

IT investment and Firm Performance: The Role of Board Gender Diversity

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Abstract

While the U.S. government requires diversity in providing equal opportunities, it is still doubtful how such governance-related corporate enforcement affects firm performance. This study investigates how gender diversity, the proportion of female board members in a firm, moderates the impact of IT investment on firm performance. We found a positive moderating effect of gender diversity on the effect of IT investment on firm performance. We believe that this study contributes to existing IS and corporate governance studies. In addition, it provides managerial and practical implications by providing empirical evidence of the effect of board diversity and IT investment and how their interaction leads to positive firm performance.

Keywords: Gender Diversity, Corporate Governance, IT investment, Firm Performance

1. Introduction

Increasing attention has been directed toward maintaining and encouraging gender diversity among board members in business spaces (Larcker and Tayan 2020). This prioritization and subsequent shifts are driven by expanded fairness and equality initiatives regarding leadership opportunities (Larcker and Tayan 2020). However, this topic raises contentions regarding the effectiveness, strategic benefits, and functionality of adding female board members to the decision-making process. Although some existing studies have demonstrated the positive role of gender diversity in a firm's managerial directives—considering the makeup of its board members – and its financial performance, there are still lingering disputes among researchers regarding the validity of these benefits (Dezsö and Ross 2012; Wowak et al. 2021)

The business value of information technology (IT) investment has become a more critical issue in a firm's strategic direction because of the importance of IT in a firm's growth and survival. Although the

existing IS studies have suggested the positive effect of IT investment, several scholars also document the mixed results (Xue et al. 2008).

Existing studies have attempted to address such inconsistent effects of IT investment on firm performance by observing various aspects such as inappropriate performance measurement and a firm's contextual, strategic, and environmental matters (Mithas et al. 2012; Saldanha et al. 2020; Xue et al. 2008; Xue et al. 2012). The same literature stream also indicates that IT investment's effect varies across firms (Mithas et al. 2012). To tackle these issues, the recent literature has moved beyond the direct effects of IT investment by examining the interactions between IT investment and other contingency factors (e.g., Havakhor et al., 2019).

However, how a firm's corporate governance structure affects the effectiveness of IT investment on firm performance remains mostly unexplored. Notably, as the size of IT investment in firms' budgets has increased over the decades, the role of corporate governance in IT investment has become vital to both supervise IT investment and monitor its execution. According to a recent report, 35 % of directors spend 6-10 % of annual board hours discussing IT-related topics (PricewaterhouseCoopers, 2013), making the study of corporate governance highly relevant in this context.

Extant studies have emphasized the role of corporate governance in firm performance and have examined the effect of various governance structures on firm performance using different theoretical backgrounds. Several governance mechanisms are devised to alleviate and resolve an agency's problems and theoretically and empirically address them (Core et al. 1999). For example, board member gender diversity can enhance the monitoring role of a board of directors and eventually mitigate an institution's problems between managers and shareholders that diminish the firm's value (Larcker and Tayan 2020).

This is partly because existing studies have emphasized that a diverse board will be less beholden to management because it can offer diverse skills, knowledge, experience, and enhanced communication

regarding a firm's investment decisions (Wowak et al. 2021).

This notion further bolsters the value of gender diversity, and the consequent diversity of thought, in the corporate realm. For example, existing studies have pointed to a difference in risk-taking attitudes between the genders; female board members tend to make less risky decisions than their male counterparts (Harjoto et al. 2018). Thus, females in the top echelons of the corporate domain affect corporate decisions and behaviors differently from their male counterparts, thereby presenting nuanced and novel contributions (Adams and Ferreira 2009; Francis et al. 2014).

However, there is a lack of studies investigating how corporate governance structure – how gender diversity influences the impact of IT investment on firm performance, specifically. Based upon this research gap, we focus on the role of female board representation (FBR) and investigate how FBR may moderate the effect of IT investment on firm performance. FBR refers to the proportion of female board members.

Using the combined data from three sources, the Computer Intelligence technology database (CI) for IT investment, Institutional Shareholder Services (ISS) for board information, and Compustat for firm performance-related data, we examine our research question and hypothesis. An unbalanced panel of 10,945 firm-year observations from 1,381 firms between 2007 and 2019 was used in this study. The results indicate that a greater ratio of female board members positively moderates the impact of IT investment on firm performance.

This study sheds light on and empirically demonstrates how gender diversity in corporate governance structures, that is, the inclusion of female board members, would increase the positive impact of IT investment on firm performance.

2. Literature Review

2.1. Corporate Governance, Gender Diversity, and Firm performance

The agency problems of managers are often pinpointed in prior studies. Jensen and Meckling (1976) argue that when a manager's self-interest deviates from that of the firm's stakeholders, the firm's value will diminish. Thus, corporate governance has emphasized the governance structure and mechanism that monitor and prevent agency issues from arising (Burns 2003; Westphal 1999). Firms that equip and utilize suitable corporate governance structures and mechanisms will, thus, be expected to perform better. It is widely accepted that

corporate governance structures influence firms' financial performance.

The growing literature on corporate governance highlights the role of diversity in board member configuration and how such diversity impacts firm performance (Srinidhi et al. 2011). Existing studies have demonstrated the positive effect of diversity in corporate governance structures in boosting firm value and performance (Carter et al. 2003). As a result, more and more corporations are interested in cultivating their board diversity over time.

A diverse board will be less beholden to management (Carter et al. 2003). Srinidhi et al. (2011) argue that diverse boards can address more difficult and challenging problems (Srinidhi et al. 2011). Ferreira (2010) also mentioned that the diversity of a board is desirable because it will lead to a wider breadth of knowledge, creativity, and innovation; improve and foster discussion; encourage the cross-fertilization of ideas; and enhance the problem-solving and decision-making capabilities of the board. Diverse groups outperform homogeneous groups due to their tendency to engage in deeper, manifold discussions of disparate knowledge and information, and in turn, leverage integrated knowledge and information (Wowak et al. 2021).

Prior studies have focused more on board independence and board size as primary elements of corporate governance structure diversity. However, growing attention has been placed on the role of gender diversity in corporate boards.

Carter et al. (2003) mentioned that what minority people (including a woman) can bring to the board are additional perspectives a company did not have before adding some "modern-day reality to the deliberation process." Those unconventional or unexpected perspectives are of great value (Campbell 1996; Carter et al. 2003). Likewise, the literature on gender diversity highlights the role of female executives in shaping alternative corporate policies and financial outcomes. Gender diversity is shown as a significant determinant in firm risk-taking behaviors and decisions, as females are less overconfident and more risk-averse than males (Dezsö and Ross 2012).

Against the above backdrop, studies across various business disciplines on gender diversity have addressed various topics: the effect of board gender diversity on firm value and performance (e.g., Matsa and Miller 2013; Post and Byron 2015), board monitoring activities (e.g., Post and Byron 2015), risk-taking (e.g., Faccio et al. 2016), operational and strategic decisions (e.g., Chen et al. 2017; Triana et al. 2014; Wowak et al. 2021).

Ferreira (2010) argues that having more women on the board may allow for greater market penetration

because of greater access to information on a market's needs and preferences. Dobbin and Jung (2011) declared that diversity in gender, to some extent, "may cause conflict, hinder communication, and interfere with cooperation among board members," thereby hindering performance.

Despite the increasing demand for board diversity, research findings on the impact of such diversity on firm performance are varied and inconsistent (Wu et al. 2022). We then have observed that some scholars have shifted the focus by examining the interaction effects of board gender diversity and other contingency factors to explain the mixed findings for the effect of gender diversity on firm performance. For example, Wu et al. (2022) examine the performance impact of gender diversity in the top management team (TMT) and board of directors (BOD). They find that the positive TMT-BOD gender diversity interaction effect on innovation improves subsequent firm performance.

2.2. Gender Diversity and IT Investment

Information system (IS) researchers have examined the business value of IT investment (Mithas et al. 2012; Saldanha et al. 2020; Xue et al. 2012). Although some of them have suggested the positive role of IT investment on firm performance (e.g., Menon et al. 2000) and its ability to enhance organizational performance (e.g., Melville et al. 2004), such beneficial effects vary across firms (Kohli and Grover 2008; Mithas et al. 2012).

The inconsistency in the effect of IT investment has been explained by contextual and environmental factors, along with inefficient investment decisions (Xue et al. 2008; Dong et al. 2021; Saldanha et al. 2020). Although previous findings have addressed various factors that can explain the efficiency or inefficiency of IT investment on firm performance, there is a lack of consideration of how corporate governance - in particular, board member gender diversity - moderates the effect of IT investment on firm performance.

Diverse boards with more decisive direction and leadership are critical to monitoring firms' IT investment decisions and execution. However, following the inconclusive findings on the relationship between IT investment and firm performance, we advance the proposition that board diversity influences the relationship between IT investment and firm performance. A more diverse board would have people from different backgrounds endowed with distinct knowledge, experiences, and skills; and they

are likely to make beneficial, quality contributions to the decision-making process.

From a theoretical perspective, well-diversified corporate governance structures will ensure better protection of the shareholders' interests through the effective supervision of the behavior of the top managers (Dezsö and Ross 2012; Larcker and Tayan 2020; Wowak et al. 2021). Moreover, this phenomenon would lend itself to the board's monitoring role, which would subsequently have the potential to generate sizeable impacts on performance.

In this regard, the effect of board diversity, through an enhanced monitoring role, can lead to firms being economically prosperous and achieving greater profitability (Dezsö and Ross 2012). This suggests that the effect of board diversity would likely positively strengthen the relationship between corporate governance structure and corporate performance (Dezsö and Ross 2012; Larcker and Tayan 2020; Wowak et al. 2021).

Additionally, prior studies have shown the positive effect of female representatives in a firm's strategic decision-making process because gender diversity enhances the information elaboration process. (Homan et al. 2007; Joshi & Roh 2009).

IT investment can be fraught with risk and does not always guarantee positive outcomes. As a matter of fact, according to KPMG's report, 70% of IT projects fail (<https://leocode.com/development/over-70-of-tech-projects-fail/>). Thus, IT investment requires serious consideration in executing and monitoring to promote and ensure positive firm performance.

Harjoto et al. (2018) explore common gendered attributes among board members. Primarily, they argue that female board members tend to make less risky investment decisions to reduce uncertainty and increase the predictivity of the results.

Thus, we argue that the impact of IT investment on firm performance depends, to some extent, on the gender diversity of the board. More specifically, we argue that a higher proportion of female board members is likely to improve the efficacy of IT investment on firm performance by helping the board make less risky but diverse decisions and enhancing the information elaboration process. Therefore, from the preceding literature, the following hypothesis is designed to test and evaluate the moderating effect of board diversity on IT investment in firm performance. We propose the following hypothesis.

H1: An increase in FBR positively moderates the effect of IT investment on firm performance.

3. Empirical Methodology

3.1 Data and Measures

Our data comes from three primary sources: the Computer Intelligence Technology Database (CiTDB), Compustat, and Institutional Shareholder Services (ISS). The IT investment data comes from the CiTDB, which is widely used in prior IS research (e.g., Dong et al. 2021). In the current study, we focus on a firm's total estimated IT budget, which is the variable available since 2007 in the CiTDB. The CiTDB is a proprietary database owned by Harte-Hanks that provides detailed survey data regarding firms' information and technology investments at the establishment level.

Table 1. Definition of Variables

VARIABLES	Definition
IT investment	The total estimated IT budget of the firm
Female board representation (FBR)	The percentage of board members who are female in the firm
Non-white board representation (NWBR)	The percentage of board members who are non-white in ethnicity
Board independence	The percentage of board members that are independent in that the firm does not employ them
CEO-chair separation	Whether the CEO and chair are different individuals (1: separation; 0: the same individual)
Shares	The average of shares held by board members of the firm
Outside public boards (OPB)	The average number of other outside public boards that board members serve
Age	The average age of board members of the firm
Tenure	The average year that each board member has been on the board of the firm
Employees	The number of estimated employees of the firm
Liabilities	Liabilities of the firm
Tobin's Q	Tobin's Q of the firm
Sales	Sales of the firm
ROE	Return on equity of the firm

Data on firm characteristics (e.g., sales, liabilities, and ROE) were derived from Compustat. Hand matching the CiTDB and Compustat was required because CiTDB provides establishment-level data that are identified by the variable siteid and does not provide a link between siteid and gvkey in Compustat. Therefore, we had to construct a link table by matching company names.

We first filtered out perfectly matched names in both databases and focused on the names with close-matched counterparts. We then hand-matched each firm, produced a link table between gvkey and siteid variables, and used other variables such as the headquarters' location zip code(s) to cross-validate the matching results. For each matched establishment observation, we aggregated its IT investment data at the firm level.

Our board data comes from ISS, which provides information on a firm's board composition based on the firm's annual shareholder meeting attendee list. Prior research has widely used this database for board related topics (e.g., Wowak et al. 2021). We then used our matched CiTDB and Compustat dataset to match ISS to construct female board representation and other board characteristics used in the current study. Our final sample utilized an unbalanced panel of 10,945 firm-year observations from 1,381 firms from 2007 to 2019.

To measure firm performance, we follow prior IT investment literature (e.g., Havakhor et al. 2019) to use the forward-looking measure to measure firm output (i.e., Tobin's Q). Our primary IT investment measurement is the total estimated IT budget of the firm.

Since we are interested in how FBR may moderate the effect of IT investment, we believe this aggregated measurement provides the relevant scope for our research objectives. Following prior gender diversity research (e.g., Wowak et al. 2021), we measure FBR as the proportion of female board members, where the number of female board members is the numerator of this, and the number of total board members is the denominator.

We also include several control variables (e.g., board independence, sales) following prior board and IT investment studies (e.g., Havakhor et al., 2019; Wowak et al. 2021). We applied the log transformation to several variables to improve the model fit. Table 1 and Table 2 show the definition of the variables and descriptive statistics.

Table 2. Descriptive Statistics

VARIABLES	(1) mean	(2) sd	(3) min	(4) max
Ln IT investment	16.96	2.159	0	24.17
Ln FBR	0.139	0.093 6	0	0.606
Ln NWBR	0.185	0.127	0	0.693
Ln Board independence	- 0.229	0.145	-1.504	0
CEO-chair separation	0.506	0.500	0	1
Ln Shares	12.25	1.419	2.813	17.02
Ln OPB	0.573	0.260	0	2.293
Ln Age	4.136	0.058 2	3.864	5.466
Ln Tenure	0.310	0.371	-0.154	1.386
Ln Employees	7.899	1.693	1.386	13.08
Ln Liabilities	7.675	1.954	1.814	14.67
Tobins_Q	1.962	1.266	0.412	19.54 8
Ln Sales	7.968	1.532	1.085	12.98
ROE	59.98	98.73	-17.19	4,050

Ln refers to the log transformation
N:10, 945

3.2 Model specification and Estimation

To examine the moderating effect of the ratio of female board members on IT investment on firm performance, we used firm-level fixed effects ordinary linear squares (OLS) regression to control unobserved firm heterogeneities. We measured the firms' performance using Tobin's Q (at time t). Additional diversity factors such as board independence and the ratio of white male Americans in board member samples are controlled to eliminate potential alternative explanations. Other variables were one-year lagged to avoid reverse causality issues. Further, we employed the Hausman test to compare and validate the use of fixed effects over the random-effects model.

Our model is specified as the following:

$$\begin{aligned}
 \text{Firm Performance}_{i,t} &= \beta_0 \\
 &+ \beta_1 \text{Ln Board Characteristics}_{i,t-1} \\
 &+ \beta_2 \text{Ln IT investment}_{i,t-1} \\
 &+ \beta_3 \text{Ln Board Characteristics}_{i,t-1} \\
 &\quad * \text{Ln IT investment}_{i,t-1} \\
 &+ \text{Controls}_{i,t-1} + \text{firm}_i + \xi_t \\
 &+ \varepsilon_{it} \quad (1)
 \end{aligned}$$

Where the subscript "i" indexes the firm, and t indexes the year, we took a natural log transformation of variables that did not have a normal distribution. We included a set of control variables, including CEO-chair separation, shares, OPB, age, tenure, employees, liabilities, sales, ROE, and Tobin's Q (see Table 1 for the definition of our variables). Moreover, $[\text{firm}]_i$ represents the unobserved firm-specific fixed effects, ξ_t represents the year time dummies, and ε_{it} is the error term of the model.

4. Results

Table 3 shows the estimation results. Model 1 only includes the IT investment and control variables. The effect of IT investment on firm performance (Tobin's Q) is not statistically significant in this model. In Model 2, we added the interaction effect (Ln FBR * Ln IT investment) and found a significant positive effect, supporting our H1 ($\beta = 0.115, p < 0.05$).

To control other corporate governance effects, we controlled additional diversity factors in Model 3. After controlling for those effects, we still observed a positive significant moderating effect of FBR.

This finding is consistent with prior studies that indicate how greater diversity in board members' backgrounds can help firms monitor and alleviate agency issues more efficiently. More heterogeneous groups can strengthen a board's ability to filter through available information, deploy effective resource allocations for IT investment, and monitor pertinent agency issues in our setting.

Given that in prior studies, the effect of IT investment varies depending on firm performance measurement, we conducted additional analyses using return on equity (ROE) measures. Table 4 shows these results. The results portray a similar consistent pattern as Model 2. It shows the significant positive moderating effect of FBR on the effect of IT investment on firm performance.

Table 3. Results (Dependent Variable: Tobin's Q)

VARIABLES	(1) Tobins_q	(2) Tobins_q	(3) Tobins_q
Ln IT investment	0.019+ (0.011)	0.004 (0.013)	0.002 (0.018)
Ln FBR	0.307+ (0.160)	-1.636+ (0.858)	-1.220 (0.907)
Ln NWBR	0.238* (0.116)	0.229* (0.116)	0.513 (0.656)
Ln Board independence	-0.354*** (0.104)	-0.348*** (0.104)	-1.152* (0.580)
Ln FBR * Ln IT investment		0.115* (0.050)	0.090+ (0.053)
Ln NWBR * Ln IT investment			-0.017 (0.039)
Ln Board independence * Ln IT investment			0.050 (0.036)
CEO-chair separation	-0.058* (0.023)	-0.056* (0.023)	-0.056* (0.023)
Ln Shares	-0.021+ (0.013)	-0.002 (0.013)	-0.019 (0.013)
Ln OPB	-0.006 (0.065)	-0.006 (0.065)	-0.003 (0.065)
Ln Age	-0.389 (0.246)	-0.364 (0.247)	-0.369 (0.247)
Ln Tenure	0.087 (0.054)	0.091+ (0.054)	0.098+ (0.054)
Ln Employees	-0.066*** (0.018)	-0.064*** (0.018)	-0.063*** (0.018)
Ln Liabilities	-0.264*** (0.018)	-0.261*** (0.028)	-0.262*** (0.028)
Ln Sales	-0.103** (0.038)	-0.097* (0.038)	-0.094* (0.038)
ROE	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
Constant	5.973*** (1.027)	6.039*** (1.028)	5.730*** (1.049)
Observations	9,564	9,564	9,564
Number of firms	1,381	1,381	1,381
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Within R-squared	0.169	0.170	0.179
Overall-R-squared	0.092	0.094	0.095

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Model 1 without any interaction. Model 2 added only

Ln FBR (female board representation) * Ln IT investment;

Model 3 added all these three interactions.

Table 4. Results (Dependent Variable: ROE)

VARIABLES	(1) ROE	(2) ROE	(3) ROE
Ln IT investment	2.559*** (0.714)	-0.191 (0.840)	4.338*** (1.182)
Ln FBR	7.712 (10.569)	-335.975*** (56.557)	-272.902*** (59.700)
Ln NWBR	4.357 (7.692)	2.741 (7.679)	212.176*** (43.166)
Ln Board independence	-13.006+ (6.915)	-11.955+ (6.902)	-128.969*** (38.204)
Ln FBR * Ln IT investment		20.333*** (3.287)	16.570*** (3.478)
Ln NWBR * Ln IT investment			-12.557*** (2.547)
Ln Board independence * Ln IT investment			7.338** (2.345)
CEO-chair separation	-4.782** (1.531)	-4.369** (1.528)	-4.383** (1.525)
Ln Shares	-2.176*** (0.827)	-1.981* (0.826)	-1.938* (0.825)
Ln OPB	-2.998 (4.308)	-2.922 (4.298)	-2.191 (4.291)
Ln Age	98.175*** (16.286)	102.208*** (16.262)	96.678*** (16.271)
Ln Tenure	-0.373 (3.576)	0.351 (3.569)	1.773 (3.574)
Ln Employees	-0.556 (1.178)	-0.303 (1.176)	-0.348 (1.175)
Ln Liabilities	5.200** (1.853)	5.611** (1.850)	5.384** (1.847)
Ln Sales	30.757*** (2.484)	31.527*** (2.482)	31.999*** (2.480)
Tobins_q	20.101*** (0.725)	19.943*** (0.723)	19.848*** (0.722)
Constant	-691.297*** (67.864)	-676.43*** (67.752)	-733.855*** (68.922)
Observations	9,564	9,564	9,564
Number of firms	1,381	1,381	1,381
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Within R-squared	0.223	0.226	0.230
Overall-R-squared	0.091	0.096	0.096

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

5. Discussion and Future Direction

This study examines the interaction effect of gender diversity and IT investment on firm performance. The key finding is that FBR positively moderates the effect of IT investment on firm performance. That is, IT investments within firms with a higher female board member ratio are more likely to beget better firm performance. To the best of our knowledge, this study represents one of the first attempts at empirically analyzing how the ratio of female board members can moderate the impact of IT investment on firm performance using the lens of corporate governance.

The benefits of IT investment have been dubious because of the inconsistent effects of firm performance in prior studies. Our study highlights the vital role of gender diversity by demonstrating the positive interaction (moderating) effect of FBR on the effect of IT investment on firm performance. Thus, this study emphasizes how corporate governance is essential in supporting the effectiveness of IT investment.

That all said, this study has some limitations and each of these limitations deserves future studies. First, despite including fixed effects for firms and years, our specification likely omits time-varying variables that impact IT investment and directly affect firm performance. We plan to follow Havakhor et al. (2019) to address some potential endogeneity issues. Second, the current study only considers gender diversity among board compositions. In future studies, it will be worthwhile to control other diversity factors to eliminate potential alternative explanations. Likewise, it will also be interesting to examine whether the threshold of the number of women directors (e.g., at least three women directors) will result in different patterns. Finally, future studies could also explore whether the industry characteristics (e.g., industry competitiveness) will demonstrate diverse patterns. Nevertheless, we believe that this study will serve as a useful starting point in understanding how gender diversity in corporate governance moderates the effect of IT investment on firm performance.

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