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EFFECT OF CORPORATE GOVERNANCE PRACTICES ON R&D AND INNOVATION COSTS: A CASE STUDY ON BORSA İSTANBUL*

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ABSTRACT

This study aimed to reveal the impact of corporate governance practices (CGP) on research and development (R&D) expenses and innovation costs. The businesses registered in Borsa Istanbul (BIST), with complete data regarding R&D and innovation costs for 2009–2017, were analyzed. The panel regression analysis performed through the STATA 15.0 program revealed that the board size, number of independent board members, gender diversity in the board of directors, chairman's tenure, board meeting frequency, and business scale had a statistically significant and positive effect on the realized R&D expenses. Furthermore, it was determined that the number of foreign members of the board of directors, board ownership, and the organizational age had a statistically significant and negative effect on the nominal R&D expenses. However, it was also discovered that the role duality and business scale had a statistically significant and positive impact. In contrast, the foreign member ratio on the board of directors and organizational age had a statistically significant and negative effect on innovation costs.

Keywords: Corporate Governance, Innovation Costs, R&D Expenses, R&D, Innovation.

JEL Codes: M40, M41, M49.

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KURUMSAL YÖNETİM UYGULAMALARININ AR-GE VE İNOVASYON MALİYETLERİ ÜZERİNDEKİ ETKİSİ: BORSA İSTANBUL' DA BİR ARAŞTIRMA

ÖZ

Hazırlanan çalışmanın amacı, kurumsal yönetim uygulamalarının Ar-Ge giderleri ve inovasyon maliyetleri üzerindeki etkisini incelemektir. Bu amaç doğrultusunda, Borsa İstanbul'a (BİST) kayıtlı işletmelerden 2009 – 2017 yıllarına ait Ar-Ge ve inovasyon maliyetleri eksiksiz şekilde elde edilen işletmeler analiz kapsamında incelenmiştir. STATA 15.0 programı kullanılarak gerçekleştirilen panel regresyon analizine göre; yönetim kurulu büyüklüğünün, bağımsız üye sayısının, cinsiyet çeşitliliğinin, yönetim kurulu başkanı görev süresinin, yönetim kurulu toplantı sıklığının ve işletme büyüklüğünün gerçekleşen Ar-Ge giderleri üzerinde istatistiksel açıdan anlamlı ve pozitif etkiye sahip olduğu görülmüştür. Ayrıca yönetim kurulu yabancı üye sayısı, yönetim kurulu sahipliği ve işletme yaşının ise ortaya çıkan Ar-Ge giderleri üzerinde istatistiksel açıdan anlamlı ve negatif etkiye sahip olduğu tespit edilmiştir. Bununla birlikte inovasyon maliyetleri üzerinde etkilerinin incelendiği rol ikiliği ve işletme büyüklüğünün istatistiksel açıdan anlamlı ve pozitif, yönetim kurulu yabancı üye oranı ve işletme yaşının ise inovasyon maliyetleri üzerinde istatistiksel açıdan anlamlı ve negatif etkiye sahip olduğu tespit edilmiştir.

Anahtar Sözcükler: Kurumsal Yönetim, İnovasyon Maliyetleri, Ar-Ge Giderleri, Ar-Ge, İnovasyon.

JEL Kodları: M40, M41, M49.

1. INTRODUCTION[1]

Corporate scandals, economic crises and bankruptcies on a global scale have created new challenges and crystallized the fundamental role of corporate management systems. It is arguable that the corporate governance (CG) understanding, including a broad framework from corporate image to shareholder rights protection with various applications, has become an integral part of the business world in developed countries.

However, the effective management of raw information and innovation is adapted to CG visions in economies with highly competitive environments. It can be stated that this interaction indirectly affects the innovation capabilities of enterprises. These innovation capabilities are usually assessed by the importance level that businesses attach to research and development (R&D) activities and new technological processes. The pressing puzzle is about how CG practices (CGPs) affect the innovation capabilities and R&D activities of enterprises.

This study aimed to determine the effects of CGPs shaped by a company's economic, legal, and social characteristics on R&D expenses and innovation costs in the case of Borsa İstanbul (BIST). The CG, R&D, and innovation

[1] This study derived from the doctoral thesis titled "The Effect of Corporate Governance Practices on R&D and Innovation Costs: A Research in Borsa Istanbul" prepared by Bekir GEREKAN under the consultancy of Prof. Dr. Hüseyin Ali KUTLU.

concepts will be briefly discussed in the following sections. The study will elaborate on the general assessments about the empirical findings obtained from the panel regression analysis followed by the findings, conclusion, and suggestions.

2. CORPORATE GOVERNANCE, R&D AND INNOVATION

2.1. Corporate Governance

Recent studies have defined the CG concept as a "holistic complex of interactions between the board, shareholders, and external partners" (OECD 2015: 9).

Various definitions of this concept can be found in the literature. Luo (2005: 2) defined the concept of CG as a bilateral relationship that strategically examines and controls the relationship between the business and its shareholders. Cuervo (2002: 84) conceptualized CG as a system that protects shareholders and other stakeholders from the discretionary power of management, while Ahlering and Deakin (2007: 876) defined it as a mechanism that reduces agency costs and maximizes business wealth. Furthermore, Sternberg (1998: 28) explained the concept of CG as the power that enables corporate activities, business assets and executive representatives to be directed towards achieving the corporate goals determined by the organization's shareholders.

The concept of CG has been a subject of research on management since the early 1980s. However, this concept changed through the studies conducted in the first half of the 1990s, as it evolved into a concept that includes business planning and internal processes (Forbes and Milliken, 1999: 498–499). Moreover, the concept experienced another transformation since the first half of the 2000s. The alternative approach of CG now includes management elements that can be effective in increasing the business performance and ensuring investor confidence (Reed, 2002: 228–232).

2.2. R&D and Innovation

In the global world order, technology and knowledge have become a priority in achieving sustainable competitive power (OECD, 1999). Technological innovations emerging as a result of R&D and innovation activities carried out on behalf of countries and enterprises play an essential role in achieving the desired competitive advantage.

There are numerous definitions in the literature regarding R&D and innovation concepts. These concepts are depicted in different ways according to their intended use and user preferences. According to the Accounting System Application General Communiqué, published in the Official Gazette dated 26/12/1992 and numbered 21447, R&D is the

activities performed to reduce production-related costs and increase sales, and adopt modern production methods. An alternative perspective argued that R&D is an effort that enables the provision of unique productions depending on the development and renewal of ideas regarding the existing structure. (Fidancı, 2017: 72). Thus, the concept of R&D can be expressed as the set of systematic efforts that enable the transformation of the knowledge into outputs that will provide added value for the organization.

On the other hand, the concept of innovation is derived from the word 'innovare' or 'innovates', originating from Latin (Başaran and Keleş, 2015: 106). This concept essentially means "doing something new" (Lin and Ho, 2007: 2). It is possible to describe this concept as revealing the non-existent in the market or improving the existing one in terms of process, service, or product (Bentz, 1997: 12).

R&D activities are vital in the innovation attempts of enterprises. However, it is not possible to say that all innovation outputs occur through R&D activities. Therefore, it is possible to say that the concept of R&D is one of the elements under the roof of innovation (Şahin, 2004: 262).

3. LITERATURE REVIEW

There are several studies in the literature on CGPs. Most of the studies on the subject are on the correlation between CGPs and financial performance (Ahmed and Hamdan, 2015; Balsarı et al. 2015; Kara et al. 2015; Labelle et al. 2015; Singh, 2015; Aytekin and Sönmez, 2016; Otluoğlu et al. 2016; Terjesen et al. 2016; Atılgan, 2017; Gunnarsson et al. 2017; Taşkın and Mandacı, 2017; Talavera et al. 2018).

Though there is little research on the correlation between CGP and R&D and innovation investments. Recent studies that have examined this phenomenon are summarized below.

The results of studies on the impact of the institutional investor level on R&D investments vary. In some studies conducted on the subject it has been stated that the increases occurring at the institutional investor level, which has business shares, positively affect R&D and innovation investments (Eng and Shackell, 2001; Tribo et al. 2007; Choi et al. 2011; Lhuillery, 2011; Choi et al. 2012; Aghion et al. 2013; Brossard et al. 2013; Setayesh et al. 2016; Doğan and Tiryakioğlu, 2018). Moreover, it was revealed as a result of these studies that this situation negatively affects R&D and innovation investments (Graves and Waddock, 1990; Ren et al., 2012; Cebula and Rossi, 2015; Lee, 2015; Minetti et al. 2015). Moreover, there are previous studies on the effects of the organizational investor level on R&D and innovation investments with findings that proved a statistically insignificant impact (Lee, 2012; Singh and Gaur, 2013).

The board size and the number of independent board members are among the analyzed CGPs regarding R&D and innovation investments. Previous studies provided divergent results regarding the effects of both the number of members and independent members on the board of directors on business performance. Some previous studies concluded that these variables affect R&D and innovation investments positively (Zhaohui and Ding, 2012; Shapiro et al. 2015; Ashwin et al. 2016; Chen et al. 2016; Chou, 2017). However, there are also arguments on this effect with a contrary direction (Mat Rabi et al. 2010; Chen, 2012; Ren et al. 2012; Zhaohui and Ding, 2012; Shapiro et al. 2015; Setayesh et al. 2016).

Furthermore, it was observed that contradictory results were reached in studies on the effects of the number of meetings held by the board of directors during a fiscal period and role duality on R&D and innovation investments. Donaldson and Davis (1991), Finkelstein and D'Aveni (1994), Mat Rabi et al. (2010), Ntim and Osei (2011), Chen (2012), and Chou (2017) discovered that the number of board meetings and role duality factors have positive effects on R&D and innovation investments. However, Rechner and Dalton (1991), Mallette and Fowler (1992), and Ren et al. (2012) stated the contrary. Moreover, Mat Rabi et al. (2010), Coles et al. (2001), Zhaohui and Ding (2012), and Shapiro et al. (2015) found that these CGPs did not have a statistically significant effect on R&D and innovation investments.

Certain schools of thought have also focused on the impact of the number of female members on the board of directors, which is one of the CGPs, on R&D and innovation investments. Recent studies have placed reservations on the mentioned variables regarding their positive effects on R&D investments (Talke et al. 2010; Torchia et al. 2011; Østergaard et al. 2011; Pfeifer and Wagner, 2012; Jiménez and Fuentes, 2015; Teruel et al. 2015; Galia and Zenou, 2012). Moreover, there are also studies in contemporary thought that have stated that the current effect level is negative (García and Velasco, 2016).

It is possible to assert that this study obtained similar results with the studies on the effects of foreign member ratio on the board of directors and the chairman’s tenure on R&D and innovation investments. Barker and Mueller (2002) found that a longer chairman’s tenure at the board increased the impact on these expenditures, as the chairmen gradually directed the R&D expenditures based on their preferences. Similar results were propounded by Mezghanni (2010) as well, who stated that R&D investments increase during the first 15 years depending on the chairman’s tenure at the board, as the chairmen begin to adopt investment-oriented attitudes with reductions in the relevant expenditures. Cucculelli (2018) further elaborated on studies conducted by Barker and Mueller's (2002) and Mezghanni (2010) and investigated the effects of the chairman’s tenure on R&D and innovation

investments depending on the organizational age. It was determined that there was a positive correlation between the chairman's tenure at the board of directors and innovation performance in enterprises where the organizational age was between 20 and 39 years. However, it was stated that this correlation was negative in businesses where the organizational age was 40+ years. On the other hand, Midavaine et al. (2016) determined that the chairman's tenure had a negative impact on these investments. Moreover, a positive relationship was found in studies examining the impact of the number of foreign members on the board of directors on R&D and innovation investments to be carried out by enterprises (Miller and Triana 2009; Makkonen et al. 2018).

4. METHODOLOGY

4.1. Subject and Purpose of the Research

There are several studies in the literature examining the impact of CGPs on financial performance. However, the research on the impact of CGPs on R&D or innovation costs is very limited. These studies are mostly in English, and there are very few studies on the subject in Turkish. However, it has been observed that CGPs are usually generalized by including only one or two elements, both in local and international studies. Therefore, there is an epistemological gap in the literature.

The aim of this study was to examine the impact of corporate CGPs shaped by the economic, legal, and social characteristics of enterprises registered in BIST on R&D expenses and innovation costs.

The corporate elements of all of the enterprises (BIST All Enterprises group) in BIST were determined and the impact of these elements on R&D expenses and innovation costs were examined. The indicators considered as a basis for the CG characteristics of the enterprises were determined by examining the studies in the literature. The indicators were determined from the most preferred variables in measuring CGPs.

This study differentiated itself by the measurement of R&D expenses and innovation costs in accordance with the TAS 38 Intangible Fixed Assets Standard and by addressing the effects of CGPs on R&D expenses and innovation costs separately. Therefore, it is believed that the findings will contribute to the literature.

4.2. Research Method

The panel data analysis method was used in this study to analyze the impact of CGPs on R&D expenses and innovation costs. The main reason behind this methodological approach was that the panel data analysis method allows more effective research through both time series and cross-section

data together. STATA 15.0 (StataCorp LLC, College Station, TX, USA) was used for the data analysis.

4.3. Data Set, Sample, and Boundaries of the Study

The first data set of the analysis was created from the financial statement data of 513 enterprises in the BIST All Enterprises group that were disclosed to the public between 2009 and 2017. These data were obtained from the official website of the Public Disclosure Platform (PDP).

The second data set was related to the CG features of the enterprises. These data were obtained from the activity reports of the enterprises, CG principles, compliance reports, and the websites of the enterprises.

However, this study had certain limitations. First, the research findings could only be generalized for companies that traded on the BIST. Second, the data only covered the years from 2009 to 2017 for the selected enterprises. The continuous data on R&D expenses in 76 of the 513 companies in BIST were obtained for this period. Moreover, the continuous data for the capitalized development costs between 2009 and 2017 were only available for 22 of the 513 enterprises in total. Furthermore, continuous data on the variable of board meeting frequency were available for 41 businesses. The fact that all 513 enterprises in BIST were not available for use in the analysis was yet another limitation in the process.

4.4. Research Variables

Three models were developed for the application stage of the study. A total of 13 variables, including 2 dependent variables (DVs), 9 independent variables (IVs), and 2 control variables (CVs), were used. Detailed explanations of the mentioned variables are provided in the following section.

Table 1: Variables of the Research

Variable Type	Variable	References	Calculation Method	Symbol
Dependent Variable (DV)	"R&D Expenses"	"Kocamış and Güngör (2014), Cebula and Rossi (2015)".	"R&D Expenses Logarithm"	R&D
	"Innovation Costs"	"Littkemann (1996), Kostellou and Tsakiri (2010), Dainien and Dagiliene (2014), Yangfan (2015), Labunska et al. (2017)".	"Capitalized Development Costs Logarithm"[2]	Inv_Mlyt
Independent Variable (IV)	"Independent Board Member"	"Chau & Gray (2010), Müller (2014), Liao et al. (2015), Akdoğan et al. (2017), Ben-Amar et al. (2017), Sword and North (2019)".	"Number of Independent Board Members/Total Number of Board Members"	IBM
	"Board Meeting Frequency"	"Laksmana (2008), Ntim and Osei (2011), Chen (2012), Ocak and Özden (2017), AlQudah et al. (2019)".	"Total Number of Board Meetings Logarithm"	BMF
	"Corporate Ownership"	"Chang et al. (2008), Laksmana (2008), Samaha et al. (2012), Juhmani (2013), Soliman et al. (2014), Lee (2015)".	"Corporate Investors Percentage"	CO
	"Board of Directors Ownership"	"Demsetz and Villalonga (2001), Eng and Mak (2003), Fauzi and Locke (2012), Bhagat and Bolton (2013)".	"Board Members' Share Percentage in the Capital"	BDO
	"Foreign Members Percentage in the Board of Directors"	"Ujunwa et al. (2012), Kılıç (2014), Sunday and Godvin (2017), AlQudah et al. (2019), Okere et al. (2019)".	"Number of Independent Board Members/Total Number of Board Members"	FMPBD
	"Board Size"	"Cheng & Courtenay (2006), Laksmana, (2008), Samaha et al. (2012), Uyar et al. (2013), Müller (2014)".	"Total Number of Members on the Board of Directors Logarithm"	BS
	"Role Duality"	"Chang et al. (2008), Aygün and İç (2010), Mezghanni (2010), Doğan et al. (2013) and Kılıç (2014)".	"1 if the General Manager is also the Chairman of the Board, 0 otherwise"	RD
	"Chairman's Tenure"	"Golden and Zajac (2001), Vafeas (2003), Musteen et al. (2006), Mezghanni (2010)".	"Term of Office for the Chairman of the Board Logarithm"	CT
	"Gender Diversity in the Board of Directors"	"Barako and Brown (2008), Rupley et al. (2012), Müller (2014), Liao et al. (2015), Ben-Amar et al. (2017)".	"The Female Member Number Board of Directors/Total Number of Board of Directors Number of Members"	GDBD

[2]"It is the calculation used under the Chart of Accounts Compliant with Financial Reporting Standards published by the Public Oversight, Accounting and Auditing Standards Authority (PO) on 31/12/2018".

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Table 1 includes the calculation methods and symbol representations of the DVs and IVs. Moreover, the information is available about cited studies for each variable.

Table 2: Control Variables

Variable Type	Variable	Calculation Method	Symbol
Control Variables (CV)	"Business scale"	"Total Assets Logarithm"	BS
	"Organizational Age"	"The Registered Period to BIST Logarithm"	OA

Several studies on CG features have found that CVs that can affect the general functions of the enterprises are widely used. Therefore, BS and OA were determined to be a CV.

4.5. Research Model and Hypotheses

Below are the 3 panel data models applied in the research.

Model 1: ***(1)***

$$R\&D_{it} = \beta 0 + \beta\ 1\ IBM_{it} + \beta\ 2\ GDBD_{it} + \beta\ 3\ CO_{it} + \beta\ 4\ BS_{it} + \beta\ 5\ RD_{it} + \beta 6\ FMPBD_{it} + \beta\ 7\ CT_{it} + \beta\ 8\ BDO_{it} + \beta\ 9\ BS_{it} + \beta\ 10\ OA_{it} + u_{it}$$

Model 2: ***(2)***

$$Inv\_Mlyt_{it} = \beta 0 + \beta\ 1\ BS_{it} + \beta\ 2\ RD_{it} + \beta\ 3\ FMPBD_{it} + \beta\ 4\ BDO_{it} + \beta\ 5\ BS_{it} + \beta\ 6\ OA_{it} + u_{it}$$

Model 3: ***(3)***

$$R\&D_{it} = \beta 0 + \beta\ 1\ IBM_{it} + \beta\ 2\ GBPD_{it} + \beta\ 3\ BS_{it} + \beta\ 4\ RDI_{it} + \beta 5\ FMPBD_{it} + \beta\ 6\ CT_{it} + \beta\ 7\ BDO_{it} + \beta\ 8\ BS_{it} + \beta\ 9\ OA_{it} + \beta\ 10\ BMF_{it} + u_{it}$$

Table 3: Research Hypotheses

Hypothesis	Explanation
H_1	"Corporate ownership level has a statistically significant effect on R&D expenses."
H_{2A}	"The board members' share level in the capital has a statistically significant effect on R&D expenses".
H_{2B}	"The board members' share level in the capital has a statistically significant effect on Innovation Costs."
H_{3A}	"Board size has a statistically significant effect on R&D expenses."
H_{3B}	"Board size has a statistically significant effect on Innovation Costs."
H_4	"The independent board members ratio has a statistically significant effect on R&D expenses."
H_5	"Board meeting frequency has a statistically significant effect on R&D expenses."
H_{6A}	"Role duality has a statistically significant effect on R&D expenses."
H_{6B}	"Role duality has a statistically significant effect on Innovation Costs."
H_7	"Gender diversity in the board of directors has a statistically significant effect on R&D expenses."
H_{8A}	"The independent board members ratio has a statistically significant effect on R&D expenses."
H_{8B}	"The foreign member ratio on the board of directors has a statistically significant effect on Innovation Costs."
H_9	"The chairman's tenure of the board has a statistically significant effect on R&D expenses."

The analysis regarding the effects of CGPs on R&D expenses and innovation costs was conducted in line with the hypotheses established utilizing the relevant literature summarized in Table 3.

5. FINDINGS

The variable stationarities should be investigated before model estimation to avoid spurious regression problems due to models with non-stationary series in the panel data analysis. Therefore, the stationarities were examined with the Levin, Lin, and Chu (LLC) tests and assessed within the scope of first and second-generation unit root tests (Tatoğlu, 2017: 68). The relevant results indicated that all of the variables were stable at the level. The results are available in Appendix 1.

However, the Hausman test was applied to determine the panel data model for regression analysis between fixed-effect (FE) and random-effect (RE) models. The Hausman test results favored the FE estimator for Model 1 and

the RE estimator for Models 2 and 3. The results are available in Appendix 2.

It is vital to examine the assumptions about autocorrelation, heteroscedasticity, and inter-unit correlation problems in fixed and random effects models. Facing one or more of such problems causes erroneous results regarding the predicted models (Ün, 2018: 75). After conducting the Bhargava et al. Durbin-Watson (DW) test, the obtained scores were below 2, which meant that there was an autocorrelation problem in the developed models (Tatoğlu, 2016: 238). Accordingly, it was observed that the DW test values in Table 7 were less than 2, which was specified as the critical value for all 3 models. Therefore, it can be said that there was an autocorrelation problem in all 3 models. However, the modified Wald test of Model 1 revealed a heteroscedasticity problem in the designed model. Moreover, the Levene, Brown, and Forsythe tests applied for Models 2 and 3 indicated a heteroscedasticity problem in these models. Nevertheless, the Pesaran test results implied an inter-unit correlation problem for Model 2, but not for Models 1 and 3. The relevant test results are provided in Appendix 3.

The Arellano, Froot, and Rogers, and Driscoll and Kraay resistant estimators, commonly used in the literature, were chosen for performing the regression analyses of Models 1–3. These estimators were chosen because of their resistance to heteroscedasticity, autocorrelation, and inter-unit correlation problems, and ability to provide effective results (Tatoğlu, 2016: 276). Accordingly, the regression results are summarized in the following section.

Table 4: Regression Results for Models

- Model 1 - Dependent Variable: R&D Year Range: 2009 - 2017 Number of Firms: 76 Total Number of Observations: 684				
Variables	**Efficiency**	**Std. Error**	**t – Statistics**	**Probability Value**
IBM	0.3863	0.2051	1.88	0.096***
GDBD	1.5200	0.3652	4.16	0.003*
CO	-0.0004	0.0025	-0.02	0.987
RD	-0.1323	0.1874	-0.71	0.500
FMPBD	-0.6559	0.3294	-1.99	0.082***
BDO	-0.0089	0.0068	-1.30	0.228
BS	0.3444	0.1019	3.38	0.010*
CT	-0.0025	0.0397	-0.06	0.950
BS	0.4940	0.1126	4.39	0.002*
OA	0.5303	0.1004	5.28	0.001*
Fixed Term	2.0531	1.9822	1.04	0.331
R^2 = 0.2290	**F = 18544.42**	**Prob > F = 0.0000**		
- Model 2 - Dependent Variable: Inv_Mlyt **Year Range: 2009 - 2017 Number of Firms: 22 Total Number of Observations: 198**				
Variables	**Efficiency**	**Std. Error**	**t – Statistics**	**Probability Value**
BS	-0.2883	0.2462	-1.17	0.275
BS	0.9690	0.1666	5.82	0.000*
OA	-0.6000	0.2026	-2.96	0.018**
FMPBD	-0.8685	0.4365	-1.99	0.082***
BDO	0.0063	0.0062	1.02	0.337
RD	0.7909	0.3613	2.19	0.060***
Fixed Term	-0.9942	3.0182	-0.33	0.750
R^2 = 0.4412	**Wald chi^2 (6) = 2460.15**	**Prob > chi^2 = 0.0000**		
- Model 3 - Dependent Variable: R&D Year Range: 2009 - 2017 Number of Firms: 41 Total Number of Observations: 369				
Variables	**Efficiency**	**Std. Error**	**t – Statistics**	**Probability Value**
BS	0.2195	0.3643	0.60	0.547
CT	0.1277	0.0767	1.66	0.096***
BS	0.6597	0.1557	4.24	0.000*
OA	-0.2689	0.4564	-0.59	0.556
BMF	0.3112	0.1440	2.16	0.031**
IBM	0.5173	0.5130	1.01	0.313
GDBD	2.2793	1.1640	1.96	0.050**
FMPBD	-0.5562	0.5126	-1.09	0.278
BDO	-0.0155	0.0098	-1.58	0.115
RD	-0.1229	0.3553	-0.35	0.729
Fixed Term	-0.2920	2.5966	-0.11	0.910
R^2 = 0.2446	**Wald chi^2 (10) = 59.97**	**Prob > F = 0.0000**		
"Note: (*), (**) and (***) signs indicate significance level at 1%, 5% and 10%, respectively."				

First, the regression results of Model 1 revealed that the variables of the GDBD, BS, and OA and BS had a positive effect on R&D, at a significance level of 1%. Moreover, it was also found that the IBM had a positive on

R&D, at a significance level of 10%. Moreover, it was determined that the FMPBD had a negative effect on R&D, at a significance level of 10%.

The regression results of Model 2 showed that the BS had a positive effect on innovation costs, at a significance level of 1%. Furthermore, it was determined that the RD had a positive effect on innovation costs, at a significance level of 10%. Moreover, it was revealed that the OA had a negative effect on innovation costs, at a significance level of 5%. Moreover, it was concluded from the previous table that the FMPBD had a negative effect on innovation costs, at a significance level of 10%.

Last, the regression results of Model 3 indicate that the BS, BMF, and GDBD had a positive impact on R&D expenses, at significance levels of 1%, 5%, and 5%, respectively. However, it was determined that the CT had a positive effect on R&D at a significance level of 10%.

5.1. Assessment

It was found that the FMPBD had a negative effect on Models 1 and 2. Although it was not statistically significant, this condition was similar for Model 3. Thus, it can be argued that the increase in the number of foreign board members should reduce the R&D expenses and innovation costs of enterprises.

Milliken and Martins (1996) also stated that the number of FMPBD negatively affected the potential innovation and R&D activities. Similarly, Balsarı et al. (2015) argued that broad racial diversity in management reduces the R&D and innovation intensity of enterprises due to business tendencies to prefer technology transfers instead of complementary inputs in their R&D and innovation processes. Chen et al. (2016) concluded that ethnic differences in business management negatively affected the potential R&D and innovation activities in their studies on Taiwanese enterprises.

Another variable that had a positive effect in all of the research models was the BS, at a significance level of 1%. The results indicated that the increase in an enterprise's total assets should positively affect future R&D and innovation costs. Recent studies have offered similar results (Choi et al. 2011; Chen, 2012; Kılıç and Keklik, 2012; Cebula and Rossi, 2015; Shapiro et al. 2015; Bobillo et al. 2017).

The empirical results showed that the BS had a positive effect on R&D. It can be argued that the increase in the number of board members should have a positive effect on R&D. This finding complied with the resource dependency theory. As the BS increases, the business accessibility and provides several advantages regarding substantial resource acquisitions. This result was similar to previous studies (Khanchel, 2007; Rabi et al. 2010; Shapiro et al. 2015; Ashwin et al. 2016).

Moreover, the regression results indicated that the BS had a negative effect on innovation costs. This finding supported the arguments of the agency theory. This theory conceptualizes conflicts rooted in the board size, and difficulties in decision-making cause the performance deteriorations in enterprises. Therefore, an optimum limit on the number of board members is necessary for businesses. Torchia et al. (2011) and Zhaohui and Ding (2012) reached conclusions in line with this argument.

It was also discovered that the IBM had a positive effect on R&D. This result was in accordance with the agency and resource dependency theory assertions. The presence of external board members is essential with regard to the board of directors' efficiency. However, it is arguable that the diversification of corporate culture will affect business performance positively. Black et al. (2006), Cornett et al. (2007), O'Connell and Cramer (2010), and Balsmeier et al. (2017) also reached results complimentary to this finding.

It can be asserted that talent pools created with gender diversity can contribute to an enterprise's performance. However, the presence of female members on the board of directors enables efficient results in decision-making regarding business activities by making the board more heterogeneous. Nevertheless, the CMB's communiqué in 2012 suggested that at least 1 female member should be on an enterprise's board of directors. The analysis of the impact regarding the GDBD has a positive effect on R&D. This result was in agreement with those of previous studies (Pearce and Zahra 1991; Ararat et al. 2010; Torchia et al. 2011; Lückerath-Rovers 2013).

Executives may be reluctant to set goals and produce projects with ambiguities in increasing shareholder profitability in businesses where the board members' capital share is high. The regression analysis regarding the effect of the BDO on R&D produced a positive correlation. It can be asserted that increases in the board members' capital share will be reflected as decreases in R&D expenses. However, it is arguable that this situation has a contrary effect on innovation costs. This difference is possibly rooted in the possibility of future economic benefits associated with intangible assets' encouraging effect on executives to have a positive attitude towards such investments. Moreover, the empirical results indicated that the BDO had a positive effect on innovation costs. The findings regarding board ownership were similar to the results obtained by previous research (Vafeas and Theodorou 1998; Beiner et al. 2006).

Another variable that examined the impact on R&D expenses and innovation costs was the RD. The regression results showed that the RD had a negative effect on R&D. It was indicated that the duality in management will affect R&D expenses negatively. This situation was similar to the

results obtained by Jermias (2007) and Blibech and Berraies (2018). Moreover, studies examining the CEO's role through the agent theory broadly accepted assertions that "the chairman of the board of directors and the general manager positions are executed by separate individuals increase the enterprise performance". Therefore, the duality is likely to positively affect business performance and innovation activities, particularly in the long-term context (Goegel and Jong 2017: 18). Nevertheless, it was observed that the RD had a positive effect on innovation costs. This finding supported the previously reached results by Goegel and Jong (2017).

Frequent board meetings increase the checks for business executives. Moreover, they also ensure that the executives receive information about the organization on time and have the opportunity to analyze the emergent problems rapidly. It can be asserted that the BMF held by the boards of directors during an activity cycle and the business performances are correlated (Al Hares et al. 2018: 3020). It was determined that the BMF had a positive effect on R&D. Thus, it can be argued that the increase in the number of meetings held by the board of directors during an activity cycle will positively affect future R&D activities. Noor (2011), Chen (2012), and Al-Najjar (2014) reached conclusions complimentary to this finding.

6. CONCLUSION

The last two decades have brought a significant increase in the number of studies regarding the impact of CGPs on business performance. However, this issue has been analyzed through cases from developed countries. Empirical studies on these topics with cases from developing countries like Turkey are only preliminary. There is merit in this state, as companies in these countries mostly address non-transparent explanations about the CG vision, and certain difficulties in the related data collection process.

Three models were created for this study. Models 1 and 3 focused on the effects of CGPs on R&D expenses, while Model 2 analyzed the effects of these applications on innovation costs.

The analyses performed via Models 1 and 3 revealed that the BS, IBM, GDBD, CT, BMF, OA, and BS had a positive effect on the realized R&D. However, it was determined that the FMPBD had a negative effect on R&D.

The regression analysis performed via Model 2 indicated that the RD and BS had a positive effect on innovation costs. Moreover, it was determined that the FMPBD and OA had a negative effect on innovation costs.

Even in the businesses operating in Turkey with potentially improved CG visions, it is considered that CGPs are not implemented properly. Therefore, CG principles, transparency, accountability, fairness, and responsibility must be internalized, and a CG culture that will appeal to all departments of

an enterprise must be established to adapt a sustainable CG vision in enterprises. Regulators should develop several strategies and practices to design a CG vision that can be suitable for business culture.

Particular sectoral distinctions can be applied in the data collection process for future studies, and alternative indicators of CGPs can be utilized.

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APPENDIX

Appendix 1: Unit Root Tests

	First Generation LLC Test		Second Generation LLC Test (Difference From Horizontal Cross Section Means)	
Variables	**Constant (p-value)**	**Constant & Trend (p-value)**	**Constant (p-value)**	**Constant & Trend (p-value)**
Model 1				
R&D	0.000*	0.000*	0.000*	0.000*
BS	0.000*	0.000*	0.000*	0.000*
CT	0.000*	0.030**	0.000*	0.000*
BS	0.000*	0.000*	0.000*	0.000*
OA	0.000*	0.000*	0.000*	0.000*
IBM	0.000*	0.000*	0.000*	0.000*
GDBD	0.000*	0.000*	0.000*	0.000*
CO	0.000*	0.000*	0.000*	0.000*
FMPBD	0.462	0.307	0.000*	0.000*
BDO	0.000*	0.000*	0.000*	0.000*
Model 2				
Inv_Mlyt	0.000*	0.000*	0.088***	0.000*
BS	0.000*	0.000*	0.000*	0.000*
BS	0.269*	0.000*	0.000*	0.000*
OA	0.000*	0.000*	0.000*	0.000*
FMPBD	0.000*	0.000*	0.003*	0.000*
BDO	0.000*	0.000*	0.000*	0.000*
Model 3				
R&D	0.0000*	0.0000*	0.0000*	0.0000*
BS	0.0000*	0.0000*	0.0000*	0.0000*
CT	0.0000*	0.476	0.0000*	0.0000*
BS	0.0136**	0.0000*	0.0000*	0.0000*
OA	0.0000*	0.0000*	0.0000*	0.0000*
BMF	0.0000*	0.0000*	0.0000*	0.0000*
IBM	0.0000*	0.0000*	0.0000*	0.0000*
GDBD	0.0140**	0.0000*	0.0000*	0.0000*
FMPBD	0.0000*	0.2508	0.0000*	0.0000*
CO	0.0000*	0.0000*	0.0000*	0.0000*

Note: (*), (**) and (***) signs indicate significance level at 1%, 5% and 10%, respectively.

Appendix 2: Hausman Test

Models	Probability Values
Model 1	0.005*
Model 2	0.783
Model 3	0.146
Note: (*), (**) and (***) signs indicate significance level at 1%, 5% and 10%, respectively.	

Appendix 3: Test Results on Assumptions

Autocorrelation Test			
Models	**Modified Bhargava et al. Durbin-Watson**		
Model 1	1.499		
Model 2	0.886		
Model 3	1.525		
Test of Heteroscedasticity - Modified Wald Test			
Models	**Probability Values**		
Model 1	0.000*		
Test of Heteroscedasticity - Levene, Brown ve Forsythe Test			
Models	**Probability Values**		
	W0	**W50**	**W10**
Model 2	0.000*	0.000*	0.000*
Model 3	0.000*	0.008*	0.000*
Cross Sectional Dependence Test			
Models	**Probability Values**		
Model 1	0.710		
Model 2	0.000*		
Model 3	0.899		
Note: (*), (**) and (***) signs indicate significance level at 1%, 5% and 10%, respectively.			