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Money Talks: Impact of SME Policies on Innovation Capabilities

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Abstract

The purpose of this paper is to explore the determinants of innovative capabilities in an emerging country context. We focus more particularly on the impact of recent changes in SME policies in Turkey. Using a unique firm-level survey conducted on 50.000 SMEs, innovative capabilities of firms are assessed at three different levels; their innovation efforts, innovation decision and innovative intensity. We analyze and compare the impact of two different incentive schemes; one a purely financial support, and the second, consultancy and technological assistance coupled with financial facilities. Our results point to access to external capital as a main issue for Turkish SMEs. Whereas all firms seem to benefit from financial support, only less innovative firms take fully advantage of the advisory services. 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.

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Keywords : Small and Medium-Sized Entreprises, technological capability building, innovation, SME policies, access to finance

JEL Codes : O31, O33, O38, L1

1 Introduction

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. Micro-enterprises and SMEs are the emerging private sector in most countries, and thus constitute 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 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 re-enforcing institutional environment, strengthening financial institutions or reducing the risks and transactions costs (Hallberg, 2000).

Although a policy measure should aim to create an innovative and strong private sector regardless to the firm size, some areas are still very much size-related. One of these areas, and probably the most important one, is the access to external sources of finance. Small firms consistently report higher financing obstacles than medium and large enterprises (Beck et al., 2006). World Bank reports that the cost of finance is rated as a major growth constraint by over 35% of SMEs, and access to finance, by over 30% (Ayyagari et al., 2003). The impact of these obstacles is stronger in small firms than in large firms: financing obstacles have almost twice the effect on small firms' growth compared to the large ones (Beck et al., 2006). We expect these problems to be even more important in emerging countries, often characterized by under-developed financial markets where the information and enforcement problems are more likely to occur.

In this context, innovative small firms are more likely to be credit constrained, given the highly risky nature of R&D projects. The cost for searching, acquiring and/or creating new technologies is higher for small firms. Hence, carefully designed policy tools are often needed in order to correct for SMEs' under-investment in technology and increase their access to finance.

The purpose of this paper is to evaluate the effectiveness of such policies, by analyzing their impact on Turkish SMEs. 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, by distinguishing between internal and external factors of technological capabilities, and highlighting the impact of policy measures. Given the complexity of measuring the innovative capabilities, we conduct an empirical analysis in three levels, by looking into innovative efforts, innovation decision, and innovation intensity of SMEs.

The focus here is on a particular policy area which is support and financial facilities. We seek to evaluate two different subvention scheme designed to develop SMEs' capabilities. The first one is the incentive certificates, whose aim is to support the Small and Medium Sized industry by offering ex-

emptions from taxes, duties and fees, facilitating and increasing their credit usage and investments. The second one is Small and Medium-Sized Industry Development Organization (KOSGEB)'s support schemes, which consist of a wide range of financial, technical and/or managerial assistance and consultancy services. Our main objective is to evaluate to what extent these two policy tools affect small and medium sized firms' innovative capabilities.

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

2 SMEs, capabilities and SME policies in Turkey

2.1 SMEs and their innovative capabilities

Turkish economy has longtime been characterized by high inflation, high real interest rates and public sector imbalances, leading to repetitive crises (TUSIAD, 2007). 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).

Medium and small sized enterprises contribute significantly to the Turkish Economy in terms of employment and value added. 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 around 4 employees 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).

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

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 EU 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, 2005). 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).

2.2 A brief overview of Turkish SME policies

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. 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

[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.

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. These 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.

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; one resulting from the new legislations; the support scheme offered by KOSGEB, and the more traditional, State-supported incentive certificates.

Investment and working capital credits are provided for investors to whom incentive certificates are given within the framework of the Resolution on State Aid for SME Investments, which is implemented by the Undersecretariat of Treasury's General Directorate of Incentive and Implementation. Furthermore, within the scope of incentive certificates, SMEs are also entitled to make use of exemptions from customs duty and Mass Housing Fund; investment allowance; VAT exclusion; and taxes, duties and fees exemption (KOSGEB, 2005).

On the other hand, KOSGEB offers a wide range of measures 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. Furthermore, SMEs using this scheme are rather well represented in the database as it is collected by KOSGEB.

3 Database, Variables and Empirical Methodology

3.1 Database

We use an unique firm-level survey data collected by Small and Medium-Sized Industry Development Organization (KOSGEB) in 2005[3]. The original database covers 50 347 SMEs in manufacturing sector, 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.

The survey gives information about the educational level of the employees, machinery and equipment, technological infrastructure, number of quality certificates and labels, and the export-

[3]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.

ing 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.

Moreover, the survey gives us information on whether a firm has a patent or an utility model[4]. We also know whether firms are performing any research and development investments, they have a research laboratory or rely on any technological outsourcing.

Table 1 presents the distribution of innovating firms by size, both by the National Institute of Statistics (TUIK) and KOSGEB. According to the 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 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. 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

[4]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).

(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).

In our sample, we note a slightly higher propensity to innovate by younger firms. 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[5].

3.2 Variables

3.2.1 Dependent variables

Measuring innovative capabilities is a difficult task, especially in an emerging country context. Our data do not provide a direct measure of innovative activities[6]. Furthermore, given the inherent complexity of innovation process, and its less knowledge-intensive nature in an emerging country SMEs, we aim to approximate the innovative capabilities at three different levels; namely the innovation efforts, the innovation decision and the innovation intensity.

Our first approximation of innovative capability is based on the question that asks whether the firm has attempted to develop new products. We use the answers to this question as an indicator of SMEs' innovation efforts: a dummy variable that equals to 1 if the firm has attempted (not necessarily succeeded) to develop a new product, and 0 otherwise.

However, this definition might be too broad, and we risk to over-estimate the Turkish SMEs' innovative capabilities if we only look at innovation efforts. Hence we decide to use also the information on patents available in the dataset, i.e. whether the firm has been granted a patent, and the number of patents that a firm holds. 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). Therefore, our second dependent variable, decision to innovate decision, will equal to 1 if the firm has a patent, and 0 otherwise.

However, by only looking at the innovation decision, we risk to underestimate the capabilities of the knowledge-intensive, persistently innovative SMEs. Therefore, in the third specification, we limit our sample to innovative firms (i.e. firms that hold a patent and/or a utility model), and assess the determinants of technology creation by exploring their behavior. Our final dependent variable is thus the number of patents.

[5] 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.

[6] We do not have a specific question on innovation activities (introduction of new or significantly improved product/process) as defined by the Frascati Manual and used commonly in innovation surveys.

3.2.2 Independent variables

As briefly 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[7]. The firm size in measured by the number of employees and by the level of net assets, an ordinal variable with 4 intervals. Squared terms of firm size and age are also introduced in order to account for potential non-linearities.

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-intensive production process[8]. 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[9]. 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 control for SMEs' institutional environment. The capability building is wrapped in economic, political and social complexities; similar patterns may be observed between innovative

[7]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 R&D and 0 otherwise.

[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.

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

Table 2: Rotated Factor Matrix

Variable	Factor1	Factor2	Factor3	Uniqueness
Urbanization rate	0.4433	0.1433	0.1845	0.6115
Proportion of employers	0.4891	0.3163	0.3316	0.2177
Proportion of higher education graduates	**0.9110**	0.0521	-0.1005	0.1757
Schooling rates in technical schools	0.1967	**0.5607**	-0.0697	0.5627
Number of medical doctors*	**0.9419**	0.0037	0.0212	0.0948
Number of hospital beds*	0.6471	-0.1134	0.1890	0.5353
Number of plots in OIZ	-0.1241	0.2940	**0.5385**	0.5970
Total capacity of power equipment	0.2020	**0.5179**	-0.0673	0.6102
Electricity consumption**	0.1489	-0.1538	**0.7005**	0.4788
Industrial value added**	0.1148	**0.5107**	0.3000	0.4606
Amount of indus., comm. and tourism credits*	-0.0419	**0.5995**	0.0110	0.6607
Total public expenditures*	0.3063	0.1073	-0.3793	0.8224
Amount of investments with incentive cert.**	-0.0919	**0.5566**	-0.0309	0.7412
Consolidated budget revenues**	0.0221	**0.6828**	-0.0209	0.5264
Proportion of asphalt road	0.0190	0.2106	**0.5123**	0.6175

Principal Factors Analysis, Oblique oblimin rotation.N==81, χ^2==632.83, p=0.000
Notes:*per 10.000 person, **per capita

activities and social, economic and political development. Especially in an emerging country context, the institutions -or the lack of them- have a direct effect on firms' capabilities. According to the social and economic development index, inequalities among Turkish cities and regions are very high (Dincer et al., 2003). We expect therefore the institutional variables to have a considerable effect on SMEs' innovation capabilities. In order to determine an adequate measure of the institutional environment, we conducted a factor analysis on different social and economic indicators at the NUTS3 (district) level. The actual factors are of considerable interest as they provide some indication of the different dimensions of social and economic development (See Table 2). Factor 1 seems to reflect the quality of the human capital endowment at the district level. Indicators loading on Factor 2 indicate the extent of public investments available at the district level. Finally, Factor 3 points towards the capacity and the quality of infrastructure. These three factors will be used to reflect the characteristics of the institutional environment at the district level.

Finally, the policy tools that we analyze relate mainly to 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), as it is the case in many of the developing/emerging countries (Beck et al., 2006). Furthermore, the cost of short-term financing has been found the highest in Turkey compared to the other European countries (EU, 2003). Following years of unstable and unfavorable macroeconomic environment characterized by high inflation, and a succession of deep recession and sharp up-turns,

the crisis in 1994 and 2000-2001, credit availability to Turkish SMEs has been dramatically limited. Various programmes have been created in order to support SMEs for many years, but in this paper we'll focus on only two of them. For each policy tool, we introduce a dummy variable which takes the value of 1 if the firm uses the particular financial facility, and 0 otherwise. Along with the impact of financial support on the innovative capabilities, we also investigate whether these supports SMEs' access to external finance. For this purpose, an interaction variable between the use of external (bank) finance and each financial facility has also been introduced.

3.3 Estimation Method

In the first two specifications (i.e. determinants of innovative efforts and innovation decision), the dependent variable is a dichotomous qualitative variable, taking on the value of 1 when a firm attempted to develop a new product/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 increasing innovative capabilities. 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 third specification, we only take into account innovating firms, and the 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[10]. 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 (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.

4 Results

Prior to the econometric estimation, first the outliers that could bias the estimation results have been removed and the observations with missing variables. 27% of the original sample has thus been eliminated, and our final sample has 33.325 firms. Sectoral dummies (not reported) have been added to each regression to account for the impact of sectoral differences. Descriptive statistics are shown in Table 6. Three models, following different factors that contribute to innovative capabilities, have been estimated for each specification. The first model distinguish between the internal and external

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

factors (Table 3). In the second model, we introduce the financial facilities (Table **??**). The interaction terms are introduced in the third model (Table 4).

First of all, we are looking at the internal determinants of Turkish SMEs' innovative capabilities. Firms size is found to increase the innovative capabilities in every level. However, we found no evidence about the non linear relationship between firm size and innovation capabilities, then again, our sample does not contain large firms. Results show that 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. 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). Although we cannot reject the existence of a non-linear relationship (the squared terms are significant), 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)[11].

Innovative efforts are found to increase with a higher educated workforce. However, this positive effect disappears when we evaluate the innovation decision, and becomes negative for the innovation intensity. A possible explanation for this puzzling finding may be the definition of education variable. The number of employees with a degree in science and technology or the number of engineers may be a better measure and have a positive impact on innovation intensity.

Overall, according to the first model, innovation efforts, innovation decision and the intensity of innovation have rather different determinants. As expected, the innovative efforts of Turkish SMEs seems to depend heavily on R&D investment, the use of technology intensive production processes, and the use of information and communication technologies. The decision for innovation, on the other hand, is found to be less dependent on R&D, but slightly more on technology intensive processes. Finally, when we look at the innovation intensity, none of these internal factors seems to matter. Furthermore, we find a negative impact of the number of utility models on innovation intensity; for every additional utility model that a firm holds, the number of expected patents decreases by 1%. The results suggest that the more SMEs increase their innovative capabilities, the less they rely on internal factors.

In fact, it is owning quality labels and certificates that have the most important impact on innovation decision and its intensity. 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, ability to meet client expectations and facilities to participate in international markets: quality labels and certificates also improve the innovation abilities of small firms.

[11] 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 Efforts

	Internal Factors			External Factors		
	Innovation effort	Innovation decision	Innovation intensity	Innovation effort	Innovation decision	Innovation intensity
Firm age	-0.010***	0.022***	0.009	-0.013***	0.022***	0.010
	(-3.56)	(5.56)	(1.44)	(-4.28)	(5.47)	(1.57)
Age squared	0.000	-0.000***	-0.000	0.000*	-0.000***	-0.000
	(1.63)	(-3.81)	(-1.16)	(2.38)	(-3.64)	(-1.30)
Firm size	0.005***	0.008***	0.006**	0.002	0.006***	0.006**
	(4.78)	(5.68)	(2.83)	(1.52)	(4.63)	(2.97)
Size squared	-0.000***	-0.000***	-0.000*	-0.000***	-0.000***	-0.000*
	(-6.08)	(-5.36)	(-2.02)	(-3.43)	(-4.52)	(-2.15)
Educational level	0.239***	-0.019	-0.089*	0.202***	-0.035	-0.073
	(13.16)	(-0.75)	(-2.17)	(10.93)	(-1.34)	(-1.76)
Quality labels	-0.011	0.225***	0.084***	-0.020	0.220***	0.082***
	(-0.77)	(13.76)	(3.59)	(-1.35)	(13.31)	(3.47)
Use of ICT	0.018***	0.003	-0.005	0.011***	-0.000	-0.004
	(8.33)	(1.39)	(-1.74)	(5.05)	(-0.07)	(-1.44)
Nr of utility models	0.040***	0.001*	-0.010***	0.036***	0.001*	-0.010***
	(5.06)	(2.29)	(-3.79)	(4.50)	(1.97)	(-3.84)
R&D	0.826***	0.237***	0.017	0.811***	0.227***	0.022
	(47.36)	(11.09)	(0.50)	(45.86)	(10.43)	(0.63)
Technology intensive	0.085***	0.082***	-0.019	0.089***	0.110***	-0.009
	(4.89)	(3.67)	(-0.56)	(5.04)	(4.82)	(-0.26)
Exporting				0.301***	0.153***	0.035
				(16.68)	(6.48)	(0.92)
Outsourcing				0.112***	0.058**	-0.024
				(6.45)	(2.61)	(-0.70)
Vertical linkages				-0.150***	-0.277***	-0.124**
				(-8.24)	(-10.93)	(-2.95)
Industry Concentration				0.012*	-0.004	0.000
				(2.30)	(-0.69)	(0.02)
Industry's R&D intensity				0.007	-0.007	-0.004
				(1.69)	(-1.59)	(-0.59)
Marshallian externalities				0.035*	0.068***	0.074*
				(2.57)	(3.66)	(2.52)
Jacobian externalities				0.309**	0.223	0.019
				(2.85)	(1.46)	(0.08)
Institutions: Human Capital				0.011	0.041***	0.017
				(1.69)	(4.81)	(1.24)
Institutions: Public Investment				-0.040***	0.001	-0.012
				(-4.23)	(0.10)	(-0.55)
Institutions: Infrastructure				0.048***	0.045***	0.023
				(5.22)	(3.59)	(1.11)
Use of bank loans				0.031	-0.054*	-0.120***
				(1.84)	(-2.38)	(-3.36)
Constant	-0.030	-1.815***	0.194**	-0.894***	-1.668***	0.200
	(-0.93)	(-39.90)	(2.58)	(-4.77)	(-8.09)	(0.60)
Number of observations	33325	33325	3316	33325	33325	3316
Log-Likelihood	4017.705	837.577	212.536	4578.314	1159.786	247.839
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000

Notes:*Significant at 10%; ** significant at 5%; *** significant at 1%.
Marginal Effects are reported for the first two specifications (innovation efforts and innovation decision).

Potential learning sources external to the firm and available institutional supports are introduced into the regression in the second specification. Exporting arises as one of the main vector of learning for innovative efforts and innovation decision. 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). Technology outsourcing is another factor which increases both innovation effort, and the innovation decision. Previous literature has shown that firms are using external technology sourcing as a complementary way with internal innovative efforts (Cassiman and Veugelers, 2002; Veugelers, 1997).

However, vertical integration is found to have a negative impact on innovative capabilities. Subcontracting has been reported to be an important channel of technology diffusion in other emerging countries, where the disembodied knowledge transmitted by vertical linkages foster the technological learning (Linsu, 1997; Amsden, 2001), this does not seem to be the case for the Turkish SMEs.

Besides exports, results show interesting results on the two other potential spillover variables. We find evidence Marshallian externalities on innovative capabilities. On the whole, agglomeration effects arising from specialized production structures increase the innovative abilities of Turkish SMEs. Furthermore, more innovative the firm, larger is the externality effect. However, we also found Jacobian externalities to increase the innovative efforts. In fact, firms that try to develop a new product seems to benefit more from a diversified industrial structure.

Market structure, as approximated by the concentration ratio, although significant in earlier studies, here is only found significant for innovative efforts. Industry's technological intensity, another market structure characteristics, is also not significant for innovative capabilities[12].

Regarding the institutional framework, the human capital index affects only the innovation decision of small and medium-sized firms whereas the industrial infrastructure seem to foster both innovative efforts and innovation decision. However, we found a negative impact of the public investment at the district level on SMEs' innovative efforts.

Finally, before evaluating financial support and facilities, we first look at the impact of external finance on the innovative capabilities. Results show a negative impact of bank loans on innovative efforts and innovation decision, and no impact on innovation intensity. 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.

Table 4 present specifications where we introduced the two policy tools. The first one is the incentive certificates, which consist mainly of financial facilities; and the second one is Kosgeb support, which also includes consultancy and technological support as well as financial facilities. The results show that the incentive certificates, a purely financial support, increases the innovative capabilities

[12]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.

Table 4: Impact of SME policies and their interaction with external finance

	Incentives and Supports			Interaction Model		
	Innovation effort	Innovation decision	Innovation intensity	Innovation effort	Innovation decision	Innovation intensity
Firm age	-0.013***	0.022***	0.010	-0.014***	0.022***	0.010
	(-4.56)	(5.33)	(1.48)	(-4.58)	(5.29)	(1.47)
Age squared	0.000**	-0.000***	-0.000	0.000**	-0.000***	-0.000
	(2.61)	(-3.54)	(-1.23)	(2.63)	(-3.50)	(-1.22)
Firm size	0.001	0.006***	0.006**	0.001	0.006***	0.006**
	(1.13)	(4.40)	(2.87)	(1.09)	(4.30)	(2.84)
Size squared	-0.000**	-0.000***	-0.000*	-0.000**	-0.000***	-0.000*
	(-3.09)	(-4.33)	(-2.05)	(-3.03)	(-4.24)	(-2.02)
Educational level	0.194***	-0.039	-0.075	0.193***	-0.042	-0.076
	(10.44)	(-1.48)	(-1.78)	(10.39)	(-1.58)	(-1.82)
Quality labels	-0.031*	0.215***	0.080***	-0.030*	0.216***	0.080***
	(-2.03)	(12.94)	(3.37)	(-2.01)	(12.97)	(3.38)
Use of ICT	0.010***	-0.000	-0.004	0.010***	-0.000	-0.004
	(4.69)	(-0.15)	(-1.50)	(4.69)	(-0.12)	(-1.49)
Nr of utility models	0.035***	0.001	-0.010***	0.035***	0.001	-0.010***
	(4.47)	(1.88)	(-3.85)	(4.47)	(1.82)	(-3.84)
R&D	0.808***	0.224***	0.017	0.807***	0.224***	0.018
	(45.63)	(10.29)	(0.51)	(45.62)	(10.27)	(0.51)
Technology intensive	0.084***	0.107***	-0.013	0.084***	0.107***	-0.013
	(4.77)	(4.68)	(-0.37)	(4.77)	(4.67)	(-0.37)
Exporting	0.290***	0.146***	0.027	0.290***	0.145***	0.027
	(16.02)	(6.18)	(0.72)	(16.01)	(6.14)	(0.70)
Outsourcing	0.108***	0.057*	-0.021	0.107***	0.055*	-0.021
	(6.23)	(2.56)	(-0.63)	(6.18)	(2.51)	(-0.62)
Industry concentration	0.011*	-0.004	-0.000	0.011*	-0.004	0.000
	(2.27)	(-0.71)	(-0.01)	(2.27)	(-0.70)	(0.00)
Vertical linkages	-0.149***	-0.278***	-0.127**	-0.149***	-0.278***	-0.127**
	(-8.19)	(-10.94)	(-3.03)	(-8.20)	(-10.95)	(-3.04)
Industry's R&D intensity	0.007	-0.007	-0.003	0.007	-0.007	-0.003
	(1.71)	(-1.57)	(-0.52)	(1.72)	(-1.56)	(-0.51)
Marshallian externalities	0.034*	0.068***	0.070*	0.034*	0.068***	0.070*
	(2.55)	(3.64)	(2.37)	(2.55)	(3.65)	(2.38)
Jacobian externalities	0.322**	0.230	0.036	0.320**	0.228	0.036
	(2.97)	(1.51)	(0.15)	(2.95)	(1.49)	(0.15)
Institutions: Human capital	0.011	0.041***	0.018	0.011	0.041***	0.018
	(1.68)	(4.82)	(1.29)	(1.69)	(4.79)	(1.29)
Institutions: Public investments	-0.038***	0.003	-0.010	-0.038***	0.004	-0.010
	(-3.97)	(0.25)	(-0.44)	(-3.95)	(0.28)	(-0.44)
Institutions: Infrastructure	0.049***	0.047***	0.025	0.050***	0.047***	0.025
	(5.39)	(3.73)	(1.18)	(5.42)	(3.77)	(1.19)
Use of bank loans	0.020	-0.061**	-0.128***	0.039*	-0.017	-0.113**
	(1.17)	(-2.69)	(-3.59)	(2.03)	(-0.63)	(-2.66)
Incentive certificates	0.069*	0.080*	0.164**	0.106*	0.156**	0.190**
	(2.27)	(2.26)	(3.25)	(2.17)	(2.90)	(2.63)
Kosgeb support	0.133***	0.042	-0.021	0.174***	0.105**	-0.008
	(5.76)	(1.53)	(-0.52)	(5.42)	(2.80)	(-0.16)
Incentive certificates X Bank loans				-0.057	-0.126	-0.048
				(-0.93)	(-1.78)	(-0.48)
Kosgeb support X Bank loans				-0.083	-0.130*	-0.029
				(-1.87)	(-2.47)	(-0.37)
Constant	-0.886***	-1.661***	0.197	-0.891***	-1.679***	0.185
	(-4.72)	(-8.04)	(0.60)	(-4.75)	(-8.12)	(0.56)
Observations	33325.000	33325.000	3316.000	33325.000	33325.000	3316.000
Log-likelihood	4621.975	1168.597	258.072	4627.125	1180.274	258.540
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000

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

of Turkish SMEs, especially for innovative firms. We found that State supported incentives increase the expected number of patents by around 15%. However, the support and facility program proposed by KOSGEB only increases the innovative efforts. We may conclude that KOSGEB support, who provides not only low-interest loans, but also advisory services and technical and managerial assistances, are mainly beneficial at the first stage of the innovation process.

A slightly different picture arises when we take into account the role of these supports and incentives in gaining access to external finance. There are some well-known issues associated with estimating interaction effects in non-linear models (Norton et al., 2004). Here we interpret the results by computing the marginal effect as the difference between the expected odds. We found that regarding the innovative efforts, the marginal effect of using bank loans is only significant and positive for the firms that don't receive any support and/or incentives. There is no complementarity effects between external finance and SME support programmes for the firms that stand in the low-end in terms of innovative capabilities. When we look at the innovation decision, however, the marginal effect of using bank loans is found to be higher for firms that benefits from SME support programmes, the impact being higher for financial facilities. Finally, for firms that already innovate, the computed marginal effects show a negative impact of bank loans for firms that do not receive any support, but positive for those who does.

5 Conclusion

This paper has analyzed the determinants of innovative capabilities in Turkish Small and Medium-Sized Enterprises, with a particular emphasis on the impact of SME policies. Three different specifications have been used in order to evaluate fully the innovative capabilities; the innovative efforts, the decision to innovate and the intensity of innovation in Turkish SMEs.

The innovative efforts increase with R&D investments, the use of ICT and technology intensive production processes, and the education level of the employees. The utility models also arise as an important determinant of innovative efforts. The innovation decision also depends on R&D investments and the use of technology intensive production processes. Results also point to exporting activities as a main channel of learning in the early stages of innovative capability building.

Whereas, once the firm becomes innovator, its propensity to innovate does not depend anymore on R&D investments, nor on the use of technology, or exporting. 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 firm size and mainly the number of quality labels and certificates.

We found evidence of Marshallian externalities, agglomeration effects arising from specialized production structures increase the innovative capabilities of Turkish SMEs. The institutional environment, particularly the industrial structure, seems particularly important for the early stages of capability building.

Results point to access to external finance as a main issue in increasing Turkish SMEs' innovative capabilities. 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. Rather than funding the innovation projects, bank loans decreases SMEs' probability to innovate.

The impact of SME support programmes varies considerably according to the level of innovative capabilities. The most effective public support to increase the innovative efforts is the financial and advisory services provided by KOSGEB. However, there is no complementarity effects between external finance and Kosgeb supports. For relatively more innovative firms, the financial support seems to have a higher positive impact. We also found that firms that benefit from subsidies access more easily and/or make a better use of external finance.

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. Given the high impact of the use of technology-intensive processes and industrial infrastructure on innovation capabilities, there is a clear need for a broader spread of technologies throughout Turkey, where there is important regional disparities. Agglomeration economies also appear to be a driving force behind the knowledge creation, and emphasize the importance of networking and interactive learning. 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.

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6 Appendix

Table 5: 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	TUIK
Kosgeb Subvention	Use of KOSGEB subventions (yes/no)	KOSGEB
Private Loan	Use of private bank credits and/or loans(yes/no)	KOSGEB

All variables are converted in constant dollar.

Table 6: 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
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
Kosgeb Subvention	.1853887	.3886189	0	1
Private Loan	.3809864	.4856371	0	1