Given that the objective of the paper is to evaluate the impact of firms' behaviour and choices in presence of entrepreneurial, technological, institutional, and market opportunities, we will introduce several interaction terms in equations 2 and 3 between firms' choices and behaviours (F_i) and entrepreneurial, technological, and institutional opportunities, leading to final specifications:

$$q_i = \alpha_1 + \alpha_2 R_i + \alpha_3 X_i + \alpha_4 E_i + \alpha_5 E_j + \alpha_6 ED_i + \alpha_7 (E_i * E_j) + \varepsilon_i \tag{2a}$$

$$q_i = \alpha_1 + \alpha_2 R_i + \alpha_3 X_i + \alpha_4 T_j + \alpha_5 M_j + \alpha_6 I_j + \alpha_7 (F_i * T_j) + \alpha_8 (F_i * I_j) + \varepsilon_i \tag{3a}$$

As our innovative capability variable is measured as binary outcomes, the empirical model estimated is probit. Given the possibility of heteroskedasticity and clustering effects, we compute robust standard errors and introduce industrial dummies at Nace 2 digit level (not reported). Although probit (and logit) models are widely used in the empirical research, there are a number of critical issues that one should be aware when interpreting the results, given their non-linear nature.[14] In what follows, we present the variables' marginal effects i.e., how much a change in variable changes the probability of innovation output in Turkish SMEs, by setting the other variables at their mean.

[14]See Hoetker (2007) for a critical review of the use of probit models.

4 Results

4.1 Determinants of Turkish SMEs' innovative capabilities

Table 2: Basic specifications

	(i)	(ii)	(iii)	(iv)
Firm age	0.003***	0.011***	0.011***	0.026***
	(16.03)	(15.81)	(14.38)	(9.38)
Age squared				-0.000***
				(-4.99)
Firm size	0.001***	0.002***	0.002**	0.016***
	(7.09)	(6.11)	(3.04)	(7.46)
Size squared				-0.000***
				(-8.12)
R&D	0.060***	0.195***	0.196***	0.185***
	(13.24)	(13.29)	(7.81)	(7.15)
Education	0.005***	0.019***	0.018**	0.023***
	(3.40)	(3.94)	(2.98)	(3.58)
Technology	0.018***	0.066***	0.047	0.029
	(3.77)	(4.17)	(1.25)	(0.83)
ICT	0.002***	0.007***	0.011***	0.009***
	(4.68)	(3.76)	(5.24)	(4.95)
Export	0.117***	0.354***	0.396***	0.352***
	(23.80)	(22.46)	(8.35)	(7.23)
Outsourcing	0.027***	0.082***	0.103***	0.092**
	(5.72)	(5.37)	(3.57)	(3.28)
Quality labels	0.281***	0.806***	0.784***	0.745***
	(47.64)	(41.59)	(11.67)	(11.16)
Assets 1	-0.034***	-0.130***	-0.162***	-0.134***
	(-6.60)	(-7.69)	(-5.31)	(-4.81)
Assets 3	0.044***	0.127***	0.129***	0.091*
	(6.30)	(5.71)	(3.85)	(2.44)
Assets 4	0.065***	0.187***	0.188***	0.139***
	(10.21)	(9.10)	(4.93)	(3.50)
Constant	0.408***	-0.301***	-0.497***	-0.766***
	(24.13)	(-5.41)	(-5.32)	(-7.34)
Pseudo R^2		0.190	0.179	0.187
Number of observations	41923	41923	41923	41923
Number of clusters			81	81
χ^2		8286.391	14552.977	32503.342
AIC	47167.936	45014.844	45566.098	45145.913

Note: *Significant at 10%; ** significant at 5%; *** significant at 1%.
Except the first column, marginal effects are reported.

We begin our analysis by evaluating the determinants of Turkish SMEs' innovative capabilities. The various estimation results for our basic specification are presented in Table 2, without the entrepreneurial and NIS variables. The first column reports the standard OLS model with fixed effects for sectors and regions (NUTS 2 level) as a benchmark. The subsequent columns report the results from the three different specifications of probit estimators: respectively sector and region-specific fixed effect model, sector specific fixed effect model with region clusters and sector-specific fixed effect model where the squared terms of firm age and size have been introduced.[15] This final specification (fourth column) is therefore our preferred specification.[16] All the variables have the expected

[15] In what follows, marginal effects evaluated at the firms' mean values for continuous variables and the discrete change in the probability for dummy variables are reported rather than the raw coefficients.

[16] Even though the specification with sector and region-specific effects performs slightly better, we choose the last one given

signs, except the use of technology, not significant in the last two columns. Investing in R&D increases the probability to innovate, as well as the exporting activity. However, it is owning the quality labels and certificates which seems to increase the propensity to innovate the most. These quality standards demonstrate the abilities of firms to adapt and adopt a body of specialized and codified knowledge (UNIDO, 2005). Therefore they seem to be more important than R&D investments in building innovative capabilities in Turkish SMEs. We also see that the odds of innovation are larger if the firm belongs to upper classes in terms of net assets, compared to the lowest one. These results draw attention to the problem of capital access in small and medium sized enterprises. We also note a inverted-U shaped relationship between the firm's age and size, and the propensity to innovate (Appendix Figure 1 and see also Figures 2 and 3 for sectoral breakdown). The precise estimate of the turning point after which extra size (age) affects innovative capabilities negatively is found to be 65.7 (39.9).[17]

4.2 Innovative capabilities, entrepreneurship, and NIS

In the following, we seek to analyse the impact of entrepreneurship capital and entrepreneurial behaviour on Turkish SMEs' innovative capabilities (Table 3). Two different specifications have been defined for that purpose. The first specification (first two columns) takes into account the firm age, and the second one (the last two columns) introduces the start-up variable as defined earlier.

We note that the introduction of entrepreneurial variables does not affect significantly the rest of the parameters, except the use of technology intensive equipment in the production process, which becomes significant once again. This result shows that the purchase of machinery and the learning of operating procedures is not sufficient for an effective technology transfer (Dahlman and Westphal, 1982). It is then possible to conclude that the entrepreneur will bring the necessary skills to adopt and adapt new technology within the firm.

When we estimate equation (2) without the interaction terms (i) and (iii), the entrepreneurial index seems to increase considerably innovative capabilities, a first evidence on the positive impact of entrepreneurship capital. When the interaction term between the firm age and entrepreneurship index is introduced (specification (ii)), our results show that the positive effect of the entrepreneurial capital on Turkish SMEs' innovative capabilities declines for older firms. Although the magnitude and statistical significance of the interaction effect varies by observation[18], the estimated effect of the interaction term is around -.003, with a standard error of 0.001.

The entrepreneurial behaviour as defined in the previous literature (i.e. being a start-up) has a negative sign ((iii) and (iv)). As one might have expected, not all start-ups are entrepreneurs. In fact, without considering the firm's environment, our approximation of firm level entrepreneurship risks to measure also the individuals who started a new company not by entrepreneurial motivations but because they have no other choice. We therefore have to refine our specification and account for the complex relationship between innovation system and entrepreneurship.

For this purpose, we introduce an interaction term between entrepreneurial behaviour and entrepreneurship index, aiming to fully capture the impact of the firm's environment, estimating thus

the risk of multicollinearity which could arise when we will introduce the NIS variables at the regional level.

[17] Only 857 firms are older than 40 years and 2502 firms (less than 5%) have more than 66 employees.

[18] The marginal effect of a change in both interacted variables is not equal to the marginal effect of changing just the interaction term. Moreover, the sign may be different for different observations. Hence, we can not determine the statistical significance from the z-statistic reported, we must compute the cross derivative of the expected value of the dependent variable and the test for the statistical significance of the interaction effect must be based on the estimated cross-partial derivative. For more detailed explanation, see Norton et al. (2004).

Table 3: Innovation capabilities and entrepreneurship

	(i)	(ii)	(iii)	(iv)
Firm age	0.0112***	0.0165***		
	(14.82)	(5.34)		
Firm size	0.0165***	0.0165***	0.0160***	0.0160***
	(8.33)	(8.38)	(8.03)	(8.02)
Size squared	-0.000123***	-0.000123***	-0.000119***	-0.000119***
	(-8.72)	(-8.73)	(-8.30)	(-8.29)
R&D	0.182***	0.181***	0.184***	0.184***
	(7.33)	(7.33)	(7.46)	(7.44)
Education	0.0178***	0.0177***	0.0182***	0.0182***
	(2.73)	(2.72)	(2.81)	(2.81)
Technology	0.0311	0.0311	0.0306	0.0305
	(0.92)	(0.92)	(0.90)	(0.90)
ICT	0.00661***	0.00668***	0.00670***	0.00672***
	(3.55)	(3.57)	(3.65)	(3.64)
Export	0.322***	0.323***	0.313***	0.313***
	(7.02)	(7.03)	(6.86)	(6.87)
Outsourcing	0.0819***	0.0815***	0.0791***	0.0791***
	(2.70)	(2.68)	(2.58)	(2.58)
Quality label	0.760***	0.760***	0.762***	0.762***
	(11.82)	(11.85)	(11.93)	(11.93)
Entrepreneur's education	0.0167	0.0171	0.0215	0.0215
	(0.81)	(0.83)	(1.06)	(1.06)
Entrepreneurship index (I_E)	0.632***	0.798***	0.632***	0.616***
	(4.07)	(5.19)	(4.05)	(3.74)
Age X I_E		-0.0123**		
		(-2.13)		
Start-up			-0.335***	-0.374***
			(-22.96)	(-6.72)
Start-up X I_E				0.0884
				(0.80)
Asset 1	-0.130***	-0.130***	-0.134***	-0.134***
	(-4.26)	(-4.28)	(-4.50)	(-4.49)
Asset 3	0.0973***	0.0971***	0.0908**	0.0908**
	(2.59)	(2.60)	(2.48)	(2.48)
Asset 4	0.150***	0.150***	0.148***	0.148***
	(3.66)	(3.66)	(3.68)	(3.68)
Constant	-0.845***	-0.917***	-0.619***	-0.612***
	(-6.17)	(-6.55)	(-4.46)	(-4.27)
Pseudo R^2	0.187	0.188	0.189	0.189
Number of observations	41923	41923	41923	41923
Number of clusters	81	81	81	81
χ^2	14901.90	26144.89	26458.31	52139.67
AIC	45112.01	45109.12	45011.61	45013.22

Notes:*Significant at 10%; ** significant at 5%; *** significant at 1%.
Marginal effects are reported.

equation (2a). Despite the lack of statistical significance of the coefficient of the interactive term (iv), the full interaction effect is S-shaped and has an overall impact of 0.002.

Table 4 shows the results of the regression where the national innovation system variables are introduced (equation 3a). Although their intensity varies, the sign of traditional determinants does not change significantly with the inclusion of NIS variables. Regarding technological opportunities, the industrial structure and capacity have expected positive signs. Firms' innovative capabilities increase with the industrial infrastructure. However, being located in larger industrial zones does not seem to affect the propensity to innovate. Industrial zones in Turkey seem to fail to promote

innovative capabilities of younger, smaller, less technology intensive, and/or more disadvantaged firms. This result can nonetheless be explained by a number of factors. First of all, all industrial estates do not have technological facilities and innovative incentives. Even so, one would expect a positive impact of agglomeration economies and spill-overs, arising from clusters. But if the spill-overs do not have a technical nature, we can expect the positive effects being captured by the market opportunities. Furthermore, previous studies have found a low level of network and interactions in Turkey (Akçomak and Taymaz, 2004) and suggested that spill-overs are more likely to occur in a diversified industrial structure (Bascavusoglu, 2008) which may partly explain these results.

Regarding the market opportunities, both location quotient and urbanization rate have expected positive values, although their impact is rather small. A location quotient greater than 1 indicates that the level of employment in that industry exceeds the local demand for the goods or services which it produces, thus indicating a full exploitation of local market opportunities. Small firms tend to operate more and more efficiently on the appropriate scale to the size of local markets. On the other hand, urbanization economies are acknowledged to be the scale effects associated with city size or density, they are external to industries but internal to geographic units (Feldman, 1999). A positive impact of the urbanization rate on innovative capabilities points to Jacobian diversification externalities. We can therefore conclude that urbanization economics seem to be more important in Turkey.

The budget revenue per capita, first of a set of variables approximating the institutional opportunities, is significant and positive as expected. The incentive variable is also significant. It clearly shows that the amount of incentive per capita increases the probability to innovate. The final result regarding institutional opportunities is the non-significance of private loans, highlighting the seriousness of the financial problem for Turkish SMEs. Not only are private bank loans scarce and not easily available for the SMEs, but they also hamper innovative capabilities when finally obtained. The cost of short term financing is the highest in Turkey compared to the other European countries (EU, 2003), discouraging small firms from investing in knowledge creation, a highly risky, uncertain, and costly process.

5 Conclusion

The purpose of this paper was to evaluate Turkish SMEs' innovative capabilities from two perspectives, namely the entrepreneurship and national innovation system. As the starting point of our paper was low level of innovative activities in Turkish SMEs, we approximated innovative capabilities with a broadly defined innovative performance measure. Through a survey conducted on 50.000 small and medium sized enterprises, we took into account entrepreneurial, technological, market, and institutional opportunities, and their interaction with firms' behaviour and choices.

Our first conclusion concerns the determinants of innovative capabilities of Turkish SMEs. Overall, investment in R&D, use of information and communication technologies, exporting activities, outsourcing and employees' educational level are found to increase Turkish SMEs' innovative activities. But more particularly, owning quality labels and certificates have the most important impact on innovative performance, regardless of the model specification. These quality standards demonstrate the firms' ability to learn, adopt, and adapt specialized and codified knowledge. Even though certified management systems and/or quality labels require a considerable economical expenses, especially for the small firms, the expected benefits seem to be substantial. The result shows that alongside the usual positive effects such as increased profits and market shares, improved performance,

Table 4: Innovative capabilities and NIS dimension

	Technological opportunities	Market opportunities	Institutional opportunities
Firm age	0.025***	0.026***	0.026***
	(9.13)	(9.39)	(9.11)
Age squared	-0.000***	-0.000***	-0.000***
	(-4.83)	(-4.96)	(-4.87)
Firm size	0.016***	0.016***	0.016***
	(7.62)	(7.63)	(7.88)
Size squared	-0.000***	-0.000***	-0.000***
	(-7.86)	(-7.95)	(-8.41)
R&D	0.186***	0.179***	0.182***
	(8.33)	(7.04)	(7.73)
Education	0.026***	0.022***	0.022***
	(4.64)	(3.64)	(3.45)
Technology	0.037	0.032	0.029
	(1.26)	(0.95)	(0.93)
ICT	0.007***	0.008***	0.009***
	(3.37)	(3.46)	(4.54)
Export	0.322***	0.330***	0.346***
	(7.36)	(7.81)	(7.92)
Outsourcing	0.080**	0.086**	0.089**
	(2.79)	(2.84)	(2.99)
Quality labels	0.762***	0.750***	0.740***
	(10.72)	(11.80)	(11.31)
Electricity per capita	0.038***		
	(4.00)		
Power capacity	0.001*		
	(2.32)		
Location	-0.114		
	(-1.82)		
OIZ size	-0.012		
	(-0.95)		
Location X OIZ size	0.010		
	(0.71)		
Location quotient		0.061*	
		(1.84)	
Urbanization rate		0.003*	
		(1.74)	
Incentives			0.128***
			(3.45)
Incentives per capita			0.004
			(0.34)
Incentive X incentive per capita			-0.016
			(-1.92)
Budget revenue per capita			0.135*
			(0.66)
Credit			-0.022
			(-0.69)
Credit per capita			-0.412
			(-1.71)
Credit X credit per capita			0.160
			(0.86)
Constant	-0.879***	-1.032***	-0.728***
	(-8.96)	(-4.99)	(-6.48)
Pseudo R^2	0.191	0.188	0.188
Number of observations	41923	41923	41923
Number of clusters	81	81	81
χ^2	35804.676	39875.944	57236.005
AIC	44897.297	45076.261	45104.381

Notes: *Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors in brackets. Marginal effects are reported. Assets dummies (not reported) are included in the estimation.

ability to meet client expectations and facilities to participate in international markets: quality labels and certificates also improve the innovation abilities of small firms.

Our second conclusion points to the weaknesses of both the Turkish national innovation system and firm's entrepreneurial behaviour, and where some interesting policy discussion arises.

The regional industrial structure, approximated by the total capacity of power equipment and per capita electricity consumption, is found to be important in building innovative capabilities. However, being located in a industrial estate does not increase the odds of innovation. Furthermore, we found no positive relationship between the size of the industrial estates and innovative performance. This finding stresses an important policy issue, considering that these organized industrial zones are reported to have an excess capacity in Turkey (OECD, 2004). Nonetheless, Turkey continues on providing extensive loans and new funds for the establishment of small industrial estates and/or organized industrial zones. Our results suggest that these types of clustering efforts may not be fully adequate for Turkish SMEs' needs. Besides, the analysis of market opportunities highlights the existence of diversification externalities in most of the specification, confirming previous studies on urbanization and productivity in Turkey (Bascavusoglu, 2008; Lall et al., 2007).

This study also underlines the extent of financial problems faced by Turkish SMEs. The amount of private loans at regional level is not channeled towards innovative capabilities of Turkish SMEs located in that region, pointing to the scarcity of available private credit for small firms. Furthermore, a private loan does not seem to foster knowledge creation.

Finally, although the start-up firms, supposed to reflect the entrepreneurial Turkish SMEs, do not show a better performance, the regional entrepreneurship capital seems to contribute positively to the SMEs' innovative capabilities, especially for young firms. However, we are aware that start-ups might not fully reflect the entrepreneurial firms, especially in a developing country context such as in Turkey. Empirically defining entrepreneurial firms is a very interesting challenge, that we would like to explore in future research.

Indeed, the Turkish small and medium sized industry is far from the knowledge-based, internationally competitive, and innovative entrepreneurial small firms. Yet, SMEs are known for their dynamism particularly in finding market niches and benefit from cheap inputs from the informal economy (EU, 2006). Our result suggests that this dynamism and flexibility might be an outcome of entrepreneurial opportunities. The empirical analysis also shows the importance of institutional opportunities in comparison to other NIS issues. In the light of our empirical analysis, we argue that the weaknesses of Turkish SMEs are more policy-related, rather than resulting from a lack of entrepreneurial behaviour.

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Appendix

Appendix Table 1. Sectoral distribution

NACE	Whole sample		Start-ups	
	Freq.	Percent	Freq.	Percent
Basic metals	2,630	5.83	474	5.39
Chemicals and chemical products	1,488	3.30	281	3.20
Coke, refined petroleum product and nuclear fuel	100	0.22	26	0.30
Electrical machinery and app. n.e.c.	1,442	3.20	219	2.49
Fabricated metal products, exp. machinery and eq.	3,576	7.93	639	7.27
Food products and beverages	5,328	11.81	938	10.67
Furniture, manufacturing n.e.c.	6,595	14.62	1,439	16.38
Machinery and equipment n.e.c.	4,314	9.56	703	8.00
Medical, precision and optical inst., watches and clocks	355	0.79	95	1.08
Motor vehicles, trailers and semi-trailers	1,053	2.33	160	1.82
Office machinery & computers	74	0.16	15	0.17
Other non-metallic mineral products	2,406	5.33	464	5.28
Other transport equipments	273	0.61	42	0.48
Publishing, printing, and reproduction of recorded media	505	1.12	119	1.35
Pulp, paper, and paper products	820	1.82	150	1.71
Radio, television, and communication equipment	137	0.30	24	0.27
Recycling	143	0.32	38	0.43
Rubber and plastic products	3,017	6.69	600	6.83
Tanning and dressing of leather	1,467	3.25	275	3.13
Textiles	6,738	14.93	1,517	17.26
Tobacco products	129	0.29	31	0.35
Wearing ap., dressing and dyeing of fur	1,468	3.25	351	3.99
Wood, products of wood and cork, exp. furniture	1,062	2.35	187	2.13
Total	45,120	100.00	8,787	100.00

Source: KOSGEB

Appendix Table 2. Performance evaluation

Performance Indicator	Whole sample freq.	Whole sample percent	Start-ups freq.	Start-ups percent
Sales				
Increase	26,034	61.90	5,128	68.74
Stable	9,280	22.06	1,581	21.19
Decrease	6,747	16.04	751	10.07
Costumer returns				
Increase	1,712	5.01	232	3.85
Stable	17,949	52.56	3,199	53.09
Decrease	14,491	42.43	2,595	43.06
Wasted products				
Increase	3,280	8.57	498	7.37
Stable	19,882	51.95	3,376	49.98
Decrease	15,107	39.48	2,881	42.65
Machinery park				
Increase	23,657	56.83	4,278	58.32
Stable	17,044	40.94	2,949	40.20
Decrease	926	2.22	109	1.49
Costumer satisfaction				
Increase	35,538	83.55	6,488	86.15
Stable	6,454	15.17	974	12.93
Decrease	544	1.28	69	0.92
Efficiency of transport				
Increase	29,619	72.21	5,300	73.27
Stable	10,662	25.99	1,816	25.10
Decrease	737	1.80	118	1.63
Product variety				
Increase	31,000	72.83	5,630	74.73
Stable	11,015	25.88	1,832	24.32
Decrease	547	1.29	72	0.96
Costumers				
Increase	31,017	73.14	5,902	78.62
Stable	8,897	20.98	1,351	18.00
Decrease	2,494	5.88	254	3.38
Production				
Increase	28,709	68.86	5,585	75.70
Stable	9,221	22.12	1,422	19.27
Decrease	3,764	9.03	371	5.03
Exports				
Increase	10,443	41.91	1,633	40.45
Stable	12,399	49.76	2,188	54.20
Decrease	2,075	8.33	216	5.35

Source: KOSGEB

Appendix Table 2 continued

Performance Indicator	Whole sample freq.	Whole sample percent	Start-ups freq.	Start-ups percent
Capital				
Increase	22,273	54.05	3,843	52.80
Stable	16,336	39.64	3,138	43.11
Decrease	2,598	6.30	298	4.09
Total debt				
Increase	12,192	32.13	2,075	30.66
Stable	18,338	48.33	3,150	46.55
Decrease	7,417	19.55	1,542	22.79
Productivity				
Increase	27,973	68.09	5,333	73.12
Stable	10,992	26.75	1,703	23.35
Decrease	2,119	5.16	257	3.52
Efficient use of personnel				
Increase	24,923	61.59	4,665	65.38
Stable	13,760	34.00	2,242	31.42
Decrease	1,786	4.41	228	3.20
Export countries				
Increase	9,392	37.56	1,438	35.39
Stable	14,228	56.91	2,460	60.55
Decrease	1,383	5.53	165	4.06
Capacity utilization rate				
Increase	23,242	57.45	4,602	64.30
Stable	13,451	33.25	2,148	30.01
Decrease	3,765	9.31	407	5.69
Cost of production				
Increase	29,529	70.55	4,681	63.32
Stable	9,166	21.90	2,022	27.35
Decrease	3,162	7.55	690	9.33
Competitiveness				
Increase	26,389	63.89	4,947	67.65
Stable	9,054	21.92	1,618	22.12
Decrease	5,864	14.20	748	10.23
Profitability				
Increase	14,167	34.87	2,927	40.79
Stable	14,082	34.66	2,779	38.73
Decrease	12,384	30.48	1,469	20.47
Distributed profit				
Increase	7,537	25.00	1,506	28.81
Stable	15,838	52.53	2,894	55.37
Decrease	6,778	22.48	827	15.82

Source: KOSGEB

Appendix Table 3. Variables, description and statistics

3a. Summary statistics

Variable	Obs	Mean	Std. Dev.
Innovation	41923	0.373924	0.48385
Firm age	41923	13.59275	9.871809
Firm size	41923	19.78928	25.01774
R&D	41923	0.369749	0.482743
Education	41923	9.843765	1.533623
Technology	41923	0.295423	0.456238
ICT	41923	3.446414	5.664331
Export	41923	0.373661	0.483781
Outsourcing	41923	0.335925	0.472319
Quality labels	41923	0.189156	0.391637
Entrepreneur's education	41923	0.376858	0.484605
Entrepreneurship index	41923	0.436472	0.124279
Start-up	41923	0.200415	0.400316
Electricity per capita	41923	3.339727	2.57617
Power capacity	41923	60.79275	69.90343
Location	41923	0.440093	0.496404
OIZ size	41923	4.250475	3.112601
Location Quotient	41923	1.162752	0.485452
Urbanization rate	41923	72.80622	16.24694
Incentives	41923	0.080505	0.272076
Incentive per capita	41923	0.171833	0.873949
Budget revenue per capita	41923	0.149877	0.185938
Credit	41923	0.338502	0.473206
Credit per capita	41923	0.143842	0.165432
Assets 1	41923	0.329056	0.469876
Assets 3	41923	0.121151	0.326306
Assets 4	41923	0.192043	0.393911

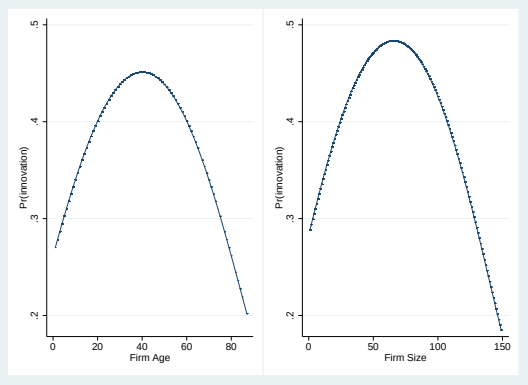
3b. Description of variables and sources

Variable	Description	Sources
Innovation	Granted patents, utility models and trademarks (yes/no)	KOSGEB
Firm age	Number of years passed since the firm's creation	KOSGEB
Firm size	Number of employees	KOSGEB
R&D	Investment in Research and Development (yes/no)	KOSGEB
Education	Average enrolment year	KOSGEB
Technology	Use of plc, cnc or robots in production process	KOSGEB
ICT	Number of computers in the firm	KOSGEB
Export	Exporting Activity (yes/no)	KOSGEB
Outsourcing	Use of external laboratories and/or acquisition of external technology (yes/no)	KOSGEB
Quality labels	Ownership of quality certificates and/or labels (yes/no)	KOSGEB
Entrepreneur's education	Average enrolment year of the manager	KOSGEB
Entrepreneurship index	Entrepreneurial Capacity at NUTS 3 Level	
Start-up	Firms that are less than 5 years old	KOSGEB
Electricity per capita	Per capita electricity consumption in manufacturing industry	SPO
Power capacity	Total capacity in power equipment	SPO
Location	Being located in an industrial park/zone and/or technological park (yes/no)	KOSGEB
OIZ size	Number of plots in organized industrial estates	SPO
Location quotient	Location quotient at NUTS 2 level $LQ = \frac{e_i/e}{E_i/E}$ where: ei = Local employment in industry i e = Total local employment Ei = Reference area employment in industry i E = Total reference area employment industry (%) ISIC Rev.2 4-digit level	TUBITAK
Incentives	Holding at least one incentive certificate (yes/no)	KOSGEB
Incentive per capita	Per capita amount of investments with incentive certificates	SPO
Budget revenue per capita	Consolidated budget revenue per capita	SPO
Credit	Use of private bank credits and/or loans(yes/no)	KOSGEB
Credit per capita	Amount of industrial, commercial and tourism credits per capita	SPO
Assets	Level of net assets Cat. 1 corresponds to assets <50 billion TL Cat. 2 corresponds to assets 51-150 billion TL Cat. 3 corresponds to assets 151-300 billion TL Cat. 4 corresponds to assets >151 billion TL	KOSGEB

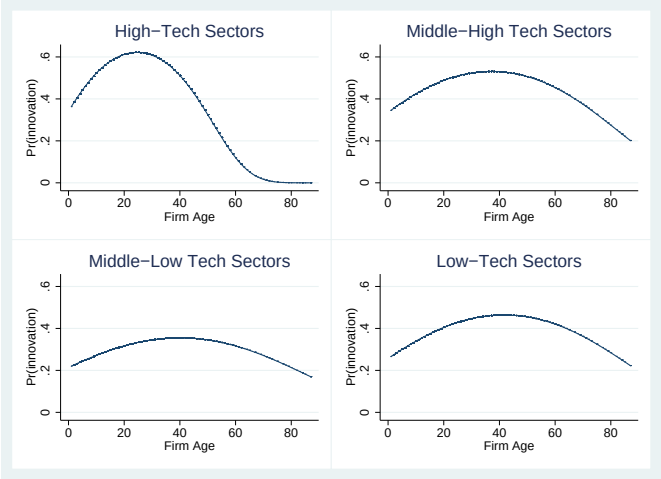
3c. List of Indicators Used for the Entrepreneurship Index

- Export per capita
- Export growth rate
- Export variety index
- Ratio of employers in total population
- Number of firms with quality labels and certificates (per 10,000 firms)
- Number of patents and utility models per 10,000 firms
- Number of new firms per 10,000 firms
- Firm turnover ratio (Entry/Exit)
- The share of joint stock corporations in total firms
- The share of agricultural sector in new firms
- The share of manufacture sector in new firms
- The share of service sector in new firms
- Amount of subventions per capita
- Cancel rate of incentive certificates
- Number of incentive certificates per 100,000 firms

Appendix Figure 1. Propensity to innovate and firm age and size



Appendix Figure 2. Propensity to innovate and firm age



Appendix Figure 3. Propensity to innovate and firm size