Innovativeness of Manufacturing Small and Medium Size Enterprises in Turkish Regional Innovation System

by

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Abstract

The literature on innovation systems considers innovation as an evolving complex learning process and theorizes innovation systems from a comprehensive perspective embracing social, cultural, and technical dimensions. As the literature continues to expand theoretically and empirically with the additions of country and region specific studies, important questions, such as how innovation processes work and how the innovation systems are in developing countries in comparison to the developed countries, arise. These questions bear significance due to globalization and integration of regions. Searching answers to the questions further expands the literature as well as it contributes to innovation policy design at various scales.

The aim of this paper is to contribute to the literature by discussing and investigating the aforementioned questions for Turkey as an emerging market economy located at the eastern neighborhood of EU. The paper examines the innovativeness of the manufacturing firms within the context of regional innovation system (RIS). It is important to initially understand the innovation process of the firms from a system of innovation perspective, in order to understand the innovative performances of macro scales such as regions and nations. As the Turkish literature investigates the innovativeness and networking activities for a few numbers of regions and sectors, it calls for the need of a comprehensive nation wide regional innovation system research. This paper is part of a research project mapping the nation's regional innovation system (TRIS) for the very first time. More specifically, the particular part of the research work that it represents, the paper analyzes the roles of firms' internal and external competences, involuntary knowledge flows including the channels of collective learning, as well as the region and sector level competences, on the firms' innovativeness. The framework developed to conduct these analyses integrates previous research on RIS with the country specific sectoral, regional, cultural and institutional characteristics.

The empirical investigations are done by employing various regression models, such as logit, ordered logit and multinomial logit, for categorical and limited dependent variables. The study uses a unique firm-level manufacturing data of 1200 small and medium size enterprises (SMEs) with employees of 10-249, gathered in 2007. The data is collected by surveying the SMEs face-to-face in 12 NUTS 3 regions of Turkey. The firms in the sample operate in ten different medium- and low- technology sectors of the manufacturing industry. Our preliminary findings reveal that the innovation system is more regional rather than sectoral. For the SMEs, the probability of innovating is significantly affected by the levels of internal and external competences, relational capital, and the collaborations with public institutions and universities at the regional level.

KEYWORDS: SMEs, Regional Innovation System, Manufacturing Industry, Turkey

JEL Classification: O3 (Technological Change; Research and Development); O52 (Economy-wide Country Studies, Europe); L6 (Industry Studies: Manufacturing).

1. Introduction

As the ultimate engine of sustainable growth, innovations are responsible both for the transformation of the human society from a hunter and gatherer to agricultural, then to industrial, and then to information society, and, in turn, for the rise of the new socio-economic classes (Erbas, 2000). During the abovementioned socio-technical revolutions, the concept of innovation has evolved by embracing social and cultural as well as technical dimensions. Following the literature (Edquist, 1997) we can include new organizational forms of businesses in addition to generation, adaptation and utilization of technical processes in the definition of innovation.

Due to the utmost importance of innovations in our everyday lives, academics and policy designers have been produced invaluable works on innovation by creating, learning, accumulating and sharing knowledge. As a part of aforementioned process, in their efforts, the scholars theorized the innovation as a system taking into account all the determinants holistically in an interdisciplinary manner (Freeman, (1986), Lundvall, (1992), Nelson, (1993), Cooke, (1992)). Although, in the academic literature, there are a large number of approaches to conceptualizing innovation, in developing our work in this study, we rely on the systems of innovation approach. In the related literature, the innovation is perceived as an evolving complex learning process in a system of interacting organizations and institutional arrangements. Furthermore, in addition to the studies embracing the importance of innovation systems, there are number of seminal studies tying innovation to competition and economic growth (Marshal (1890), Arrow (1962), Romer (1986), Glaeser et al. (1992), Griliches (1992), Porter (1990), Audretsch and Feldman (1996)).

In the studies of innovation systems, the innovation process is generally accepted to be a locally embedded process, yet the level analyses differ, as studies range from national to sub-national levels and sometimes to sectoral levels. In this study we are primarily interested at sub-national scale, since our research is conducted as a part of a research project funded by Turkish Scientific and Technological Council (TÜBİTAK) to explore regional innovation system dynamics of Turkey. When we focus on recent studies analyzing local learning processes at sub-national scale, a number of interesting research findings emerge.

From the sub-national system of innovation perspective, Ronde and Hussler (2005) investigates the innovation as a learning process, by undertaking the questions of whether the process is external or internal, voluntary or unintended, and of what are boundaries of the process. They analyze the regional innovativeness of French manufacturing sectors. The empirical portion of the study is constructed by employing the sample of 5000 businesses with 20 or more employees in 14 manufacturing sectors in NUTS 3 regions. They employ logit and negative binomial regressions to estimate knowledge production function and to identify the determinants of the innovation system. The study finds that, on the performance of the regional innovation system, the effects of the external competences are more important than that of the internal ones, and the effects of unintentional spillovers is less important than that of the intentional spillovers. Finally, the authors conclude that the French innovation system is regional rather than sectoral.

While emphasizing the conceptual differences between industrial and regional economists, Capello and Faggian (2005) analyze the importance of the relational capital, as the basis for local collective learning, in the innovation activity of firms. The authors make a distinction between the approach of "knowledge spillover" developed by Jaffe (1989), Acs et

al (1994), Audretsch and Feldman (1999) and De Groot (2001), and that of "socialized process of local knowledge creation" developed by Camagni (1991), Lawson and Lorenz (1999) and Camagni and Capello (2002). The empirical part of the study consists of regressions in 5 stages explaining the degree of innovativeness of the business by the factors such as firm size, R&D expenditures, local labor market, cooperation with local suppliers and clients, technology sector group, diversified local labor and specialized local labor. The data for their work is collected through surveys from 217 firms from 15 sectors in Milan, Piacenza, ve Belluno regions of Italy. The authors investigate whether the different regional, sectoral, and firm characteristics has any effect on the role of relational capital. The study empirically shows the importance of relational capital for firms' innovativeness. The authors conclude for the different frameworks of regional, sectoral and firms, relational capital will have different roles.

From the regional and organizational science point of view, Oerlemans and Meeus (2005) study the level of the effects of firm-specific resources, networks, physical distances, similar organizational structures, and the sector specific factors on innovative and economic outcomes. The data analyzed in the study consists of 5500 firms with 5 or more employees from 11 manufacturing and services sectors in Netherlands. Factor analysis and the ordinary least squares stepwise regressions are employed. It is found that the relationship between buyers and suppliers in the region and between the regions contributes to the innovation performance of the firms. It is also shown that the sectoral research and development spillovers have a positive influence on the outcome. Finally, in regard to the role of the similarity and dissimilarity of the innovation strategy, the authors conclude that the innovating firms have to balance two types of different activities, innovating and commercializing their innovations, to be successful.

Doloreux (2004) conducted a comparative study investigating the innovation activities of small and medium size enterprises in the regional innovation system of Canada. The author specifically look at the innovation activities of SMEs in Ottowa and Beauce regions, the level of the SMEs' involvement with other organizations in systematic innovation activities, and the nature of the innovation related relationships within and outside the regions. The study is based on the data collected by the telephone surveys conducted for 308 firms with the number of employees between 20 and 249 in Ottawa ve Beauce regions. The similar innovation activities of the SMEs in both regions and non existence of region specific factors supporting the innovation are the main findings of the study. It is discovered that the firms exploit the regional, national and global information sources to support their innovation activities.

Van Stel and Nieuwenhuijsen (2004) contribute to this literature by looking at effects of various types of spillovers, intra- and inter-sectoral, within a model of regional growth. The model is mapped into a regression analysis with a value-added growth in a sector in a region as a dependent variables, and specialization, local competition, diversity and regional dummies, as independent variables. The data employed for the empirical analysis consist of 240 observations from 6 sectors and 40 regions. It is unearthed that local competition is particularly important for the manufacturing and construction industries. While diversity, as a proxy for inter-sectoral spillovers, is found to be important for the growth in the service industries, the influence of specialization, a proxy for intra-sectoral spillovers, on growth is not observed. As the authors conclude, they specifically call for the need for more comparable country specific studies, and emphasize the importance of basing policy measures

concerning regional firm clustering on the empirical findings of more countries, for the policy makers.

As can be seen from the previous discussions, the analysis of the RIS is increasingly reframed in the analysis of a broader context of local learning processes that tries to take into account organizational, regional and sectoral effects and spillover dynamics. The development of such an analysis that incorporates multi-level dynamics is broadly in line, we believe, with the holistic aspirations of the innovation theory highlighted at the beginning of our discussion. It is critical, at this juncture, to note that most of the studies we reviewed focus on developed economies, as Lundvall (2003) recently acknowledged innovation theory do not sufficiently take into account developing country examples. This study, we hope will provide some contributions to the literature on this area.

Subsequent to the short review of the international literature above, it is essential to provide a brief discussion on the relevant literature on Turkey as an emerging market economy. Although there are studies on innovative performances of firms in different cities, the literature is still underprovided since the existing studies cover only few manufacturing sectors, such as textile, machinery, and automobile, and few cities namely Gaziantep, Denizli, Konya, the so-called Anatolian tigers, and Eskişehir, Istanbul, Ankara, Bursa (Gürbüz, (2001), Özdaşlı, (2002), Armağan, (2003), Çakmaklısoy, (2001), Gökalp (1998), Çakır (2001), Varol (2002) and Buğra, (1998)). On the other hand, at larger scale, there are projects conducted by the State Panning Organization of Turkey (2007). These projects aim to identify the level of socio-economic development of cities at NUTS 3 level, sectoral concentrations in each region, and the leading sectors in each region. Among the projects, some of them also aim to determine the leading cities in various regions of the country such as Eastern, Southeastern, Black Sea and Central Anatolia.

Taymaz (2005) study the textile and engineering firm behaviors and observers that while textile firms in different regions exhibit similar myopic view and destructive competition, engineering sectors has long term perspective and cooperative behavior. The author concludes that parallel discrepancies in short- and long-run views also exist in different sectors. Varol (2002) finds that the firms from Denizli operate in the low value added parts of the global value chain, while the firms from Gaziantep function independently and employ collaborative patterns of competition strategies in their supplier-customer relationships.

Eraydin and Köroğlu (2005) study the innovative capacities and network relations of industrial clusters in Ankara, Denizli and Bursa. As the authors compare the clusters in these cities with each other, they find significant discrepancies between the cities, in terms of the level of socio-economic development, the level of innovativeness, the degree of integration into the global economy and networking activities. Moreover, they also report that the local networks are as important as the national ones and they contribute to the innovativeness of the firms in the clusters. Finally, the authors discover that the firms that are in relation with the global networks are more innovative than the firms that have intense relation with local networks.

Most of these studies concentrate on manufacturing firms, since businesses at smaller scale constitute 99% of the manufacturing entities. As noted in Buğra (1998), and Eraydın

and Köroğlu (2005), these businesses, which are located more heavily in less metropolitan areas of Turkey, are competing against the larger size enterprises by taking advantage of the opportunities offered by the post-1980s export-oriented liberalization process. Furthermore, the focuses of the majority of these studies, except the few, are on the regional development policies and their implementations where innovation is not the primary interest and it stays aside. Yet, these studies provide some useful information and shed light on the local learning processes that are crucial for the analysis of the innovation process by emphasizing the role of the external relationships such as ethnic networks and export intermediaries. The relationships in these networks appear to be an important source of knowledge for the firms in their attempt to enter export markets and in their internationalization processes. However, the analysis of recent developments in the innovation systems literature indicates that a number of other factors are needed to be taken into account, if the goal is to arrive to a better understanding of the innovation process.

In view of the international and the domestic literature, we can state that there are several motivating reasons to conduct this study. Firstly, embedded in the scholarly discussions and interesting findings of the international literature, there is need for further comparable country specific studies to contribute to ongoing debate in the literature. Secondly, specifically for the policy makers, there is also a need of empirical evidences of more countries to base regional firm clustering policies measures concerning regional firm clustering on the empirical findings of more countries. Among the various means of interdependencies of the developing nations' economies to the economies of the developed ones, technology transfers are the ones affect to the economic growth of both nations the most. Given the formal channels of transfers - FDI, joint ventures, licensing and other hybrid forms, and the informal channels through, reverse engineering, international trade and others, one can infer that identifying and establishing the innovation systems at different scales for the developing countries is not only beneficial to the developing ones but also to the developed countries in establishing strategies and planning policies for innovation and economic growth. Therefore, the third reason we state, is the need for innovation system analyses for developing countries. Finally, the lack of comprehensive research studies in Turkish regional innovation system in the literature calls for contributions from both international and national scholars.

We believe that our work, as a developing country study, enables cross country comparisons and facilitates the understanding of the innovation dynamics of Turkish SMEs as the actors of systems of innovation. Moreover, as pronounced by the policy makers, there is an urgent need for structural micro reforms to transform the production processes of the country's manufacturing industry in order to reduce the chronic current trade deficit, while keeping economic growth and social equity into perspective. This requires the adoption of policies that will improve Turkish firms' innovativeness that can possibly create a virtuous cycle of high wages-high value added production. Therefore, we contemplate that the study contributes to the existing literature and provides valuable information to policy makers. This work on Turkish regional innovation system is motivated by the reasons listed above. To build the research model and specify the hypotheses in this work, we rely on the theoretical and empirical studies in the literature while taking into account the country's idiosyncratic characteristics and dynamics.

Considering the literature on Turkey, the following briefly summarizes how this study integrates to the literature. In parallel to Ayaydın (2005), we look into the multiple

dimensions of the innovation process in Turkish regions. However, different than Ayaydın (2005) study, in explaining the innovativeness of the firms, we investigate the boundaries of the learning process, the role of the relational capital versus knowledge spillovers, and whether this process is external or internal and it is voluntary or unintended. In addition, we further examine, both at the regional and sectoral levels, the impacts of the external and the internal sources of innovation, and thus determine which sources are effective at regional level and sectoral level. Together with the broader rage of questions, by employing the larger dataset collected in 12 cities and 10 sectors, this study qualifies to be the first comprehensive study of Turkish regional innovation system.

More specifically, given the primary goal of the TRIS project, i.e. mapping the regional innovation system for the country, this study, as a part of the project, aims to understand the various factors affecting the innovativeness of the manufacturing SMEs from the perspective of regional innovation systems. We believe that in understanding the innovative performance of the regions and nations, it is vital to understand the innovation process of micro scales, such as firms in a system of innovation. Although we acknowledge the contributions of the whole literature to our work, to be more specific, but not to name, we denote that we especially benefit from Ronde and Hussler (2005), Capello and Faggian (2005), and Doloreux (2004) in conducting our empirical work. However, we modify and extend these models in the light of the discussions presented in other studies in the domestic and international literature.

To sum up, in this section, we provide a brief review of the international and domestic literature and motive our work. In the following section we introduce the data and the variables constructed for the empirical analysis. Section 3 presents the econometric models and the methods of the estimation, as the results are reported in section 4. Finally, we summarize policy and theory related implications of our findings. It is important to note that as we write this paper, our research efforts in general and econometric analysis in particular continues. Therefore, this version does not include the whole analysis and the relevant results.

2. Data and Variables

The analysis in this study use primary data gathered by face-to-face surveying of manufacturing firms for the purpose of mapping Turkish Regional Innovation System (TRIS). The dataset includes the detail information on the profiles of the firms, their innovation and competition strategies, R&D activities and spillovers, the internal and external sources of innovation and relational capital. The face-to-face surveys are conducted in twelve NUTS 3 cities - Istanbul, Ankara, İzmir, Bursa, Kocaeli, Denizli, Eskişehir, Konya, Adana, Kayseri, Gaziantep and Tekirdağ – in Turkey. These cities correspond to eleven NUTS 2 and eight NUTS 1 regions and they represent their corresponding regions in terms of their level of socio-economic development. The dataset does not have the data on three NUTS 1 and the corresponding fifteen NUTS 2 regions, since the excluded regions have lower level of socio-economic development than the nation's average. In these areas the manufacturing activities are very limited. Therefore, the dataset consist of the random sample of 1200 small and medium size firms with employees of 10-249. The data is collected from 12 cities and 10 manufacturing sectors (Table 1). The sectors are chosen from medium- and low-technology groups classified by OECD. The main reason for this is to do with the fact that these sectors have the highest shares in the country's exports.

Table 1. The Manufacturing Sectors in the Dataset.

NACE Codes	Description
15 (Low Tech)	Manufacture of food products and beverages
17 (Low Tech)	Manufacture of textiles
18 (Low Tech)	Manufacture of wearing apparel; dressing and dyeing of fur
24 (Medium High Tech)	Manufacture of chemicals and chemical products
25 (Medium Low Tech)	Manufacture of rubber and plastics products
26 (Medium Low Tech)	Manufacture of other non-metallic mineral products
27 (Medium Low Tech)	Manufacture of basic metals
28 (Medium Low Tech)	Manufacture of fabricated metal products, except machinery and equipment
29 (Medium High Tech)	Manufacture of machinery and equipment n.e.c
34 (Medium High Tech)	Manufacture of motor vehicles, trailers and semi-trailers

The dataset includes the competences data to provide detail information on the internal and external sources of innovation, including non-innovative as well as innovative partners of the firms. While modeling the roles of both innovative and non-innovative partners eliminate a bias in the sample (Ronde and Hussler, 2005), it also provides us a holistic view of the innovation dynamics of the firms in TRIS. In parallel to the approach developed by Ronde and Hussler (2005), we also rely on competences in explaining the roles of various partners in the SMEs innovativeness. It is important to note that as Ronde and Hussler (2005) investigates the innovativeness of the regions, in this study, at the micro level, we examine the firms' innovation process. In other words, in a system of regional innovation, by the help of the internal and external competences, we try to determine the actors that the firms work with to innovate. The competences are conceptualized, as in Ronde and Hussler (2005), to represent the firms voluntary actions performed to innovate. On the other hand, there are other variables to represent unintended portion of the knowledge flows in innovation process at the regional and sectoral levels.

The dataset includes the elementary competences that might or might not be possessed by 1200 Turkish manufacturing small and medium size enterprises (SMEs). In Turkey, 99% of the manufacturing companies are SMEs and this fact constitutes our primary reason for working on SMEs in this study. It is important to note that this might lead us to overestimate the role of external competences and underestimate the role of internal competences. The opposite of this situation is also the case in Ronde and Hussler (2005) study, where the role of external competences might be underestimated and the role of internal competences might be overestimated. Although it is not a fundamental drawback, it is rater a tradeoff that needs to be bear in minds of the readers.

The existence of elementary competences is measured by 61 questions in the survey. These elementary competences are categorized into two main groups, internal and external, and within the two, seven subgroups are constructed. We represent the firms' own abilities and characteristics facilitating innovation as the internal competences. The abilities regarding the use of information generated by their innovation partners are classified as external competences. The two subgroups of internal competences are technical and organizational (Ronde and Hussler (2005)). As described in Ronde and Hussler (2005), we specify five subgroups of external competences with customers, financers, competitors, suppliers, and public institutions and universities. We lump the competences with public institutions and

universities, because the survey does not include enough number of elementary competences in these categories. We resent the competences measured in the survey and their aggregate correspondence in the appendix.

In order to calculate the level of aggregate competences for a firm, we sum the number of elementary competences that the firm indicates processing it under each competence category. By following this approach we obtain seven independent competence variables for each firm in the sample. Our approach differs from that of Ronde and Hussler (2005) in constructing these variables. Since Ronde and Hussler (2005) examine the regional level of innovativeness, they assign ones or zeros to firms depending on the fact that their competence levels are above or below the median level of competences in the sample. In order to compute the regions' level of competences, they sum the number of firms scoring one, i.e. the firms exceeding the median level of competences in each competence category. On the other hand, we are interested in the innovativeness of the firms in the system and, in turn, we directly work with the level of competences for each firm. In addition, rather than using dummy variables indicating whether the firm exceeds the median level of competence as independent variables, we choose to work with the number of competences, since we would make more use of the information carried in the data and have more variations for the firm level analysis.

The firm level competences represent the voluntary knowledge flows in our model, as in Ronde and Hussler (2005). In order to test the effect of the unintended knowledge spillovers on the firm innovativeness we introduce several variables representing different types of spillovers. To see the effect of the unintended knowledge spillover from the universities to the firms in the regions, we introduce a dummy variable (papinst) taking the value of one if the region is above the sample average, in terms of the number of scientific publications per million people. The other possible source of unintended knowledge spillovers is the regional R&D efforts. Due to the budgeting methods of city governments, we were unable to get data on public R&D expenditures for the cities. However, we were able to find a detail data on R&D expenditures in each university in the country by The Turkish Scientific and Technology Council (TUBİTAK). The latter is also a valuable data, since it permits us to measure the effect of spillovers due to the regional R&D efforts of TUBİTAK. Therefore, we create the variable (RDreg) calculated as the regional percentages of total R&D expenditures of our sample.

In addition to the proxy variables for unintended spillovers mentioned above, to be able to take into account the effect of channels of collective learning on the firm innovativeness, we employ two measures of relational capital, local labor market (Lcllabor) and specialized local labor market (Sectlabor) or sectoral labor market. By introducing these two variables to our model, we are able to measure the effects of involuntary knowledge spillovers obtained not only through physical space but also relational space. Capello and Faggian (2005), and Capello (1999a, b) use these two variables plus the third one, diversified local labor, in explaining the factors affecting the degree of innovativeness of the firms in Milan, Cadore, and Piacenza in Italy. Both Lcllabor and Sectlabor are categorical variables having 5 categories for percentages of employment coming from regional and specialized labor markets.

Since we are interested in explaining how the innovativeness of the manufacturing SMEs is affected by several actors in a regional innovation system, we introduce variables measuring the collective effects of both the neighbor firms in the region and the firms within

the same sectors. In order to measure these effects, for each firm in the sample, we introduce 7 region and 7 sector level competence variables, across twelve regions and ten sectors. This enables us to differentiate and observe the influence of each region and sector level competences. For each region and for each competence category, we calculate the city competence levels by summing the number of firms having higher number of competences than the country's median level of competences (ccomp1, ccomp2, ccomp3, ccomp4, ccomp5, ccomp6, and ccomp7). Similarly, for each sector and for each competence, we calculate the sector level of competence by calculating the percentage of firms having higher number of competences than the sector median level of competences (sccomp1, scomp2, scomp3, scomp4, scomp5, scomp6, and scomp7). It needs to be noted that, different than the region level competences, in the computation of sector level competences, we use percentages of firms as measures due to the fact that we have unequal number of firms in each sector. In other words, in our sample, each region is represented by 100 SMEs, whereas each sector is represented by different number of SMEs. Thus, using the number of firms as a measure, in calculating sector level competences would introduce a heterogeneity bias. As a result, to overcome this problem, in each sector, we rely on the percentage of firms having higher number of competences than the sector median level of competences. These variables provide us the information on through which competences the cities and sectors are affecting the innovativeness of the firms. We also note that regional and sectoral effects are captured in a different manner in Ronde and Hussler (2005), since their level of analysis is regional and the data availability is different enabling them to construct other variables they need such as technological neighbors.

In order to control the other affects, we employ a series of variables presented below. The industry characteristics are taken into account by a dummy variable (Techm). This variable takes the value of 1 if the firm is in one of the medium high or medium low technology sectors and the value of 0 if the firm is in one of the low technology sectors. The sectors are assigned to medium and low technology groups according to the OECD classification (Table 1). Moreover, we include another explanatory variable (Size), measured by the number of employees, capturing the effect of the size of the firms on their innovativeness. Furthermore, this variable also controls for the differences in size of the firms in measuring the effects of other explanatory variables. Finally, in order to eliminate spatial heterogeneity bias and control for the effect of the differences in population across regions, we introduce the variable (Pop) measuring the population of each region in millions of inhabitants in the year 2007. This variable is an estimate obtained from the Turkish Statistics Institute (TUİK). Both exogenous and endogenous variables and their short definitions are summarized in Table 2 below.

In this research, consistent with Lundval's (1992) definition of innovation, we adopt the OECD definition of innovation and conduct our work by considering innovations in several dimensions of business activities. Hence, rather than using only patents, in addition we use utility models and brand name, as indicators of innovative output. Patents are the measure of technical innovations such as process and product innovations and are widely used in the literature as an overall measure of innovative output. Although the terms and conditions are different in some details, such as the length of protection, similar to patents, utility models are also the measure of technical innovations. On the other hand, registered brand names, represent a type of intangible assets created by organizations, are also innovations. Considering only the patents as a measure of innovative output, might not capture innovativeness of firms completely. Therefore, we take into account, brand names and utility models as well as patents to measure the innovative output of the firms. We do have a

question in the survey asking whether the firm holds any of the three intellectual properties. If a firm indicates that it has at least one of them, the endogenous dummy variable (Tmpfm) takes the value of one, if otherwise, it takes the value of zero. In other words, our dependent variable is a dummy variable (Tmpfm) taking the value of one or zero for each firm. The descriptive statistics of the variables are summarized in Table 3.

Table 2. Model Variables and Definitions

Variables	Short Description of the Variables
Tmpfm	Indicates whether a firm has an innovation or not
Size	The number of employees working at firm
Comp1	The number of elementary organizational competences that firm has
Comp2	The number of elementary technical competences that firm has
Techm	A dummy indicating the sector group that the firm belongs to
Comp3	The number of elementary customer related competences that firm has
Comp4	The number of elementary financial competences that firm has
Comp5	The number of elementary competitor related competences that firm has
Comp6	The number of elementary supplier related competences that firm has
Comp7	The number of elementary public institution and university related competences that firm has
Lcllabor	Categorical variable for the percentage of employment coming from local labor market.
Sectlabor	Categorical variable for the percentage of employment coming from specialized labor market.
Papinst	A dummy indicating the regions' status in terms of per capita publications
RDreg	The percentage of total public R&D expenditures allocated to the regions
Pop	2007 population estimate from TUIK
CComp1	The number of neighbor firms possessing more elementary organizational competence than the country median level of competences.
CComp2	The number of neighbor firms possessing more elementary technical competence than the country median level of competences.
CComp3	The number of neighbor firms possessing more elementary customer competence than the country median level of competences.
CComp4	The number of neighbor firms possessing more elementary financial competence than the country median level of competences.
CComp5	The number of neighbor firms possessing more elementary competitor competence than the country median level of competences.
CComp6	The number of neighbor firms possessing more elementary supplier competence than the country median level of competences.
CComp7	The number of neighbor firms possessing more elementary public institution and university competence than the country median level of competences.
SComp1	The percentage of firms in the same sector possessing more elementary organizational competence than the sector median level of competences.
SComp2	The percentage of firms in the same sector possessing more elementary technical competence than the sector median level of competences.
SComp3	The percentage of firms in the same sector possessing more elementary customer competence than the sector median level of competences.
SComp4	The percentage of firms in the same sector possessing more elementary financial competence than the sector median level of competences.
SComp5	The percentage of firms in the same sector possessing more elementary competitor competence than the sector median level of competences.
SComp6	The percentage of firms in the same sector possessing more elementary supplier competence than the sector median level of competences.
SComp7	The percentage of firms in the same sector possessing more elementary public institution and university competence than the sector median level of competences.

Table 3. Descriptive Statistics

Variables	Maximum*	Minimum*	Mean	Standard Deviation
Tmpfm	1 (733)	0 (460)	0.61	0.49
Size	250	6	50.05	50.02
Comp1	12	0	7.35	2.53
Comp2	8	0	2.74	1.84
Techm	1 (828)	0 (372)	0.69	0.46
Comp3	7	0	5.05	1.90
Comp4	3	0	0.46	0.59
Comp5	10	0	4.33	2.89
Comp6	7	0	3.66	1.69
Comp7	6	0	2.06	1.70
Lcllabor	5	1	4.52	1.06
Sectlabor	5	1	2.64	1.68
Papinst	1 (300)	0 (900)	0.25	0.43
RDreg	0.52	0	0.08	0.14
Pop	11.92	0.72	2.78	2.98
CComp1	69	15	38.33	16.48
CComp2	52	13	32.08	11.49
CComp3	59	11	27.33	11.65
CComp4	65	25	41.92	11.14
CComp5	60	31	44.83	8.67
CComp6	54	15	35.08	11.27
CComp7	61	6	38.33	17.48
SComp1	44.10	20.73	36.61	6.23
SComp2	52.17	19.17	30.49	9.09
SComp3	36.18	10.36	26.27	6.70
SComp4	50	20.73	40.19	8.27
SComp5	60.87	18.14	43.32	11.48
SComp6	40.37	18.65	33.53	6.00
SComp7	51.09	20.21	36.65	7.93

Note: (*) Numbers in parentheses denotes the frequencies.

Before we present the model and the estimations methods, we believe it is important to provide the following information. The first one is to with the fact that our data is a cross section data. The implication of this is we can not take into account the lag effect of exogenous and endogenous variables in our modeling. Therefore, the stronger effect of our variables on the innovativeness of the firms might not be observed. Moreover, this version of the study presents the effect of exogenous variables on the probability of firms having innovation or probability of firm being innovative. The complete form of the study will include the materials of and the results for the degree of innovativeness of the firms.

3. Model and Estimation Methods

In constructing our model we benefit from both international and national studies and their findings on regional innovation systems in general and Turkey in special. As mentioned earlier, we build our methodology in such a way that as we observe our specific characteristics, we can also allow for cross country and region comparisons.

More specifically, in this study, for the specified regions of Turkey, we try to investigate effects of: 1. various competences, 2. unintended knowledge spillovers through both physical

space and relational space, 3. region level competences and 4. sector level competences, on the innovativeness of the SMEs. To investigate aforementioned questions, we form the following hypotheses:

Hypothesis I: The internal competences have no effect on the Turkish SMEs probability of innovating.

Hypothesis II: The external competences have no effect on the Turkish SMEs probability of innovating.

Hypothesis III: The unintended knowledge flows do not bear any significance for the Turkish SMEs to be innovative.

Hypothesis IV: The relation capital does not bear any significance for the Turkish SMEs to be innovative.

Hypothesis V: The regions do not have any roles in the innovation process of Turkish SMEs.

Hypothesis VI: The sectors do not have any roles in the innovation process of Turkish SMEs.

In testing the hypotheses mentioned above, we work with econometric model in (1):

$$Tmpfm = \ln(Size) + Comp1 + Comp2 + Techm + \sum_{c=3}^{c=7} Comp(i) + Lcllabor + Sectlabor + Papinst + RDreg + Pop + \sum_{c=1}^{c=7} CComp(i) + \sum_{c=1}^{c=7} SComp(i) \quad \textbf{(1)}$$

We run logit regressions stepwise to test the effect of the exogenous variables. At the first stage we regress size, internal competences and Techm on the innovative output, Tmpfm. The second stage involves external competences in addition to variables in the first stage. In the third stage, we introduce knowledge spillover including relational capital variables on top of the variables included in the previous stage. Region level competences and sector level competences are sequentially added to model in the fourth and the fifth stages, respectively.

In the following section, we provide the results of our empirical work. We continue to our work on performing the econometric analysis for the parts that we do not include in this study. When we complete the whole modeling exercise, we integrate them all into this paper.

4. The Results

We summarize estimation results in Table 4. The detail interpretations on the significance or insignificance of the variables are reported by following the order specified in the five stages.

Table 4. Regressions Results (Absolute value of z statistics in parentheses, * significant at 5%; ** significant at 1%)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Size	0.021	-0.025	0.003	0.035	0.130
	(0.26)	(0.31)	(0.04)	(0.38)	(1.38)
Comp1	0.000	-0.083	-0.088	-0.069	-0.074
	(0.01)	(2.61)**	(2.64)**	(1.96)*	(2.08)*
Comp2	0.363	0.319	0.355	0.396	0.376
	(8.49)**	(7.24)**	(7.54)**	(7.87)**	(7.35)**
Techm	-0.161	-0.206	-0.312	-0.297	-0.623
	(1.18)	(1.48)	(2.13)*	(1.97)*	(2.09)*
Comp3		0.113	0.100	0.095	0.090
		(2.94)**	(2.51)*	(2.33)*	(2.15)*
Comp4		0.232	0.215	0.330	0.383
		(1.89)	(1.68)	(2.44)*	(2.77)**
Comp5		0.081	0.094	0.087	0.099
		(2.60)**	(2.91)**	(2.54)*	(2.84)**
Comp6		0.027	0.028	0.033	0.041
		(0.61)	(0.60)	(0.69)	(0.84)
Comp7		0.102	0.031	-0.017	-0.044
		(2.31)*	(0.66)	(0.32)	(0.84)
Lcllabor			-0.094	-0.030	-0.037
			(1.37)	(0.40)	(0.48)
Sectlabor			-0.167	-0.155	-0.139
			(3.92)**	(3.28)**	(2.86)**
RDreg			1.164	1.595	2.129
			(1.64)	(0.76)	(0.98)
Papinst			0.028	-0.381	-0.602
			(0.14)	(0.62)	(0.96)
Pop			-0.125	-0.144	-0.157
			(4.10)**	(4.17)**	(4.42)**
Ccomp1				-0.017	-0.016
				(0.97)	(0.88)
Ccomp2				0.021	0.020
				(0.88)	(0.82)
Ccomp3				0.031	0.033
				(1.41)	(1.49)
Ccomp4				-0.031	-0.032
				(1.66)	(1.69)
Ccomp5				0.015	0.015
				(0.79)	(0.80)
Ccomp6				-0.058	-0.061
				(2.35)*	(2.44)*
Ccomp7				0.036	0.042
				(2.92)**	(3.23)**
Scomp1					0.096
					(1.57)
Scomp2					0.048
					(1.90)
Scomp3					-0.002
					(0.06)
Scomp4					-0.031
					(1.10)
Scomp5					-0.038
					(1.40)
Scomp6					-0.059
					(1.00)
Scomp7					0.007
					(0.25)
Constant	-0.439	-0.833	0.374	0.355	-0.117
	(1.39)	(2.40)*	(0.76)	(0.27)	(0.08)
Observations	1193	1193	1173	1173	1173

The first model measures the effects of size, technology group, and the firms' internal abilities, on the probability of the firms having an innovation. Among the internal capabilities, we observe that the technical competence is significant at 1% level, and reject the hypothesis I. The technical competences embrace the various capabilities of firms in R&D activities as well as technical routines and certifications. Technical competences of the Turkish manufacturing SMEs determine whether they are innovative or not or they hold at least a type of innovation. This result is not a surprising one, and it is consistent with findings in the literature where observing R&D capabilities and efforts of firms are found to contribute to their innovativeness. The other variables, size, technology group, organization competence are, found to have no effect on the probability of firms having an innovation.

In the second model, we intend to see the effect of external competences in addition to the internal capabilities of the firms. Similar to the results obtained in first model, among the internal competences, technical competence is significant at 1% level. However, different than the first regression results, we find that the organizational competence has also significant at 1% level, but detrimental effect on the probability of having an innovation. This is an interesting result. Rather than providing the possible explanation for this at this point, we prefer to wait so that we make a note that in is consistently coming out through out the other models. In regard to various abilities of firms in their relationship with the their innovation partners, external competences related to customers, competitors and public institution and universities are found to have significant effects on the SMEs having at least one type of innovation. Therefore, we reject the hypothesis II. The relationship with financers and suppliers do not seem to affect the probability of innovating. The other variables, size and technology group still stay unimportant.

In order to measure the impact of various types of unintended knowledge flows, in addition to all the variables used until now, we include the following exogenous variables in the model: the categorical variables representing the percentages of employees coming from the local labor pool and from the sectoral labor pool as proxies for relational capital, the percentages of public R&D spending for each region as a proxy involuntary R&D spillover, and per capita paper publications in the regions as a proxy for unintended knowledge flow from the universities. Moreover, since the populations of the regions are different, in order to eliminate a possible heterogeneity bias, we include the cities' population in millions. In consistent with the findings in the first two regression, technical competences still significantly, at 1% level, affecting whether the SMEs are innovative one or not. The interesting result that we observe in regard to the organizational competence continues hold under this model too. Thus, our results on internal competences in the previous models are also observed in this model. In consistent with the previous findings, the competences related to customers and competitors are found to have significant effects on the probability of the SMEs having at least a type of innovation. However, in this model we do not observe the significant affect of competences related to public institutions and universities. Moreover, different than the first two regressions, the technology group is found to have a negative significant effect at 5% level. Given what this dummy represents in the models, we conclude that being in low technology sector group positively affects the probability of having an innovation. This result is in consistent with the generally observed situation where firms in medium low or medium high technologies are more innovative. Although we do not have full explanation of this result, we think that it might be due to the fact that we include utility models and registered brand names as well as patent in the calculation of innovative output. Since the low technology group includes the manufacture of food products and beverages and textile sectors, there might be higher number of brand named and utility models in this group

and this, in turn, might have an impact on the result. As far as the unintended knowledge flows, the SMEs do not seem be benefiting from them. Therefore we reject the hypothesis III. While one of the collective channels of learning, local labor force, do not affect the probability of the firms having an innovation, interestingly, the other channel, sectoral labor force, seems to have an unfavorable effect leading the rejection of the hypothesis IV. Similarly, being in a more populated area also detriments the probability. Together with the due explanation for the negative effect of organization competence, below we provide an explanation of these interesting results by considering certain facts about the business environment in the manufacturing industry in the country.

When we put together the negative effects of organizational competence, the level of sectoral labor employment, and population of the regions, on the SMEs having at least a type of innovation, we argue that all together they point us to two well recognized pieces of reality of the business atmosphere, i.e. higher turnover rates and unregistered economy. The organization competence includes the following elementary competences; practices to benefit knowledge accumulation and experience, restructuring of organization, collaboration between departments, training of employees, performance evaluation and reward mechanisms, team work and rotation between department, and motivational incentives. The SMEs that are using up time, effort and money, to attain skills and abilities to gain the organizational competence, are certainly sacrificing from their resources to be innovative. When there is a turnover problem of the specialized labor, i.e. the turnover rate is high enough, it damages both the efforts made by firms to gain the organizational competence as well as the potential knowledge flow from these specialized employees. As the firms try to gain more competences, high turnover of specialized labor makes this effort more difficult and costly, which in turn reduces the chances of being more innovative. In addition, for the firms with higher percentage of labor force coming from the same sector, the higher turnover rate of specialized employees detriment the benefit from the relational capital. While for an optimal level of turnover, this channel of collective learning becomes positive externality, an excessive rate of it might create negative externality. Furthermore, the high population in the regions and thus higher labor pool, together with unregistered economy, facilitate these unpleasant incidences. Therefore, we believe that these statistical findings are interesting and the association of turnover rates and unregistered with innovativeness in this contexts need to be investigated further.

After measuring the effects of unintended knowledge flows and relational capital, we introduce a set of region level competences into the model. The statistical results are under the model four in Table 4. Most of our previous results concerning, the effects of internal and external competences, other firms' characteristics, involuntary knowledge flows, and relational capital, on the probability of the SMEs being innovative hold. There is only one exception in regard to the external competences. In addition to the other significant external competences, the competences with financers turn out to be also significant at 5% level. Therefore, we can claim that the manufacturing SMEs benefit from the knowledge of their financiers in being innovative. The competences at region level are represented by the intensity of the neighbor firms possessing more abilities and skills than the national average. The existence of a certain business culture of the Turkish SMEs and the social norms of the society motivates us to model the competences at the regional level. Therefore, we would be able to see whether the regional level abilities and skills are also transmitted to individual firms, and in turn affect their innovativeness. We find the regional level competences with public institutions and universities and with suppliers significant at 1% and 5% levels by rejecting the hypothesis V. More specifically, while being in the regions with over-performers

as regards competences with public institutions and universities contribute to having an innovation, interestingly being in the regions with over-performers as regards competences with suppliers have negative effect on the probability to innovate. While the number of firms having higher level of supplier competences than the national average increase in the region, the probability of the firms having innovation in that region decreases.

To evaluate this result from a larger perspective, we need to disclose that fact that the negative effect of this region level of competence with suppliers turns to a significant positive effect on the on the degree of innovativeness of the SMEs. We note that our results on the impacts of these explanatory variables on the degree of innovativeness of the manufacturing SMEs are not presented in this paper, since they are still preliminary. In order to provide an explanation to these findings, it is important to list the elementary competences briefly in this category; the adaptation of technologically new equipment, materials and ideas, obtaining the advance materials from international sources, licensing of new technologies from international markets, buying machinery, and doing investments to develop new technologies. As the number of firms having above average competences with suppliers in the region, the pool of patented or legally protected intellectual property that an individual firm faces gets higher, this, in turn, might negatively affect the probability of the firms having an innovation. In other words, it might become more challenging for the SMEs to come up with innovations. On the other hand, if the firm is already an innovative one, being exposed to large body of information of the pool might contribute to the number of innovations that firm came up with. In the view of the complex nature of the relationship between the manufacturing SMEs and suppliers, in order to provide a detail explanation, we believe that there is a need for a carefully crafted model specifically designed to analyze these dynamics. Without such framework, one might fall into trap of over interpreting the results.

Furthermore, to measure the effects of sector level competences on the probability of firms innovating, we run the regression in the fifth model. While we get the same results over the importance of the explanatory variables as those in the previous model, we observe that the sector level competences have no significant effects on the probability of the SMEs to be innovative and thus accept the hypothesis VI. Therefore, we conclude that there is no positive or negative effect of being with higher ability firms in the same sector on the probability to innovate. In sum, there is not effect of the competences at the sectoral level.

Lastly, we find that as we add various group of exogenous variables to explain their effect on the probability of having a least one type of innovation, the r-squares of the models consistently improves from 6% in the first regression to 19% in the fifth regression. In other words, as we add the independent variables the explanatory power of our models increase. Moreover, throughout the models, as we move from one model to the next by adding more independent variables, consistently the same variables turn out to be significant, except few minor deviations. While this result enforces the importance of these variables in determining the factors affecting the SMEs' probability to innovate, it also indicates that the model specification is successful.

5. Conclusions

In the light of the recent developments in domestic and international literature on regional innovation systems, we build a model measuring the importance of several explanatory variables on the probability of the Turkish manufacturing SMEs to innovate. In line with recent developments in the theory addressing sub-national innovation processes, we argue that local learning processes should be analyzed by taking into account both regional and other possibly complimentary or conflicting factors. We incorporate the following factors in our model; internal competences presenting the organizational and technical capabilities of firms, external competences measuring the abilities of firms with their innovation partners, unintended knowledge spillovers as positive externalities of innovation process by also taking into account the channels of collective learning in lieu of the relational capital, and the region and sector level competences measuring the cumulative effect of the capabilities of firms.

We find both internal and external competences with customers, financers, competitors significantly affecting the chances of having patents, utility models or registered brand names. The SMEs do not seem to benefit from the voluntary knowledge flows from suppliers and public institutions and universities as innovation partners. Furthermore, we observe that the specialized labor, as a channel of collective learning, has a detrimental effect which brings up the importance of the two unfavorable circumstances, namely high turnover and unregistered economy, when analyzed together with the negative impact of organizational competence and population of the regions. As we analyze the effects of competences at the region and sector levels, we find that being in a neighborhood of firms having above average competences with public institutions and universities benefit the individual firms. However, being around the firms with higher levels of supplier competences is observed to be detrimental for the probability of the firms to innovate due to the effect of the theorized pool effect.

In general, within the system of regional innovation, the Turkish SMEs in manufacturing industry seem to benefit various external knowledge sources as they are successful in utilizing their technical competences. Turkish innovation system seems to be regional rather than sectoral. Although region level effects are found to be limited to public institutions and universities, and suppliers.

Finally, while the system does not generate unintended knowledge spillovers which are crucial for innovativeness, it seems that it is negatively affected by unfavorable economic dynamics that are characteristics of developing and emerging market economies. It is perhaps too early to draw a general conclusion about these findings, yet in our view these results seem to point out towards an important observation as regards the innovation theory in the specific context of developing country dynamics. As labor market conditions are not institutionalized in a way to achieve a certain amount of capital-labor compromise, insisting on organizational learning processes, one of the core components of innovation theory's policy prescriptions might be a counterproductive policy tool for innovation policy designers. In the absence of proper working conditions, workers might not be able to benefit or willing to participate in organizational learning processes. We believe that these findings deserve further exploration as it might have serious implications for innovation theory. Lastly, we note that the empirical work continues as we present the first part of our research on the innovativeness of the manufacturing SMEs in this study.

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