

EVEN ONE CAN MAKE A DIFFERENCE — FEMALE BOARD REPRESENTATION AND CAPITAL STRUCTURE: EVIDENCE FROM TAIWAN

Chia-Wei Chen^{*}, Bingsheng Yi^{**}, Meng Zhao^{***},
Qiancheng Zheng^{****}

^{*} Tunghai University, Taichung, Taiwan

^{**} Corresponding author, California State University, Dominguez Hills, Carson, the USA

Contact details: California State University, Dominguez Hills, 1000 E. Victoria St., I&I 4302, Carson, CA 90747, the USA

^{***} California State University, Dominguez Hills, Carson, the USA

^{****} University of Massachusetts Lowell, Lowell, the USA



Abstract

How to cite this paper: Chen, C.-W., Yi, B., Zhao, M., & Zheng, Q. (2022). Even one can make a difference — Female board representation and capital structure: Evidence from Taiwan. *Corporate Ownership & Control*, 19(3), 112–122.
<https://doi.org/10.22495/cocv19i3art8>

Copyright © 2022 The Authors

This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0).
<https://creativecommons.org/licenses/by/4.0/>

ISSN Online: 1810-3057

ISSN Print: 1727-9232

Received: 28.01.2022

Accepted: 03.05.2022

JEL Classification: G3, G32, G34

DOI: 10.22495/cocv19i3art8

This paper investigates whether and how female board representation will affect firms' capital structure using a sample of 16,477 firm-year observations during the period from 2006 to 2017 obtained from *Taiwan Economic Journal* (TEJ). While 67% of Taiwanese firms have female directors, most firms have only one female director. We find that firms with female directors use more debt financing, particularly, more short-term debt. Our results support the notion that female board representation is associated with increased monitoring through increased use of debt, particularly short-term debt. Our results remain consistent with various robustness tests using alternative samples, measures, and methodologies.

Keywords: Director, Female Board Representation, Capital Structure, Gender Diversity

Authors' individual contribution: Conceptualization — B.Y. and M.Z.; Methodology — C.-W.C. and B.Y.; Validation — Q.Z.; Formal Analysis — C.-W.C.; Data Curation — C.-W.C.; Writing — Original Draft — B.Y.; Writing — Review & Editing — C.-W.C., B.Y., M.Z., and Q.Z.; Project Administration — B.Y.

Declaration of conflicting interests: The Authors declare that there is no conflict of interest.

1. INTRODUCTION

It is said that women can hold up half of the sky. However, women have never been able to hold half of the corporate board seats across the world. If a board has more (less) female directors, we say the board has higher (smaller) gender diversity. Usually, board gender diversity is measured by the percentage of female board members. Board gender diversity varies greatly globally. According to the 2021 report by The Deloitte Global Boardroom Program, in 2021, French firms have the greatest board gender diversity, 43.2% of French board members are female; in contrast, Qatar has the lowest board gender diversity as only 1.2%

of Qatar corporate board members are female (Deloitte, 2021). Due to the significantly low female representation on corporate boards, board gender diversity has become a hot topic of board reform in many countries and regions. Adams and Kirchmaier (2015) report that 17 countries implemented boardroom diversity reforms for listed companies (5 quota-based legislation and 12 comply-or-explain governance codes) from 2008 to 2012. On Sunday, September 30, 2019, California Governor Jerry Brown signed California Senate Bill 826 (Fuhrmans, 2018) and made California become the first state in the US to mandate female board directors. In recent years firms across the world have been facing increasing pressure from various stakeholders to adopt more female board members, yet studies on

the impact of female board members still cannot generate solid evidence on whether the increase in board gender diversity generates more positive impacts or not, whether female directors are effective in corporate decision-making involving corporate board members.

The past decades have seen a rich literature on the relationship between board gender diversity and firm performance while empirical findings have been mixed. Many empirical studies have documented a positive relationship between board gender diversity and firm performance. Using Fortune 1,000 firms as their sample, Carter, Simkins, and Simpson (2003) report evidence of a positive relationship between Tobin's Q and the percentage of female and minority directors. Erhardt, Werbel, and Shrader (2003) report evidence of a positive relationship between board diversity and return on assets (ROA). Campbell and Minguez-Vera (2008) find a positive relationship between gender diversity and company value for Spanish firms. Using a sample of over 3,800 firms from 47 countries, Terjesen, Couto, and Francisco (2016) find a positive association between female directors and firm performance as measured by both Tobin's Q and ROA.

In contrast, some studies have found that board gender diversity is negatively related to firm performance. An early empirical study by Shrader, Blackburn, and Iles (1997) reports evidence of a negative relationship between the percentage of female directors and ROA and return on equity (ROE). Ahern and Dittmar (2012) examine the government-established 40% female director quota in Norway in 2003. They find a significant drop in Tobin's Q after the setting of the quota. Boubaker, Dang, and Nguyen (2014) show evidence of a negative and significant effect of board gender diversity on financial firm performance among a sample of listed French firms over the 2009 to 2011 period. Haslam, Ryan, Kulich, Trojanowski, and Atkins (2010) report that there is no association between the presence of female directors on a board and firm performance for FTSE 100 companies. Gregory-Smith, Main, and O'Reilly (2014) report that they did not find evidence that the presence of females on boards is associated with higher firm performance. Marinova, Plantenga, and Remery (2016) find no association between gender diversity and firm performance for a sample of Dutch firms, using Tobin's Q as a measure of firm performance,

In recent years, a strand of literature has been investigating how board gender diversity may affect major corporate decisions. Among these, a few studies examined the impact of board gender diversity on corporate financing decisions, and the evidence is inconclusive. García and Herrero (2021) investigate a sample of European firms over the period 2002 to 2019 and find board gender diversity is negatively related to leverage — the total book value of debt (long- and short-term debt) to *total assets*. Alves, Couto, and Francisco (2015) find evidence that board gender diversity is positively related to more external equity capital (less long-term debt) in the capital structure but negatively associated with total debt to asset ratio from a set of listed firms across the world between 2006 and 2010. In contrast, Nisiyama and Nakamura (2018) find board gender diversity is positively associated with firm leverage, measured as net debt to earnings before interest, taxes, depreciation, and

amortization (EBITDA), using a set of public-listed Brazilian companies from 2010 to 2014. Shettima and Dzolkarnaini (2018) use data of 584 microfinance institutions (MFIs) from 79 countries over 2010–2014 and find that female directors in MFIs boards are not significantly related to leverage. Adusei and Obeng (2019) use 441 MFIs located in 69 countries over 2010–2014 period to investigate the effect of board gender diversity on capital structure. They find a robust negative and statistically significant effect of board gender diversity on the debt-to-equity ratio. Using a sample of French non-financial listed companies over the period 2006–2019, Ben Saad and Belkacem (2021) find the effect of board gender diversity on capital structure decisions varies with the approach adopted (voluntary, enabling or coercive).

Most studies on board gender diversity use data in western countries, which have developed markets and better corporate governance systems, less severe gender inequality than East-Asia countries and regions. Given the rare literature with non-western samples and the limited and mixed findings on board gender diversity and capital structure, this paper investigates whether and how female board representation will affect firms' capital structure. We also explore whether the education level of female directors and their affiliation with the ultimate firm controllers will affect firms' capital structure. We employ 16,477 firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. We find consistent evidence that female board representation is positively associated with debt financing, particularly short-term debt, indicating increased usage of debt as a monitoring tool. Our results remain robust with alternative methods such as fixed-effect models and two-step regression models, various samples such as restricting to sample of firms with female directors to only those changed from having no female directors to having female directors, and different measures of financial leverages such as *total debt ratio* and *short-term debt ratio*.

Our study contributes to the literature in several ways. First, our study adds new evidence to the limited literature investigating female board representation (board gender diversity) and capital structure. We show that female board representation is positively associated with debt financing. And, in particular, firms with greater female board representation tend to use more short-term debt. In addition, we present the first empirical evidence on how female directors' education level and affiliation with a firm's ultimate controller affect the firm's capital structure. We find that the graduate degree of female directors is not significantly associated with debt use, and, in contrast, the affiliation of female directors with ultimate firm controllers is positively related to debt financing. Third, our study provides empirical evidence against tokenism (Kanter, 1977, among others). Kristie (2011) hypothesizes that "one is a token, two presences, and three is a voice" (p. 22), and many studies find evidence supporting this critical mass theory (Konrad, Kramer, & Erkut, 2008; Joecks, Pull, & Vetter, 2013; Shettima & Dzolkarnaini, 2018). Our data indicate that most Taiwanese boards have only one female director. It thus is even more enlightening that the empirical evidence is strong and pervasive. Apparently, even one female director can make a difference. Fourth, our paper also

contributes to the international corporate governance literature by showing that female directors in Taiwanese firms play a significant role in determining the capital structure of Taiwanese firms.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and develops the hypothesis. Section 3 describes the data and variables, also reports the univariate test results. Section 4 presents and discusses the multivariate analysis results. Section 5 concludes the paper.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1. Women's risk aversion and capital structure

Women are commonly considered as more risk-averse than men. Many studies investigate the risk attitudes of people in the overall population and find that females are more risk-averse than males. Byrnes, Miller, and Schafer (1999) conduct a meta-analysis of 150 studies on risk-taking behavior between men and women. They show that men are more likely to be involved in 'risky experiments', 'intellectual risk taking' and 'gambling' than women. Croson and Gneezy (2009) review the literature on gender differences in risk preference and find robust evidence that, under experimental settings, men show a greater tendency to make more risky choices than women. Since debt financing increases firms' financial and bankruptcy risk, firms with more female directors may be less likely to use debt financing. However, recent studies have shown that women in male-dominated majors or professions are not necessarily more risk-averse than men. Deaves, Lüders, and Luo (2009) find women are not less overconfident than men in a sample of economics, finance, and business students. Using a large survey of directors, Adams and Funk (2012) find female directors to be more risk-loving than male directors. They suggest that more female directors may not result in more risk-averse decisions. Sila, Gonzalez, and Hagedorff (2016) investigate the causal relationship between boardroom gender diversity and firm risk and find "no evidence that female boardroom representation influences equity risk" (p. 26). Given the mixed evidence on women's risk preference and the impact of board gender diversity on firm risk, it seems that it is still an empirical question as to whether female directors affect a firm's capital structure.

2.2. Female directors' monitoring and capital structure

Jensen (1986) posits that debt may mitigate the agency costs resulting from the conflict of interest between managers and shareholders. Managers of firms with substantial cash flows are more likely to overinvest and consume perquisites. Debt financing obligates firm managers to pay out future cash flows, therefore, reduces cash flows available for managers to spend at their discretion. Adams and Ferreira (2009) find that female directors provide better monitoring than male directors because female directors are more likely to serve on monitoring-related committees. Female board representation improves board meeting attendance and increases the sensitivity of CEO turnover to stock returns. Since female directors are better monitors than male directors, firms with more female board representation may be more likely to use debt in disciplining managers' behaviors. In addition, debt with shorter maturities requires more frequent renewal or refinancing, thus subjects firm managers to greater scrutiny and monitoring. Thus, short-term debt may serve as an important monitoring device in curbing managers' risk-taking actions.

Summarizing the above discussions, we hypothesize that firms with more female directors will use more debt financing than equity financing and will use more short-term debt than longer-term debt. As a result, we expect to observe a positive relationship between female board representation (board gender diversity) and *total debt ratio* and *short-term debt ratio*.

3. DATA SELECTION, VARIABLE DESCRIPTION AND UNIVARIATE ANALYSIS

To test our hypotheses, we employ firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. The selection of this period and focusing on listed firms traded in either Taiwan Stock Exchange (TWSE) or Taipei Exchange (OTC) are primarily due to data availability from our data source, *Taiwan Economic Journal* (TEJ). We exclude non-calendar-year firms since most variables demanded are reported annually. After excluding observations with missing variables, our final sample contains 16,477 firm-year observations representing roughly 95% of listed firms during these 12 years.

Table 1. Summary statistics and univariate test (Part 1)

Panel A: Summary statistics				
Variables	Mean	P1	Median	P99
Board with female director(s)	0.67	0	1	1
Female director (%)	12.8	0	11.1	50
Total debt ratio	36.4	3.23	34.6	92.6
Short-term debt ratio	26.1	1.39	23.2	75.0
Total assets	26,856	253	3,017	444,387
Free cash flow	903	-5,054	82	21,964
Fixed assets	3,333	0	421	42,969
Long-term investment	8,035	0	656	133,951
Firm age	27.6	5	26	61
Return on assets	7.42	-24.9	7.16	34.4
Std. dev. of stock return	2.53	0.73	2.34	6.32
Institutional ownership	38.1	0.95	35.3	91.0
Managerial ownership	1.62	0	0.56	11.86
Board size	9.44	6	9	18
Independent director (%)	17.8	0	20	50

Table 1. Summary statistics and univariate test (Part 2)

Panel B: Univariate test				
Variables	Statistic	Female director		Difference (1) - (2)
		With (1)	Without (2)	
Total debt ratio (%)	Mean	36.64	35.98	0.66**
	Median	34.84	34.24	0.60**
Short-term debt (%)	Mean	26.44	25.41	1.03***
	Median	23.54	22.50	1.04***
N		11,097	5,380	

Notes: The sample contains 16,477 firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. Board with female director(s) is a dummy indicator. It is 1 if there is at least 1 female director on board and 0 otherwise. Female director (%) is the percentage of female director(s) on board calculated as the number of female directors scaled by the number of total board members. Total debt ratio is the percentage of book value of total debt in book value of total assets. Short-term debt ratio is the percentage of short-term debt in total assets. Total assets, free cash flow, fixed assets, and long-term investment are all measured in millions of New Taiwanese dollars. Firm age is the number of years since establishment. Return on assets is the net income before interests, taxes, depreciation and amortization divided by total assets. Std. dev. of stock return is the standard deviation of daily stock return. Institutional (managerial) ownership is the percentage of shares held by institutions (managers). Board size is the number of board members. Independent director (%) is the number of independent directors scaled by the number of total board members. All variables are extracted from Taiwan Economic Journal (TEJ). For the univariate tests in Panel B, *** and ** represent the levels of significance at 1% and 5%, respectively.

The key variables in this paper are the measures for capital structure and female board representation. Following earlier studies, we use a widely adopted proxy for capital structure, *total debt ratio*, calculated as book value of total debt divided by book value of *total assets*. As shown in Panel A of Table 1, mean (median) *total debt ratio* is 36.4% (34.6) for our sample. Panel B of Table 1 compares mean (median) *total debt ratio* for firms with female director versus firms without female director. Mean (median) *total debt ratio* is 36.64% (34.84%) for the former and 35.98% (34.24%) for the latter. The difference is somewhat small in magnitude but statistically significant at the 5 percent level.

Besides *total debt ratio*, we also examine the relationship between *short-term debt ratio* and female board representation. *Short-term debt ratio* is calculated as book value of short-term liabilities divided by book value of *total assets*. Li and Zhang (2019) suggest that female directors' stronger monitoring is tied to more use of short-term debt. In Table 1, mean (median) *short-term debt ratio* is 26.1% (23.2%) for the full sample. In Panel B of Table 1, firms with female director have mean (median) *short-term debt ratio* of 26.44% (23.54%) versus 25.41% (22.50%) for firms without female directors. The differences are significant at the 1% level and somewhat larger than the differences in *total debt ratio*. This supports the findings of Li and Zhang (2019).

For measuring female board representation, or board gender diversity, we use both a dummy variable, *board with female director(s)* and *female director (%)*. *Board with female director(s)* is 1 if the firm's board includes at least one female director, and zero otherwise. *Female director (%)* is calculated as the number of female director(s) divided by the number of total board members. In Table 1, the mean (median) of *female director (%)* on board is only around 12.8% (11.1%), indicating that, in a board of 9 or 10 members, which is common for most companies in Taiwan (mean *board size* is 9.44 in Table 1, with median of 9), there is only 1 female director on board in most Taiwan firms. This percentage is very low compared to firms in the US. In the 2018 Spencer Stuart US Board Index Report (Spencer Stuart, 2018), 99% of firms have at least one female director and 87% of S&P 500 boards

have 2 or more female directors. Furthermore, female directors account for 24% of all directors. In a way, the low number of female directors in Taiwan accentuates the difference between firms with and without female directors, as the performance differences are quite literally driven by adding only 1 female director to the board.

Among the other control variables, we note that *managerial ownership* is quite low, with a mean of only 1.62%. Mean *independent director (%)* is at 17.8%, also much lower than in western economies. In the US, for example, 85% of directors are independent for S&P 500 companies, as reported in the 2018 Spencer Stuart US Board Index Report (Spencer Stuart, 2018). It is clear that corporate governance practices in Taiwan, as one of the leading economies in emerging markets, have only started to develop and have a lot to do to catch up with the western countries.

4. MULTIVARIATE ANALYSIS AND RESULTS DISCUSSION

Besides our key variables measuring female board representation, *board with female director(s)* dummy, *female director (%)*, following the literature (Fukui, Mitton, & Schoulau, 2022) and data availability, we use a set of determinants on firms' capital structure, represented by the independent variable vector $X_{i,t}$ in equation (1), which includes firm characteristic measure (*free cash flow*, *fixed assets*, *firm age*, *long-term investment*, *return on assets*, *stock return volatility*), and other corporate governance measures (*institutional ownership* and *managerial ownership*, *board size* and *independent director (%)*). To control for the impact of time-invariant unobservable factors on firms' *total debt ratio* and *short-term debt ratio*, we use the fixed-effect model to do the regressions as shown in equation (1).

$$\text{Capital Structure}_{i,t} = \alpha_0 + \alpha \times X_{i,t} + u_{i,t} \quad (1)$$

where, *Capital Structure* is measured as *total debt ratio* and *short-term debt ratio*. We add industry and year dummies to capture factors not incorporated in our regressions but related to either industry or annual characteristics.

Table 2. Fixed-effect model regression results

Variables	(1)	(2)	(3)	(4)
	Total debt ratio		Short-term debt ratio	
Board with female director(s)	0.674*** (2.84)		0.780*** (3.51)	
Female director (%)		0.042*** (4.04)		0.044*** (4.53)
Log (total assets)	6.676*** (26.01)	6.665*** (25.97)	4.982*** (20.72)	4.970*** (20.68)
Log (free cash flow)	-0.036*** (-4.88)	-0.036*** (-4.88)	0.106*** (15.31)	0.106*** (15.31)
Log (fixed assets)	0.292*** (3.31)	0.293*** (3.32)	-0.262*** (-3.17)	-0.261*** (-3.15)
Log (long-term investment)	-0.490*** (-10.07)	-0.491*** (-10.11)	-0.593*** (-13.01)	-0.594*** (-13.05)
Log (firm age)	-6.016*** (-7.54)	-5.981*** (-7.50)	-4.383*** (-5.86)	-4.338*** (-5.81)
Return on assets	-0.262*** (-25.13)	-0.263*** (-25.18)	-0.182*** (-18.62)	-0.182*** (-18.66)
Std. dev. of stock return	0.049** (2.53)	0.050** (2.57)	0.038** (2.08)	0.039** (2.12)
Log (institutional ownership)	-0.472** (-2.37)	-0.485** (-2.44)	-0.325* (-1.74)	-0.339* (-1.82)
Log (managerial ownership)	1.280*** (5.11)	1.292*** (5.16)	1.033*** (4.40)	1.047*** (4.46)
Log (board size)	-3.684*** (-4.54)	-3.431*** (-4.26)	-3.040*** (-4.00)	-2.745*** (-3.64)
Independent director (%)	-0.037*** (-4.02)	-0.036*** (-3.94)	-0.034*** (-4.03)	-0.034*** (-3.96)
Year dummies	Yes	Yes	Yes	Yes
R ²	0.11	0.12	0.02	0.02

Notes: The sample contains 16,477 firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. The dependent variable in regressions (1) and (2) is total debt ratio. The dependent variable in regressions (3) and (4) is the short-term debt ratio. Total debt ratio is the percentage of book value of total debt in book value of total assets. Short-term debt ratio is the percentage of short-term debt in total assets. Board with female director(s) is a dummy indicator. It is 1 if there is at least 1 female director on board and 0 otherwise. Female director (%) is the percentage of female director(s) on board calculated as the number of female directors scaled by the number of total board members. Free cash flow, fixed assets, and long-term investment are all measured in millions of New Taiwanese dollars. Firm age is the number of years since establishment. Return on assets is the net income before interests, taxes, depreciation and amortization divided by total assets. Std. dev. of stock return is the standard deviation of daily stock return. Institutional (managerial) ownership is the percentage of shares held by institutions (managers). Board size is the number of board members. Independent director (%) is the number of independent directors scaled by the number of total board members. All variables are extracted from Taiwan Economic Journal (TEJ). ***, ** and * indicate the levels of significance at 1%, 5% and 10%, respectively.

Table 2 reports the fixed-effect model regression results for the whole sample firms. In regressions (1) and (2), the dependent variable is total debt ratio, and in regressions (3) and (4) the dependent variable is short-term debt ratio. The coefficients of key variables, board with female director(s), and female director (%) are all positive and significant at the one percent level for all regressions. Holding the control variables constant, firms with female directors on the board increase their total debt ratio by 0.674 percentage point on average (p-value = 0.001), and increase their short-term debt ratio by 0.780 percentage point on average (p-value = 0.001); also, firms with one percentage point increase in female directors on the board increase their total debt ratio by 0.042 percentage point on average (p-value = 0.001), and increase their short-term debt ratio by 0.044 percentage point on average (p-value = 0.001). This is strong evidence supporting our hypothesis that total debt ratio and short-term debt ratio are positively associated with female board representation, but our finding is

opposite to the negative relation between board gender diversity and total debt ratio in a sample of European firms over the period 2002 to 2019 documented in García and Herrero (2021). In addition, we find consistent negative impacts of board size, independent director (%) and institutional ownership on total debt ratio and short-term debt ratio. Consistent with many prior studies, we find with firms with more tangible assets, greater long-term investment has higher financial leverage, and return on assets is significantly negatively related to financial leverage. Our results here are different from those reported by Alves et al. (2015), who document the insignificant effect of board size on capital structure, and that firms with more female directors and more independent boards use less debt financing instead. Similar to our results, Nisiyama and Nakamura (2018) find board gender diversity is positively associated with firm leverage, measured as net debt to EBITDA, using a set of public-listed Brazilian companies from 2010 to 2014. However, Shettima and Dzolkarnaini (2018) use data

of 584 MFIs from 79 counties over 2010-2014 and find that female directors on MFI boards are not significantly related to leverage. Adusei and Obeng (2019) use 441 MFIs located in 69 countries over 2010-2014 period to investigate the effect of board gender diversity on capital structure. They find a robust negative and statistically significant effect of board gender diversity on the debt-to-equity ratio. So, using different measures on financial leverage,

and a more recent and much larger sample from Taiwan, we add new evidence to the limited literature on the relationship between board gender diversity and financial leverage. As we can see, there is no consistent relationship across different samples, which implies there is no one size fits all policy. Governments and regulators should be careful in making policy mandating firms to follow.

Table 3. Two-step regression results

Variables	(1)	(2)	(3)
	Female director (%)	Total debt ratio	Short-term debt ratio
Residual female director (%)		0.041*** (3.94)	0.044*** (4.51)
Log (free cash flow)		-0.036*** (-4.88)	0.106*** (15.31)
Log (fixed assets)		0.292*** (3.31)	-0.261*** (-3.16)
Log (long-term investment)		-0.491*** (-10.11)	-0.595*** (-13.06)
Return on assets		-0.263*** (-25.17)	-0.182*** (-18.65)
Std. dev. of stock return		0.050** (-2.57)	0.039** (-2.12)
Log (managerial ownership)		1.295*** (-5.17)	1.050*** (-4.48)
Independent director (%)		-0.036*** (-3.94)	-0.034*** (-3.96)
Log (total assets)	0.464** (2.58)	6.683*** (26.04)	4.989*** (20.76)
Log (firm age)	1.068* (1.76)	-5.937*** (-7.45)	-4.292*** (-5.75)
Log (institutional ownership)	0.355** (-2.35)	-0.468** (-2.35)	-0.320* (-1.72)
Log (board size)	0.92 (1.46)	-3.393*** (-4.21)	-2.705*** (-3.58)
Log (ultimate controllers' ownership)	0.526** (2.45)		
Family firm dummy	-0.298 (-0.62)		
Year dummies	Yes	Yes	Yes
R ²	0.034	0.12	0.02

Notes: The sample contains firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. All regressions are firm fixed-effect analyses. The dependent variable in regression (1) is female director (%), the percentage of female directors on a firm's board. The dependent variable in regression (2) is total debt ratio, the percentage of book value of total debt in book value of total assets. The dependent variable in regression (3) is the short-term debt ratio, calculated as the short-term debt over total assets measured in percentage. Residual female director (%) is the difference between the actual female director (%) minus the predicted female director (%) generated from regression (1). Free cash flow, fixed assets, and long-term investment are all measured in millions of New Taiwanese dollars. Firm age is the number of years since establishment. Return on assets is the net income before interests, taxes, depreciation and amortization divided by total assets. Std. dev. of stock return is the standard deviation of daily stock return. Institutional (managerial) ownership is the percentage of shares held by institutions (managers). Board size is the number of board members. Independent director (%) is the number of independent directors scaled by the number of total board members. All variables are extracted from Taiwan Economic Journal (TEJ). ***and * indicate the levels of significance at 1% and 10%, respectively.

To control for the endogeneity of female board representation and capital structure, we use a two-step procedure (Heckman, 1979) to investigate the relationship between female board representation and capital structure. In the first step, we use the fixed-effect model and regress female director (%) against a set of independent variables including the natural log of total assets, firm age, institutional ownership, ultimate controllers' ownership, board

size, a dummy indicator of family firms, industry, and year dummies, as shown in equation (2).

$$\text{Female director } (\%)_{i,t} = \beta_0 + \beta \times Z_{i,t} + v_{i,t} \quad (2)$$

From the above regression, we get predicted value of female director (%). We then calculate the residual female director (%) as the difference between the actual female director (%) and

the predicted value of *female director (%)*. In the second step, we use the residual *female director (%)* plus other independent variables in equation (1) to explain the capital structure as measured by *total debt ratio* and *short-term debt ratio*. The results are reported in Table 3. Regression (1) reports the results of the first-step regression, which shows that the percentage of female directors on firm boards is significantly and

positively related to *firm size*, *firm age*, *institutional ownership*, and *ultimate controllers' ownership*, but is unrelated to *board size* and *family firms*. The second step results are reported in regressions (2) and (3). All the coefficients of *residual female director (%)* are again positive and statistically significant at the 1% level, confirming earlier findings. Results of other independent variables are also like those reported in Table 3.

Table 4. Regression results by excluding possible outliers

Variables	(1)	(2)	(3)	(4)
	Total debt ratio		Short-term debt ratio	
Board with female director(s)	0.663*** (2.83)	0.575** (2.14)	0.545** (2.59)	0.597** (2.37)
Log (total assets)	6.926*** (27.27)	6.685*** (21.76)	4.904*** (20.93)	4.817*** (16.73)
Log (free cash flow)	-0.038*** (-5.27)	-0.032*** (-3.74)	0.098*** (14.94)	0.120*** (15.02)
Log (fixed assets)	0.305*** (3.50)	0.397*** (3.83)	-0.283*** (-3.57)	-0.194** (-2.00)
Log (long-term investment)	-0.502*** (-10.44)	-0.438*** (-8.22)	-0.511*** (-11.65)	-0.553*** (-11.08)
Log (firm age)	-6.191*** (-7.81)	-7.072*** (-8.04)	-4.731*** (-6.65)	-5.256*** (-6.38)
Return on assets	-0.246*** (-23.79)	-0.245*** (-21.56)	-0.149*** (-15.94)	-0.160*** (-15.01)
Std. dev. of stock return	0.051*** (2.64)	0.031 (1.62)	0.033* (1.90)	0.022 (1.26)
Log (institutional ownership)	-0.476** (-2.42)	-0.529** (-2.34)	-0.382** (-2.15)	-0.752*** (-3.55)
Log (managerial ownership)	1.360*** (5.50)	1.117*** (3.92)	0.733*** (3.27)	0.967*** (3.62)
Log (board size)	-3.370*** (-4.17)	-3.246*** (-3.53)	-2.490*** (-3.44)	-2.657*** (-3.08)
Independent director (%)	-0.036*** (-4.01)	-0.041*** (-4.00)	-0.030*** (-3.73)	-0.035*** (-3.64)
Year dummies	Yes	Yes	Yes	Yes
R ²	0.08	0.05	0.01	0.03
N	16,312	12,344	16,312	12,344

Notes: The sample contains firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. All regressions are firm fixed-effect analyses. The dependent variable in regressions (1) and (2) is total debt ratio. The dependent variable in regressions (3) and (4) is the short-term debt ratio. Total debt ratio is the percentage of book value of total debt in book value of total assets. Short-term debt ratio is the percentage of short-term debt in total assets. In regression (1), firm-year observations with financial leverage within the highest 1% are excluded. In regression (3), firm-year observations with short-term debt (%) within the highest 1% are excluded. In regressions (2) and (4), financial firms, firms controlled by the government and firms with stock price below 10 New Taiwanese dollars per share are dropped. Board with female director(s) is a dummy indicator. It is 1 if there is at least 1 female director on board and 0 otherwise. Free cash flow, fixed assets, and long-term investment are all measured in millions of New Taiwanese dollars. Firm age is the number of years since establishment. Return on assets is the net income before interests, taxes, depreciation and amortization divided by total assets. Std. dev. of stock return is the standard deviation of daily stock return. Institutional (managerial) ownership is the percentage of shares held by institutions (managers). Board size is the number of board members. Independent director (%) is the number of independent directors scaled by the number of total board members. All variables are extracted from Taiwan Economic Journal (TEJ). ***, ** and * indicate the levels of significance at 1%, 5% and 10%, respectively.

In Table 4, we try to eliminate the potential influence of outliers. In regression (1), firm-year observations with *total debt ratio* within the highest 1% are excluded. In regression (3), firm-year observations with *short-term debt ratio* within the highest 1% are excluded. In regressions (2) and (4),

financial firms, firms controlled by the government and firms with a stock price below 10 New Taiwanese dollars per share are dropped. The results are broadly consistent with earlier results, with *board with female director(s)* positive and significant for all 4 regressions.

Table 5. Regression results: Firms from without female director(s) to with female director(s) and vice versa

Variables	(1)	(2)	(3)	(4)
	Total debt ratio		Short-term debt ratio	
Board with female director(s)	0.854*** (3.26)		0.963*** (3.90)	
Female director (%)		0.051*** (3.65)		0.061*** (4.64)
Log (total assets)	6.557*** (18.84)	6.549*** (18.82)	5.236*** (15.97)	5.228*** (15.95)
Log (free cash flow)	-0.028*** (-2.65)	-0.029*** (-2.66)	0.119*** (11.71)	0.118*** (11.70)
Log (fixed assets)	0.412*** (3.59)	0.413*** (3.60)	-0.225** (-2.08)	-0.224** (-2.07)
Log (long-term investment)	-0.546*** (-7.90)	-0.544*** (-7.88)	-0.653*** (-10.03)	-0.651*** (-10.01)
Log (firm age)	-6.756*** (-6.28)	-6.694*** (-6.22)	-5.580*** (-5.50)	-5.517*** (-5.45)
Return on assets	-0.300*** (-20.99)	-0.300*** (-21.03)	-0.215*** (-15.99)	-0.216*** (-16.05)
Std. dev. of stock return	0.763*** (7.32)	0.763*** (7.33)	0.620*** (6.32)	0.620*** (6.32)
Log (institutional ownership)	-0.347 (-1.19)	-0.363 (-1.25)	-0.046 (-0.17)	-0.067 (-0.24)
Log (managerial ownership)	1.422*** (4.07)	1.431*** (4.10)	1.003*** (3.05)	1.011*** (3.08)
Log (board size)	-4.208*** (-3.70)	-3.857*** (-3.43)	-4.200*** (-3.92)	-3.821*** (-3.61)
Independent director (%)	-0.041*** (-3.07)	-0.040*** (-3.02)	-0.032** (-2.52)	-0.031** (-2.44)
Year dummies	Yes	Yes	Yes	Yes
R ²	0.13	0.13	0.01	0.01

Notes: The sample contains 8,677 firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. All regressions are firm fixed-effect analyses. The dependent variable in regressions (1) and (2) is total debt ratio. The dependent variable in regressions (3) and (4) is the short-term debt ratio. Total debt ratio is the percentage of book value of total debt in book value of total assets. Short-term debt ratio is the percentage of short-term debt in total assets. Board with female director(s) is a dummy indicator. It is 1 if there is at least 1 female director on board and 0 otherwise. Female director (%) is the percentage of female director(s) on board calculated as the number of female directors scaled by the number of total board members. Free cash flow, fixed assets, and long-term investment are all measured in millions of New Taiwanese dollars. Firm age is the number of years since establishment. Return on assets is the net income before interests, taxes, depreciation and amortization divided by total assets. Std. dev. of stock return is the standard deviation of daily stock return. Institutional (managerial) ownership is the percentage of shares held by institutions (managers). Board size is the number of board members. Independent director (%) is the number of independent directors scaled by the number of total board members. All variables are extracted from Taiwan Economic Journal (TEJ). ***, ** and * indicate the levels of significance at 1%, 5% and 10%, respectively.

In Table 5, we restrict our sample of firms with female directors to only include firms that changed from without female directors to with female directors and firms that changed from with female directors to without female directors. In other words, we focus on firms with changes in female directors from no female directors to with directors

and vice versa. Board with female director(s) is positive and statistically significant at the 1% level. In addition, the magnitude of the coefficients is somewhat larger than those in Tables 2 and 3. Female director (%) is also positive and significant at the 1% level, and the magnitude of coefficients is also somewhat larger.

Table 6. Regression results: Different types of female directors

Variables	(1)	(2)	(3)	(4)
	Total debt ratio		Short-term debt ratio	
Grad female director (%)	0.027		0.026	
	(1.57)		(1.58)	
Related female director (%)		0.054***		0.038**
		(2.86)		(2.18)
Log (total assets)	6.675***	6.668***	4.981***	4.975***
	(26.00)	(25.97)	(20.71)	(20.69)
Log (free cash flow)	-0.036***	-0.036***	0.106***	0.105***
	(-4.87)	(-4.90)	(15.32)	(15.29)
Log (fixed assets)	0.290***	0.291***	-0.263***	-0.262***
	(3.29)	(3.30)	(-3.18)	(-3.17)
Log (long-term investment)	-0.490***	-0.488***	-0.592***	-0.591***
	(-10.07)	(-10.04)	(-13.00)	(-12.97)
Log (firm age)	-5.966***	-5.966***	-4.320***	-4.314***
	(-7.48)	(-7.48)	(-5.78)	(-5.77)
Return on assets	-0.262***	-0.262***	-0.181***	-0.181***
	(-25.10)	(-25.08)	(-18.57)	(-18.55)
Std. dev. of stock return	0.049**	0.050**	0.038**	0.038**
	(2.54)	(2.56)	(2.09)	(2.11)
Log (institutional ownership)	-0.472**	-0.439**	-0.324*	-0.300
	(-2.37)	(-2.20)	(-1.74)	(-1.61)
Log (managerial ownership)	1.298***	1.290***	1.052***	1.046***
	(5.18)	(5.15)	(4.48)	(4.46)
Log (board size)	-3.428***	-3.325***	-2.739***	-2.661***
	(-4.25)	(-4.12)	(-3.63)	(-3.52)
Independent director (%)	-0.038***	-0.036***	-0.036***	-0.034***
	(-4.20)	(-3.93)	(-4.25)	(-4.03)
Year dummies	Yes	Yes	Yes	Yes
R ²	0.11	0.11	0.02	0.02

Notes: The sample contains 16,477 firm-year observations of listed firms in Taiwan during the period from 2006 to 2017. All regressions are firm fixed-effect analyses. The dependent variable in regressions (1) and (2) is total debt ratio. The dependent variable in regressions (3) and (4) is the short-term debt ratio. Total debt ratio is the percentage of book value of total debt in book value of total assets. Short-term debt ratio is the percentage of short-term debt in total assets. Grad female director (%) is the percentage of female director(s) with a graduate degree, calculated as the number of these female directors scaled by the number of total board members. Related female director (%) is the percentage of female director(s) with relation to the ultimate controller, calculated as the number of these female directors scaled by the number of total board members. Free cash flow, fixed assets, and long-term investment are all measured in millions of New Taiwanese dollars. Firm age is the number of years since establishment. Return on assets is the net income before interests, taxes, depreciation and amortization divided by total assets. Std. dev. of stock return is the standard deviation of daily stock return. Institutional (managerial) ownership is the percentage of shares held by institutions (managers). Board size is the number of board members. Independent director (%) is the number of independent directors scaled by the number of total board members. All variables are extracted from Taiwan Economic Journal (TEJ). ***, ** and * indicate the levels of significance at 1%, 5% and 10%, respectively.

To examine whether female directors' characteristics affect a firm's capital structure, Table 6 considers 2 aspects: 1) female director education level, as measured by the percentage of female directors with a graduate degree on firms' boards, and 2) whether a female director is affiliated with the ultimate controller of the firm. In regressions (1) and (3) the variable *grad female director (%)* is positive but statistically insignificant, indicating that the higher education level of female directors does not affect a firm's capital structure. In regressions (2) and (4), *related female director (%)* is positive and significant, indicating that female directors related to the ultimate controller retain our main result of using debt as a monitoring tool.

5. CONCLUSION

Studies on the relationship between board gender diversity and financial leverage are limited and inconclusive. This paper sheds new light on the relationship using a more recent and much larger sample of firms in Taiwan, where the traditional Confucian culture and feudal thought discriminate against women. As a leading economy in the emerging markets, Taiwanese firms have lagged the western firms in their development of corporate governance practices. In particular, there is a significantly lower percentage of female directors on corporate boards. Thus, our empirical evidence adds to the literature where most earlier studies focus on advanced economies in the west.

We find consistent evidence that board gender diversity is positively related to debt financing more short-term debt, which has been suggested by earlier papers as a tool of increased monitoring. Our results remain robust with alternative samples and measures. Our data indicate that most corporate boards in Taiwan have only one female director. It thus is even more enlightening that the empirical evidence is strong and pervasive. Apparently, even one female director can make a difference in Taiwanese firms, which is quite different from studies using data in western countries, finding one female board member is more like a token in the corporate boardroom. Like other East Asia countries and regions, traditionally men enjoy higher power and women are discriminated against, in such an environment a woman must be very outstanding to become a board member. So, the female board member can be very respectful and influential in corporate decision-making. Since we only examine the Taiwanese data, we need to investigate data in other societies in which men stand for greater power to see whether female board members can be truly more influential in corporate decision-making than those in societies with less gender inequality.

A big problem in identifying the causality between gender diversity and capital structure is that female board participation and capital structure may be endogenous. For example, women board participation and leverage may be simultaneously correlated to some unobservable variables; or leverage will affect women participation in the board, or the sample is non-random and thus is subject to selection bias. Although we use the fixed-effect model and Heckman two-step procedure to

control for the endogeneity and get consistent results, it does not mean our methodology is perfect. The fixed-effect model only controls for the impact of time-invariant unobservable factors on both dependent variables and independent variables. In our two-step procedure to control for endogeneity, the independent variables explaining the percentage of female board members in the first step are used in the second step to explain leverage. A better way to control for endogeneity is to use the instrumental variable approach, which requires the instrumental variable(s) to be only related one dependent variable. For the study on women board participation, a possible instrumental variable may be a board member's marital status, or the number of children, which will be related to a woman's participation in the board but not related to capital structure. In many countries and regions, married women tend to center around their families, and spend efforts mainly on taking care of their family and children, therefore, will be less likely to become board directors compared with unmarried women. On the other side, a female director's marital status or the number of children may be unrelated to the financial leverage. Unfortunately, we cannot find such information in our data source. Another method to control for endogeneity is to use samples in countries and regions which have passed an act to mandate female board representation. Our paper shows that board gender diversity affects firms' capital structure in Taiwan but does not answer whether female board representation affects cost of capital, whether adopting female board members will improve firm value. These may be what we will do in future studies.

REFERENCES

1. Adams, R. B., & Ferreira, D. (2009). Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics*, 94(2), 291-309. <https://doi.org/10.1016/j.jfineco.2008.10.007>
2. Adams, R. B., & Kirchmaier, T. (2015). *Barriers to boardrooms* (ECGI Finance Working Paper No. 347/2013). Retrieved from https://ecgi.global/sites/default/files/working_papers/documents/SSRN-id2192918.pdf
3. Adams, R., & Funk, P. (2012). Beyond the glass ceiling: Does gender matter? *Management Science*, 58(2), 219-235. <https://doi.org/10.1287/mnsc.1110.1452>
4. Adusei, M., & Obeng, E. Y. T. (2019). Board gender diversity and the capital structure of microfinance institutions: A global analysis. *The Quarterly Review of Economics and Finance*, 71, 258-269. <https://doi.org/10.1016/j.qref.2018.09.006>
5. Ahern, K. R., & Dittmar, A. K. (2012). The changing of the boards: The impact on firm valuation of mandated female board representation. *The Quarterly Journal of Economics*, 127(1), 137-197. <https://doi.org/10.1093/qje/qjr049>
6. Alves, P., Couto, E. B., & Francisco, P. M. (2015). Board of directors' composition and capital structure. *Research in International Business and Finance*, 35(3), 1-32. <https://doi.org/10.1016/j.ribaf.2015.03.005>
7. Ben Saad, S., & Belkacem, L. (2021). Does board gender diversity affect capital structure decisions? *Corporate Governance*. Advance online publication. <https://doi.org/10.1108/CG-12-2020-0575>
8. Boubaker, S., Dang, R., & Nguyen, D. K. (2014). Does board gender diversity improve the performance of French listed firms? *Gestion 2000*, 31(1-2), 259-269. <https://doi.org/10.3917/g2000.311.0259>
9. Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. *Psychological Bulletin*, 125(3), 367-383. <https://doi.org/10.1037/0033-2909.125.3.367>
10. Campbell, K., & Mínguez-Vera, A. (2008). Gender diversity in the boardroom and firm financial performance. *Journal of Business Ethics*, 83(3), 435-451. <https://doi.org/10.1007/s10551-007-9630-y>
11. Carter, D. A., Simkins, B. J., & Simpson, W. G. (2003). Corporate governance, board diversity, and firm value. *The Financial Review*, 38(1), 33-53. <https://doi.org/10.1111/1540-6288.00034>
12. Chen, S., Ni, X., & Tong, J. Y. (2016). Gender diversity in the boardroom and risk management: A case of R&D investment. *Journal of Business Ethics*, 136, 599-621. <https://doi.org/10.1007/s10551-014-2528-6>
13. Croson, R., & Gneezy, U. (2009). Gender differences in preferences. *Journal of Economic Literature*, 47(2), 448-474. <https://doi.org/10.1257/jel.47.2.448>
14. Deaves, R., Lüders, E., & Luo, G. Y. (2009). An experimental test of the impact of overconfidence and gender on trading activity. *Review of Finance*, 13(3), 555-575. <https://doi.org/10.1093/rof/rfn023>
15. Deloitte. (2021). *Progress at a snail's pace. Women in the boardroom: A global perspective* (Deloitte Global Boardroom Program, 7th ed.). Retrieved from <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/gx-women-in-the-boardroom-seventh-edition.pdf>

16. Erhardt, N. L., Werbel, J. D., & Shrader, C. B. (2003). Board of director diversity and firm financial performance. *Corporate Governance: An International Review*, 11(2), 102-111. <https://doi.org/10.1111/1467-8683.00011>
17. Fuhrmans, V. (2018, September 30). California becomes the first state to mandate female board directors. *The Wall Street Journal*. Retrieved from <https://www.wsj.com/articles/california-becomes-first-state-to-mandate-female-board-directors-1538341932>
18. Fukui, T., Mitton, T., & Schonlau, R. J. (2022). *Determinants of capital structure: An expanded assessment*. <https://doi.org/10.2139/ssrn.3293965>
19. Garcia, C. J., & Herrero, B. (2021). Female directors, capital structure and financial distress. *Journal of Business Research*, 136, 592-601. <https://doi.org/10.1016/j.jbusres.2021.07.061>
20. Gregory-Smith, I., Main, B. G. M., & O'Reilly, C. A., III. (2014). Appointments, pay and performance in UK boardrooms by gender. *The Economic Journal*, 124(574). <https://doi.org/10.1111/econj.12102>
21. Haslam, S. A., Ryan, M. K., Kulich, C., Trojanowski, G., & Atkins, C. (2010). Investing with prejudice: The relationship between women's presence on company boards and objective and subjective measures of company performance. *British Journal of Management*, 21(2), 484-497. <https://doi.org/10.1111/j.1467-8551.2009.00670.x>
22. Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1), 153-161. <https://doi.org/10.2307/1912352>
23. Jensen, M. C. (1986). Agency cost of free cash flow, corporate finance, and takeovers. *The American Economic Review*, 76(2), 323-339. Retrieved from <https://www.jstor.org/stable/1818789>
24. Joecks, J., Pull, K., & Vetter, K. (2013). Gender diversity in the boardroom and firm performance: What exactly constitutes a "critical mass"? *Journal of Business Ethics*, 118, 61-72. <https://doi.org/10.1007/s10551-012-1553-6>
25. Kanter, R. M. (1977). *Men and women of the corporation*. New York, NY: Basic Books.
26. Konrad, A. M., Kramer, V., & Erkut, S. (2008). Critical mass: The impact of three or more women on corporate boards. *Organizational Dynamics*, 37(2), 145-164. <https://doi.org/10.1016/j.orgdyn.2008.02.005>
27. Kristie, J. (2011). The power of three. *Directors and Boards*, 35(5), 22-32.
28. Li, Y., & Zhang, X.-Y. (2019). Impact of board gender composition on corporate debt maturity structures. *European Financial Management*, 25(5), 1286-1320. <https://doi.org/10.1111/eufm.12214>
29. Marinova, J., Plantenga, J., & Remery, C. (2016). Gender diversity and firm performance: Evidence from Dutch and Danish boardrooms. *The International Journal of Human Resource Management*, 27(15), 1777-1790. <https://doi.org/10.1080/09585192.2015.1079229>
30. Nisiyama, E. K., & Nakamura, W. T. (2018). Diversidade do conselho de administração e a estrutura de capital [Diversity of the board and capital structure]. *Revista de Administração de Empresas*, 58(6), <https://doi.org/10.1590/s0034-759020180604>
31. Shettima, U., & Dzolkarnaini, N. (2018). *Female directors and capital structure decision of microfinance institutions (MFIs)*. Retrieved from <http://www.fmaconferences.org/Norway/Papers/Manuscript.pdf>
32. Shrader, C. B., Blackburn, V. B., & Iles, P. (1997). Women in management and firm financial performance: An exploratory study. *Journal of Managerial Issues*, 9(3), 355-372. Retrieved from <https://www.jstor.org/stable/40604152>
33. Sila, V., Gonzalez, A., & Hagendorff, J. (2016). Women on board: Does boardroom gender diversity really affect firm risk? *Journal of Corporate Finance*, 36, 26-53. <https://doi.org/10.1016/j.jcorpfin.2015.10.003>
34. Spencer Stuart. (2018). *2018 United States Spencer Stuart board index*. Retrieved from https://www.spencerstuart.com/-/media/2018/october/ssbi_2018.pdf
35. Terjesen, S., Couto, E. B., & Francisco, P. M. (2016). Does the presence of independent and female directors impact firm performance? A multi-country study of board diversity. *Journal of Management & Governance*, 20, 447-483. <https://doi.org/10.1007/s10997-014-9307-8>