Finance Research Letters 79 (2025) 107254

Contents lists available at ScienceDirect

Finance Research Letters

journal homepage: www.elsevier.com/locate/frl

Board gender diversity and organization capital☆

Chu-Bin Lin [a], Zhengyang Qi [a,*], Yi-Wen Chen [b], Yicheng Sun [c]

[a] School of Economics and Management, Southwest Jiaotong University, China
[b] School of Finance, Southwestern University of Finance and Economics, China
[c] School of Accounting and Finance, Hong Kong Polytechnic University, Hong Kong

ARTICLE INFO

JEL classifications:
E22
G32
G34

Keywords:
Board gender diversity
Organization capital
Firm value

ABSTRACT

This study examines the effects of board gender diversity on firms' investment in organization capital (OC), drawing on a comprehensive dataset of US public firms from 2000 to 2019. The main findings suggest that firms with greater board gender diversity tend to allocate more resources toward OC. Our results remain robust when employing an instrumental variable approach and propensity score matching with difference-in-differences analysis to address endogeneity concerns. Furthermore, we find that board gender diversity amplifies the positive effects of OC on firm value. Our investigation provides new evidence of the positive relationship between board gender diversity and firm value.

1. Introduction

Gender diversity on corporate boards (board gender diversity) has become a prominent topic of academic inquiry, attracting considerable research attention in recent years (Bao and Li, 2024; Gow et al., 2023). As more countries and companies take steps to increase female representation on corporate boards, the trend toward gender diversity has become increasingly evident. This shift not only reflects societal calls for gender equality but also promotes diversity in corporate governance structures. Nonetheless, the impact of gender diversity on boards remains a topic of debate. While many studies highlight the positive effects of female board members—such as alleviating informational disadvantages, reducing carbon emissions, and enhancing corporate transparency and accountability (Mobbs et al., 2021; Barroso et al., 2024; Alkhawaja et al., 2023)—other studies suggest that gender diversity may, in some contexts, reduce firm performance or shareholder value (Adams and Ferreira, 2009; Darmadi, 2011; Ahern and Dittmar, 2012; Greene et al., 2020). This ongoing debate has spurred both academic and practical investigations to further explore the specific effects of gender diversity in various settings.

Organization capital (OC), often referred to as "the mother of intangible assets" by Lev and Radhakrishnan (2015), is a key intangible asset. Firm-level OC may be defined as the accumulation of firm-specific knowledge that "enables superior operating, investment, and innovation performance, represented by the agglomeration of technologies-business practices, processes, and designs"

☆ We would like to thank the Editor (Samuel Vigne) and one anonymous referee of the Finance Research Letters for their constructive and insightful comments that help us significantly improve our paper. Lin acknowledges the financial support from the National Natural Science Foundation of China (No. 72073109). Chen acknowledges financial support from the Guanghua Talent Project of the Southwestern University of Finance and Economics.

* Corresponding author at: Department of Finance, School of Economics and Management, Southwest Jiaotong University, 111, Section 1, North Erhuan Road, Chengdu 610031, China.

E-mail addresses: cblin@swjtu.edu.cn (C.-B. Lin), qizhengyang@my.swjtu.edu.cn (Z. Qi), ywchen@swufe.edu.cn (Y.-W. Chen), yicheng.sun@connect.polyu.hk (Y. Sun).

https://doi.org/10.1016/j.frl.2025.107254
Received 11 November 2024; Received in revised form 13 January 2025; Accepted 17 March 2025
Available online 18 March 2025

(Lev et al., 2009). Prior studies suggest that OC plays a crucial role in enhancing a firm's efficiency and productivity. Lev and Radhakrishnan (2005) and Lev et al. (2009) further suggest that investment in OC forms the foundation of a firm's competitive advantage.

In this study, we focus on female directors on corporate boards to investigate the relationship between board gender diversity and investment in OC and explore whether such a relationship, if it exists, improves firm value.

Based on resource dependence theory, diverse directors hold unique information that can potentially improve the board's ability to advise managers and help in business decision-making (Hillman et al., 2000). The literature shows that diversity in input contributes to the quality of decision-making (Knippenberg and Schippers, 2007). Female directors, with their diverse perspectives and experiences, contribute to high-quality deliberations and help resolve complex issues (Huang and Kisgen, 2013; Miller and Del Carmen Triana, 2009). More importantly, when making decisions that will have long-term effects on a firm, diverse boards tend to invest more in research and development (R&D) (Miller and Del Carmen Triana, 2009). Given the importance of OC as an intangible asset and its alignment with R&D, gender-diverse boards are likely to allocate more resources towards OC, improving a firm's competitiveness and generating long-term returns.[1] Furthermore, investment in OC is essential for firms to consistently outperform competitors and maintain their leadership position over an extended period (Lev and Radhakrishnan, 2005). Thus, whether a gender-diverse board invests more in OC and, in turn, whether the OC initiated by a gender-diverse board significantly improves firm value, warrants further exploration.

We propose and empirically test the long-term investment hypothesis, which posits that board gender diversity has a decisive and positive effect on corporate investments in OC. First, gender-diverse boards may focus more on long-term rather than short-term firm performance (Griffin et al., 2020). Psychology and organizational behavior studies have shown that diversity enhances the breadth of perspectives and, in turn, the problem-solving skills of groups (Hoffman and Maier, 1961; Hong and Page, 2004). Given that OC enhances competitiveness and future returns, we propose that gender-diverse boards will place greater emphasis on OC and allocate more resources to it.

Second, gender diversity brings a broader range of perspectives, cognitive approaches, and decision-making processes, thereby enhancing board effectiveness. By incorporating diverse viewpoints, gender-diverse boards can strike a balance between risk-taking and caution, fostering innovation and strategic decision-making (Hillman et al., 2000; Knippenberg and Schippers, 2007; Miller and Del Carmen Triana, 2009).[2] Griffin et al. (2020) and Almor et al. (2022) highlight that gender-diverse boards allocate resources toward innovation and R&D, reflecting a long-term focus that aligns with investments in OC. Since OC and R&D capital share fundamental concepts, we assume that female directors' motivations for OC investment align with those for R&D, leading firms with gender-diverse boards to invest more in OC.[3]

Using a sample of US data covering 2000 to 2019, we find evidence that gender-diverse boards significantly enhance OC investment. We adopt a battery of female directors' proxies, including female directors' proportion, tenure-weighted female proportion, and dummy variables for one or two female directors. Our findings consistently show that female directors are positively associated with higher OC investment.

In addition, we employ two methods to address endogeneity concerns. First, we adopt the instrumental variable approach, using the "fraction of male directors linked to female directors" as our instrument. This variable is defined as the fraction of male directors on the board who also sit on other boards that include at least one female director. The more connected a firm's male directors are to female directors, the more likely the firm will have female directors on its own board, suggesting a positive relationship between this instrument and the proportion of female directors (Adams and Ferreira, 2009). As expected, the 2SLS results confirm the positive impact of board gender diversity on investment in OC.

Second, we use the replacement of a departing male director with a female director as an exogenous shock. Employing propensity score matching and a difference-in-differences approach as our identification strategies, the treatment group consists of firms that appointed a female director to replace a departing male director in a given year, while the control group includes firms that appointed a male director to replace a departing male director. After matching the treatment group and control group using the PSM method, the DID regression results indicate that, after controlling for observable firm differences, firms that appoint female directors exhibit higher OC levels than those that appoint male directors.

Finally, drawing on the research by Eisfeldt and Papanikolaou (2013) and Zareie et al. (2024), we first verify the positive relation between OC and firm value and further explore whether the investment in OC by a gender-diverse board is associated with superior firm value. The result shows that a higher proportion of female directors leads to a stronger positive effect of OC on firm value.

[1] OC capital and R&D are long-term firm assets and account for nearly 30% and 16% of intangible assets, respectively, in the US (Corrado et al., 2009). They are also both organizational processes that can result in organizational renewal.

[2] A potential concern is that R&D investment may be influenced by the risk appetite of top management. The general consensus suggests that women, on average, tend to be more risk-averse than men (Croson and Gneezy, 2009), which could result in lower R&D investment under female leadership. However, this gender difference in risk appetite may not extend to top management positions. Women working in male-dominated environments might not exhibit the same level of risk aversion as those in other contexts. Evidence on this issue within top management is mixed. While some studies indicate that female leaders tend to make more conservative decisions (Huang and Kisgen, 2013; Cole, 2013; Faccio et al., 2016), others suggest that female leadership does not necessarily correspond to higher risk aversion and may even lead to riskier decision-making (Berger et al., 2014; Sila et al., 2016).

[3] Conceptually, OC includes the value contained in the knowledge of key personnel, such as managers and technical professionals (Eisfeldt and Papanikolaou, 2013). As R&D activities are initiated by technical professionals and skilled workers, some R&D expenditures include their salaries; therefore, OC coincides with the driving force of R&D (Belo et al., 2017; Brown et al., 2009; Francis et al., 2021; Chan et al., 2022).

Our study contributes to the literature in several ways. First, it complements the research stream on the relationship between board gender diversity and corporate investment. While recent studies emphasize the importance of board gender diversity for R&D (Almor et al., 2022; Griffin et al., 2020), our study explores another key component of intangible capital, OC, and finds that boards with greater gender diversity also focus more on OC investment.

Second, research on how gender-diverse boards affect corporate performance has two sides. Carter et al. (2003) investigated the impact of board diversity on firm value in the US and reported a positive relationship between the presence of female directors and firm performance. In contrast, Carter et al. (2010) and Miller and Del Carmen Triana (2009) find neither a positive nor a negative effect on firms' financial performance. Our study, based on research by Eisfeldt and Papanikolaou (2013) and Zareie et al. (2024), demonstrates that gender-diverse boards amplifies the positive effects of OC on firm value.

The remainder of this paper is organized as follows: Section 2 describes the data and methodology, Section 3 reports the results, and Section 4 presents the conclusion.

2. Data and methods

2.1. Data

Our sample comprises US firms from 2000 to 2019. We construct our sample from multiple sources. Board gender data are obtained from the BoardEx database. Accounting information is collected from the COMPUSTAT database. Institutional ownership data are obtained from the Thomson-Reuters Institutional Holdings database. We exclude observations with missing accounting information on OC. Our full sample contains 46970 firm-year observations from 5430 firms, excluding financial firms (SIC codes 6000–6999) and regulated utilities (SIC codes 4900–4999). Detailed variable definitions are provided in Appendix Table A1.

2.2. Variables

2.2.1. Measuring organization capital

We follow the methodology of Eisfeldt and Papanikolaou (2013) to estimate OC based on selling, general, and administrative (SG&A) expenses. Eisfeldt and Papanikolaou (2013) argue that SG&A expenses are related to labor and information technology (IT) (white-collar wages, training, consulting, and IT expenses), which is consistent with the idea that any accrued value will be somewhat firm-specific and must be shared with key talent.

We construct the stock of OC using the perpetual inventory method as follows:

$$OC_t = (1-\delta_0)OC_{t-1} + SG\&A/cpi_t \tag{1}$$

where δ_0 is the depreciation rate of 15 %, which is the same as the depreciation rate used by BEA in its estimation of R&D capital, and cpi_t is the consumer price index. We choose the initial stock based on the following:

$$OC_0 = SG\&A/(g+\delta_0) \tag{2}$$

Table 1
Descriptive statistics.

Variable	N	Mean	Std.	P10	Median	P90
Panel A: Dependent Variable						
OC	46970	0.120	0.222	0.002	0.017	0.437
Panel B: Gender Diversity Variables						
Female Proportion	46970	0.097	0.099	0.000	0.100	0.250
TW Female Proportion	46970	0.077	0.098	0.000	0.025	0.240
Female One Dummy	46970	0.567	0.495	0.000	1.000	1.000
Female Two Dummy	46970	0.168	0.374	0.000	0.000	1.000
Panel C: Firm-level Variables						
ROA	46970	0.079	0.142	-0.119	0.108	0.225
PPE	46970	0.246	0.224	0.031	0.165	0.643
Leverage	46970	0.214	0.194	0.000	0.184	0.513
Capex	46970	0.046	0.043	0.007	0.031	0.112
Tobin's Q	46970	0.570	0.505	-0.028	0.476	1.360
Sales	46970	6.237	1.996	3.332	6.349	8.922
Firm_Age	46970	2.602	0.933	1.099	2.708	3.761
Board_Size	46970	2.071	0.255	1.609	2.079	2.398
IO	46970	0.506	0.368	0.000	0.577	0.962

Note: This table presents the summary statistics of the variables for the full sample from 2000 to 2019. The dependent variable is investment in organization capital (OC), which is defined as OC divided by total assets. The variable of interest in Panel B is *Female Proportion*, defined as the percentage of female directors on the board. Panel B describes the firm-level variables. All variables are winsorized at the 5th and 95th percentiles. Detailed variable definitions are provided in Appendix Table A1.

where *g* is the average real growth rate of firm-level SG&A expenditures. Following Eisfeldt and Papanikolaou (2013), we set *g* as equal to 10 %, replace the missing SG&A values as zero, and remove firms with no records of SG&A expenses. Then, we scale OC by total assets.

2.2.2. Measuring board gender diversity

We follow prior studies that use the percentage of female directors on the board to capture gender diversity (Adams and Ferreira, 2009; Atif et al., 2021; Chen et al., 2017; Huang and Kisgen, 2013) and define it as *Female Proportion*. Following Baghdadi et al. (2023), we define an indicator that takes the value of one if at least one female director is on the board and zero otherwise and define it as *Female One Dummy*. *Female Two Dummy* takes the value of one if there are two or more female directors on the board and zero otherwise. Finally, following Shoham et al. (2020), we construct the tenure-weighted female ratio (*TW Female Proportion*), which represents the sum of the tenure of female directors divided by the total tenure of all directors on the board. *TW Female Proportion* indicates that female directors will have greater influence on corporate decision-making if the length of their tenure is sufficient.

3. Results

3.1. Descriptive statistics

Table 1 presents the descriptive statistics for our key dependent and independent variables. The mean (median) of OC is 0.120 (0.017) with a standard deviation of 0.222. Female directors' proportion, on average, represents 9.7 % of total board size. The tenure-weighted female proportion has a mean of 0.077 with a standard deviation of 0.098, highlighting that women currently comprise a small percentage of corporate boards.

3.2. Baseline regression

Table 2 presents the OLS regression results, which we obtain by using four different dependent variable specifications. In all regressions, we control for the year- and firm-fixed effects, and standard errors are clustered at the firm level. We find that all measures of female directors significantly influence firms' OC investment. Specifically, the coefficient estimates for *Female proportion* and *TW Female Proportion* are 0.028 and 0.032, with t-statistics of 1.88 and 1.89, respectively. *Female One Dummy* and *Female Two Dummy* are also positive and statistically significant. Our results indicate that gender diversity on board has a significant positive effect on OC investment. This finding is consistent with our expectation that female directors provide a long-term investment perspective to boards, directing more resources toward OC.

4. Addressing endogeneity concerns

4.1. Instrument variable

Although our baseline results show positive causality between board gender diversity and a firm's OC, they may still be subject to endogeneity. In this section, following previous research (Adams and Ferreira, 2009; Levi et al., 2014; Chen et al., 2017), we use an instrument variable, which is the proportion of a firm's male directors who sit on other boards with at least one female director and define it as *Fraction of Male Directors Linked to Female Directors*. Adams and Ferreira (2009) argue that the absence of women on boards is due to their lack of connections; therefore, the more connected male directors are to female directors, the more female directors should be observed. Moreover, no empirical evidence suggests that a male director's link to a female director affects a firm's OC investment. Thus, the *Fraction of Male Directors Linked to Female Directors* should satisfy the exclusion condition and serve as an appropriate instrument for board gender diversity.

Table 3 presents estimates using the instrumental variables method based on two-stage least square (2SLS) panel regressions, and the explanatory variables include the above-mentioned instrument and four proxies of board gender diversity mentioned in Table 2. Column 1 to Column 4 of Table 3 reports the results of the first-stage regression, the coefficients of the instrument variable with the four board gender diversity proxies are all positive and statistically significant at the 1 % level and the F-statistics are beyond the cutoff value of 16.38, which refuses the weak instrument hypothesis according to Stock and Yogo (2005). The second-stage results in Column 4 to Column 8 of Table 3 show that the coefficients of instrumented board gender diversity proxies are positive and statistically significant. This is consistent with our main hypothesis and suggests that the main results are robust against potential endogeneity issues.

Table 2
Effects of female board members on organization capital.

	(1) OC	(2) OC	(3) OC	(4) OC
Female Proportion	0.028*			
	(1.88)			
TW Female Proportion		0.032*		
		(1.89)		
Female One Dummy			0.009***	
			(3.10)	
Female Two Dummy				0.006***
				(2.75)
ROA	-0.088***	-0.089***	-0.088***	-0.088***
	(-6.76)	(-6.78)	(-6.73)	(-6.76)
PPE	0.050***	0.051***	0.050***	0.051***
	(3.860)	(3.89)	(3.82)	(3.89)
Leverage	-0.009	-0.009	-0.009	-0.009
	(-1.06)	(-1.09)	(-1.02)	(-1.05)
Capex	-0.042	-0.042	-0.041	-0.043
	(-1.50)	(-1.49)	(-1.48)	(-1.55)
Tobin's Q	-0.005	-0.005	-0.005	-0.005
	(-1.58)	(-1.57)	(-1.57)	(-1.59)
Sales	-0.012***	-0.012***	-0.012***	-0.012***
	(-4.33)	(-4.29)	(-4.41)	(-4.33)
Firm_Age	-0.193***	-0.193***	-0.193***	-0.193***
	(-28.80)	(-28.80)	(-28.77)	(-28.82)
Board_Size	-0.009	-0.008	-0.012*	-0.009
	(-1.39)	(-1.27)	(-1.78)	(-1.44)
IO	-0.030***	-0.030***	-0.031***	-0.030***
	(-5.76)	(-5.75)	(-5.82)	(-5.74)
Intercept	0.672***	0.670***	0.678***	0.674***
	(30.54)	(30.62)	(30.29)	(30.60)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observation	46970	46970	46970	46970
adj. R^2	0.380	0.380	0.380	0.380

Notes: This table presents the regression results on the relationship between board gender diversity and OC using alternative measures of female directors. The dependent variable is OC. The independent variables include the following: *Female Proportion*, which is the percentage of female directors on the board; *TW Female Proportion*, representing the sum of the tenure of female directors divided by the total tenure of all directors on the board; *Female One Dummy*, which takes the value of one if at least one female director is on the board, and zero otherwise. *Female Two Dummy*, which takes the value of one if there are two or more female directors on the board, and zero otherwise. All explanatory variables are lagged by one year. All regressions control for firm and year-fixed effects. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. ***, **, and * denote significance at the 1 %, 5 %, and 10 % levels, respectively.

4.2. PSM-DID-female directors' appointment

In this section, we follow recent studies (Baghdadi et al., 2023; Atif et al., 2021; Chen et al., 2017) using the PSM-DID framework to identify the causal effects of female directors on OC around female and male director appointments. Following the spirit of Baghdadi et al. (2023) and Atif et al. (2021), we construct a treatment group of firms in which a female director replaces a departing male director over 60 years old in a given year. To make the control group more comparable, another male director must be appointed to replace a departing male director aged over 60.[4]

The sample used in this analysis includes firm-year observations within one year before and after the director's appointments. In order to accurately observe the effect of replacing a male director with a female director, we exclude samples that involved multiple female or male director appointments during the sample period. After applying these criteria, we identify 261 female director appointments for our treatment group and 1055 male directors to replace a departing male director. Then, we apply propensity score matching (PSM) to match the treatment and control groups using the nearest neighbor matching approach with the replacement of the same control variables in Table 2 to ensure that both groups are comparable with no significant differences between them.

Panel A of Table 4 presents the univariate mean comparisons between the characteristics of the treatment and control firms. No statistically significant differences are observed in firm characteristics, indicating that the PSM method effectively eliminates differences between the two groups.

To conduct the DID regression, we estimate the following regression model:

[4] To consider the departing male director could be prompted by corporate strategy or poor performance, we follow the methods of Baghdadi et al. (2023) and Atif et al. (2021) to limit the age of departing male directors to over 60 years old. We alternatively set the departing male directors' age to 62, and the results remained consistent, as shown in Appendix Table A2.

Table 3
Effects of female board members on organization capital – instrument variable.

	(1) First Stage	(2)	(3)	(4)	(5) Second Stage	(6)	(7)	(8)
	Female Proportion	*TW_Female_Proportion*	*Female One Dummy*	*Female Two Dummy*	OC	OC	OC	OC
Fraction of male directors linked to female directors	0.124***	0.052***	1.138***	0.116***				
	(56.02)	(23.11)	(107.60)	(10.50)				
Female Proportion					0.287***			
					(6.89)			
TW_Female_Proportion						0.689***		
						(6.79)		
Female One Dummy							0.031***	
							(6.94)	
Female Two Dummy								0.307***
								(5.82)
All controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40550	40,499	40550	40550	40550	40,499	40550	40550
F-statistic	81.71***	49.98***	48.34***	110.31***				
Stock and Yogo (2005) critical value	16.380							

Notes: This table presents estimates using the instrumental variables method based on two-stage least squares panel regression. Column 1 through 4 report the first-stage regression results, where the dependent variables are board gender diversity proxies*: Female Proportion, TW_Female_Proportion, Female One Dummy* and *Female Two Dummy*. The instrumental variable is the *Fraction of male directors linked to female directors*, defined as the fraction of male directors on the board who sit on other boards with at least one female director. Columns 4 through 8 report the second-stage regression results, with OC as the dependent variable. The same set of control variables, firm- and year-fixed effects as in baseline models are included. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. ***, **, and * denote significance at the 1 %, 5 %, and 10 % levels, respectively.

$$OC_{it} = \alpha + \beta_1 Treat \times Post_{it} + \beta_2 Treat_i + \beta_3 Post_t + \sum \beta_z Controls + Year_t + Industry_i + \varepsilon_{it} \quad (3)$$

where *i* and *t* refer to firm and year, respectively. The dependent variable is *OC*, as measured by Eisfeldt and Papanikolaou (2013). *Treat* is a dummy variable that equals one if the firm belongs to the treatment group, and zero otherwise. *Post* is an indicator variable that equals one in the period after the appointment, and zero otherwise. We present the results of the DID regression in Panel B of Table 4, which include industry and year-fixed effects. Notably, Column 1 incorporates control variables, whereas Column 2 does not. We find that the coefficients for *Treat* × *Post* are 0.016 and 0.018, with t-statistics of 1.94 and 2.45, respectively. This suggests that, compared to after male director appointments, firms exhibit higher levels of OC after female director appointments. For example, the coefficient estimates on *Treat* × *Post* in Column 2 suggests that, on average, OC levels are 1.80 percentage points higher for the year after the female director appointment than they are after the male director appointment.

4.3. Board gender diversity and firm performance

Our findings suggest that board gender diversity fosters corporate investment in OC. In this section, we explore the benefits firms gain from such investments. Eisfeldt and Papanikolaou (2013) argue that firms with high OC exhibit a higher Tobin's Q compared to those with low OC, and that firms with a higher ratio of OC to physical capital demonstrate higher productivity. Zareie et al. (2024) demonstrate a positive relationship between OC and both concurrent and future corporate value. In this part, we first examine the relationship between OC and Tobin's Q. Then, we investigate whether board gender diversity amplifies this relationship.

We present our findings in Table 5. In Column 1, we first examine the relationship between OC and Tobin's Q after controlling for the firm- and year- fixed effects. The coefficient of OC is 0.204 (t-statistics of 2.92), which is positive and statistically significant at the 1 % level. The result is consistent with Eisfeldt and Papanikolaou (2013) and Zareie et al. (2024), suggesting that investment in OC enhances firm value. In Column 2, we construct the interaction term *Female Proportion*OC* to assess whether a gender-diverse board strengthens the positive relationship between OC and firm value. The results show that the coefficient of *Female Proportion*OC* is 0.239 with t-statistics of 1.87, indicating that the positive effects of OC on firm value are amplified by the proportion of female directors on the board. Our findings provide a novel perspective on studying the relationship between female directors and firm value, revealing that board gender diversity amplifies the positive correlation between OC and firm value.

5. Conclusion

Gender diversity on corporate boards continues to attract research attention. This study explores the relationship between board

Table 4
Effects of female board members on organization capital – PSM-DID regressions.

Panel A: Post-Match Mean Differences

Variable	*Treated*	*Control*	*Difference*	*T-statistic*
IO	0.607	0.633	-0.026	-0.530
Tobin's Q	0.552	0.491	0.061	0.890
Capex	0.045	0.044	0.001	0.210
Leverage	0.231	0.210	0.021	0.880
PPE	0.239	0.248	-0.009	-0.330
ROA	0.090	0.109	-0.019	-1.030
Sales	6.727	7.223	-0.496	-2.070
Firm_Age	2.902	2.988	-0.086	-0.850
Board_Size	2.146	2.189	-0.043	-1.440

Panel B: Post-Match Differences-in-differences Regression

	(1)	(2)
	OC	OC
*Treat*Post*	0.016*	0.018**
	(1.94)	(2.45)
Treat	-0.043*	-0.061***
	(-1.89)	(-2.90)
Post	-0.027***	-0.013**
	(-3.57)	(-2.14)
Intercept	0.053**	0.511***
	(2.17)	(4.81)
All other Control	No	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observation	578	578
adj. R^2	0.293	0.473

Notes: This table presents the propensity score matching estimation and difference-in-differences (PSM-DID) result. Panel A reports the propensity score matching results and shows univariate mean comparisons of female directors' appointments between treatment and control firms along with their corresponding t-statistics. The treatment firms are those that replaced a departing female director aged above 60 with a female director and control firms are those firms that replaced a departing male director aged above 60 with another male director. Panel B presents the DID estimates of female directors' appointments where the dependent variable is OC. *Treat* is a dummy variable that equals one if the firm belongs to the treatment group, and zero otherwise. *Post* is an indicator variable that equals one in the period following the appointment, and zero otherwise. Column 2 includes control variables, while the Column 1 does not. The sample used in this analysis includes firm-year observations within one year before and after the director's appointments. All regressions control for industry and year-fixed effects. Detailed variable descriptions can be found in the Appendix Table A1. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. ***, **, and * denote significance at the 1 %, 5 %, and 10 % levels, respectively.

gender diversity and firms' investment in OC, based on the premise that gender-diverse boards tend to focus more on long-term performance (Griffin et al., 2020) and that OC and R&D capital share foundational concepts. Using a sample of US public firms, our findings suggest that gender-diverse boards adopt longer-term investment perspectives, leading to greater resource allocation toward OC. Moreover, we find that board gender diversity amplifies the positive effects of OC on firm value.

Our study contributes to the literature on board gender diversity and OC in two ways. First, we complement existing research on the relationship between board gender diversity and firm investments by showing that boards with higher gender diversity also focus on investing in OC. Second, this study enriches the literature on board gender diversity and firm value. Building on the work of Eisfeldt and Papanikolaou (2013) and Zareie et al. (2024), our study demonstrates the extent to which a gender-diverse board amplifies the positive effects of OC on firm value. Our results indicate that gender-diverse boards contribute to enhanced decision-making and strategic planning. Encouraging firms to prioritize gender diversity could have broader implications for economic competitiveness and corporate governance standards. Therefore, we suggest that both public and private sector initiatives aimed at fostering diversity that are actively supported, as they may lead to more sustainable business practices and long-term value creation.

Future research in this area is crucial. Our findings indicate that female directors are more likely to invest in OC, an intangible asset that yields long-term returns. Further exploration is needed to understand the mechanisms through which female directors influence OC investment and whether their presence on specific committees impacts this relationship. Additionally, while this study focused on the proportion of female directors, future research could explore potential upper limits to female representation on boards, an intriguing avenue for investigation.

CRediT authorship contribution statement

Chu-Bin Lin: Writing – review & editing, Supervision, Methodology, Conceptualization. **Zhengyang Qi:** Writing – original draft, Methodology, Formal analysis, Data curation. **Yi-Wen Chen:** Writing – review & editing, Methodology, Funding acquisition. **Yicheng Sun:** Writing – review & editing, Supervision, Resources, Data curation.

Table 5
Board gender diversity and firm performance.

	(1) Tobin's Q	(2) Tobin's Q
*Female Proportion*OC*		0.239*
		(1.87)
Female Proportion		-0.010
		(-0.46)
OC	0.204***	-0.010
	(2.92)	(-0.74)
ROA	-0.290	-0.452***
	(-0.73)	(-21.48)
PPE	-0.881***	0.150***
	(-5.93)	(7.13)
Leverage	0.253*	0.113***
	(1.81)	(9.71)
Capex	1.067***	-0.855***
	(5.24)	(-15.61)
IO	-0.077***	-0.043***
	(-2.80)	(-5.89)
Sales	-0.155***	-0.016***
	(-3.99)	(-5.31)
Firm_Age	-0.104**	0.028***
	(-2.39)	(5.05)
Board_Size	-0.143**	-0.009
	(-2.08)	(-0.93)
Intercept	3.888***	0.073***
	(17.33)	(2.60)
Year FE	Yes	Yes
Firm FE	Yes	Yes
Observation	46970	46970
adj. R^2	0.116	0.187

Notes: This table presents how female directors' investment in OC affects firm value. The dependent variable is firm value, measured by Tobin's Q. Column 1 of Table 5 presents the regression result where the dependent variable is OC and the independent variable is Tobin's Q. Column 2 examines whether board gender diversity amplifies the relationship between OC and Tobin's Q. The variable of interest is *Female Proportion*OC*. The same set of control variables, along with firm- and year-fixed effects as in baseline models are included. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. ***, **, and * denote significance at the 1 %, 5 %, and 10 % levels, respectively.

Appendix

Table A1
Variable definition.

Variables	Definition and description
OC	We first calculate the stock of organization capital using the perpetual inventory method: $OC_t = (1-\delta_0)OC_{t-1} + SG\&A/cpi_t$ where SG&A is selling, general, and administrative expenses; δ_0 is the depreciation rate of 15 % that was used by the Bureau of Economic Analysis in its estimation of R&D capital in 2006; and cpi_t is the consumer price index. We compute the initial organization capital (OC_0) as: $OC_0 = SG\&A/(g+\delta_0)$ where g is the average real growth rate of firm-level SG&A expenses that is assumed to equal 10 % in our sample. OC is then scaled by total assets and measured at year t.
Female Proportion	Total number of female directors divided by board size.
TW Female Proportion	Tenure-weighted female proportion is the sum of the tenure of female directors divided by the total tenure of all directors on the board as per Shoham et al. (2020).
Female One Dummy	An indicator variable that equals one if there is one female directors on the board, and zero if otherwise.
Female Two Dummy	An indicator variable that equals one if there are two female directors on the board, and zero if otherwise.
ROA	ROA (Return-on-assets ratio) is defined as operating income before depreciation divided by the book value of total assets that is measured at the end of year t.
PPE	PPE is the ratio of property, plant, and equipment divided by the book value of total assets measured at the end of year t.
Leverage	Leverage is defined as the book value of short-term and long-term debts divided by the book value of total assets measured at the end of year t.
Capex	Capex is the capital expenditure scaled by the book value of total assets measured at the end of year t.

(*continued on next page*)

Table A1 (*continued*)

Variables	Definition and description
Tobin's Q	Tobin's Q is the market-to-book ratio during the year t, calculated as the market value of equity plus the book value of assets, minus the book value of equity, minus balance-sheet deferred taxes (set to zero if missing), and then divided by the book value of assets, then take the logarithm.
Sales	Sales measured at the end of year t.
Firm_Age	Firm_Age calculates from the year in which the transaction data first appears in the CRSP database and takes a logarithm.
Board_Size	Total number of directors on the board and take the logarithm.
Fraction of male directors linked to female directors	The fraction of male directors on the board who sit on other boards with at least one female director.

Table A2
Effects of female board members on organization capital –PSM-DID regressions.

Panel A: Post-Match Mean Differences

Variable	*Treated*	*Control*	*Difference*	*T-statistic*
IO	0.631	0.639	-0.008	-0.160
Tobin's Q	0.568	0.586	-0.018	-0.260
Capex	0.044	0.044	0.000	-0.010
Leverage	0.223	0.205	0.0018	0.710
PPE	0.238	0.227	0.011	0.380
ROA	0.090	0.116	-0.026	-1.400
Sales	6.804	6.908	-0.104	-0.420
Firm_Age	2.854	2.768	0.086	0.870
Board_Size	2.160	2.179	-0.019	-0.610

Panel B: Post-Match Differences-in-differences Regression

	(1)	(2)
	OC	OC
*Treat*Post*	0.017**	0.018**
	(2.00)	(2.45)
Treat	-0.046*	-0.058***
	(-1.93)	(-2.70)
Post	-0.029***	-0.014**
	(-3.60)	(-2.12)
Intercept	0.052**	0.547***
	(2.07)	(5.01)
All other Control	No	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observation	548	548
adj. R^2	0.131	0.455

Notes: This table presents the propensity score matching estimation and difference-in-differences (PSM-DID) result. Panel A reports the propensity score matching results and shows univariate mean comparisons of female directors' appointments between treatment and control firms along with their corresponding t-statistics. The treatment firms are those that replaced a departing male director aged above 62 with a female director and control firms are those firms that replaced a departing male director aged above 62 with another male director. Panel B presents the DID estimates of female directors' appointments where the dependent variable is OC. *Treat* is a dummy variable that equals one if the firm belongs to the treatment group, and zero otherwise. *Post* is an indicator variable that equals one in the period following the appointment, and zero otherwise. Column 2 includes control variables, while the Column 1 does not. The sample used in this analysis includes firm-year observations within one year before and after the director's appointments. All regressions control for industry and year-fixed effects. Detailed variable descriptions can be found in the Appendix Table A1. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. ***, **, and * denote significance at the 1 %, 5 %, and 10 % levels, respectively.

Data availability

The authors do not have permission to share data.

References

Adams, R.B., Ferreira, D., 2009. Women in the boardroom and their impact on governance and performance. J. Financ. Econ. 94 (2), 291–309.
Ahern, K.R., Dittmar, A.K., 2012. The changing of the boards: the impact on firm valuation of mandated female board representation. Q. J. Econ. 127 (1), 137–197.
Alkhawaja, A., Hu, F., Johl, S., Nadarajah, S., 2023. Board gender diversity, quotas, and ESG disclosure: global evidence. Int. Rev. Financ. Anal. 90, 102823.
Almor, T., Bazel-Shoham, O., Lee, S.M., 2022. The dual effect of board gender diversity on R&D investments. Long Range Plan. 55 (2), 101884.
Atif, M., Hossain, M., Alam, M.S., Goergen, M., 2021. Does board gender diversity affect renewable energy consumption? J. Corp. Financ. 66, 101665.
Baghdadi, G.A., Safiullah, M., Heyden, M.L., 2023. Do gender diverse boards enhance managerial ability? J. Corp. Financ. 79, 102364.
Bao, Y., Li, J., 2024. Cross-border M&A, gender-equal culture, and board gender diversity. J. Corp. Financ. 84, 102527.

Barroso, R., Duan, T., Guo, S.S., Kowalewski, O., 2024. Board gender diversity reform and corporate carbon emissions. J. Corp. Financ. 87, 102616.
Belo, F., Li, J., Lin, X., Zhao, X., 2017. Labor-force heterogeneity and asset prices: the importance of skilled labor. Rev. Financ. Stud. 30 (10), 3669–3709.
Berger, A.N., Kick, T., Schaeck, K., 2014. Executive board composition and bank risk taking. J. Corp. Financ. 28, 48–65.
Brown, J.R., Fazzari, S.M., Petersen, B.C., 2009. Financing innovation and growth: cash flow, external equity, and the 1990s R&D boom. J. Finance 64 (1), 151–185.
Carter, D.A., D'Souza, F., Simkins, B.J., Simpson, W.G., 2010. The gender and ethnic diversity of US boards and board committees and firm financial performance. Corp. Gov.: Int. Rev. 18 (5), 396–414.
Carter, D.A., Simkins, B.J., Simpson, W.G., 2003. Corporate governance, board diversity, and firm value. Financ. Rev. 38 (1), 33–53.
Chan, K., Li, M.X., Lin, C.B., Wang, Y., 2022. Organization capital effect in stock returns—the role of R&D. J. Bus. Financ. Account. 49 (7-8), 1237–1263.
Chen, J., Leung, W.S., Goergen, M., 2017. The impact of board gender composition on dividend payouts. J. Corp. Financ. 43, 86–105.
Corrado, C., Hulten, C., Sichel, D., 2009. Intangible capital and US economic growth. Rev. Income Wealth. 55 (3), 661–685.
Darmadi, S., 2011. Board diversity and firm performance: the Indonesian evidence. Corp. Ownersh. Control. 8.
Eisfeldt, A.L., Papanikolaou, D., 2013. Organization capital and the cross-section of expected returns. J. Finance 68 (4), 1365–1406.
Francis, B., Mani, S.B., Sharma, Z., Wu, Q., 2021. The impact of organization capital on firm innovation. J. Financ. Stab. 53, 100829.
Gow, I.D., Larcker, D.F., Watts, E.M., 2023. Board diversity and shareholder voting. J. Corp. Financ. 83, 102487.
Greene, D., Intintoli, V.J., Kahle, K.M., 2020. Do board gender quotas affect firm value? Evidence from California Senate Bill No. 826. J. Corp. Financ. 60, 101526.
Griffin, D., Li, K., Xu, T., 2020. Board gender diversity and corporate innovation: international evidence. J. Financ. Quant. Anal. 56 (1), 123–154.
Hillman, A.J., Canella, A., Paetzold, R., 2000. The resource dependency role of corporate governance directors: strategic adaptation of board composition in response to environmental change. J. Manag. Stud. 37 (2), 235–256.
Hoffman, L.R., Maier, N.R., 1961. Quality and acceptance of problem solutions by members of homogeneous and heterogeneous groups. J. Abnorm. Soc. Psychol. 62 (2), 401.
Hong, L., Page, S.E., 2004. Groups of diverse problem solvers can outperform groups of high-ability problem solvers. Proc. Natl. Acad. Sci. U.S.A. 101 (46), 16385–16389.
Huang, J., Kisgen, D.J., 2013. Gender and corporate finance: are male executives overconfident relative to female executives? J. Financ. Econ. 108 (3), 822–839.
Lev, B., Radhakrishnan, S., 2005. The valuation of organization capital. In: Measuring Capital in The New Economy, 65, pp. 403–472.
Lev, B., Radhakrishnan, S., (2015). Organization Capital. NYU Stern Working Paper.
Lev, B., Radhakrishnan, S., Zhang, W., 2009. Organization capital. Abacus 45 (3), 275–298.
Levi, M., Li, K., Zhang, F., 2014. Director gender and mergers and acquisitions. J. Corp. Financ. 28, 185–200.
Miller, T., Del Carmen Triana, M., 2009. Demographic diversity in the boardroom: mediators of the board diversity–firm performance relationship. J. Manag. Stud. 46 (5), 755–786.
Mobbs, S., Tan, Y., Zhang, S., 2021. Female directors: why are some less informed than others? J. Corp. Financ. 68, 101938.
Shoham, A., Lee, S.M., Khan, Z., Tarba, S.Y., Ahammad, M.F., 2020. The effect of board gender diversity on cross-listing. J. Corp. Financ. 65, 101767.
Sila, V., Gonzalez, A., Hagendorff, J., 2016. Women on board: does boardroom gender diversity affect firm risk? J. Corp. Financ. 36, 26–53.
Stock, J.H., Yogo, M., 2005. Testing for weak instruments in linear IV regression. Identification and Inference for Econometric Models: Essays in Honour of Thomas J. Rothenberg. Cambridge University Press, pp. 80–108.
Van Knippenberg, D., Schippers, M.C., 2007. Work group diversity. Annu. Rev. Psychol. 58, 515–541.
Zareie, M., Attig, N., El Ghoul, S., Fooladi, I., 2024. Firm digital transformation and corporate performance: the moderating effect of organizational capital. Financ. Res. Lett. 61, 105032.