

The Effect of Ownership and Board Diversity on Innovation

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Abstract

This study examines that the effect of ownership and board diversity affects the R&D and innovation in Japanese corporations. This study divides board diversity into board demographic diversity and board task-related diversity. This study finds that the interaction between institutional investor's ownership and board task-related diversity makes a positive effect on the patent application as a surrogate of innovation while I do not obtain a significant result regarding board demographic diversity. The implication of this study is that by introducing diversity in the boardroom without caring ownership and a positive corporate situation, the corporate governance practice may become ostensible

1. Introduction

In Japanese corporate governance, foreign institutional investors' ownership has emerged, while stable shareholding (cross-shareholding) has declined in the last two decades. Corporations are being exposed to strong market pressures that force them to enhance their vigilance. Recent reforms in corporate governance are aimed at encouraging corporations to take risks and embark in innovative business. The purpose of the corporate governance code, executed by the financial agency in Japan and the Tokyo Stock Exchange in 2015, is to increase firm value in the medium to long term as well as attain corporate sustainability. R&D investment is essential for a corporation's growth and is a source of innovation because developing new products, processes, or technologies constitutes a source of competitive advantage and productivity. Corporate strategy and governance affect R&D expenditures (Scherer, 1982; Ettlie, 1998).

Recent reforms such as the corporate governance code require a corporation to have at least two outside directors, and recent reforms of the corporate board have attempted to enhance board independence and its monitoring capabilities. The trend toward corporate governance reform is inclined to make board composition diverse in terms of gender, nationality, career, education, and age. A board with a diverse composition may contribute to ensuring that different opinions and perspectives flow into the boardroom, which leads to stimulating discussions and prevents the board from falling into groupthink. Proxy advisor, Glass Lewis, proposes a new voting guideline regarding board gender diversity, which requires TOPIX100 corporations to take on female board members and auditors, and it is opposed to the provision of approving the nominating committee chair and the chair of the company in corporations where there are not any female auditors or board members (Glass

Lewis, 2018).

This study examines that the effect of ownership and board diversity affects the R&D and innovation in Japanese corporations. In other words, this study focuses on the influence of diversity in the boardroom on innovation. This study assumes that the diversity of board members stimulates discussions in the boardroom, which would be a factor to generate innovation through corporate governance.

2. The review of previous studies

2-1. Ownership and R&D investment

This research reviews previous studies focusing on the relationship between ownership and R&D investment and the study about board diversity. Studies on the relationship between ownership and R&D investment focused on the effects of ownership on R&D projects in terms of concentrated ownership and agency theory (Hill and Snell, 1988; Baysinger, Kosnik, and Turk, 1991; Francis and Smith, 1995; Laverty, 1996; Lazonick and O'Sullivan, 2000; Carpenter, Lazonick, and O'Sullivan, 2003), ownership and commitment (Lacetera, 2001), firm-specific investment (Mayer, 1997; Miozo and Dewick, 2002), managerial aspects (Ortega-Argiles et al., 2009; Aoki, 1999), and the takeover effect (Johnson and Roa, 1997; Honoré, Munari, and van Pottelsberghe de La Potterie, 2015).

From the agency theory perspective, concentrated ownership has a positive effect on R&D and innovation. Concentrated ownership helps alleviate the conflicts of interest between stockholders and managers. It reduces agency costs and promotes risk-taking among managers (Hill and Snell, 1988; Baysinger, 1991; Francis and Smith, 1995), while information asymmetry in R&D projects motivates a corporation to pursue short-term business. Institutional investors encounter difficulties grasping the features of an R&D project. Institutional investors are also sensitive to the immediate costs of a firm's R&D and have an orientation toward short-term earning prospects (Laverty, 1996; Lazonick and O'Sullivan, 2000; Carpenter et al., 2003).

In agency theory, a takeover is supposed to be a corrective method to improve corporate performance, correct managerial failure, and provide a disciplinary mechanism (Scharfstein, 1988). Managers concerned that low short-term profits will result in unwanted takeover attempts will focus on projects with short-term payoffs instead of long-term management (Stein, 1988; Maher and Andersson, 2002). In such cases, anti-takeover strategies would be useful to prevent a corporation from focussing on short-term management. Johnson and Roa (1997) note that anti-takeover amendments do not have any detrimental effects on R&D. Rather, strengthening anti-takeover protection causes corporate managers to focus on long-term benefits. Honoré et al. (2015) find a negative association between the limitations on anti-takeover measures and voting right restrictions and R&D intensity. However, a takeover would have a positive effect on R&D expenditures because it would increase the extent of ownership concentration, which forces alignment between the interests of stockholders and managers. It also contributes to long-term value (Zahra, 1995).

Managerial theory, which partly shares the basic premise of agency theory in terms of shareholding,

indicates that dispersed shareholding generates manager discretion in business while reducing shareholders' power, which enables top management to focus on the long-run business prospect. Ortega-Argiles et al. (2005) show that dispersed ownership also positively affects innovation because it favours managers' flexibility and specialisation. Furthermore, Aoki (2000) reveals that diffused ownership gives managers the discretion to pursue long-term business. Contrary to the general view of agency theory, in which the owner pressures managers to take short-term risks, Mayer (1997), Miozzo and Dewick (2002), and Lactera (2001) show that concentrated ownership positively affects innovation in the long term. Mayer (1997) and Miozzo and Dewick (2002) assert that concentrated ownership tightens reputational constraints and favours long-term relations, while Lactera (2001) describes how it favours financial commitments and organisational integration.

The findings from studies examining the relationship between R&D investment and ownership are inconsistent. This appears to be because they did not consider the characteristics of CEOs and top management. Top executives' differing personalities might lead them to interpret and process information about the corporation differently, leading to different patterns of inter-organisational strategy. Hambrick and Mason (1984) argue that organisational outcomes—both strategies and effectiveness—can be viewed as reflections of the values and cognitive bases of the top managers in an organisation.

2.2 Studies on the relationship between top management team and board diversity

In their seminal study on the relationship between Top Management Team (TMT) characteristics and R&D projects, Hambrick and Mason (1984) argue that the organisation's strategy can reflect the values of the cognitive bases of the top managers who adopted the upper-echelon perspective as well as examine how R&D spending varies from TMT characteristics. Diversity in a TMT's composition is a key factor that determines the level of R&D in a corporation. Innovation and creativity require a combination of skills and knowledge. Diversity in a TMT positively impacts innovation (Iansiti, 1993; Leonard and Sensiper, 1998; Thieme et al., 2003) because diversity in skills and experience among members might lead them to contribute various kinds of ideas and knowledge, resulting in the company being more likely to pursue innovation. In contrast to this positive view of innovation, diversity in a TMT team might impede innovation by increasing conflict among TMT members and lowering social cohesion due to their differing values, objectives, and backgrounds, which could complicate decision-making. In terms of this approach, diversity may lead to information overload, internal conflicts, and difficulties finding a common perspective (Olson et al., 1995). Moreover, diversity in a TMT positively impacts innovation (Iansiti, 1993; Leonard and Sensiper, 1998; Thieme et al., 2003) because diversity in skills and experience among members might lead them to contribute various kinds of ideas and knowledge, resulting in the company being more likely to pursue innovation.

The board takes the main role of governing corporations by monitoring and advising corporate managers. While top management executes the strategy and business decided and guided by the board, the board's role is to enhance firm value through governance capabilities. There are several

studies regarding board diversity and corporate performance and strategy. The idea of diversity in the board impacts performance through two channels: 1) a larger pool of candidates for directorship roles lead to higher quality directors—those with greater knowledge and skills—and the ability and willingness to put forth efforts to be selected for directorship roles; or 2) a change in board dynamics (Wahid, 2017).

Ben-Amar et al. (2013) divide diversity into statutory board diversity and demographic board diversity. Statutory board diversity refers to regulation-mandated or highly recommended 'best practices' or guidelines for governance put forward in several countries, such as separating the chairperson from the CEO and increasing the ratio of outsiders in the boardroom. This view emphasises the monitoring function and fiduciary role with respect to agency cost. On the other hand, demographic board diversity relates to the advisory role of the board and promotes the inflow of resources into the corporation. Amar et al. (2013) show that ownership affects the board's diversity and that institutional and family ownership with a low demographic diversity on the board have positive effects on a board's strategic decisions. Demographic diversity is relevant to resource allocation (Barney, 1991; Hillman, Nicholson, and Shropshire, 2008).

Kagzi and Guha (2018) summarise previous studies and define board diversity based on three criteria: 1) observable and less-observable criteria (Kang *et al.*, 2007); 2) structural diversity of the board (Srivastava, 2015); and 3) task-/non-task-related diversity in the board (Ararat *et al.*, 2015; Adams *et al.*, 2015). Kang *et al.* (2007) define board diversity as observable criteria such as nationality, age, and gender and as relatively less-observable criteria such as the educational, functional, and occupational backgrounds of board members. Structural diversity of the board (Srivastava, 2015) refers to attributes such as size, leadership structure (duality of chairman and CEO), founder leader as director, and the presence of international directors. Ararat *et al.* (2015) claim that task-related diversity is related to an educational or functional background, while non-task-related diversity includes gender, age, race, and nationality.

This study analyses the relationship among ownership, board diversity, R&D, and innovation based on these previous studies. Depending on the categorisation by Kagzi and Guha (2018), this study adopts two aspects of board diversity such as demographic diversity based on gender, age, and nationality and task-related diversity such as function, career, and ability.

3. Hypotheses development

Japanese corporate governance has been characterised by block shareholding among corporations and financial institutions, resulting in extensive intercorporate shareholding and low foreign shareholding ratios. An external market for corporate control was absent. This was also sustained by Japanese corporate conventions, such as strategic orientations and the employment system. After exposure to the global financial market and the emergence of foreign investors in the Japanese stock market from the mid-1990s, the Japanese corporate board system underwent considerable changes and is now more oriented towards stockholder value. Pressure from institutional investors drives

corporate managers to take a risk-preferred attitude. However, Japanese corporations still stick to insider-dominant boards. Boards composed of insiders avoid interference from owners and prioritise investors' interests. Recent moves (i.e., the imposition of statutory codes such as the corporate governance code and stewardship code) oblige corporations to adopt outside directors. This might have a two-sided effect on board composition. When retaining a low rate of institutional investors and cross-shareholding, firms may tend to pursue statutory diversity but possibly to a low extent. In contrast, corporations with high institutional investor stockholding might include outsiders in the boardroom, which might increase diversity in the boardroom.

The stewardship code recommends that institutional investors engage in invested corporation business in the long run to enhance firm value. Corporate governance code requires corporations to take risks and challenge innovative business. In light of these studies, the following hypotheses were formulated:

Hypothesis 1: Institutional investors' stockholdings increase R&D investment in corporations.

Followed by the emergence of institutional investors in the Japanese stock market, statutory code, such as the corporate governance code and the amendment of corporate law, forces the public to pay attention to the feasibility of the board's monitoring. However, the conventional corporate governance system, which is insider oriented, would still be intact. In 2015, in order to promote the committee system and the appointment of an outside director, company law introduced the audit committee to the company, which is a hybrid of the conventional system with an auditor and committee system. The conventional board system (i.e., the auditor system) must appoint two outside auditors, and it is also recommended to appoint two outside directors. For a company with an audit and supervisory committee, the corporation should reduce the burden in terms of setting an outsider as a product of compromise.

Diversity affects cohesion, which in turn affects innovation. Diversity in a top management team and board composition are key factors that determine the level of R&D in a corporation. A certain level of diversity permits the convergence of a multitude of perspectives and increases innovation. If conflict requires board members to reach a consensus and coordinate the various opinions among themselves, then diversity enables them to hold different views. A diverse team will inevitably have conflicts due to differing opinions, although this is not necessarily bad. Amason (1996) divides conflict into cognitive and affective conflict. Cognitive conflict contributes to high-quality decisions because the synthesis that emerges from the contest among diverse perspectives is generally superior to individual perspectives (Mason and Mitroff, 1981; Schweiger et al., 1986; Schweiger and Sandberg, 1989; Schwenk, 1990). Amason (1996) finds a strong relationship between cognitive and affective conflict as well as affective acceptance. Cognitive conflict could be important for a TMT because it provides evidence that the decision-making process is fair and open (Amason, 1996). Cognitive conflict is task oriented, and taking advantage of cognitive conflict increases the quality of decision-making. However,

if the conflict becomes affective, an individual’s opinion could be interpreted as hostile and hurt another person’s feelings. This would decrease the board’s ability and cause low productivity within the corporation.

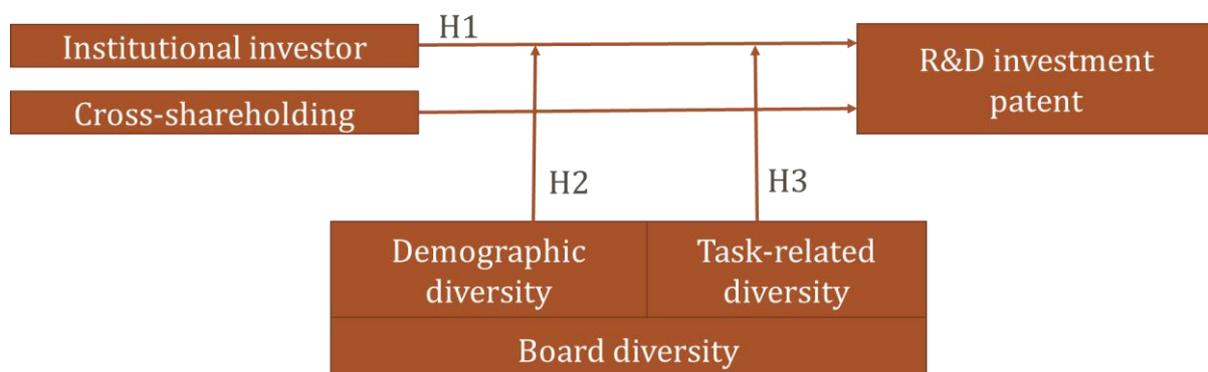
On this point, the introduction of demographic diversity based on gender, age, and nationality in the boardroom might not work well without caring about the task and ability of each board member because it would cause emotional conflict and might make it difficult to receive consensus. On the other hand, emphasising the task in comprising the members of the board, board members can be utilised to solve the issues faced by the corporation, and task-oriented governance would lead them to make high-quality decisions. Based on the task and problem, the board can create effective governance and would be expected to stimulate the efficiency of R&D activity and increase the number of patents as the surrogate for the outcome of R&D and innovation.

Yang and Wand (2014) reveal that corporate ownership moderates the relationship between board characteristics and entrepreneurial strategic orientation. Ben-Amar et al. (2013) show that ownership affects the board’s diversity. Institutional and family ownership with a low demographic diversity on the board have positive effects on a board’s strategic decisions, and demographic diversity is relevant to resource allocation (Barney, 1991; Hillman, Nicholson, and Shropshire, 2008). Therefore, in this study, board diversity can be interpreted as the moderating factor between ownership and R&D investment.

Hypothesis 2: A board with demographic diversity does not have a positively moderate relationship between ownership and R&D investment, an outcome of R&D investment.

Hypothesis 3: A board with task-related diversity moderates the relationship between ownership and R&D investment, outcome of R&D investment (patent).

Table 1. The analysis framework in this study



4. Methodology

4-1. Data collection and model

This study analyses the effect of ownership and board diversity on R&D and the outcome of R&D. This study focuses on 335 Tokyo Stock Exchange-listed corporations, and data were collected from 2007-2015. Data on ownership were collected from the Nikkei Corporate Governance Evaluation System. The female board rate data were collected from the Thomson Reuters DataStream, and financial data were collected from the Nikkei financial database. Patent data were collected from the Publication of Patent Application. OLS multiple regression was applied to analyse the relationship between ownership, R&D, and innovation. The model is estimated as a fixed-effect model with year-specific dummy variables to control for the systematic time period effect. The model is formulated below.

$$\begin{aligned} R\&D_{it} \text{ intensity } (\log R\&D_{it}) = & \alpha + \beta_1 \text{ Institutiona_Investor}_{it} + \beta_2 \text{ logsize}_{it} + \beta_3 \text{ CROSS_Shareholding}_{it} + \\ & \beta_4 \text{ the ratio of outside director}_{it} + \beta_5 \text{ Institutiona_Investor}_{it} \times \text{ Demographic_Diversity}_{it} + \\ & \beta_6 \text{ Institutiona_Investor}_{it} \times \text{ task_related_Diversity}_{it} + \beta_7 \text{ tobinQ}_{it} + \beta_8 \text{ debt_to_asset}_{it} \\ & + \beta_9 \text{ ROA}_{it} + \beta_{10} \text{ freecashflow}_{it} + \beta_{11} \text{ LaggedRD}(t-1)_{it} + \mu_i + \varepsilon_{it} \\ \\ \text{Patent}_{it} (\text{LogPatent}_{it}) = & \alpha + \beta_1 \text{ Institutiona_Investor}_{it} + \beta_2 \text{ logsize}_{it} + \beta_3 \text{ CROSS_Shareholding}_{it} + \beta_4 \text{ the ratio} \\ & \text{ of outside director}_{it} + \beta_5 \text{ Institutiona_Investor}_{it} \times \text{ Demographic_Diversity}_{it} + \\ & \beta_6 \text{ Institutiona_Investor}_{it} \times \text{ task_related_Diversity}_{it} + \beta_7 \text{ tobinQ}_{it} + \beta_8 \text{ debt_to_asset}_{it} \\ & + \beta_9 \text{ ROA}_{it} + \beta_{10} \text{ freecashflow}_{it} + \beta_{11} \text{ LaggedRD}(t-1)_{it} + \mu_i + \varepsilon_{it} \end{aligned}$$

4-2. Variables

4-2-1. Dependent variables

The dependent variables are R&D intensity and patent. R&D intensity is the annual R&D expenditure. R&D intensity characterises R&D policy and is defined as the ratio of R&D expenditures to total sales. The log of R&D investment is the natural logarithm of R&D investment. This study takes patent as the surrogate for the efficiency of R&D activities and innovation. Patent is the number of patent applications made annually by the company. Logpatent is the natural logarithm of patent applications.

4-2-2. Independent variables

Institutional investor is the percentage of stockholdings by foreign investors and mutual trust

accounts (i.e., insurance corporations' special accounts). Cross is the percentage of cross-shareholding with other publicly held companies permitted to hold their shares. Outsider rate in the boardroom is the natural logarithm of the ratio of nonexecutives and/or outside directors to the number of directors on the board. Bio-demographic diversity is the percentage of female board members in the boardroom. This study's aim was to include other types of elements regarding bio-demographic diversity; however, due to the constraints in data collection, the data I could collect in this study included the rate of female members in the boardroom. Task-related diversity is calculated as the Herfindahal-Hirshman Index (HHI) about board members' careers, which assesses board career diversity. HHI is defined as the sum of the squares of shares across the category. HHI is normally used to measure the rate of a business' concentration rate and can be decomposed by subtracting the concentration rate from one to obtain the extent of diversity according to the percentage of each career in the boardroom. I divided board members' previous careers into five categories: 1) bank, 2) controlling company, 3) affiliated company, 4) mutual dispatch, and 5) president of another company. Task_related diversity is formulated below.

$$\text{Task-related diversity} = 1 - \sum_i^n P_i^2$$

Also, this study includes interacting items with the stockholding of institutional investor, demographic diversity and task-related diversity. This study takes Board diversity as the moderating factor between ownership and R&D investment. With interaction item between ownership and diversity (demographic and task-related diversity), this study examines the effect of moderating factor on the relationship between both of two variables.

4-2-3. Control variables

I control for size effects with the sales variable, which is the amount of sales on a log scale. I also control for the financial structure. The debt-to-equity ratio affects the relationship between institutional ownership and R&D investment. The debt-to-equity ratio is the ratio of total debt to total assets. Free cash flow may have an effect on the corporation's decision for R&D investment. Free cash flow is taken as a control variable, and free cash flow is calculated as the ratio of free cash flow to total assets. I also control for firm performance variables like Tobin's Q and ROA. Tobin's Q is calculated as the sum of the market value of equity and the book value of total debt divided by the book value of total assets. ROA is calculated as the operating profit before tax over total assets. I consider the existence of some inertia in R&D investment decisions, which are mainly long term, I put R&D intensity lagged by one year period R&D (t-1) (Tribo et al., 2007).

Table 2: The result of descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
logpatent	2170	4.61	2.19	0.00	9.50
Institutiona_Investor	2046	37.84	14.11	1.54	79.76
logsize	2891	13.69	1.36	9.40	19.06
cross_shareholding	2822	7.03	7.08	0.00	46.38
The_ratio_of_outsider_director	2897	18.18	16.55	0.00	86.67
demographic_diversity	2897	0.01	0.04	0.00	0.38
task_related_diversity	2897	0.14	0.11	0.00	0.48
debt_to_asset	2891	53.75	21.91	4.09	99.33
ROA	2875	6.46	10.34	-17.88	359.19
Tobin's Q	2877	1.28	0.78	0.48	13.53
free_cash_flow	2879	7.60	9.46	-14.06	342.16
laggedRD(t-1)	2650	2.94	4.43	0.00	33.62

Table 3: The result of correlation

		1	2	3	4	5	6	7	8	9	10	11	12
1	logpatent	1											
2	Institutional_Investor	0.1932	1										
3	logsize	0.3495	0.1685	1									
4	cross_shareholding	-0.0201	-0.0943	0.0068	1								
5	The_ratio_of_outsider_director	0.0102	0.1826	0.1292	-0.1138	1							
6	demographic_diversity	-0.0637	0.0892	0.13	-0.0308	0.2401	1						
7	task_related_diversity	0.0162	0.2112	0.1451	-0.0732	0.9445	0.2071	1					
8	debt_to_asset	0.0387	-0.1749	0.4071	0.0343	0.0299	0.0396	0.0511	1				
9	ROA	-0.089	0.0074	-0.1509	-0.077	-0.0078	-0.0005	-0.0229	-0.2422	1			
10	Tobin's Q	-0.1048	0.1047	-0.1992	-0.1372	0.0122	0.0495	-0.0228	-0.2612	0.5592	1		
11	free_cash_flow	-0.021	-0.0427	-0.1011	-0.0752	-0.0215	-0.003	-0.0332	-0.1528	0.9229	0.4552	1	
12	laggedRD(t-1)	0.2053	0.1335	-0.072	-0.0962	0.1702	-0.0105	0.1363	-0.3702	-0.0091	0.077	-0.0012	1

5. Findings and discussion

This study did not determine a significant result between R&D intensity, corporate governance and financial variables. The stockholding of institutional investors has a significantly negative association with R&D investment (ln). Free cash flow is negatively associated with R&D investment. Agency theory assumes that free cash flow is related to managers' interests in entrenching their position. In sample corporations, cash flow would not be appropriate to spend for the investment, which would have the potential to earn a future profit. I could obtain interesting findings in the relationship between corporate governance variables and patent (ln) as the outcome of R&D investment and the surrogate for innovation. The stockholding of the institutional investor has a significantly negative association with the patent (ln). These results show that Hypothesis 1 is not supported. Also, the rate of the outside director has a negative impact on the patent (ln). Among the control variables, the ratio of debt to total assets is significantly and negatively associated with the patent (ln). I observe that the debt has a negative impact on generating the patent and stimulating innovation.

Table 4: The result of panel regression

VARIABLES	model1	model2	model3	model4
	RDintensity	RDintensity	logRD	logpatent
logsize	0.199 (0.942)	0.198 (0.937)	0.593*** (9.950)	0.726*** (6.407)
Institutional Investor	-0.00322 (-0.376)	0.00319 (0.330)	-0.00647*** (-2.740)	-0.0117*** (-2.738)
cross_shareholding	0.00612 (0.667)	0.00610 (0.664)	-0.00156 (-0.728)	0.00171 (0.437)
The_ratio_of_outsider_director	0.0183** (2.418)	0.0105 (1.077)	0.00384 (1.624)	-0.0118*** (-2.747)
demographic Diversity		0.0343 (0.861)	-0.00941 (-0.846)	0.0307 (1.463)
Task_related_diversity		2.182 (1.256)	-0.794* (-1.894)	-1.065 (-1.411)
Institutional Investor × Demographic_Diversity	-0.000133 (-0.439)	-0.000825 (-0.920)	0.000118 (0.474)	-0.00109** (-2.258)
Institutional Investor × Task_Related_Diversity	-0.0256 (-1.046)	-0.0538 (-1.598)	0.0110 (1.368)	0.0636*** (4.377)
Debt_to_Asset	-0.0105 (-1.510)	-0.0104 (-1.490)	-0.00111 (-0.687)	-0.0163*** (-5.614)
ROA	-0.0185** (-2.114)	-0.0178** (-2.026)	0.00434* (1.940)	-0.00574 (-1.458)
Tobin's Q	-0.0961 (-0.878)	-0.102 (-0.927)	-0.00381 (-0.126)	-0.00590 (-0.118)
Free_cash_flow	0.0101 (1.211)	0.00930 (1.114)	-0.00403* (-1.961)	0.00365 (1.027)
laggedRD(t-1)	0.249*** (10.29)	0.247*** (10.20)	0.0338*** (6.576)	0.0175 (1.617)
Constant	-0.1000 (-0.0352)	-0.361 (-0.126)	1.311 (1.632)	-4.275*** (-2.757)
R-squared	0.092	0.093	0.147	0.106
Observations	331	331	261	285
FIX EFFET	YES	YES	YES	YES
Year_Dummy	YES	YES	YES	YES

t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

This study focusses on the interaction among the institutional investors, and board task-related diversity was shown to be positively associated with R&D (coefficient=0.0636, $p < 0.1$). In other words, while each outside director and institutional investor has a negative effect on the patent, the interaction between board task-related diversity and the institutional investor has a positive effect on the patent. Hypothesis 3 is partly supported. Board task-related diversity is a positive moderator of the relationship between the institutional investor's ownership and the patent, which is a surrogate for innovation.

6. Concluding Remarks

As the stockholding rate of the institutional investor increases, it is important for the board to be composed of members with diversity in terms of function, career, and ability, which contributes to executing governance and promotes the corporation to take risks and practice innovative business. By introducing diversity in the boardroom without caring ownership and a positive corporate situation, the corporate governance practice may become ostensible. The academic implication of this study in board diversity research is that task-related diversity can contribute to improving the quality in decision-making in boardroom while introducing demographic diversity without considering task would not be effective in decision-making. Also on agency theoretical perspective, the appropriate combination of institutional ownership and board diversity could go up the monitoring capability and the feasibility of corporate governance and may stimulate corporate strategy. This study does not determine the relationship between board demographic diversity and R&D investment and how different types of owners influence R&D and patents. These matters would be studied in the future research.

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