CORRELATES OF INNOVATION CAPABILITY AMONG SMES IN TURKEY: AN EMPIRICAL STUDY

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Abstract

The aim of this study is to determine the impact of innovation indicators on innovation capability for small and medium enterprises (SMEs) operating in Turkey. To this purpose, a causal framework is developed where the internal and external indicators of innovation lead to enhanced innovation capability. Data sample covers 1663 SMEs. Sample distribution resembles the population in Turkey. The empirical findings emphasize the positive effect of training and customer cooperation on process innovation and product innovation. Moreover, R&D expenditure in total revenue is very influential on product innovation activities, indicating its significance for new product development of SMEs. Among ICT application indicators, the impact of e-trade dominates web-site ownership and portal membership. Results indicate that the SMEs are open to training and they regard knowledge as an important channel for creating innovative activities. However, their technical infrastructure utilization should be encouraged and their international links should also be strengthened through incentives and supports by government, public and private sectors. [i]

Keywords: SME, Turkey, innovation indicators, innovation capability, process innovation, product innovation, property rights innovation

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1. Introduction

Innovation is widely recognized as a key factor for competitiveness and growth of SMEs (Raymond and Pierre, 2010, Mcadam et al., 2010, O'Cass et al., 2009). In current multiple knowledge economy, where market is dominated by innovation, the major challenge for SMEs is to integrate into the complex network of technology and keep up with innovations. Despite the existence of a large number of policies designed to promote and facilitate the operation of the innovation process within SMEs, the knowledge about how SMEs actually undertake innovative activities remains quite limited. Thus, the innovation capability of SMEs becomes a critical issue at micro and macro level. Throughout the study, innovation is defined as realization of new or significantly improved product, service or process; a new marketing or an organizational method in management practices, organization or external relations (Oslo Guide OECD, 2005). Innovation definition of OECD, which is valid in EU, is also adopted by Turkey in 2005.

In this study, innovation indicators and innovation types are compiled under a framework using a survey conducted in 2010. The aim is to determine innovation awareness and capability of SMEs; analyze the impact of innovation indicators on different types of innovation within the innovation ecosystem; and develop related policy implications.

The rest of the paper includes an overview section about innovation and SMEs and an innovation section which discusses the indicators and types of innovation. The paper proceeds with research methodology and data section; data analysis and empirical findings section and finally the conclusion and remarks section.

2. An Overview of Innovation and SMEs

Pullen et al. (2009) explore patterns of internal SME characteristics that lead to high innovation performance and conclude that SMEs that achieve high innovation performance and focus on incremental innovation projects combine business strategy with adhocracy business culture, high level of marketing and R&D integration. However, a greater investment in product R&D does not necessarily lead to greater assimilation of product development technologies on the part of manufacturing SMEs known to innovate in an incremental manner (Raymond and Pierre, 2010). Madrid-Guijarro et al. (2009) provide a supportive claim and conclude that the most significant barriers to innovation in manufacturing sector are associated with costs. As a consequence SMEs

need adequate financing to develop their innovative capability and, thus, policies devoted to financing innovation in SMEs become critical. In that respect, it becomes important to find out the factors that enhance innovation among SMEs.

Hall et al. (2009) find out that firm size, R&D intensity and investments in equipment enhance the likelihood of process and product innovations. Terziovski (2010) shows that for SMEs, similar to large firms, innovation strategy and formal structure are the key drivers of performance, but SMEs don't utilize innovation culture in a strategic and structured manner.

Networking and cooperation activities play an important role in enhancing the SME innovativeness. Based on a survey to 137 Chinese manufacturing SMEs, Zeng et al. (2010) find significant positive relationships between innovation capability of SMEs and inter-firm cooperation, cooperation with intermediary institutions and research organizations.

Internationalization affects the innovative capability of SMEs since innovative firms are better equipped to exploit international market opportunities and perform better in such markets as emphasized by O'Cass et al. (2009).

A number of studies (Thomas, 2003; Thomas et. al. 2004) state the importance of web sites and the Internet for SME innovation support. Scupola (2003) points to the importance of managerial and technological aspects as well as external factors in acceptance and implementation of innovation. Tie-Jun and Jin (2006) study the relationship between SME innovation capability and the firms' internal and external resources and detect some significant factors such as total R&D expenditure and number of technological know-how. Maylor (2001) discovers significant positive correlation between new methods, tools and new product development performance for 46 manufacturing firms in England.

In analyzing four sectors of the Turkish manufacturing industry, Ulusoy (2003) concludes that innovation is significant in increasing competitive power of firms.

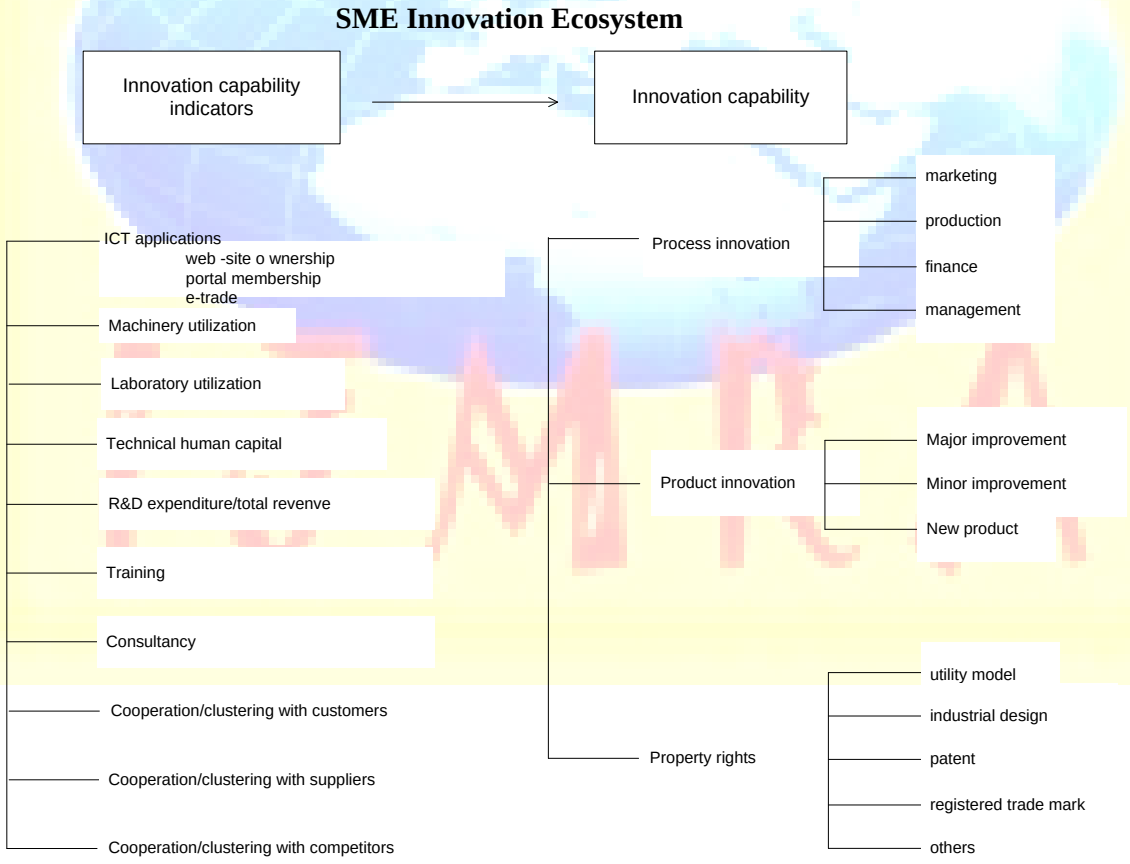
3. SME Innovation Ecosystem

Innovation ecosystem is perceived as a major source of competitive advantage in global business environment. The constituents of this ecosystem include venture capitalists; knowledge professionals; universities and research institutes; a sophisticated service structure; and many customers, lead-users, and early adopters of new technologies (Hautamäki, 2009). The dynamics

of ecosystem is based on flexible recycling of professionals, ideas, and knowledge. Similarly, controlling ecosystems is a new source of competitive advantage for SMEs. From SMEs' perspective, they have limited resources and difficulties to access global value chains, knowledge, specific services (e.g. legal), as well as adopt new technologies, new and distributed business models and work organizations (Nachira, 2006). Therefore, innovation ecosystem is critical for survival and competitiveness of SMEs.

In this study, the innovation ecosystem for SMEs is defined within a causal framework where the internal and external indicators of innovation lead to enhanced innovation capability (Tektas et al, 2011) (Figure 1). To this purpose, the list of potential indicators of innovation capability is compiled and then the significant ones are determined for SMEs in Turkey based

Figure 1- SME Innovation Ecosystem



on an analysis of the sample selected. Indicators are compiled through a literature survey and using the findings of the pilot study (Tektas et al., 2008). The indicators are grouped as internal and

external factors. Internal factors are information communication technology (ICT) applications (active web site ownership, portal membership, e-trade), technical human capital (technician, engineer etc.), laboratory/machine park utilization and ratio of R&D expenditure in total revenue. External factors are identified as training and consultancy services received and cooperation/clustering activities with customers/suppliers/competitors.

The innovation capability covers product innovation, process innovation and property rights. Most research defines patents as a measure of product innovation; however, this study refers to a general term that includes "patenting" in services and products. Therefore, the terminology is redefined as "property rights" and includes trademarks, utility models and industrial design besides patents. This is in line with recent trends accepting trademarks as an output of marketing innovations carried out for new product (Millot (2009), Groupp and Schubert, 2010).

4. Research Methodology and Data

The research is designed as a two-stage field survey. First stage comprises a pilot study undertaken in early 2008 (Tektas et al., 2008). Its objectives are to identify the correlation between utilization levels of different innovation types for a group of SMEs from machinery industry in an Organized Industrial Zone in Istanbul; and to form a basis to develop the main questionnaire for the second stage. The pilot study indicates that the SMEs with higher ICT adoption capabilities have higher innovation utilization rates. In addition, a positive correlation between utilization levels of innovation types is observed. At the second stage, a self-administered survey is employed. The survey questionnaire is designed to conduct a situation analysis about the innovation indicators and to determine sample SME innovation capability. Innovation capability measurements in literature are mostly based on the performances of last three years due to the time lag between R&D, making the innovation and implementing it. This study also defines the innovation period as three years and the data refer to 2008-2010 period.

The questionnaire is mailed in 2010 summer to approximately 10,000 SMEs registered under KOSGEB (Republic of Turkey, Small and Medium Enterprises Development Organization) in Turkey. Among these, 1663 SMEs that responded make up the sample of the study. Sample size is more than acceptable given that most sample sizes in the literature (Zeng et al., 2010; Raymond and St-Pierre, 2010; Marques and Ferreira, 2009; Wziatek-Kubiak, 2009) vary

between 30 and 500.

5. Data Analysis and Empirical Findings

The empirical findings are derived from descriptive and multivariate analyses of the sample data. The analyses are conducted using SPSS statistical software.

5.1. Descriptive Analysis

Economic activities of SMEs in the sample are classified using NACE codes. 695 (75%) SMEs are involved in manufacturing (mainly textile, metal, rubber and plastic, food, machinery and equipment) and 232 (25%) in services (mainly computer programming and consulting, wholesale and retail trade, machinery maintenance).

Among the respondents, 69% is located in Istanbul, 14% in Izmir, 13% in Ankara, 4% in other cities. The sample distribution is very similar to SME distribution in Turkey. Istanbul, a mega-city of about 15 million inhabitants, is also the leading economy in Turkey. It produces almost 27% of GDP, 38% of total industrial output, 50% of services, and generates 40% of tax revenues (OECD Territorial Review: Istanbul, Turkey OECD Publications, March 2008). 51% of the sample employs 1-9 employees, 39% are small size SMEs with 10-49 employees and 10% employ more than 50 employees. Marques and Ferreira (2009) state that micro organizations possess higher levels of innovation capability but have more problems about sustainable innovation.

Table 1 presents the major characteristics of innovation capability indicators in the sample.

Table 1 - Descriptive Statistics for Innovation Capability Indicators

Innovation Capability Indicators		Percentage
ICT applications		
Active web-site ownership (AWO)		85
Portal membership (PM)		38
E-trade (ET)		52
Machinery utilization (MU)	Does not use	21
	Owns	70
	Outsources	9
	Shares	0.2
Laboratory utilization (LU)	Does not use	55
	Owns	18
	Outsources	27
	Shares	0.4
Technical human capital (THC)	Engineers	44

	Technicians	46
R&D Expenditure/Revenue (RDR)	0%	22
	1% - 9%	41
	10% - 19%	14
	< 20%	23
Training (T)		45
Consultancy (C)		30
Cooperation and Clustering with		
Customers (CwC)		60
Suppliers (CwS)		50
Competitors (CwR)		10

Among ICT applications, higher utilization of web-site and e-trade imply that SMEs are aware of ICT facilities in business. Lower usage of portal membership might show that SMEs are not that experienced in generating network through virtual connections. Machinery and laboratory sharing is minimal. This is a consequence of individualistic competition strategies; however, sharing decreases the investment expenses, speeds up knowledge diffusion and establishes cooperative production culture. Technical human capital in SMEs also encourages and speeds up innovation. Around half of the SMEs in the sample don't employ technical personnel. Therefore, there exists an important potential for improvement in terms of innovation capability. The expenditure on R&D, which is an indication of priority for innovative activities, seems to be below sufficient levels to induce innovation.

Cooperation networks promote competition and knowledge diffusion in knowledge based economies; therefore, becoming players of such networks increases SME innovative capability and encourages knowledge diffusion. Cooperation tendency of the SMEs is analyzed on dimensions like information sharing, technology, trade, purchasing, design, logistics, quality control, participation in fairs, finding new customers. In all dimensions, level of SME cooperation with customers (around 60%) dominates suppliers (around 50%) and competitors (around 10%). Significantly higher level of cooperation at finding new domestic customers compared to the international customers point to the fact that SMEs basically focus on domestic markets and not the international ones.

In terms of SME clustering, 33% are at an industrial site, 19% in organized industrial zone, 6% in free zone and 3% in techno-park. 39% don't belong to any clusters at all. Clustering affects the relationships with customers, suppliers and competitors positively. The fact that majority

SMEs do not belong to a cluster implies that clustering should be promoted and subsidized as a policy.

One fourth of the SMEs in the sample have their most important customers abroad. This implies the presence of some export activity and also the potential for increasing it. Relationship with suppliers points to very high levels of domestic and quite limited levels of international relationships. SMEs state that a significant percent of competitors are also located abroad. This designates the presence of international competition for SMEs in Turkey.

This study classifies innovation as process, product and property rights. The manuscript proceeds with a discussion about the innovation types. Related descriptive statistics are presented in Table 2.

Table 2 - Descriptive Statistics for Innovation Types

		Percent
Process Innovation	Avg: 51%	
Marketing	Systemic market research	59
	New product development	73
	Participation in domestic fairs	47
	Participation in foreign fairs	25
	Customer demand forecast	71
	Customer satisfaction	60
	After sale support services	79
	Change in design and packaging	64
	New logistics and distribution methods	53
	Innovation and R&D based new exports	26
Management	SWOT Analysis	41
	Employee performance evaluation	63
	Vocational training and development applications	56
	Information management system	46
Finance	Annual plan - budget	65
	Monthly budget control	73
	Cost-profit analysis	85
	Innovation and R&D based credit use	17
	Innovation and R&D based investment	34
Production	Computer based manufacturing	48
	Sales planning	66
	Personnel backup	29
	Statistical process control	33
	Waste control	34
	Break-even analysis	31

	Technological R&D	40
	Material requirement planning	73
	New logistics and distribution methods	37
	Productivity measurement	55
	Quality control	55
Product innovation	Avg: 28%	28
Property rights	Avg: 30%	
	Registered trade mark	61
	Patent	25
	Certificate of standardization	42
	Utility model	13
	Industrial design	10

Process innovation is grouped as marketing, management, finance and production (Tektas et al., 2008). For the sample, average levels of marketing, management and finance process innovation levels range between 52% and 56%. Production has the lowest average (45%). This might be because production systems require relatively higher technological investments besides technological know-how and skills.

Product innovation is defined as new product or major or minor improvement in an existing product. Average product innovation level is 28%. 16% of this is realized by SMEs' own institution, 6% by cooperation with other SMEs and 6% by other SMEs.

Among SMEs 61% possess registered trade mark, 25% has patents, 13% hold utility models, 10% has industrial design. A majority of each property right is acquired in the last three years. Acquiring trademarks for new products is recognized as marketing innovation. High percentage of trademarks may highlight the strategic use of trademarks in marketing of new products. It should be noted that all new products are not innovations as the patent rate is only 25%. Certificate of standardization is an important factor for accreditation of production and/or management skills. Such an accreditation enhances international trade potential and increases consumer trust.

Average utilization rate for process innovation (51%) is higher than product innovation (28%) and property rights (30%). This is an expected outcome for SME innovativeness. SMEs, apart from some highly creative companies, tend to be followers in innovation. Product innovation is dependent on high quality research, competitive know-how and sustainable knowledge diffusion. However, process innovation is much easier to attain and less costly. Utilization rates in property

rights are normally lower when patents are accepted as the only output. However, including trademarks impacts utilization rates positively.

5.2. Multivariate Analysis

Factor analysis is applied to each innovation capability type so that the variables are grouped to a manageable size; redundancy is reduced by decreasing multi collinearity probability and variables with similar behaviors are grouped for policy implications. Factor analysis is applied to three innovation types separately and the results of three analyses are given in Table 3. Principal-Component Analysis with Varimax with Kaiser Normalization is used as the extraction method of factor analysis and eigen-values greater one are selected. The factors are defined on the basis of highest loaded items. Kaiser-Meyer-Olkin measure of sampling adequacy checks the appropriateness of data for factor analysis. It's an index to compare the magnitudes of observed correlation coefficients to the magnitudes of partial correlation coefficients. Bartlett's test of sphericity is another test to assess whether the correlation matrix is appropriate for factor analysis.

Table 3 - Factor Analysis of Innovation Types

	Factors	**Factor Loading**
Process Innovation		
	F1 - Production planning and control ($\lambda = 7.102$, $\sigma^2=23.673$)	
	Quality control	0.762
	Productivity measurement	0.692
	Waste control	0.692
	Material requirement planning	0.559
	Break-even analysis	0.541
	Statistical process control	0.445
	F2 - Marketing sales and distribution ($\lambda = 2.203$, $\sigma^2=7.343$)	
	Improved sales and distribution methods	0.664
	Systemic market research	0.638
	New logistics and distribution methods	0.540
	Sales planning	0.442
	Customer satisfaction	0.436
	Customer demand forecast	0.435
	Personnel backup	0.375
	F3 - Innovation and R&D ($\lambda = 1.501$, $\sigma^2=5.002$)	
	Innovation and R&D based investment	0.808
	Technological R&D	0.685
	Innovation and R&D based credit use	0.685

	Innovation and R&D based new export	0.593
	F4 - Performance and strategy management ($\lambda = 1.450, \sigma^2=4.832$)	
	Vocational training and development applications	0.721
	Information management system	0.702
	Employee performance evaluation	0.557
	Computer based manufacturing	0.485
	SWOT Analysis	0.474
	F5 - Financial planning ($\lambda = 1.247, \sigma^2=4.156$)	
	Monthly budget control	0.766
	Cost-profit analysis	0.675
	Annual plan budget	0.618
	F6 - New product and after sale services ($\lambda = 1.198, \sigma^2=3.995$)	
	Change in design and packaging	0.594
	New product development	0.577
	After sale support services	0.577
	F7 - New Market access ($\lambda = 1.067, \sigma^2=3.558$)	
	Participation in domestic fairs	0.793
	Participation in foreign fairs	0.784
	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy: 0,9	
	Bartlett's Test of Sphericity Approx. Chi-Square: sig=0,00	
Product Innovation	**F8 – Product Innovation** (The share in total revenue of)	
	new product	0.858
	significantly improved product	0.807
	slightly improved product	-0.301
	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy: 0,483	
	Bartlett's Test of Sphericity Approx. Chi-Square: sig=0,00	
Property Rights	**F9 - Industrial Property ($\lambda = 1.970, \sigma^2=32.838$)**	
	Utility model	0.795
	Industrial design	0.790
	Patent	0.494
	F10 - Intellectual Property ($\lambda = 1.054, \sigma^2=17.567$)	
	None	0.745
	Registered trademark	0.672
	Others	0.440
	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy: 0,664	
	Bartlett's Test of Sphericity Approx. Chi-Square: sig=0,00	

Through factor analysis, thirty dimensions of process innovation are reduced to seven factors; three dimensions of product innovation to one factor and five dimensions of property rights to two factors.

First process innovation factor, 'production planning and control', covers components that have common goals of quality control and improvement in production processes.

Grouping under 'marketing sales and distribution' factor can be explained by the fact that each element in the group support marketing decisions with quantitative modeling tools. Another

marketing related factor is 'new product and after sales services'. This group accumulates elements related to stages before production and after launching of a product. Third marketing related factor is 'new market access' which includes participation in domestic and foreign fairs. Both elements are tools for entering new markets.

'Innovation and R&D' factor consists of innovation and R&D based components from marketing, finance and production areas of process innovation. This finding indicates that innovation based activities act similarly independent of the functional area.

'Performance and strategy management' factor brings together human and computer based components that improve the performance in SMEs.

'Financial planning' factor includes components which are parts of effective budget planning.

There is only one factor under product innovation. The factor consists of the share of new, significantly improved and slightly improved products in total revenue. Grouping under a single factor implies that innovating makes the difference not the degree of innovation.

'Property rights' factor is categorized as industrial and intellectual property. This differentiation serves to identify company's innovativeness. Greater numbers of intellectual property signify process innovation whereas industrial property points out product innovation capability.

Factors derived from Factor Analyses are regressed on innovation indicators grouped as internal and external factors which were discussed previously within SME ecosystem.

The base model is defined as

$IT = \alpha_0 + \alpha_1 IEF + e$

Dependent variable is the innovation type (IT) and independent variables are innovation indicators. The main findings of combined innovation capability indicators are presented in Table 4.

Table 4 - Regression results for internal and external innovation capability indicators

	Process Innovation							Product Innovation	Property Rights	
FACTORS	F1	F2	F3	F4	F5	F6	F7	F1	F9	F10
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Constant	1.690***	2.552***	-0.395**	1.256***	1.834***	1.158***	0.309**	5.942***	0.056	0.873***
	(5.753)	(8.028)	(-2.032)	(5.379)	(11.807)	(8.226)	(2.528)	(11.738)	(0.497)	(15.679)

AWO	-0.253	-0.428*	0.305**	-0.202	-0.074	0.106	0.143	0.730**	0.049	0.016
	(-1.170)	(-1.824)	(2.140)	(-1.172)	(-0.650)	(1.017)	(1.586)	(1.974)	(0.590)	(0.387)
PM	0.064	0.186	0.170*	0.036	-0.094	0.104	0.094	0.049**	0.025	0.022
	(0.456)	(1.221)	(1.828)	(0.323)	(-1.273)	(1.545)	(1.608)	(0.201)	(0.458)	(0.816)
ET	0.009**	0.013***	0.001	0.012***	0.003**	0.002	0.002*	0.015***	-0.003**	0.001*
	(2.801)	(3.916)	(0.344)	(4.699)	(2.055)	(1.385)	(1.701)	(2.589)	(-2.140)	(1.652)
MU	0.548***	-0.161	0.134	0.039	0.043	0.227**	-0.003	0.505	0.080	0.049
	(2.888)	(-0.786)	(1.056)	(0.258)	(0.432)	(2.500)	(-0.040)	(1.521)	(1.086)	(1.365)
LU	0.891***	0.796***	0.435***	0.259*	0.235**	0.215**	0.236***	0.078	0.034	0.015
	(4.650)	(3.738)	(3.418)	(1.704)	(2.319)	(2.345)	(2.957)	(0.303)	(0.599)	(0.536)
THC	-0.144	-0.066	0.145*	0.128	0.059	0.090*	-0.100*	-0.100	-0.043	-0.006
	(-1.328)	(-0.561)	(2.012)	(1.486)	(1.018)	(1.737)	(-2.205)	(-0.532)	(-1.020)	(-0.309)
RDR	0.002	0.006	0.023***	0.014***	-0.001	0.010***	0.001	0.029***	0.005***	-0.001
	(0.430)	(1.549)	(9.332)	(4.530)	(-0.527)	(5.371)	(0.430)	(4.207)	(3.248)	(-0.798)
T	0.316**	0.318*	0.326**	0.748***	0.163**	0.107	0.120*	0.507*	0.065	0.016
	(2.059)	(1.912)	(3.221)	(6.135)	(2.004)	(1.460)	(1.874)	(1.905)	(1.101)	(0.563)
C	0.071	0.194	0.190	0.323**	0.054	0.039	0.042	-0.549*	0.128**	-0.041
	(0.430)	(1.088)	(1.746)	(2.474)	(0.626)	(0.493)	(0.614)	(-1.941)	(2.022)	(-1.310)
CwC	0.106***	0.160***	0.075***	0.072***	0.027**	0.041***	0.031***	0.123***	0.016	-0.003
	(4.070)	(5.693)	(4.374)	(3.493)	(1.991)	(3.286)	(2.905)	(2.747)	(1.605)	(-0.683)
CwS	-0.009	0.077***	0.006	0.043**	0.020*	0.032***	0.016*	0.047	0.007	-0.005
	(-0.408)	(3.163)	(0.379)	(2.437)	(1.716)	(2.989)	(1.685)	(1.171)	(0.856)	(-1.077)
CwR	-0.018	0.037	0.015	0.019	0.024	-0.028	-0.028	-0.050	0.049**	-0.004
	(-0.361)	(0.677)	(0.467)	(0.473)	(0.922)	(-1.175)	(-1.332)	(-0.588)	(2.523)	(-0.432)
R^2	0.11	0.16	0.27	0.23	0.06	0.15	0.08	0.08	0.06	0.03
Adjust. R^2	0.09	0.15	0.25	0.22	0.04	0.14	0.06	0.08	0.04	0.02
F	6.79	10.46	18.69	16.27	3.17	9.50	4.55	19.51	3.65	1.18

Parameters are statistically different from zero at the 1, 5 and 10% confidence level in a two-tailed t test.
t-statistics and ***, **, and * denote significance levels, respectively.

R^2 measures reveal that the combined innovation capability indicators explain variation in factors of innovation types. The highest R^2 values are found in models of F3 'Innovation and R&D' and F4 'Performance and Strategy Management'. Components of F3 are more directly related with all aspects of innovation compared to other factors. F4 includes strategic dimensions of business. Therefore, the indicators seem to be more effective at strategic and innovation related factors. In order to test the robustness of the results and trace individual impact of innovation ecosystem variable, components of innovation capability indicators in the model are decomposed as internal and external factors. R^2 measures are lower compared to base Model; therefore, the empirical results of the base Model are presented in the study.

All base model runs have high F values (Table 4), showing that the hypothesis of innovation

indicators are not important is rejected at one percent level in all models.

In analyzing the effect of innovation indicators on innovation type, cooperation with customers seems the most influential indicator. It is significant at 1% confidence level at F1, F2, F3, F4, F6, F7, F8 and 5% at F5. This finding states that the impact of customer cooperation is very strong at both process and product innovations. On the other hand, cooperation with suppliers has a high impact only on F2 and F6, which are related to sales and distribution. This might be expected since suppliers, distributors are linked to the sales operation within the supply chain. However, the results indicate that cooperation with competitors has no significant effect on any innovation type in the sample.

R&D expenditure in total revenue is significant at 1% confidence level for F3, F4, F6, F8 and F9. These factors are mostly related to product innovation activities. Therefore, R&D expenditure is an important indicator for new product development of SMEs in the sample.

Among ICT application indicators, the impact of e-trade dominates the others. E-trade is significant at 1% for F2, F4 and F8. This implies that e-trade promotes sales and distribution activities and encourages product innovation through technology diffusion in export and import activities. On the contrary to expectations, web-site ownership and portal membership have minor influence on a few factors. In terms of machinery and laboratory utilization, the latter affects all process innovation factors at different significance levels. The former is only significant for F1 and F6.

A striking finding is that training has a significant effect on product innovation and on all process innovation factors at varying significance levels. This is a very promising finding, stating that SMEs are prone to training and are successful at transforming this to innovative activities. The characteristics of the sample also reflect the importance of training from SMEs point of view. 45% of the SMEs in the sample receive training. On the other hand, consultancy has a much weaker impact on innovation types.

6. Conclusion

Innovation ecosystem is perceived as a major source of competitive advantage in global business environment. This study defines the innovation ecosystem for SMEs in Turkey in a causal framework where the internal and external indicators of innovation lead to enhanced innovation

capability. The study is based on a survey study with 1663 SMEs and empirical findings are derived from multivariate analyses of the sample data. Through factor analysis, thirty dimensions of process innovation are reduced to seven factors; three dimensions of product innovation to one factor and five dimensions of property rights to two dimensions.

Regression analysis results emphasize the significant effect of training on process and product innovations. Therefore, SMEs have a tendency to transform knowledge to innovative activities. Secondly, the impact of customer cooperation is very strong at both process and product innovations while cooperation with suppliers has a limited impact on any type innovation. Third important finding shows that R&D expenditure in total revenue is very influential on product innovation activities, indicating that R&D expenditure is important for new product development of SMEs. Among ICT application indicators, the impact of e-trade dominates web-site ownership and portal membership. This implies that e-trade promotes sales and distribution activities and encourages product innovation through technology diffusion in export and import activities. In terms of technical infrastructure utilization, laboratory affects all process innovation factors. Main policy implication of the study emphasizes that the SMEs are open to training and they believe that knowledge is an important channel for them to create innovative activities. However, their technical infrastructure utilization should be encouraged and their relations with the rest of the world should also be strengthened through incentives and supports by government, public and private sectors.

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