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Innovative Capacity Determinants: An Empirical Study of Turkish Firms

Aysa Ipek Erdogan

Correspondence: Aysa Ipek Erdogan, Department of Banking and Finance, Okan University, Tuzla Kampusu, 34959 Akfirat Tuzla Istanbul, Turkey. Tel: 90-216-677-1630. E-mail: aysa.erdogan@okan.edu.tr

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Abstract

This paper presents an empirical examination of the determinants of innovative capacity of Turkish firms. The sample consists of 215 domestically-owned firms and is confined to the period of 2005-2008. Innovative capacity is measured with patent and trademark applications. The results show that patent intensity is not affected by financial performance, firm growth and value-added productivity. Trademark intensity is also not affected by financial performance and firm growth. Larger and younger domestically-owned firms are more patent-intensive in Turkey. On the other hand, smaller and older firms are more trademark-intensive. Less capital-intensive firms have more propensity to innovate. In addition, exporting increases patent intensity even though it decreases trademark intensity.

Keywords: innovation, patent, trademark, Schumpeterian hypothesis

1. Introduction

Innovation, which can be defined as the exploitation of new ideas that results in the creation of a new product, process or service, is considered to be a driver of economic prosperity for nations. For firms, innovation is important to gain competitive advantage and it is expected to bring about survival and growth.

Because innovation is considered as a major engine of growth, it becomes important to make an empirical examination of how several factors contribute to the innovative activities of companies. Examining the determinants of innovative capacity is a crucial step in the search for policies to enhance growth and development. There are several empirical studies that identify potential determinants of innovative capacity. However, these studies have contradictory findings.

Research on the issue of the determinants of innovative capacity of Turkish firms is deficient mainly because of the difficulty of access to up-to-date data on firms. The aim of this paper is examining how several factors contribute to the innovative capacity of the companies in Turkey. We analyze whether firm size, profitability, firm growth and exporting, which are considered to be the relevant factors in innovation, have any effect on the innovative activities of Turkish firms. Using a panel of 215 firms over the period 2005-2008, we find that financial performance, firm growth and value-added productivity have no effect on patent intensity. Financial performance and firm growth also do not affect trademark intensity. Patent intensity of larger and younger firms is higher in Turkey. On the other hand, smaller and older firms are more trademark-intensive. Less capital-intensive firms have more propensity to innovate. In addition, exporting increases patent intensity even though it decreases trademark intensity.

The remainder of this paper is structured as follows: In the next section, we review the literature on the determinants of innovative capacity. Section 3 depicts our sample. Research methodology is described in Section 4. Section 5 discusses our empirical results and section 6 concludes.

2. Literature Review

There are several empirical studies that identify the potential factors that influence innovative capacity. The potential factors and their expected relationships with innovativeness are discussed below.

2.1 Firm Size

In the literature, size is considered to be a relevant factor in innovation. Schumpeter (1912, 1939) argues that smallness is the driving force behind innovation activity because small firms have the necessary flexibility that is

needed for the implementation of innovation related projects. However, Schumpeter (1942) reverses himself later and suggests that large firms have more incentives to innovate because they have the chance to sell their inventions to a larger number of consumers. Maatta (2001) indicates that large firms are more innovative because it is easier for them to absorb the losses of unprofitable projects. Moreover, the author argues that large firms can diversify the risk of innovation projects by undertaking many projects at the same time. Kamien and Scwartz (1982) suggest that bureaucracy in large firms brings about a less motivating environment for the creative contributions of the employees. Therefore, innovative employees are expected to prefer to work in smaller companies where they can find greater latitude.

The literature that focuses on studying the impact of size on innovativeness has contradictory findings. Scherer (1965) demonstrates that size has a negative effect on the patent intensity of the US firms. Mansfield (1971) finds that the market share of the largest firms in the pharmaceuticals, petroleum, coal and steel industries is higher than their share in the innovative activities of these industries. Audretsch (1995) provides evidence showing that small firms are more innovative than large firms in the US.

Lee (2004), Bhattacharya and Bloch (2004) and Murro (2011) find a positive relationship between firm size and innovation in Malaysia, Australia and Italy, respectively. Pamukcu and De Boer (2001) and Gunday, Ulusoy, Kilic and Alpkan (2008) show that firm size exert a positive impact on innovation propensity in Turkey. Crespi and Zuniga (2010) provide evidence that large firms are more innovative than small firms in Latin American countries.

Chandy and Tellis (1998) demonstrate that firm size is not a powerful driver of innovation. Crepon, Duguet and Mairesse (1998) show that firm size does not have any relationship with innovation propensity in France. Mel, McKenzie and Woodruff find that (2009) size has no effect on innovation activities in Sri Lanka.

Freeman (1971) provides evidence that small firms are more innovative than large firms in industries with low capital intensity, low entry costs and low product development costs. In industries with high capital intensity, large firms are more innovative. The author denotes that low industry entry costs (for example, costs of scientific instruments) reduce the barriers to innovation. Acs and Audretsch (1988) show that there is a U-shaped relationship between innovation and firm size.

2.2 Profitability

Profitability is considered as another relevant factor in innovation. Grabowski (1968) indicates that availability of funds from profits should be conducive to innovative activities as well as capital expenditures. Branch (1974) suggests that in low-technology industries, innovative activities have a secondary strategic role for the firms. The author argues that firms in these industries pursue an innovation strategy only when profits are suffering.

Grabowski (1968) shows that the level of internally generated funds has a positive relationship with innovation activities. Pamukcu and De Boer (2001) find that financial performance exerts a positive impact on innovation propensity in Turkey. Bartoloni (2010) provides evidence that operating profits are positively associated with innovation propensity in Italy. Hall, Mairesse, Branstetter and Crepon (1999) find that R&D spending is more sensitive to cash flows in the United States than in France and Japan.

Audretsch (1995) demonstrates that profitability has a positive effect on innovativeness only in high-technology industries. In contrast to this finding, Bhattacharya and Bloch (2004) show that profitability has a positive relationship with innovative activity in the low technology group. The authors suggest that low technology firms undertake innovation when there is availability of funds from profits. Heshmati and Loof (2006) provide evidence that gross profitability does not have any influence on R&D investments in Sweden.

2.3 Firm Growth

Another factor to study is firm growth. Mueller (1967) argues that high growth in sales is an important incentive for innovation because it increases the confidence of the firm in the rewards from innovative activity. Audretsch (1995) suggests that firm growth has a greater positive effect on the innovative activities of the firms that operate in low-technology industries because these firms see the currently offered products as the reason of low growth.

Mueller (1967) finds that growth in sales reinforces R&D spending in the US. Audretsch (1995) provide evidence showing that high growth generates more innovative activity in low-technology industries. Bhattacharya and Bloch (2004) demonstrate that firm growth does not have any impact on innovative activity.

2.4 Exporting

Exporting is considered to enhance innovation efforts because exposure to foreign trade gives the firms the chance to learn about more sophisticated technologies through trading partners and exerts competitive pressure

to attain superior performance. Braga and Willmore (1991) and Alvarez (2001) show that export intensity has a positive relationship with innovativeness in Brazil and Chile, respectively. Mel et al. (2009) also show that export intensity is positively associated with innovation activities in Sri Lanka. However, Lee (2004) demonstrates that there is a negative relationship between the share of exports in sales and innovation propensity in Malaysia. Ebling and Janz (1999) find that exporting does not enforce innovation activities in the service industries in Germany. Monreal-Perez, Aragon-Sanchez and Sanches-Marin (2011) provide evidence showing that there are no learning by exporting effects on innovation activities in Spain. Damijan, Kostevc and Polanec (2010) demonstrate that exporting leads to only process innovations in Slovenia.

3. The Sample

The sample consists of 215 private domestically-owned firms that are among the top 500 industrial enterprises in Turkey. Firms with majority domestic ownership are labeled as domestically-owned firms. We conduct panel data regressions on the unbalanced panel that covers the period of 2005 to 2008. Data on patents and trademarks is hand-collected from the Turkish Patent Institute database. Financial data is extracted from the survey data of Istanbul Chamber of Industry.

The industry distribution of the sample is presented in Table 1.

Table 1. Industry distribution of the sample

Industry	Number of Firms
Mining and Quarrying	3
Food, Beverages and Tobacco	42
Textile, Wearing Apparel, Leather and Shoe	30
Forest Products and Furniture	9
Paper, Paper Products and Printing	7
Chemicals, Petroleum Products, Rubber and Plastic Products	28
Non-Metal Mineral Products	20
Basic Metal	38
Metal Products and Machinery	17
Automotive Industry	11
Other	3
Electricity	7
TOTAL	**215**

4. Research Methodology

The determinant factors of innovation capacity are explored with an econometric model. Our panel data regression equation is:

$$Y_{it} = \gamma_0 + \gamma_1 TA_{it} + \gamma_2 PPM_{it} + \gamma_4 ROE_{it} + \gamma_5 CS_{it} + \gamma_6 EI_{it} + \gamma_7 CI_{it} + \gamma_8 AGE_{it} + \gamma_9 LP_{it} + \gamma_{10} SPOV_{it} + \sum \beta_m ID_{im} + h_t + e_{it} \quad (1)$$

where Y_i stands for the innovation propensity measure and h_t captures the time fixed effects. e_i is the unobserved influence on innovation propensity. We also include industry dummies (ID) in the estimation.

Two different variables are employed to measure innovative capacity: patent intensity (number of patents granted whose applications are made in the last four years/total assets) and trademark intensity (number of trademarks registered whose applications are made in the last four years/total assets).

The independent variables included in the model are firm size (TA), pretax profit margin (PPM), return on equity (ROE), percentage change in sales (CS), export intensity (EI), capital intensity (CI), age (AGE), labor productivity (LP) and horizontal productivity spillover effects of foreign ownership (SPOV). Pretax profit margin and return on equity are taken as alternative measures of profitability.

Pretax profit margin, return on equity, sales growth and export intensity are expected to have a positive effect on innovation capacity. We also expect to find a positive relationship between capital intensity and innovativeness. Value-added productivity is expected to have a positive impact on innovation because high productivity that implies a high expected return from innovation creates an incentive for innovative activity. We measure value-added productivity with labor productivity.

Productivity spillovers that stem from the existence of foreign-owned firms in the same industry are called horizontal spillovers. We expect to find that the spillover of the technological capabilities, innovativeness, and

marketing and management know-how of foreign-owned firms has a positive impact on innovation capacity. Therefore, a positive sign is expected for the horizontal spillovers variable.

SPOV is our proxy for foreign presence in the related industry and we calculate it by the ratio of majority foreign-owned firms' employment to total employment in the industry. This ratio is calculated with the employment data of the top 1000 industrial enterprises that is provided by Istanbul Chamber of Industry.

We do not prognosticate on the impact of firm size and age on innovation propensity.

Least squares panel data estimator with period fixed effects is used to obtain the parameter estimates. Eviews 7.0 software package is used to conduct the analysis. Parks coefficient covariance estimator method (Period SUR) is used in panel data regressions.

We include the period fixed effects in the models because they are jointly significant. The cross-section random effects are also significant, however we could not include both period fixed effects and cross-section random effects in our estimation because mixed and fixed effects are not allowed with unbalanced data. When we estimate our models with a cross-section random effects estimator, we see that the results are broadly similar.

Table 2 presents the description of the variables that will be used in panel data model building.

Table 2. Description of the variables

Dependent Variable	Name	Description
Patent Intensity	PI	Number of patent applications made in the last four years/Total Assets*
Trademark Intensity	TI	Number of trademark applications made in the last four years/Total Assets*
Independent Variable	**Name**	**Description**
Size	TA	Total Assets*
Pretax Profit Margin	PPI	Net Profit before Taxes/Net Sales
Return on Equity	ROE	Net Profit before Taxes/Stockholders' Equity
Percentage Change in Sales	SG	$(\text{Total Sales}_t^* - \text{Total Sales}_{t-1}^*)/\text{Total Sales}_{t-1}^*$
Export Intensity	EI	Exports/Net Sales
Capital Intensity	CI	Total Assets*/Number of Employees
Age	AGE	
Labor Productivity	LP	Gross Value Added* / Number of Employees
Horizontal Spillovers	SPOV	Majority foreign-owned firms' employment/Total employment in the industry

Note: * million TL. Inflation adjustment is done by calculating the change in wholesale price index, 2003=100.

Descriptive statistics of the variables for years 2005 and 2008 are presented in Table 3.

5. Empirical Findings

Table 4 shows our empirical results. Column 1 presents the result of the model where patent intensity is the dependent variable. Trademark intensity is the dependent variable of the model whose result is shown in column 2.

In our model where patent intensity is the dependent variable, we see that the coefficients of total assets, capital intensity and age are significant at 0.01 level. In addition, the coefficient of export intensity is significant at 0.10 level. Firm size has a positive relationship with patent intensity. Counter to our expectation, capital intensity is found to have a negative relationship with it. Positive coefficient of export intensity is in line with our expectation. We also find that patent intensity is not affected by value-added productivity.

In our model where trademark intensity is the dependent variable, we see that the coefficients of total assets, export intensity, capital intensity and age are significant at 0.01 level. In addition, the coefficient of value-added productivity is significant at 0.10 level. Size has a negative relationship with trademark intensity. Negative coefficients of export intensity, capital intensity and productivity are not in line with our expectations. Age is found to have a positive impact on trademark intensity.

We see that profitability measures and firm growth does not have any effect on our measures of innovation capacity. These results are not in line with our expectations. Our results also do not show any impact of foreign presence on the innovation capacity of Turkish firms.

Table 3. Descriptive statistics

Dependent Variables	Mean	S.D.	Median
Patent Intensity			
2005	0.0026	0.0103	0.0000
2008	0.0057	0.0182	0.0000
Trademark Intensity			
2005	0.0802	0.1679	0.0126
2008	0.1052	0.2426	0.0229
Independent Variables	Mean	S.D.	Median
Size			
2005	306.71	547.39	166.14
2008	335.97	567.42	173.22
Pretax Profit Margin			
2005	0.05	0.11	0.03
2008	0.03	0.12	0.03
Return on Equity			
2005	0.12	0.24	0.10
2008	0.04	1.43	0.08
Percentage Change in Sales			
2005	0.10	0.20	0.07
2008	-0.07	0.19	-0.09
Export Intensity			
2005	0.29	0.26	0.23
2008	0.32	0.26	0.26
Capital Intensity			
2005	0.43	0.47	0.29
2008	0.43	0.56	0.26
Age			
2005	33.47	17.27	33.00
2008	36.47	17.27	36.00
Labor Productivity			
2005	0.09	0.13	0.05
2008	0.08	0.14	0.04
Horizontal Spillovers			
2005	0.11	0.09	0.05
2008	0.12	0.12	0.08

6. Conclusion

Firm-level innovation is an important factor that brings about survival, competitive advantage and growth. Examining the influences on innovativeness is important in the search for policies to enhance growth and development. Moreover, it will help in the effort to determine potential candidates for innovation incentives. This paper aims to make an empirical examination of the determinants of innovation capacity of domestically-owned companies in Turkey. Seven determinants of innovation were tested: size, profitability, sales growth, export intensity, capital intensity, value-added productivity and horizontal spillover effects of foreign-ownership. A panel data set of 215 domestic firms for the period 2005-2008 is used for the analysis. We find that patent intensity is not affected by financial performance, firm growth and productivity. Trademark intensity is also not affected by financial performance and firm growth. Patent intensity increases with firm size and export intensity. However, it decreases with age and capital intensity. Age has a positive impact on trademark intensity. Size, export intensity, capital intensity and labor productivity are found to have a negative impact on it. The negative effect of size on trademark intensity implies a hopeful result for Turkish firms, most of whom are SMEs.

Table 4. Panel data regression results

Dependent Variable	Patent Intensity	Trademark Intensity
Independent Variables		
Constant	0.009	0.07
	(5.19)	(4.77)
Size	0.0002	-0.0001
	(4.25)***	(-7.73)***
Pretax Profit Margin	-0.005	-0.008
	(-1.01)	(-0.22)
Return on Equity	0.004	-0.015
	(1.56)	(-0.65)
Percentage Change in Sales	-0.002	0.007
	(-0.69)	(0.56)
Export Intensity	0.002	-0.092
	(1.65)*	(-9.24)***
Capital Intensity	-0.004	-0.03
	(-6.49)***	(-6.70)***
Age	-0.0005	0.007
	(-4.96)***	(4.68)***
Labor Productivity	-0.002	-0.04
	(-0.98)	(-1.78)*
Horizontal Spillovers	0.01	-0.05
	(2.11)	(-0.44)
R^2	0.16	0.23
F-Statistic	6.27	9.93
Prob(F-Statistic)	0.000	0.000
Total panel	777	767

Note: Industry dummies are included in estimates. The null hypothesis that the coefficient equals zero is tested. T-value is in brackets. *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

Negative effect of export intensity on trademark intensity can be the result of contract manufacturing done by Turkish firms. We see that low capital intensity has an enforcing effect on innovativeness in Turkey.

Because of limited available data, we cannot use additional non-financial variables in this study. Future studies can attempt to examine the role of the non-financial variables on the innovation capacity of Turkish firms.

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