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Impact of foreign ownership on innovation

Abstract

Prior research provides evidence on the impact of ownership structures on corporate performance. One attribute of corporate performance is the technological achievement. Foreign ownership might have positive impact on technological achievement through increase in research and development (R&D) intensity or technology transfers. The aim of this study is analyze the impact of foreign ownership on both R&D intensity and technological achievement measured by patents and patent applications in a developing country context. When interpreted together, results suggest that technological achievement is mostly related to internationalization of the firm both through trade and ownership in addition to size and R&D intensity.

Keywords: Foreign ownership, R&D expenditures, patents, Turkey.

JEL Classification: G32, M40, O32.

Introduction

In today's complex and rapidly changing business environment, converging technology and business strategy is crucial for sustainability of the companies, specifically in developing economies. One of the main drivers of facilitating explorative and revolutionary technology innovations is corporate governance mechanisms, including ownership structure of the companies.

Innovation and technology are one of the main aspects in which foreign-owned and domestically owned firms differ in European and non-European

countries [Dachs, Peters 2013]. Ebersberger and Lööf [2005] analyzed the innovation behavior and performance of foreign owned firms in the Nordic region, and found that in Norway, foreign-owned firms have a larger propensity to patent than domestically owned firms. These results does not hold for other Nordic countries [Ebersberger, Lööf 2005]. Consistently, Vishwasroa and Bosshardt [2001] argue that technological achievement is essential for the long-run economic growth and foreign-owned firms are more likely to adopt new technology in India. Diaz-Diaz et. al. [2008] reports that there is no significant difference between the innovation of foreign and domestic firms for Spanish sample. Since different results are found for different countries, evidence from more countries are necessary to contribute to the literature that analyzes the impact of foreign ownership on innovation. Considering relatively scarce resources (micro and macro) devoted to innovative technology in emerging markets, the necessity of technological investment and transfer by foreign partners is crucial. Thus, we mainly focus on *foreign ownership* and technology achievement relationship in emerging market context.

Literature generally uses R&D investments and patent applications as innovation output and foreign ownership variables are found as significant determinants of innovation process [Ebersberger, Lööf 2005]. However, Bishop and Wiseman [1999] suggest that ownership has an indirect influence on innovation by affecting the probability of the presence of R&D expenditures. This indirect influence is important on understanding whether foreign ownership triggers technological transfer or increase R&D investment as a technological achievement policy.

This study explores the relationships between foreign ownership and technological achievement in a developing country context. The aim of this study is to show the impact of foreign ownership not only on R&D intensity but also on the technological achievement measured by patents and patent applications. Results suggest that, foreign ownership improves technological achievement. Additionally, in a developing country context, technology transfer seems to be preferred to R&D investment. More importantly, more internationalized firms are expected to achieve technologic success.

The second section includes the literature review, the third section will present the methodology used. The fourth section reports the results of the empirical analysis, and the fifth section concludes.

1. Literature review

While literature provides evidence that foreign ownership has a positive impact on domestic technological achievement through technology transfers, some researchers argue that foreign firms acquire the most productive firms in an industry, and technological achievement may be expressed by Schumpeterian

hypothesis [Schumpeter 1943]. Schumpeterian hypothesis argues that large firms are advantageous in carrying out the R&D necessary for innovation [Schumpeter 1943; R&D and technology transfer are substitutes rather than complementary inputs to the innovation process [Love, Ropper 1999].

Falk [2008] found that the differences between the innovation intensities of foreign-owned and domestic firms are mainly due to the firm based factors rather than the differences in coefficients; the dominance of foreign-owned firms in the largest firm size group is the main factor contributing to the gap in the percentage of innovators between foreign-owned firms and domestic firms. According to Griffith, Redding and Simpson [2004], foreign owned firms tend to be larger, and have higher export intensity. Thus according to these findings, a large part of the differences in innovation intensity between foreign owned and domestic firms may be due to a compositional effect, i.e. to the high concentration of foreign owners in specific industries, internationalization through exports, and to the presence of a size factor [Falk 2008]. Vishwasroa and Bosshardt [2001] also report that larger firms, as measured by assets, sales or age, tend to purchase more technology.

Bishop and Wiseman [1999] found that foreign ownership has a negative indirect impact upon innovation as a mixed support for the Schumpeterian hypothesis for UK. However, the sample of this study is interesting since defense related industries of UK are investigated. The results of Bishop and Wiseman [1999] show that involvement in export markets, technological opportunity and R&D collaboration have positive impacts on innovation.

Thus according to the literature, both R&D intensity and internationalization (export) are mediating factors on the relationship between foreign ownership and innovation. Since the aim of this study is to analyze the impact of foreign ownership on the technological achievement, mediating effects of R&D intensity and internationalization (export) should be also considered. Although Bishop and Wiseman [1999] found positive results for these relationships, the impact of foreign ownership on innovation may differ according to firm and country specific factors [Dachs, Peters 2013]. This study expects that the joint impact of foreign ownership with R&D intensity, and foreign ownership with export intensity significantly effects technological achievement in Turkey as an emerging country.

2. Research methodology

2.1. Data and variables

Love and Roper [1999, p. 48] define innovation as “the number of new or improved products introduced at plant level”. According to Lofts and Loundes [2000, p. 1], “Innovation is the activity of marketing or implementing new or improved products and processes”.

These definitions reflect the two aspects of innovation those are the “technological” and “commercial”, respectively. Patents may be fair indicators of the technological aspect of innovation, whereas the commercial aspect of innovation is related to and affects firms’ competitive position and economic advantage [Love, Roper 1999]. Additionally, Mansfield [1984] argue that the measures of innovation such as R&D expenditure or employment are disadvantageous for having no necessary link to any tangible innovation output. Therefore, this study measures innovation as the existence of patent activities.

The literature points out R&D expenditures, exports, debt level and foreign ownership as the explanatory factors explaining innovation [Gambardella et al. 2007; Bishop, Wiseman 1999; Vishwasroa, Bosshardt 2001; Falk 2008]. Additionally, in accordance with the Schumpeterian hypothesis [Schumpeter 1943], size is added to the model. Thus, we developed the following research model, including these determinant variables suggested by the above literature.

$$\begin{aligned} INNOVATION (PATENT) = & \alpha + \beta_1 (Foreign\ Ownership) \\ & + \beta_2 (Export\ Intensity) \\ & + \beta_3 (R\&D\ Expenditures) \\ & + \beta_4 (Foreign\ Ownership * Export\ Intensity) \\ & + \beta_5 (Foreign\ Ownership * R\&D\ Expenditures) \\ & + \beta_6 (Sales, Size, Debt) \end{aligned}$$

The dependent variable PATENT takes value of 1, in case of a patent application(s) for the year in question, and 0 otherwise. Since the dependent variable is a binary variable, probit and logit models may be applied [Maddala 1991, pp. 789-790]. According to Hamilton et al. [1977, p. 714] “it is difficult to choose between the logit and probit models. If the true response curve is closely approximated by one model, it probably is closely approximated by the other”. In this study, a probit model is applied in parallel with Gambardella et al. [2007], however, the results are robust for the use of either probit or logit models.

Our sample includes all the non-financial firms that are listed in Borsa Istanbul (BIST) during the period of 2005-2010 with 1149 observations. The financial and ownership variables in this study are hand collected from the annual and financial reports of the listed firms. These reports are obtained from the web pages of BIST and the Public Disclosure Platform of Turkey.

Three kinds of patent data are used in this study as national, regional, and international patent applications. A patent application may be filed in one or more national patent offices can be filed at regional patent offices (European Patent Office (EPO)) or can be filed in the PCT (WIPO Patent Cooperation Treaty) as an international patent application [Parisi, Rodriguez-Cerezo, Thangaraj 2007].

Data on national and international patent applications were obtained from the publicly available database [www1]. “Esp@cenet” comprises a worldwide patent collection from more than 80 countries including Turkey, additionally WIPO and European patents that the EPO provides free Web access.

For the data collection, first the “Change Country” mode is used, and “Turkey” field is chosen and the page is directed to [www3]. “Advanced Search” mode is used for the generation of the PATENT variable. “Advanced Search” mode allows the researcher to analyze four data collections as follows:

1. Complete collection of Turkish National published patent applications.
2. Worldwide collection of published applications from 90+ countries.
3. Complete collection of European published applications.
4. Complete collection of WIPO PCT published applications.

Using the “Applicant” field in the “Advanced Search” mode, non-financial firms that are listed in BIST are scanned for the four collections listed above. An applicant is defined as a person or organization that has filed a patent application.

As an example, if the company “Turk Demir Dokum Fabrikalari A.S.” is analyzed, firstly if “Turk Demir Dokum Fabrikalari A.S.” is written in the “Applicant” field, 27 results are found in the Complete collection of Turkish National published patent applications. “Turk Demir”, “Turk Demir Dokum”, “Demir Dokum” are searched additionally for sensitivity. PATENT variable takes value of 1 if the company has a patent application for the year in question. The search is revised for the worldwide collection of published applications from 90+ countries, complete collection of European published applications, and the complete collection of WIPO PCT published applications. “Application date” is used for the variable generation.

Nevertheless, there may be several applications for the same invention. The company may have a national patent application in 2008, and an international PCT patent application in 2010 for the same invention. In this case, PATENT variable takes value of 1 for 2008, and 0 for 2010.

The independent variables are FOREIGN, FOREIGND, EXPORT, RD, SALES, SIZE, and DEBT as stated in the model.

FOREIGN variable is shows the percentage of equity held by foreign shareholders; while FOREIGND is a dummy variable, taking the value “1” if the firm has foreign shareholders, and “0” otherwise. EXPORT is the percentage of export sales over total net sales, and RD is calculated as the percentage of research and development expenditures over total net sales. SALES is the total net sales over total assets, SIZE is the natural log of the firms’ total assets and lastly DEBT is long term debt over total assets.

We expect positive coefficients for FOREIGN, FOREIGND, EXPORT, RD, and SIZE. Yet, we make no predictions for the SALES and DEBT variables.

3. Results

To be able to see the relationship between foreign ownership and R&D Intensity, a t-test is applied yearly for the sample period. The results are presented at Table 1. The results show that R&D intensity is significantly lower for firms with foreign ownership. This finding might suggest that firms with foreign ownership prefer technology transfer instead of complementary inputs to the innovation process as suggested by Love and Ropper [1999].

The descriptive statistics and the t-tests for the Mean Values of the Dependent Variables are shown in Table 2 and Table 3. Table 2 presents the differences in the mean values of patent applications based on existence of foreign ownership, export intensity, sales level and size factors. Specifically, mean foreign ownership is significantly higher for firms with patent applications. This finding interpreted together with findings presented at Table 1 provides interesting insight that, foreign owned firms achieve technological achievement through technology transfer. Additionally, findings show that firms with high export levels has more technological achievement. This finding might suggest that internationalization in the form of trade as well as ownership has a positive impact on technological achievement. The impact of size on technological achievement is also in line with the previous literature. In Table 3, it is shown that foreign firms with high exports level have significantly more propensity to have patents than domestic firms. Furthermore, the foreign ownership and R&D Intensity differs for firms that have patent applications.

Table 1. Descriptive statistics and T-tests for the Mean Values of the foreign ownership and R&D intensity

T-tests FOREIGND	(RD)**	
	0	1
2005	.004	.002
2006	.008	.003
2007	.008	.003
2008	.007	.002
2009	.009	.003
2010	.008	.002

* p < .10, ** p < .05, *** p < .01.

Note:

FOREIGND = dummy variable, taking the value 1 if the firm has foreign shareholders; RD = the percentage of research and development expenditures over total net sales.

Table 2. Descriptive statistics and T-tests for the Mean Values of the Dependent Variables

T-tests	(FOREIGN)***	(EXPORT)***	(RD)	(SALES)**	(SIZE)***	(DEBT)						
PATENT	0	1	0	1	0	1						
2005	9.34	18.94	.22	.38	.0036	.0051	1.42	18.74	19.75	.15	.14	
2006	9.58	23.56	.22	.43	.0066	.0052	1.06	1.22	18.81	20.32	.15	.10
2007	11.46	17.38	.23	.32	.0064	.0054	1.01	1.3	18.88	19.65	.13	.12
2008	11.43	15.96	.25	.34	.0059	.0073	1.003	.95	19.01	20.28	.16	.15
2009	12.08	12.14	.24	.27	.0077	.0082	.95	.96	18.98	19.92	.15	.17
2010	10.8	19.52	.2	.33	.0062	.0069	.94	1.20	19.11	20.26	.15	.16

* p < .10, ** p < .05, *** p < .01.

Note:

PATENT = dummy variable, taking the value 1 if the firm has published patent application; FOREIGN = the percentage of equity held by foreign shareholders; EXPORT = the percentage of export sales over total net sales; RD = the percentage of research and development expenditures over total net sales; SALES = Total Net Sales over total assets; SIZE = natural log of total assets; DEBT = long term debt over total assets.

Table 3. Descriptive statistics and T-tests for the Mean Values of the Interaction Variables

T-tests	(FOREIGNx EXPORT)***		(FOREIGNx RD)**	
PATENT	0	1	0	1
2005	1.87	6.26	.027	.06
2006	1.79	10.31	.042	.13
2007	2.48	6.34	.042	.09
2008	3.03	5.71	.034	.06
2009	3.06	4.70	.046	.06
2010	2.41	6.46	.016	.09

* p < .10, **p < .05, *** p < .01.

Note:

PATENT = dummy variable, taking the value 1 if the firm has published patent application; FOREIGN = the percentage of equity held by foreign shareholders; EXPORT = the percentage of export sales over total net sales; RD = the percentage of research and development expenditures over total net sales.

Table 4. Results of the Pooled¹ Probit Regression, 2005-2010, (n = 1149)

Variables ^a	Pred.	Dependent Variable: PATENT Coefficients					
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
FOREIGN	+	----	----	----	-.03	.190	.350***
FOREIGND	+	----	----	-.17	----	----	----
EXPORT	+	----	----	.50**	.64***	.770***	.910***
RD	+	----	----	4.70**	4.95**	5.190**	3.580*
FOREIGN* EXPORT	+	----	.020***	----	.01	----	----
FOREIGN* RD	+	----	.140	----	.11	----	----
FOREIGND* EXPORT	+	1.09***	----	1.19**	----	----	----
FOREIGND*RD	+	13.12	----	14.70	----	----	----
SALES		.06	.070	.09	.09	.090	.090*
SIZE	+	.21***	.220***	.22***	.22***	.210***	----
DEBT		.08	.120	.12	-.11	-.120	-.009
_cons		-5.51***	-5.550***	-5.77***	-5.80***	-5.770***	-1.730***
Wald chi2		69.84***	68.350***	81.63***	77.63***	74.810***	34.030***
Log likelihood		-347.528	-365.798	-341.63	-343.64	-345.042	-365.430

* p < .10, ** p < .05, *** p < .01

Note:

PATENT = dummy variable, taking the value 1 if the firm has published patent application; FOREIGN = the percentage of equity held by foreign shareholders; FOREIGND = dummy variable, taking the value 1 if the firm has foreign shareholders; EXPORT = the percentage of export sales over total net sales; RD = the percentage of research and development expenditures over total net sales; SALES = Total Net Sales over total assets; SIZE = natural log of total assets; DEBT = long term debt over total assets.

¹ In all models, rho is zero meaning that the panel-level variance component is unimportant, and the panel estimator is not different from the pooled estimator. Rho test formally compares the pooled estimator (probit) with the panel estimator [www2].

Table 4 presents the results of the Probit Regression. When different models are interpreted together, R&D intensity, Export intensity, the interaction of foreign ownership and export intensity and size are significant determinants of technological achievement. The results for R&D intensity and size are consistent with literature.

However, more interestingly, the interaction of two internationalization variables, namely export intensity and foreign ownership have significantly positive impact on technological achievement in addition to the positive significant effect of export intensity. This suggests that internationalization is a triggering factor in technological achievement.

Conclusions

Literature argues that technological achievement is essential for the long-run economic growth. One of the main drivers of facilitating explorative and revolutionary technology innovations is corporate governance mechanisms, including ownership structure, of the companies.

The aim of this study is to analyze the direct impact of foreign ownership on the technological achievement measured by patents and patent applications in a developing country context. Additionally, the joint impact of foreign ownership and research and development intensity and foreign ownership and export intensity on technological achievement are analyzed.

The findings show that, in a developing country context, firms with foreign ownership prefer technological transfer instead of R&D investment as a technological achievement policy. Additionally, larger firms exhibiting high sales and export level with foreign ownership have higher technological achievement.

When interpreted together, results suggest that technological achievement is mostly related to internationalization of the firm both through trade and ownership in addition to size and R&D intensity. As conclusion it can be said that internationalization has a positive effect on technological achievement confirming Falk [2008] results in a developing country context.

As a limitation of this study, we provided evidence only from Turkish market by using a sample composed of relatively larger and publicly owned listed firms. Moreover, due to the limited sample, industry effect could not be discussed. Further research may be conducted in various emerging markets by considering industry effects as well.

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