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Impact of SME Policies on Innovation: The Turkish Case

Elif Bascavusoglu-Moreau[*†]

Abstract

The purpose of this paper is to explore the determinants of innovative capabilities in Turkish SMEs, with a particular emphasis on the impact of recent changes in science and technology policy. Two different analyses are conducted in order to evaluate both the decision to innovate and the propensity to innovate, using a unique firm-level survey realized among 50.000 SMEs. Our results suggest that the new policies did not manage to address the whole issues that are preventing Turkish SMEs to achieve a higher innovative capability and growth.

Keywords : Small and Medium-Sized Entreprises, technological capability building, innovation, industrial/technology policies

JEL Codes : O31, O33, O38, L1

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1 Introduction

The well-known model of knowledge production function links investments in research and development (R&D) to the innovative activities, through the firm that endogenously generates new knowledge (Griliches, 1979). However, the high growth and innovation rates reached by the small enterprises in the last decades have somehow attenuated the implications of knowledge production function model (Audretsch, 1995; Acs and Audretsch, 1990). That is because small and medium sized enterprises (SMEs) have emerged as important agents of industrial growth since 1980s, even though they account for a small part of overall R&D investments (Acs and Audretsch, 1990; Cohen and Levin, 1989). It's 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.

Microenterprises and SMEs are the emerging private sector in most countries, and thus constitutes the base for private sector-led growth (Hallberg, 2000). Furthermore, given that the World Trade Organization (WTO) regulations forbid all industrial support policies with the exception of those for the promotion of SMEs, local development and R&D activities, the support for the SME sector is one of the main policy tools available to the developing countries to support its industries (Taymaz, 2001). In this context, accumulation of technological capability is crucial for the ability of small and medium manufacturing enterprises to make a significant contribution to local industrial development (Caniëls and Romijn, 2001).

Technological capability is defined as the knowledge, skills and experience necessary in firms to produce, assimilate, improve and develop technologies (Lall, 1992). This is not a straightforward process and can not be promoted simply by investing in and/or buying new technology, but by active technological learning and capacity building. Firms should invest in their own capabilities and develop skills and experiences in order to absorb, adopt or create new technologies. Capabilities here refer to routines that allow firms to combine efficiently their tangible and intangible assets, and to transform them into a marketing function (Dosi et al., 2000).

Several taxonomies of technological capabilities have been proposed in the literature (Linsu, 1997; Lall, 1992). They can be categorized by their complexity or by their function. According to their complexity, capabilities can be viewed as routine or adaptive, compared to innovative and risky. It is possible to break down the capability notion by its function, into investment, production, linkages and/or innovation. However, these categorizations are rather indicative and do not aim to show a necessary sequence of learning.

Investment capabilities are the skills to identify needs, prepare and obtain the necessary technology, then design, construct, equip, and staff the facility, before a new facility is commissioned or existing plant is expanded (Salomon et al., 1994). Production capabilities range from basic skills like operation and maintenance to more advanced ones like adaptation or improvement. Linkage capabilities include establishing links among other enterprises, suppliers, sub-contractors and services firms, as well as with institutions such as universities, consultants, or development agencies: and therefore foster the diffusion of technology within the firm, and throughout the economy.

In this paper, we are interested in innovation capabilities of Turkish firms, that is 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). It is a very difficult task to measure or evaluate adequately the innovation capability. Generally, knowledge creation is reduced to be the outcome of the R&D expenditures and the number of engineers, scientists, or high-skilled human capital. However, firms learn in a variety of ways, thus the innovation capability is composed by a number of sources, both internal and external to the firm. Whilst the internal processes that lead to technological capability building are training, learning by using and learning by searching (Dosi, 1988; Rosenberg, 1982), the external resources correspond to learning by interacting (Lundvall, 1988). Further to these internal and external factors, governments also should be concerned with capability building, especially in newly industrializing countries (Kim and Nelson, 2000). Government policies should stimulate the development of industrial technology capacity by building institutional capacity, strengthening financial institutions or reducing the risks and transactions costs (Hallberg, 2000).

The purpose of this paper is to evaluate the effectiveness of such policies, by analyzing the impact of recent science and technology (S&T) policy changes in Turkey. In line with the European harmonization programmes, Turkey has recently established a business support infrastructure for SMEs, through a certain number of institutions, technology development centers and agencies, and by implementing credit and banking facilities. However, the extent of penetration of these programmes into small firms has not been properly evaluated, mainly because of the lack of data (OECD, 2005).

We aim to fulfill this gap by conducting an empirical analysis on the determinants of innovation activities, measured by patents. Given the small number of innovating firms in our sample, we conduct two different analysis, within the theoretical framework of innovative capabilities. In the first place, we look at the decision to innovate among our whole sample. Then, we focus on the determinants of technology creation by exploring the behavior of innovator firms. Finally, we assess the new policy changes' effect on Turkish SMEs. Our main objective is to evaluate to what extent different policy tools affect firms decision to become innovative, and increase innovation activity by the firms that are already innovative.

The next section reviews briefly the national system of innovation in Turkey and existing policies. In Section 3 we present our database and variables. Results will be discussed in Section 4. Section 5 concludes.

2 S&T Capabilities in Turkey : State of the Art

Turkish economy has longtime been characterized by high inflation, high real interest rates and public sector imbalances, leading to repetitive crises. The export-led growth strategy adapted in early 1980s came off with an export boom, but to the expense of real wages and a non-increasing gross fixed capital formation[1]. The burden of state economic enterprises and the heavy bureaucracy blocked a rapid liberal transformation. Furthermore, Turkey failed to implement adequate productive and technological policies to accompany its export promotion (Ozcelik and Taymaz, 2004).

A long period of political instability, growing public sector debt, the persistency of high inflation, the unhealthy structure of the financial sector and the cautious approach of international capital towards emerging markets resulted in two consecutive crises in November 2000 and in February 2001. Interest rate went up, floating currency system has been introduced and Turkish Lira devaluated. These developments created an ambiguous environment in economy and negatively affected the industrial sectors. Government launched series of policy reforms, with the assistance of a modified IMF program and EU conditionality, followed by an Urgent Action Plan of the government aiming macroeconomic stabilization and growth. As a consequence of the wide-ranged structural reforms, Turkey experienced a recovery, favoring the transition to a more stable economy since 2003. The inflation rate is now at its lowest level for the last 30 years (9.98% in 2006 versus 84.6% in 1998), and the growth of Gross Domestic Products (GDP) passed to 7.5% as opposed to -7.50% in 2001 (Eurostat, 2007). Turkey is one of the fastest growing economies among the OECD member countries.

However, the picture is rather different when we look at the main science and technology indicators. Turkey is rather low-ranked, with a share of the expenses of public R&D and of information and communication technologies in GDP respectively of 0.47% and 3.2%, compared to 0.69% and 6.4% in EU-25. On the technology outputs' side, the number of EPO (USPTO) patents per million people is 1 (0.2) in Turkey, whilst 133.6 (59.9) in EU-25. But as pointed by the European Trend Chart Report, innovation performance may not be adequately measured by these data in a newly industrializing country such as Turkey. In fact, when we look at the overall country trends of the 13 new member countries, Turkey ranks among the top three trend leaders for the following three indicators: business R&D/GDP, USPTO patents/population, and high-tech manufacturing value-added share (EU, 2005b). We can therefore conclude that the country demonstrates a strong willingness to catch-up. Turkey also displays a relative strength in the areas of science and engineering enrolment at tertiary level and scientific and technical journal articles, as well as royalty and license fee payments and patent applications, compared to the Europe and Central Asia Region (WorldBank, 2004).

The last European Trend Chart Report reckon 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, 2005a). However, although main actors such as government bodies, business federations, technology parks, incubators and universities are present and numerous, their number is insufficient given the size of the country. There are actually 40 technology development regions and agencies and only 7 university-industry joint-ventures, mostly founded after 2000. Moreover, the

[1]For a comparative analysis of export-led growth strategies in Turkey and East Asian countries, see Rodrik (1995).

lack of linkages and cooperation between different entities stands for the major weakness of Turkish innovation system: neither the cooperation among industries nor the cooperation between universities and private sector is well developed. On the other hand, Turkey seems to be above the EU average concerning business sophistication sub-index: it has a 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 their competitors elsewhere in Europe, particulary the new members in Central and Eastern Europe (WEF, 2005, p. 29). As for its strengths, we can consider a dynamic and export-oriented private sector, active semi-public and non-governmental organizations, widespread knowledge institutes and the existence of an entrepreneurial culture. Overall, Turkey seems to be relatively stronger in inputs but weaker in outputs.

Starting business seems to take less time and require less capital than the regional average (WorldBank, 2004). Survival rates of Turkish companies tend to be higher comparing to other Central and Eastern Europe (CEE) countries and the level of business owners is 17.04% (EU, 2002). This favorable situation is further improved by the recent laws on administrative requirements on starting companies. In 2005, year of the survey, 3676 new firms and 3230 trade names have been established, with an increase of respectively 11.9% and 18.7% comparing to 2004 (TUIK, 2006). But, there is considerable differences in entry and exit rates according to the firm size. Furthermore, large firms have higher survival rates, but small firms that survive grow more than larger firms (Sak and Taymaz, 2004).

Medium and small sized enterprises contribute significantly to the Turkish Economy in terms of employment and value added (Ozar, 2003). It has been highlighted that the growth of the last decade were relying on the SMEs, whose dynamism comes from a high level of profitability and a highly flexible labor market (CEPII, 2004). According to the latest Census of Industry and Business Establishments (2002), the Turkish firms' average size is 3.68 persons employed and enterprises employing 1-49 persons constitute 99.41% of the total enterprises in Turkey (TUIK, 2002). SMEs account for 61.1% of the employment and 27.3% of the value added, but only for 38% of capital investment, 10% of exports and 5% of bank credit (KOSGEB-OECD, 2005). The small size of Turkish SMEs and their relatively small contribution to national output and exports is also revealed by international comparisons with similar countries. In transition economies, small firms' share of total turnover is around 14-31% and of exports, 20-44%, for an employment share of 15-20% (Serger and Hansson, 2004). In the East Asian countries, small enterprises tend to be more export-oriented, in S&T-intensive sectors in highly competitive countries like Taiwan and South Korea, and in more labor-intensive industries in late-developers such as Malaysia, Thailand, Indonesia and Philippines. Whereas in China, knowledge intensive small firms have higher productivity and capital intensity, but a lower export ratio (Lundin et al., 2007).

SME policies have been put in the agenda in Turkey only after mid-90s, and until recently, small and medium sized industry has particularly suffered from an unfavorable business environment, characterized by high inflation, exchange rate instabilities, recessions, fluctuation in GDP and introduction of adjustment policies (Isik, 2005). OECD points to six main weaknesses of the Turkish Support System for SMEs, identified by the private sector representatives in Turkey, as following: insufficient support mechanisms, non-availability of information on support mechanisms, insufficient knowledge of how to apply for the benefits, inability to obtain bank loans and equity financing, and excessive taxation (OECD-UNIDO, 2004). It has been reported that the recent programmes providing credits/guaranteed funds to small businesses have experienced a lack of demand (Napier et al., 2004). This seems to indicate that besides the lack of capital, the lack of people with adequate entrepreneurial skills to make use of the capital that is available is also critical.

There are several public organizations responsible for defining and implementing SME policies in Turkey, which lead to some coordination problems and effectiveness of ensuing schemes[2]. In 2003, a "SME Strategy and Action Plan" has been adopted, indicating that policy changes should be implemented in the areas of finance, technology and competitiveness, weakest points of Turkish SMEs. In order to improve the overall the business environment, increase competitiveness and create sustainable growth, Turkey has also adopted an "Industrial Policy for Turkey" in 2003, where improving SMEs and entrepreneurship stands out as one of the main objectives. The SME Strategy and Action Plan and Industrial Policy provide the basis for policies to enhance SMEs. In line with the European harmonization programmes, Turkey has also adopted the "European Chart for Small Enterprises", and hence committed itself to develop programmes and projects in ten areas specified by the Charter[3].

However, the extent of penetration of these programmes into small firms has not been properly evaluated, mainly because of the lack of data. In this paper, we are interested in the impact of two policy tools resulting from the new legislations. The first one concerns the financial support. More particularly, we evaluate the effect of the Credit Guarantee Fund (CGF), a joint stock company established with the assistance of Germany and issuing guarantees for SMEs since 1994. CGF provides guarantees for various needs of SMEs, such as working capital, export finance, investment loans, short and long term credits. It works as an intermediary with 11 banks and two financial leasing corporations. CGF gives guarantees up to 80% of the loan, with a guarantee limit of 400 000 euros per enterprise and a maximum maturity of 8 years. As for 2006, the total amount of guarantees is 88 million euros and the total amount of loans, 124 million euros. Under the financial support, we

[2]The Ministry of Industry and Trade is the primary authority for SME policies through KOSGEB. The Undersecretariat of State Planning Organization is responsible for planning long-term development plans that also covers SME policies. The Undersecretariat of Treasury is responsible for state aids to SMEs, whilst the Undersecretariat of Foreign Trade develops programmes to foster the export activities. Finally, Halkbank could be seen as the main financial institution to support small and medium sized industry (Isik, 2005). There are also a number of institutions to enhance the SMEs such as Scientific and Technical Research Council of Turkey, Turkish Patent Institute, Ministry of National Education, Turkish Union of Chambers and Commodity Exchange, to name a few.

[3]The 10 key areas are education and training for entrepreneurship, cheaper and faster start-ups, better legislation and regulation, availability of skills, improving the online access, getting more out of the Single Market, taxation and financial matters, strengthening the technological capacity, making use of successful e-business models and developing top-class small business support and developing stronger, more effective representation of small enterprises' interest at Union and national level.

also evaluate the impact of the wide range of measures offered by KOSGEB, which consists not only on low-interest loans, but also technical and managerial advices, training programmes and laboratory services. Between 2003-2007, 44 544 small and medium sized enterprises have benefited from KOSGEB's support schemes.

The second policy tool is about the promotion of technology dissemination towards SMEs. There has been a real emphasis on the development of dynamic and innovative clusters and science parks in Turkey. Whilst industrial zones existed since longtime in Turkey, the creation of technological parks are one of the results of the recent reforms. They are examples of Technology Development Zones, located in an university campus, with the aim of fostering innovation and growth[4]. All the firms in these zones are SMEs, and the earning derived from software and R&D activities are exempted from income and corporation tax, as well as salaries paid to researchers. Since 2001, 22 technology development zones have been established, with 533 innovative firms, 7 757 R&D staff and 2 470 R&D project (Karabulut, 2006). Export activities from these zones have reached 105 million dollars, and inward foreign investments, 300 million dollars. Alongside to these new technology clusters, Turkey has also numerous Small Sized Industrial Estates, where SMEs can obtain some financial facilities and support programmes.

3 Database and Variables

3.1 Database

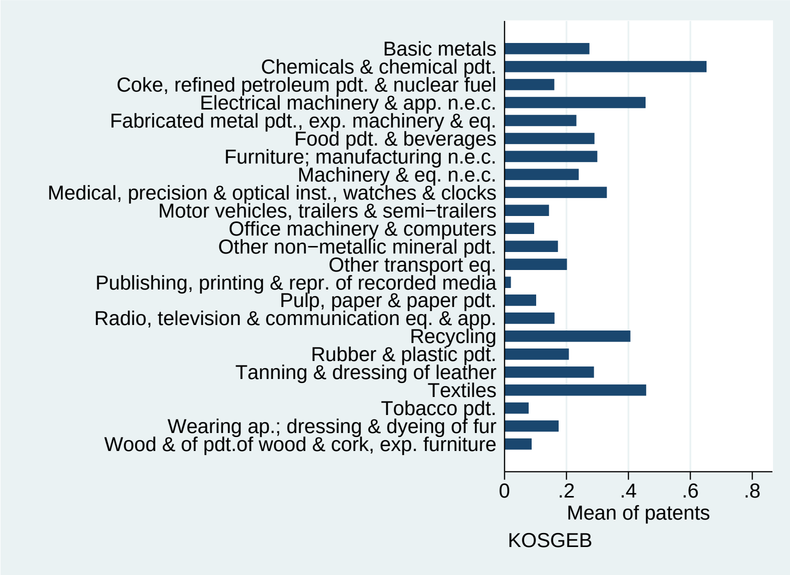
We use an unique firm-level survey data collected by Small and Medium-Sized Industry Development Organization (KOSGEB) in 2005[5]. The original database covers 50 347 SMEs, where 71.83% are small firms employing less then 25 people and only 0,05%, more than 150 people. 71% of the firms are founded after 1980, so our sample has also old and established firms as well as new entrants. We have 23 sectors following 2-digit NACE classification. As it can be seen from Figure 1, the industrial distribution of patents are rather heterogeneous, with chemicals, textiles and electric-electronic being the most innovative industries. This finding shows that Turkey is specialized in medium technology industries.

The survey gives information about the educational level of the employees, machinery and equipment, technological infrastructure, quality level of the production revealed by the ownership of quality certificates and labels, and the type of the exporting activity. Besides, we also have some information about the access to financial markets, such as the type of loans, the incentives and credits -if any- that the firm have beneficiated.

[4]The Law on Technology Development Zones has been introduced in 2001, with the aim of strengthening cooperation between universities, research institutions and productive sector, in order to raise the knowledge creation.

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

Figure 1: Average Patents by Industry



Moreover, the survey gives us information on whether a firm has a patent or an utility model[6]. We also know whether firms are performing any research and development investments, they have a research laboratory or rely on any outsourcing in terms of technology.

Table 1 presents the distribution of innovating firms by size, both by the National Institute of Statistics (TUIK) and KOSGEB. According to the latest innovation survey conducted by TUIK for the period 2002-2004, 34.58% of the firms in the manufacturing sector, and 25.9% in the service sector are innovative. Whilst the share of innovative manufacturing firms has increased by 4.8% compared to the 1995-1997 period, those in service sector has decreased by 9.7%. Concerning the sectoral distribution, office, accounting and computing machinery and electrical machinery are the most innovative activities, with a high increase for the former between the two periods. In the service sector, the major part of innovation comes from telecommunications.

Table 1: Innovation Distribution by Size

	TUIK Database (200-2004)			KOSGEB Database (2005)		
Size	Innovators	Non-Innovators	Total	Innovators	Non-Innovators	Total
1	n.a.	n.a.	n.a.	0.92	99.08	100
1-9	n.a.	n.a.	n.a.	4.26	95.74	100
10-49	31.2	68.8	100	11.33	88.67	100
50-249	46.24	53.76	100	14.29	85.71	100
250+	56.27	43.73	100			100
Total	34.58	65.42	100	7.90	92.10	100

Source:TUIK and KOSGEB

The percentage of innovating firms are considerably low in KOSGEB database that we use in this

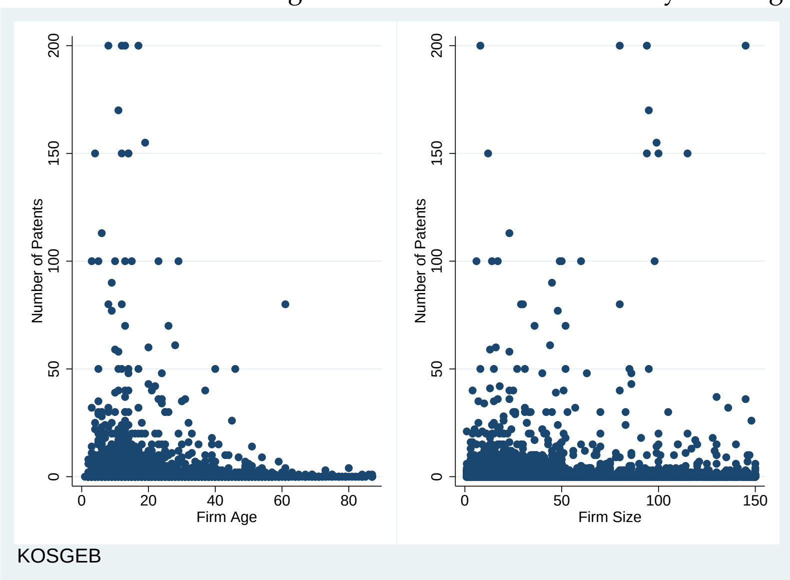
[6]Utility models are a form of patent-like protection for minor or incremental innovations, which tend to protect the functional aspect of a product. The main difference between utility models and patents lie on the cost of application and the length of protection. Utility models are very common in the mechanical, optical and electronic fields and played a role in the industrial development of countries like Germany and Japan, as well as South Korea and India (Suthersanen, 2006).

paper, and the industrial distribution of innovative activities do not correspond to the one revealed by TUIK. This is due to the different methodologies, definitions and particularly to the differences in sample sizes. TUIK follows the methodology of Community Innovation Surveys, and hence innovator firms are those who introduced either (i) a product improvement; (ii) a new product for the market; (iii) a process improvement; (iv) use of new processes for production during the period 2000-2002. In KOSGEB survey, the innovators are the firms that have been granted a patent. TUIK survey has been sent to 8375 firms, with a response rate of 15%, whilst KOSGEB survey covers 50 347 SMEs.

Earlier studies analyzing the determinants of innovation in Turkish manufacturing firms with TUIK data, highlight a non-linear relationship between the innovation capacity and market structure, as well as with the firm size, suggesting therefore an unexpected higher innovation propensity for SMEs compared to larger firms (Pamukçu and Cincera, 2004). However, SMEs do not seem to have any internal (in terms of technology and labor) flexibility advantages compared to larger firms (Sak and Taymaz, 2004). Therefore this situation may be explained by the lack of innovativeness of large firms performing in traditional manufacturing sectors.

Another result shown by these empirical analysis concern technological spillovers. Being a technology licensee, an exporter or having a foreign partner do not affect the probability to innovate (Pamukçu, 2003), and moreover, there is evidence about negative spillovers from multinational corporations in Turkish manufacturing industry, especially for the very small and very large firms (Taymaz and Lenger, 2004).

Figure 2: Distribution of Patents by Firm Age and Size



In our sample, we note a higher propensity to innovate by younger firms (Figure 2). However, firm size do note seem to affect the patenting activity. This last point is expected given that our sample does not include large firms that are the most innovative according to TUIK statistics[7].

3.2 Variables

We approximate the innovation capability by the number of granted patents. A patent should fulfil the requirements of originality, non-obviousness and economically profitable use; and this definition corresponds to that of a new ideas (Peri, 2005). As it can be seen from Table 1, patenting activities in Turkish SMEs are rather small. Therefore we chose to conduct two different analysis. In the first place, we look at the decision to innovate among our whole sample. Then, we assess the determinants of technology creation by exploring the behavior of innovator firms. Finally we evaluate the new policies' effect on Turkish SMEs. This two-level analysis allow us to explore the impact of policy tools both the innovation decision and the increase of innovative activities.

In the first specification, our dependent variable is a dichotomous qualitative variable, taking on the value of 1 when a firm has a patent and the value of 0 when it has not. Our estimation method is hence a binomial probit model, which allows us the explore how each explanatory variable affects the probability of patenting. Given the possibility of heteroskedasticity and clustering effects, we compute robust standard errors that are also adjusted for clustering at the regional level.

In the second estimation we only take into account innovating firms, and our dependent variable is the number of patents held by a firm. The non-negative and discrete nature of patent data advocates the use of count models. Poisson regression provides the standard framework to estimate count data[8]. However, the Poisson Model assumes equidispersion, i.e. equality between expected value and the variance, which makes it very restrictive. The non respect of equidispersion yields the same implications as heteroscedasticity in a model of Ordinary Least Squares (OLS) (Cameron and Trivedi, 1998). Furthermore, the Poisson Model assumes homogeneity, given that the conditional expectation has a determinist form depending on the explanatory variables. Given the nature of our data, the non-consideration of specific effects may lead to overdispersion. Therefore, the use of a negative binomial model which allows for the unobserved heterogeneity is more adequate.

Prior to the econometric estimation, we first removed the outliers that could bias the estimation results, and the observations with missing variables. 27% of the original sample has thus been eliminated, and our final sample has 36 757 firms. Sectoral dummies have been added to each regression to account for the impact of sectoral differences. Descriptive statistics are shown in Table 2.

As mentioned earlier, we consider two sets of independent variables to explain Turkish SMEs' propensity to innovate; factors internal and external to the firm.

In the first set of explanatory variables, we consider firm size, firm age, workforce' qualifications and whether the firm is investing in R&D[9]. The firm size in measured by the number of employees

[7] Although we could not have access to the raw data from TUIK's innovation survey, the descriptive statistics suggest that the innovation propensity increases with the firm size.

[8] For a survey on the specification and estimation of count models, see Greene (1994) and Winkelmann and Zimmermann (1995).

[9] The database do not report the R&D expenses, so we use a dummy variable which equals to 1 if the firm is investing in

Table 2: Descriptive Statistics for Sample Regression

Variable	Mean	Std. Dev.	Min	Max
Patent Counts	.3243164	3.593736	0	200
Patent	.0890854	.2848716	0	1
Firm age	13.43463	9.660413	1	87
Firm size	22.98856	26.87029	1	150
Age squared	273.8099	474.5384	1	7569
Size squared	1250.463	3162.651	1	22500
Educational level	.6493481	.4771819	0	1
Quality	.28943	.6141748	0	6
ICT	4.277205	6.10146	0	150
Utility Model	.5922879	20.99721	0	2000
R&D	.401372	.490184	0	1
Assets	2.341451	1.189706	1	4
Technology	.3346555	.4718776	0	1
Export	.4348604	.4957467	0	1
Outsourcing	.3702572	.4828813	0	1
Concentration	40.06668	8.838249	27.68933	87.59
Vertical linkages	.3705498	.4829599	0	1
Marshallian Ext.	1.20274	.596302	0	9.725545
Techno intensity	38.19207	11.03483	12.08	80.61
Jacobian Ext.	.3421688	.1413598	.046	.504
Ind. Zone size	4.318433	3.139287	0	9.21
Credit per capita	.1475645	.1701152	.001223	.776
Public inv. per capita	.2602873	.1374433	.001708	1.727
Subvention per capita	2.35177	2.412763	.007	23.539
Pub. spending per capita	.1572911	.1969068	.001088	.686
Kosgeb Subvention	.1853887	.3886189	0	1
Private Loan	.3809864	.4856371	0	1
Clustering	.4228306	.494017	0	1
CGF	.0033813	.0580519	0	1

and by the level of net assets, an ordinal variable with 4 intervals. We also introduce the squared terms of firm size and age in order to account for any potential non-linearity. Following recent studies which highlight entrepreneurship as the mechanism that converts knowledge into growth (Acs et al., 2004), we also include entrepreneurial variables in our regression, such as the educational level of the owner/manager and dummies indicating start-ups and self-employment. Other potential sources of technological learning inside the firm are formal or informal training, number of computers, number of quality labels and the use of technology[10]. Finally, the number of utility models, a potential innovation tool for developing economies, held by the firm is also taken into account.

As for the factors external to the firm, we consider traditional variables such as market structure, sector's technological intensity or firm's participation in international markets, as well as potential learning sources by taking into account vertical linkages, acquisition of technology or agglomeration economies. The market structure, highlighted as the principal determinant of innovative activities in industrial economics (Arrow, 1962), is approximated by the share of four largest firms in a given sector. The relationship between market structure and innovation has so far yield to ambiguous conclusion (Cohen et al., 1987). The vertical linkages have been taken into account by a dummy variable which takes the value of 1 if the firm is a subcontractor. As the South Asian experience has shown, we expect a positive relationship between vertical linkages and innovation (Linsu, 1997). The sectoral technological intensity is measured by the share of Business R&D expenditures.

Agglomeration externalities are proven to have a positive effect on firms' productivity, and to play an important role on the regional development (Glaeser et al., 1992; Feldman and Audretsch, 1999). However, the literature is rather ambiguous on the underlying rationale of these externalities, that is whether the more specialized or diversified structures foster the innovativeness. In order to take into account the impact and the type of agglomeration economies, we introduce both Marshallian and Jacobian externalities into our regression at regional (NUTS 2) level. Marshallian externalities are measured by the location quotient which shows the locational advantage of a region in a given industry[11]. Whereas Jacobian externalities correspond to the benefits gained from the industrial diversity in the region. This variable is constructed in two steps. First, a $Gini$ index at the regional level is computed. As, a Gini index close to 1 implies a highly concentrated region, we consider that $1 - Gini$ would correspond to the degree of diversification in regional production.

Finally, we evaluate the extent of institutional support received by SMEs by introducing into our regressions the public investments, loans, subventions per capita and the size of industrial zones at the city level. According to the social and economic development index, inequalities among Turkish cities and regions are very high (Dincer et al., 2003). We can observe the same patterns between the innovative activities and social development. We expect therefore the institutional variable to have

R&D and 0 otherwise.

[10]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.

[11]We use location quotient ratios calculated by TUSIAD/SPO (2005).

a considerable effect on SMEs' innovation capacities.

The main policies tools that have been analyzed concerns clustering efforts and financial facilities. Technological opportunities are reckon to be localized and geographically bounded (Fagerberg, 2003). Regional clustering is believed to foster interaction and learning (Cooke, 2001). Given the market and systemic failures, technology development zones and incubators provide assistance to small and innovative firms in the early phases. A recent study on the Turkish regional innovation system points the positive impact of technology development centers on knowledge creation (Lenger, 2007). However, the results of empirical studies on the benefits of these science parks and technology development zones in developed countries are rather mixed (Vedovello, 1997; Oakey and Mukhtar, 1999). They are considered to be important policy tools in countries with weak innovation systems (Colombo and Delmastro, 2002). We approximate these technological opportunities by introducing a localization variable which equals to 1 if the firm is localized in a particular cluster, i.e. in a technological park or in an industrial zones.

The second set of policies concern the financial support to the SMEs. Previous literature has shown that the smaller the enterprise, the more it is likely to have financial constraints (Jurgenson et al., 2003). Information asymmetries in financial markets lead to adverse selection and moral hazard problems (Stiglitz and Weiss, 1981). The risk of credit rationing is increased when banks ask for collateral, as a substitute for information. Therefore, even in mature financial markets, the access to the capital could be difficult for the SMEs, who often lack resources to provide the collateral. Furthermore, in Turkey, both small and large enterprises view high innovation costs and lack of appropriate finance as the main barrier for innovation activities (Napier et al., 2004). The cost of short-term financing is the highest in Turkey compared to the other European countries (EU, 2003). Following the crisis in 1994 and 2000-2001, credit availability to SMEs has been dramatically limited. The Credit Guarantee Fund (CGF) has been assigned by the Turkish government to solve the problems related to SME guarantees. This is the first policy tool that we will evaluate among the financial facilities. The second one concerns the capital and advisory services and low-interest loans to SMEs provided by KOSGEB. Finally, given that the Turkish credit markets are dominated by banking (accounting for over 85% of financial system assets), we also analyze the impact of bank credits. For each policy tool, we introduce a dummy variable which takes the value of 1 if the firm uses the particular financial facility.

4 Results

Three models have been estimated for each specification (Tables 3 and 4). The first model only includes the factors internal to the firm. We add external factors and institutional settings in the second model. The third model evaluates the impact of the science and technology policy, according to the four variables specified in the preceding section.

We found no evidence about the non linear relationship between firm size or age and the innovation capabilities, in either specification. Larger and older firms tend to innovate, and innovate more. Since Schumpeter (1942), larger firms have been acknowledged to have a critical advantage in innovation, given the costly and risky nature of R&D investments. The positif and significative coefficient of our second size variable (assets) confirm this argument. With the firm size, the ability to achieve scale economies, diversify, obtain funds and/or to offer higher wages also increases (Amsden, 2001; Cohen and Klepper, 1992). However, in both specification, although negligible, the squared terms have a negative and significant effect. Given that our analysis concerns the small and medium-sized industry, and that the largest firm on our sample has 150 employees, this results may suggest that the turning point of the inverted-U shape could not be included in our sample. Therefore, we cannot reject the existence of a non-linear relationship. But we can at least conclude that our results do not confirm previous studies about the highly innovative nature of young and small firms (Acs and Audretsch, 1990)[12].

Another non significant variable among the internal factors, in both specifications, is the educational level of the workforce. Intriguingly, this result is also robust to the different approximations of the education variable. We used the number and level of degrees obtained by the employees, the average enrollment year, the ratio of higher educated workforce, as well as internal training programmes in order to test the impact of firm's human capital, but failed to find an evidence.

Overall, according to the first model, the decision to innovate and the propensity to patent have rather different determinants. The innovation decision of Turkish SMEs seems to depend on R&D investment, the use of technology in production and the use of information and communication technologies. Quality labels and documents have also a positive impact. Whereas, once the firm becomes innovator, its propensity to innovate does not depend anymore on R&D investments, nor on the use of technology. This result may be explained by the higher percentage of R&D performers and technology users among the innovative sample. It appears that these factors are not determinant for the extent of innovative activities. The innovative performance depends on the age of firm and the number of utility models, suggesting a potential persistency in knowledge creation. However we are not able to explore further this issue, for we do not have the timing of the innovative activities.

Potential learning sources external to the firm and available institutional supports are introduced into the regression in the second column. Exporting arises as one of the main vector of learning in both specifications. This is consistent with the view that international trade carries knowledge flows, via technological spillovers (Coe and Helpman, 1995). Furthermore, competition in international markets is likely to yield to higher growth rates in exporting firms, mainly through technological change, in order to gain new market shares, or even not to loose the existing ones (Clerides et al., 1998; Bernard and Jensen, 1999; Hahn, 2004).

Besides exports, results show evidence on two other spillover effects. We find evidence on both Marshallian specialization and Jacobian diversification externalities on innovative activities. On the

[12] A number of variables (not reported) on entrepreneurship and start-ups, such as the educational level of the owner/manager, self-employment or dummies approximating younger firms, has also been found insignificant.

Table 3: Determinants of Innovation Decision : Probit Analysis

	Model 1	Model 2	Model 3
Firm age	0.015***	0.016***	0.016***
	(5.46)	(5.67)	(5.58)
Firm size	0.007***	0.005***	0.005***
	(5.63)	(4.15)	(4.11)
Age squared	-0.000***	-0.000***	-0.000***
	(-3.63)	(-3.72)	(-3.70)
Size squared	-0.000***	-0.000***	-0.000***
	(-5.83)	(-4.57)	(-4.52)
Educational level	-0.032	-0.049	-0.050
	(-1.18)	(-1.80)	(-1.83)
Quality	0.202***	0.197***	0.194***
	(12.15)	(11.73)	(11.44)
ICT	0.004*	0.001	0.001
	(2.27)	(0.59)	(0.68)
Utility Model	0.002***	0.002***	0.002***
	(4.13)	(3.95)	(3.90)
R&D	0.227***	0.221***	0.221***
	(10.36)	(9.92)	(9.91)
Assets	0.041***	0.041***	0.042***
	(4.02)	(3.88)	(4.03)
Technology	0.126***	0.143***	0.144***
	(5.54)	(6.17)	(6.24)
Export		0.180***	0.177***
		(7.44)	(7.27)
Outsourcing		0.028	0.028
		(1.25)	(1.21)
Concentration		-0.009	-0.009
		(-1.37)	(-1.38)
Vertical Linkages		0.289***	-0.284***
		(11.17)	(-10.91)
Marshallian Ext.		0.107***	0.107***
		(5.84)	(5.81)
Techno intensity		-0.007	-0.007
		(-1.51)	(-1.51)
Jacobian Ext.		0.558***	0.546***
		(5.52)	(5.32)
Ind. Zone size		0.006	0.005
		(1.40)	(1.22)
Credit per capita		-0.295**	-0.308**
		(-2.68)	(-2.79)
Public inv. per capita		0.143	0.151
		(1.60)	(1.69)
Subvention per capita		0.002	0.003
		(0.49)	(0.61)
Pub. spending per capita		-0.062	-0.057
		(-0.65)	(-0.60)
Kosgeb Subvention			0.072**
			(2.62)
Private Loan			-0.058*
			(-2.51)
Clustering			-0.039
			(-1.65)
CGF			-0.192
			(-1.04)
intercept	-1.783***	-1.506***	-1.471***
	(-38.57)	(-6.28)	(-6.11)
Observations	29581	29581	29581
Log-likelihood	-8361.41	-8196.82	-8189.05
Chi(2)	921.802	1253.240	1269.296
Prob>chibar2	0.000	0.000	0.000

Standard errors in brackets.

*Significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Determinants of Innovation Output: Negative Binomial Analysis

	Model 1	Model 2	Model 3
Firm age	0.022***	0.016*	0.015*
	(3.48)	(2.54)	(2.39)
Firm size	0.010****	0.008**	0.007**
	(3.87)	(2.91)	(2.69)
Age squared	-0.000**	-0.000*	-0.000
	(-2.82)	(-2.01)	(-1.86)
Size squared	-0.000	-0.000	-0.000
	(-1.66)	(-1.24)	(-1.05)
Educational level	0.061	0.011	0.010
	(1.01)	(0.18)	(0.17)
Quality	0.104**	-0.063	-0.062
	(2.99)	(-1.81)	(-1.79)
ICT	0.013***	0.010**	0.009**
	(3.51)	(3.10)	(2.61)
Utility Model	0.005****	0.005***	0.005***
	(6.50)	(6.14)	(6.29)
R&D	0.056	0.033	0.045
	(1.15)	(0.68)	(0.93)
Assets	0.063**	0.089***	0.087***
	(2.81)	(4.07)	(3.97)
Technology	0.077	0.067	0.067
	(1.56)	(1.35)	(1.36)
Export		0.276***	0.262***
		(5.15)	(4.86)
Outsourcing		0.198***	0.209***
		(4.16)	(4.37)
Concentration		-0.017	-0.017
		(-1.00)	(-1.02)
Vertical Linkages		0.103	0.111*
		(1.84)	(1.98)
Marshallian Ext.		0.312***	0.307***
		(7.79)	(7.63)
Techno intensity		-0.009	-0.008
		(-0.70)	(-0.65)
Jacobian Ext.		1.153***	1.061***
		(4.98)	(4.46)
Ind. Zone size		0.022*	0.022*
		(2.16)	(2.16)
Credit per capita		0.707**	0.609*
		(2.76)	(2.35)
Public inv. per capita		0.767***	0.786***
		(3.72)	(3.81)
Subvention per capita		0.035*	0.036*
		(2.31)	(2.39)
Pub. spending per capita		-0.353	-0.317
		(-1.59)	(-1.42)
Kosgeb Subvention			0.114*
			(2.04)
Private Loan			0.012
			(0.24)
Clustering			-0.163**
			(-3.16)
CGF			-0.224
			(-0.55)
intercept	0.244*	0.137	0.224
	(2.21)	(0.23)	(0.37)
Observations	2608	2608	2608
Log-likelihood	-6063.37	-5967.72	5960.72
Chi(2)	411.69	602.99	616.99
Prob>chibar2	0.000	0.000	0.000
LR test of α=0	0.000194	0.000184	0.000184

Standard errors in brackets.
*Significant at 10%; ** significant at 5%; *** significant at 1%

whole, agglomeration effects arising from diversified, rather than concentrated production structures increase the innovative abilities of Turkish SMEs.

Vertical integration has a positive impact on the innovation decision, but not on the innovation propensity. Sub-contracting has been reported to be an important channel of technology diffusion in South Corea (Linsu, 1997; Amsden, 2001). It also seems to be the case for the Turkish SMEs, where the disembodied knowledge transmitted by vertical linkages foster the technological learning. However, these relations do not encourage further innovations (Table 4).

Regarding the institutional framework, only the amount of credit per capita seem to affect the innovation decision of small and medium-sized industry, with a negative impact. Turkish banking sector is known to be reluctant to engage in SME lending due to high risk and lack of experience. We hence interpret this result as an evidence of limited credit availability for small firms. Bearing in mind that this variable is available at city level, the increase of overall loans clearly do not benefit to the SMEs, on the contrary, it restricts even more the available funds. On the other hand, the picture is completely different for the innovator sub-sample. Once the high- risky period of early-stage product development has been overcome, capital markets play a crucial role for financing in business development. Not only credits, but also public investment per capita appears to be determinant in the increase of innovative activities. Similarly, the size of industrial zones has a significant and positive coefficient, suggesting the importance of interactions and networking for innovative firms.

Market structure, as approximated by the concentration ratio and sectoral technological intensity, although crucial in theory, and significant in earlier studies, is found non significant in our estimations. Before further conclusion, it should be noted that these two variables are the only ones that were available at ISIC Rev.2 4-digit level, which could have induced a bias in their approximation. Finally, external training or consulting has a positive impact on the second specification, emphasizing the importance of disembodied knowledge acquisition.

Finally, the last column in the two tables evaluates the impact of policy changes on innovative activities (Model 3). In the first specification, clustering efforts appear non significant. The only positive policy change is the assistance from KOSGEB, who provides not only low-interest loans, but also advisory services and technical and managerial assistance. The coefficient of private loan has a significant and negative sign, emphasizing once again the seriousness of financial access problem for Turkish SMEs. The previous model has shown the scarcity of bank loans, but it seems that even when a small firm can get a bank credit, its innovative capabilities would deter. The available loans are generally short-term and expensive, and thus prevent small firms from investing in knowledge creation, which is a highly risky, uncertain and costly process.

When we look at the innovative sub-sample, access to financial markets do not appear as a major obstacle. However, KOSGEB subvention has positive and significant effect, suggesting that innovative firms that benefit from KOSGEB' services have a higher propensity to innovate. The other policy tools concerning the financial facilities being non significant, we can deduce that it is more the advisory services and assistance that benefits to those firms. We also see that clustering efforts have a significant and negative coefficient; being located in an industrial zone or science park decreases the innovative activities. A number of factor could explain this unexpected results. Among the firms that are located in a particular cluster, the major part is situated in an industrial zone rather than a science park. But, our results suggest that agglomeration economies arise in a diversified industrial structure, whereas industrial zones are highly specialized, which may explain the negative impact on the innovative activities. On the other hand, firms located in the science parks may not be the ones that would potentially benefit from industry-university linkages or other technological facilities available in these areas, for their main motivation could be the tax incentives. Finally, as mentioned earlier, technology development zones and science parks are recently established in Turkey, so it may be still early to evaluate fully their impact.

5 Conclusion

This paper has analyzed the determinants of knowledge creation in Turkish Small and Medium-Sized Enterprises, with a particular emphasis on the impact of recent changes in science and technology policies. Two different econometric specification have been used in order to evaluate the decision to innovate and the propensity to innovate of Turkish SMEs.

The innovation decision is found to depend on R&D investments, use of technology, vertical linkages and exports. Although our results show evidence on agglomeration economies, being located in a particular cluster does not seem to foster innovative capabilities. Access to financial markets appears to be the main obstacle for Turkish SMEs.

As for the innovator sub-sample, disembodied knowledge flows, firm size and agglomeration economies are found to increase the propensity to innovate. The results also draw attention to the importance of institutional support.

Overall, the determinants of innovative capabilities depend considerably on the sample, suggesting the need for differentiated policy measures according to the firm's technological capabilities. Exports seem to be a major vector of knowledge for both samples. The detailed analysis of agglomeration effects points Jacobian rather than Marshallian externalities, suggesting the existence of inter-sectorial spillovers. Finally, our study show that Turkish SMEs haven't reached yet the status of knowledge-based, innovative, internationally competitive small firms, that are acknowledged to be the engine of growth in more developed countries.

Given the high impact of the technology use on innovation capabilities, there is clearly a need for a broader spread of information and communication technologies throughout Turkey, where there is important regional disparities. The most effective public support arising from this study is the consultancy and advisory services provided by KOSGEB. Turkish SMEs seem to lack an adequate supporting system which will help them to pursue innovation and internationalization strategies. Agglomeration economies appear to be a driving force behind the knowledge creation, and emphasize the importance of networking and interactive learning. Turkey has to strength its national and regional innovation systems, and particularly the collaboration between industry and institutions. Our findings suggest that the establishment of clusters of similar firms in a particular location may not be the most effective policy to promote innovative capabilities.

Access to capital is the most important problem faced by the Turkish small and medium-sized industry. Even though a public financial assistance is needed, the recently established credit guarantee fund does not appear to foster knowledge creation. Given the highly informal nature of Turkish economy, especially for SMEs, the conditions to benefit from CGF could not be easily satisfied by a number of small firms. On the other hand, the credit guarantee fund policy has also been criticized for impairing the development of private financial sectors and venture capital.

This paper is the first, to our knowledge, to evaluate empirically the innovative capabilities of Turkish Small and Medium-Sized industry. Exploring an unique-firm level survey, realized among 50.000 SMEs, we attempted to analyze the efficiency of recently established policy tools in Turkey. Despite the considerable efforts to enhance the small and medium-sized industry, we found that so far, the new policies did not manage to address the issues that are preventing Turkish SMEs to achieve a higher innovative capabilities and growth.

References

Acs, Z. J. and D. B. Audretsch (1990). *Innovation and Small Firms*. Cambridge: Cambridge University Press.

Acs, Z. J., D. B. Audretsch, P. Braunerhjelm, and B. Carlsson (2004). The missing link: The knowledge filter and entrepreneurship in endogenous growth. CEPR Discussion Papers 4783, C.E.P.R. Discussion Papers.

Amsden, H. (2001). *The Rise of The Rest: Challenges to the West from Late-Industrialized Economies*. Oxford University Press.

Arrow, K. (1962). *The Rate and Direction of Inventive Activity*, Chapter Economic Welfare and the Allocation of Resources for Inventions. Princeton Univ.

Audretsch, D. B. (1995). *Innovation and Industry Evolution*. Cambridge: MIT Press.

Bernard, A. B. and J. B. Jensen (1999). Exceptional Exporter Performance : Cause, effect, or Both? *Journal of International Economics 47*, 1–25.

Cameron, A. and P. Trivedi (1998). *Regression Analysis of Count Data*. Cambridge UK : Cambridge University Press.

Caniëls, M. and H. Romijn (2001). Small-industry clusters, accumulation of technological capabilities, and development: A conceptual framework. Working Paper 01.05, ECIS.

CEPII (2004). La turquie au tournant. La lettre du cepii, Centre d'Etudes Prospectives et d'Informations Internationales.

Clerides, S. K., A. Lach, and J. Tybout (1998). Is Learning by Exporting Important? Micro-dynamic Evidence from Colombia, Mexico, and Morocco. *The Quarterly Journal of Economics 113*, 903–947.

Coe, D. T. and E. Helpman (1995). International R&D spillovers. *European Economic Review 39*(5), 859–887.

Cohen, W. M. and S. Klepper (1992). The tradeoff between firm size and diversity in the pursuit of technological progress. *Small Business Economics 4*(1), 1–14.

Cohen, W. M., R. C. Levin, and D. C. Mowery (1987). Firm size and R&D intensity: A re-examination. *Journal of Industrial Economics 35*(4), 543–65.

Cohen, W. R. and R. Levin (1989). *Empirical Studies of Innovation and Market Structure*. in R. Schmalensee & R. Willig : Handbook of Industrial Organisation, North Holland.

Colombo, M. G. and M. Delmastro (2002). How effective are technology incubators?: Evidence from italy. *Research Policy 31*(7), 1103–1122.

Cooke, P. (2001). Regional innovation systems, clusters, and the knowledge economy. *Industrial and Corporate Change 10*(4), 945–74.

Dincer, B., M. Ozaslan, and T. Kavasoglu (2003). Illerin ve bölgelerin sosyo-ekonomik gelismislik siralamasi arastirmasi. Technical Report 2671, Devlet Planlama Teskilati.

Dosi, G. (1988). *Technical Change and Economic Theory*, Chapter The Nature of the Innovative Process, pp. 1988. Printer Publishers.

Dosi, G., N. R.R., and S. Winter (2000). *The Nature and Dynamics of Organizational Capabilities*. Oxford: Oxford University Press.

EU (2002). Business demography in europe. Enterprise Publications 5, European Commission, Observatory of European SMEs.

EU (2003). 2003 european innovation scoreboard:indicators and definitions. Technical Paper 01, European Commision.

EU (2005a). European trend chart report. Technical report, European Commission.

EU (2005b). Innovation scoreboard. Technical report, European Commission.

Fagerberg, J. (2003). Schumpeter and the revival of evolutionary economics: an appraisal of the literature. *Journal of Evolutionary Economics 13*(2), 125–159.

Feldman, M. and D. B. Audretsch (1999). Science-based diversity, specialization, localized competition and innovation. *European Economic Review 43*, 409–429.

Glaeser, E., H. Kallal, J. Scheinkman, and A. Shleifer (1992). Growth in the cities. *Journal of Political Economy 100*, 1126–1152.

Greene, W. H. (1994). Accounting for excess zeros and sample selection in poisson and binomial regression models. *Working paper No. EC-94-10. New York University*.

Griliches, Z. (1979). Issues in assessing the contribution of research and development to productivity growth. *Bell Journal of Economics 10*(1), 92–116.

Hahn, C. (2004). Exporting and performance of plants: Evidence from korean manufacturing. Working Paper 10208, NBER Working Paper No. 10208.

Hallberg, K. (2000). A market-oriented strategy for small and medium scale enterprises. Discussion Paper 40, International Finance Corporation (IFC), The World Bank, Washington, D.C.

Isik, S. I. (2005). Strengthening turkish small and medium size enterprises and promoting entrepreneurship in the light of european union policies. Master's thesis, Middle East Technical University.

Jurgenson, A., A. Oks, R. Silliov, and K. Varno (2003). Development problems and state support masures of smes in estonia.

Karabulut, Z. (2006). Teknoparklar ve kentsel kalkinma.

Kim, L. and R. Nelson (2000). *Technology, Learning and Innovation: Experiences of Newly Industrializing Economies*. Cambridge University Press.

KOSGEB-OECD (2005). Turkiye'de kucuk ve orta olcekli isletmeler: Mevcut durum ve politikalari. Arastirma raporu, Kucuk ve Orta Olcekli Sanayi Gelistirme ve Desteklama Idaresi Baskanligi.

Lall, S. (1992). Technological capabilities and industrialization. *World Development 20*(2), 165–186.

Lenger, A. (2007). Bölgesel yenilik sistemleri ve devletin rolü: Türkiye'deki kurumsal yapi ve devlet universiteleri. Working Papers 0704, Ege University, Department of Economics.

Linsu, K. (1997). *Imitation to Innovation: The dynamics of Korea's technological learning*. Boston, MA: Harvard Business School.

Lundin, N., F. Sjöholm, H. Ping, and J. Qian (2007). The role of small firms in china's technology development. Working Paper Series 695, Research Institute of Industrial Economics.

Lundvall, B.-A. (1988). *Technical Change and Economic Theory*, Chapter Innovation as an Interactive Process: from User-Producer Interaction to the National System of Innovation, pp. 1988. Printer Publishers.

Napier, G., S. S. Serger, and E. W. Hansson (2004). Strengthening innovation and technology policies for SME development in turkey. Policy report, International Organisation for Knowledge Economy and Enterprise Development.

Oakey, R. and S.-M. Mukhtar (1999). Uk high-technology small firms in theory and practice:a review of recent trends. *International Small Business Journal 17*(2), 48–64.

OECD-UNIDO (2004). Effective policies for small business. Policy guidelines and recommendations, OECD Istanbul Centre for Private Development and UNIDO.

Ozar, S. (2003). Micro and small enterprises in turkey: Uneasy development. Research Report 0420, ERF.

Ozcelik, E. and E. Taymaz (2004). Does innovativeness matter for international competitiveness in developing countries?: The case of turkish manufacturing industries. *Research Policy 33*(3), 409–424.

Pamukçu, T. (2003). Trade liberalization and innovation decisions of firms: Lessons from post-1980 turkey. *World Development 31*(8), 1443–1458.

Pamukçu, T. and M. Cincera (2004). Analyse des détérminants de l'innovation technologique dans un nouveau pays industrialisé:une étude économétrique sur données d'entreprises dans le secteur manufacturier turc. *Cahiers Economiques de Bruxelles*.

Peri, G. (2005). Determinants of knowledge flows and their effect on innovation. *The Review of Economics and Statistics 87*(2).

Rodrik, D. (1995, November). Trade strategy, investment, and exports: Another look at east asia. NBER Working Papers 5339, National Bureau of Economic Research, Inc.

Romijn, H. and M. Albaladejo (2002). Determinants of innovation capability in small electronics and software firms in southeast england. *Research Policy 31*, 1053–1067.

Rosenberg, N. (1982). *Inside the Black Box: Technology and Economics*. Cambridge: Cambridge University Press.

Sak, G. and E. Taymaz (2004). How flexible are small firms? an analysis on the determinants of flexibility.

Salomon, J.-J., F. R. Sagasti, and C. Sachs-Jeantet (Eds.) (1994). *The uncertain quest: Science, Technology and Development*. Number UNUP-835. United Nationas University Press.

Schumpeter, J. (1942). *Capitalism, Socialism and Democracy*. Harper, New-York.

Serger, S. S. and E. W. Hansson (2004). Competing in the single market: SMEs and innovation in the baltic countries and poland. Policy report, International Organisation for Knowledge Economy and Enterprise Development.

Stiglitz, J. and A. Weiss (1981). Credit rationing in markets with imperfect information. *American Economic Review 71*(3), 393–410.

Suthersanen, U. (2006). Utility models and innovation in developing countries. Unctad-ictsd project on iprs and sustainable development, ICTSD.

Taymaz, E. (2001). Small and medium size entreprises in turkish manufacturing industries. *Journal of Economic Cooperation 22*(43-72).

Taymaz, E. and A. Lenger (2004). Multinational corporations as a vehicle for productivity spillovers in turkey. Technical report.

TUIK (2002). Census of industry and business establishments. Technical report, State Institute of Statistics.

TUIK (2006). Established and liquidated companies and firms. Technical report, State Institute of Statistics.

TUSIAD-DPT (2005). Turkiye'de bolgesel gelisme politikalari: Sektor-bolge yiginlasmalari. Buyume Stratejileri Dizisi 04, Turk Sanayicileri ve Isadamlari Dernegi ve Devlet Planlama Teskilati.

Vedovello, C. (1997). Science parks and university-industry interaction: Geographical proximity between the agents as a driving force. *Technovation 17*(9), 491–502.

Wilkelmann, R. and K. Zimmermann (1995). Recent developments in count data modelling : Theory and application. *Journal of Economic Surveys 9*, 1–24.

WorldBank (2004). Turkey knowledge economy assessment study. Technical report, Private and Financial Sector Development Unit.

6 Appendix: Description of Variables and Sources

Patent Counts	Number of granted patents	KOSGEB
Patent	Patenting Activity (yes/no)	KOSGEB
Firm age	Number of years passed since the firm's creation	KOSGEB
Firm size	Number of employees	KOSGEB
Educational level	Average enrollment year	KOSGEB
Quality	Ownership of quality certificates and/or labels	KOSGEB
ICT	Number of computers in the firm	KOSGEB
Utility Model	Number of granted utility models	KOSGEB
R&D	Investment in Research and Development (yes/no)	KOSGEB
Assets	Level of net assets (4 categories) 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
Technology	Use of plc, cnc and/or robots	KOSGEB
Export	Exporting Activity (yes/no)	KOSGEB
Outsourcing	Use of external laboratories and/or acquisition of external technology (yes/no)	KOSGEB
Concentration	Market share of the four largest firms in the industry (%) ISIC Rev.2 4-digit level	TUIK
Vertical Linkages	Subcontracting (yes/no)	TUIK
Marshallian Ext.	Location quotient at NUTS 2 level $LQ = \frac{\frac{e_i}{e}}{\frac{E_i}{E}}$ where: e_i = Local employment in industry i e = Total local employment E_i = Reference area employment in industry i E = Total reference area employment	TUSIAD-SPO
Techno intensity	Share of Business R$D expenditure in the industry industry (%) ISIC Rev.2 4-digit level	TUIK
Jacobian Ext.	Degree of diversification in regional production $1 - Gini$ at the NUTS 2 level $Gini_j = \frac{1}{2n^2\overline{s_j}} \sum \lvert s_{ij} - s_{kj} \rvert$ where $s_{i(k)j}$ = share of industry i(k)'s employment in region j n= number of industries $\overline{s_j}$ = mean of the shares	TUIK
Ind. Zone size	Number of plots in organized industrial estates	SPO
Credit per capita	Share in total bank credits	SPO
Public inv. per capita	Total public expenditures per capita	SPO
Subvention per capita	Per capita amount of investments with incentive certificates	SPO
Pub. spending per capita	Total public expenditures per capita	SPO
Kosgeb Subvention	Use of KOSGEB subventions (yes/no)	KOSGEB
Private Loan	Use of private bank credits and/or loans(yes/no)	KOSGEB
Clustering	Being located in an industrial park/zone and or technological park	KOSGEB
CGF	Use of credit guaranteed funds (yes/no)	KOSGEB

All variables are converted in constant dollar.

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