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從女性董事談女性經濟賦權(L07)

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本研究具有政策應用參考價值：□否 ■是，建議提供機關金融監督管理委員會
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本研究具影響公共利益之重大發現：□否 ■是

中 華 民 國 113 年 01 月 20 日

中 文 摘 要 ： 這項研究探討在具有運營風險的條件下，女性董事對上市的臺灣公司績效的影響。採用“差異中的差異”（DiD）方法，研究透過外生衝擊解決潛在的內生性問題，即臺灣證券交易所在2015年將女性董事納入公司治理評估標準。分析2002年至2020年的資料，重點關注市場和會計績效指標，包括股票報酬、產業調整後股票報酬、資產報酬率和股東權益報酬率。研究中包括各種女性董事變數，如人數和比例，以及關鍵臨界值的二元指標。研究將公司分為高和低運營風險，並利用DiD迴歸模型探討女性董事任命對公司價值和績效的影響。研究結果顯示，在運營風險高的公司中，任命女性董事有助提高股票報酬，此研究為瞭解在具有挑戰性的商業環境中，性別多樣性的角色提供了寶貴的發現。

中 文 關 鍵 詞 ： 性別多樣性；女性董事；公司治理評估；差異中的差異法（DiD）；公司績效

英 文 摘 要 ： This study examines the influence of female directors on the performance of publicly listed Taiwanese companies amid challenging operational conditions. Employing the Difference-in-Differences (DiD) methodology, the research tackles potential endogeneity concerns by capitalizing on an exogenous shock—specifically, the Taiwan Stock Exchange’s 2015 integration of female directors into corporate governance evaluation criteria. Analyzing data spanning from 2002 to 2020, the study focuses on market and accounting performance metrics, including stock return, industry-adjusted return, return on assets (ROA), and return on equity (ROE). Various female director variables, such as count and proportion, are scrutinized, alongside binary indicators assessing critical mass representation. The research categorizes companies into high and low operational risk, utilizing a DiD regression model to explore the impact of female director appointments on firm value and performance. The findings highlight that, especially in high-risk firms, appointing female directors positively influences stock return, providing valuable insights into the nuanced role of gender diversity in demanding business environments.

英 文 關 鍵 詞 ： Gender diversity; Female directors; Corporate governance evaluation; Difference-in-Differences (DiD) methodology; Firm performance

Gendering Corporate Success: The Role of Female Directors in Crisis

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Abstract

This study examines the influence of female directors on the performance of publicly listed Taiwanese companies amid challenging operational conditions. Employing the Difference-in-Differences (DiD) methodology, the research tackles potential endogeneity concerns by capitalizing on an exogenous shock—specifically, the Taiwan Stock Exchange's 2015 integration of female directors into corporate governance evaluation criteria. Analyzing data spanning from 2002 to 2020, the study focuses on market and accounting performance metrics, including stock return, industry-adjusted return, return on assets (ROA), and return on equity (ROE). Various female director variables, such as count and proportion, are scrutinized, alongside binary indicators assessing critical mass representation. The research categorizes companies into high and low operational risk, utilizing a DiD regression model to explore the impact of female director appointments on firm value and performance. The findings highlight that, especially in high-risk firms, appointing female directors positively influences stock return, providing valuable insights into the nuanced role of gender diversity in demanding business environments.

Keywords: Gender diversity; Female directors; Corporate governance evaluation; Difference-in-Differences (DiD) methodology; Firm performance

JEL:J16; G30

1. Introduction

In recent years, there has been a growing call to increase the representation of female directors on corporate boards. According to the statistical data from MSCI ESG Research LLC's Women on Boards 2020 Progress Report, the average proportion of female board members among companies in the MSCI ACWI Index was 20.6% in 2020. When ranked by countries, the top three were France with 43.3%, New Zealand, and Norway, both with 42.3%. Major countries, such as the United States, had 28.2%, and the United Kingdom had 34.3%. In Asia, the percentages were notably lower than the global average, with China at 13%, Japan at 10.7%, Singapore at 19.5%, South Korea at 4.9%, and Taiwan at 11.5%.[1]

In order to enhance gender diversity on corporate boards, European countries pioneered requirements for the representation of female directors. Norway led the way in 2004 by mandating a 40% quota for female directors on boards. Other European countries, including Germany, France, Belgium, Iceland, Italy, among others, have enacted legislation mandating a certain proportion of female directors through mandatory quotas.[2] Norway, with its mandatory requirement and no opt-out mechanism, found that enforcing gender equality in board composition incurred high costs after several years (Bøhren & Staubo 2014). In contrast, other countries have adopted a more lenient approach, often using "comply-or-explain" or ethical constraints, allowing companies the freedom to determine the extent of gender equality in their boards. Examples include Austria, Finland, the Netherlands, Spain, Sweden, the United Kingdom, etc., which encourage companies to voluntarily set gender diversity goals ranging from 25% to 40% and disclose relevant information. Taiwan's current practices align more closely with the latter approach, with regulations specified in the "Corporate Governance Best Practice Principles for Listed and OTC Companies," the "Guidelines for Contents in Annual Reports of Public Issuers," and the "Corporate Governance Evaluation Indicators for Taiwan Stock Exchange and Over-the-Counter Listed Companies."

The Financial Supervisory Commission (FSC) actively promotes the increase of female director seats in listed companies, based on gender equality plans. In 2013, the Taiwan Stock Exchange (TWSE) and the Gretai Securities Market Center amended the "Corporate Governance Best Practice Principles for Listed and OTC Companies."[3] The 20th article emphasizes gender equality in the composition of board members, stating that "the composition of the board should focus on gender equality and generally possess the knowledge, skills, and qualities necessary to perform their duties." It regulates that the composition of the board members of listed and OTC companies should consider gender diversity. Considering gender information on decision-making levels, directors, and supervisors helps investors understand the diversity promotion status of the company's management. In 2017, the FSC revised the "Guidelines for Annual Reports of Public Issuers,"[4] adding requirements for disclosing gender information. It mandates public companies to disclose gender information about directors in their annual reports, including whether the board has formulated a diversity policy and the implementation status.

[1] https://money.udn.com/money/story/8944/5532212

[2] https://hbr.org/2016/11/what-board-directors-really-think-of-gender-quotas

[3] The 20th amendment was revised and promulgated in 2013. For the complete text, please refer to the following link: http://www.selaw.com.tw/LawArticle.aspx?LawID=G0100259&ModifyDate=1020311

[4] The 10th amendment was revised and promulgated in 2017. For the complete text, please refer to the following link: https://law.moj.gov.tw/LawClass/LawOldVer.aspx?pcode=G0400022&lnndate=20170209&lser=001

Board diversity is also included as a relevant evaluation indicator in corporate governance evaluations. Although Taiwan does not enforce a mandatory gender ratio for boards, the Corporate Governance Evaluation Guidelines by the Taiwan Stock Exchange strongly emphasizes whether a company has established a board member diversity policy. In 2015, an indicator was added, stating that "the board of directors should include at least one female director." As companies highly value corporate governance evaluations, Table 1 shows an increasing trend in the percentage of female directors in listed companies, from 11.64% in 2015 to 14.34% in 2020. The proportion of female independent directors has also increased from 9.49% in 2015 to 12.26% in 2020. The proportion of female directors and female independent directors in OTC companies also shows a consistent upward trend.

Since the outbreak of the Covid-19 pandemic, female leaders in countries such as Denmark, Finland, Iceland, New Zealand, Germany, and Taiwan have received praise for their efficient handling of the crisis.[5] These leaders took proactive measures to address the threat of the virus, implemented social distancing regulations early on, and sought expert advice to inform public health strategies. From a business management perspective, the onset of the pandemic posed unprecedented challenges for companies. With various countries implementing border controls and the global supply chain severely impacted, businesses faced unforeseen risks.

Past research indicates that diversity is especially valuable during economic downturns, as different backgrounds can bring forth diverse perspectives. Female directors can demonstrate their value more prominently during economic crises (Adams & Funk 2012). While women, in general, tend to be more risk-averse than men, this might not necessarily hold true at the managerial level. Female managers may not exhibit higher risk aversion compared to male managers. For instance, a study by Adams and Ragunathan (2017) found that banks with a higher proportion of female directors did not have lower risk tolerance. However, during crisis periods, gender-diverse boards indeed contribute higher value to companies.

This study utilizes data from Taiwanese publicly listed companies to investigate whether gender-diverse boards can better demonstrate their value when companies face crises. The focus is on exploring the association between female directors and the company's value or performance, considering variations based on the company's situation. The research question is whether gender-diverse boards bring more value to the company when operating risks are high.

Starting from 2015, the Taiwan Stock Exchange included female directors as part of the corporate governance evaluation criteria. In response, listed companies have actively appointed female directors to comply with these evaluation requirements. The increasing proportion of female directors in boards since 2015, prompted by the external shock of being included in the evaluation criteria, is observed. However, this external shock related to the appointment of female directors does not have a direct correlation with

[5] U.S. News reported on March 8, 2021: "Why More Countries Need Female Leaders." You can read the article at https://www.usnews.com/news/best-countries/articles/2021-03-08/why-countries-with-female-leaders-have-responded-well-to-the-pandemic. Additionally, the BBC covered a news report on April 21, 2020: "Pandemic: Why Have Female Leaders Been More Successful in Dealing with the New Coronavirus?" The article can be found at https://www.bbc.com/zhongwen/trad/world-52373401. Vital Strategies also released a publication on March 8, 2021: "Vital Stories: Women Leaders at the Center of the COVID-19 Response." The publication is available at https://www.vitalstrategies.org/vital-stories-women-leaders-at-the-center-of-the-covid-19-response/.

the company's value or performance.

The research employs a robust methodology to investigate the causal relationship between female directors and firm performance, addressing potential endogeneity concerns. The Difference-in-Differences (DiD) approach is utilized, with an exogenous shock provided by the TWSE's 2015 inclusion of female directors in corporate governance evaluation criteria. This criterion mandated the presence of at least one female director on boards, aiming to enhance diversity.

Data from publicly listed Taiwanese companies (2002-2020) is sourced from the Taiwan Economic Journal (TEJ) database. The study evaluates market and accounting performance metrics, including stock return, industry-adjusted return, return on assets (ROA), and return on equity (ROE). Various female director variables, such as count and proportion, are analyzed, along with binary indicators for critical mass representation.

The focus is on companies facing high operational risk, categorized by their financing policies. A DiD regression model considers the impact of female director appointments (Treatment) post-2015 (Post), with control variables ensuring a comprehensive analysis. The DiD coefficient elucidates the influence of female directors in high-risk firms, contributing to a nuanced understanding of gender diversity's effects on company value and performance during challenging operational conditions.

The research finds a significantly positive impact of female directors on stock returns for companies facing high operational risk (crisis companies). Robustness checks and a risk index further validate this positive effect, indicating enhanced market and accounting performance for crisis companies with female directors. The findings underscore the importance of female representation in corporate leadership, particularly during crises, providing valuable insights for policymakers and companies seeking to promote gender diversity in boardrooms.

This research makes a substantial contribution to the existing literature on gender diversity and its impact on corporate performance. The utilization of the DiD methodology, specifically addressing endogeneity concerns, adds methodological rigor to the literature, ensuring robustness in exploring the causal relationship between the inclusion of female directors and firm performance. This research provides a viable solution to the past proposition by Adams and Ferreira (2009) that mandating gender quotas for directors might diminish firm value for well-governed firms. Our study emphasizes Taiwan's progressive approach in addressing this issue. The incorporation of the criterion "the board of directors should include at least one female director" into corporate governance evaluations, despite being non-mandatory, has led to a consistent increase in the appointment of female directors over the years. Notably, this inclusive strategy has empowered female directors to positively influence corporate performance, particularly in companies facing high operational risks, thereby stabilizing overall effectiveness.

One key contribution lies in the innovative approach of investigating the impact of gender diversity on corporate boards under challenging operational conditions. The study categorizes companies based on operational risk, offering valuable insights into how external shocks, such as the inclusion of female directors in corporate governance criteria, influence firm success across different risk scenarios. The introduction of diverse metrics, including the number and proportion of female directors, as well as binary variables indicating the presence of a critical mass of female directors, enriches the analytical toolkit in the literature, contributing to a more comprehensive understanding of gender diversity dynamics.

Furthermore, the research extends its contributions by incorporating a risk indicator analysis, encompassing various risk variables, thereby deepening the literature's understanding of the multifaceted relationship between gender diversity and firm performance. By exploring both market and accounting performance, this research offers a holistic perspective, advancing the literature's comprehension of the complex interplay between gender diversity and corporate success in diverse and dynamic business landscapes.

The subsequent sections of this paper are structured as follows: Section 2 formulates our hypotheses. Section 3 outlines the methodology employed. Section 4 presents the empirical findings. Section 5 conducts robustness checks. Section 6 explores results using a risk indicator. Finally, Section 7 concludes the paper.

2. Literature review and hypothesis development

The impact of female directors on company performance yields inconsistent results in the literature. Some studies indicate a negative or no correlation between the two, suggesting that female directors are unrelated to operational performance and may even have a negative association with stock performance (Adams & Ferreira 2009; Haslam *et al.* 2010). For instance, Haslam *et al.* (2010) focused on companies in the FTSE 100 index from 2001 to 2005, finding no clear relationship between female directors and operational performance (including ROA and ROE). However, they observed a negative correlation between female directors and stock-related performance (Tobin's Q). On the contrary, some studies discover a positive correlation. Schwartz-Ziv (2017) found that having at least three female directors on the board enhances metrics such as ROE and profit margins. Liu *et al.* (2014) analyzed Chinese listed companies and found a positive correlation between female directors and company performance. Their research revealed that (1) the positive impact of female executive directors on company performance is more pronounced than that of female independent directors, and (2) companies with three or more female directors outperform those with two or fewer, supporting the critical mass theory. The causal relationship between female directors and company performance remains a subject of investigation. Farrell and Hersch (2005) studied Fortune 500 companies and identified a reverse causal relationship between female directors and company performance. They argued that women tend to join boards of well-performing companies. However, their research did not find wealth effects associated with the announcement of the addition of female directors to the board.

As for the relationship between female directors and company risk, some literature suggests a negative correlation between female directors and company risk (Farrell & Hersch 2005). However, other studies have found that female directors may assume higher risks compared to male directors (Adams & Funk 2012). What happens when Lehman Brothers becomes Lehman Sisters? Adams and Ragunathan (2017) found that having more female directors in banks does not necessarily lead to lower risk exposure. Therefore, even if Lehman Brothers were to become Lehman Sisters, the results might not differ significantly. However, they did observe that diversified boards in banks perform better, indicating that gender diversity may not be directly linked to lower risk, but it can bring value to the company, especially in crisis situations.

Based on the literature mentioned earlier, the impact of female directors on company performance and risk is inconsistent. Different studies yield varying results, and the critical factor of reaching a threshold level of female directors has a decisive influence on the findings. Additionally, considering whether the company is in a crisis situation leads to different conclusions.

In our study focused on Taiwanese listed companies, we specifically examine the influence of female directors on company value and performance under challenging business conditions. Referring to the study by Adams and Ragunathan (2017), if Lehman Brothers were Lehman Sisters from the start, would the crisis still have occurred? While the general public tends to observe higher risk aversion among women, at the managerial level, the differences in risk aversion between male and female managers are not as pronounced. The study, which used listed banks as the sample, found that when there are more female directors in a listed bank, the bank does not engage in significantly fewer risky activities during a crisis, suggesting that the risk level is not lower than in banks with fewer female directors. However, when the board of directors is more diverse, the bank's performance is indeed better.

Therefore, gender diversity does not necessarily reduce risk, but it does bring value to the company, especially during a crisis. Diversification may play a different role during a crisis, as companies need to approach problem-solving from various perspectives. In times of economic downturn, diversity is particularly valuable (Adams & Funk 2012). However, Kanter's (1977) research suggests that trust at the board level is crucial during uncertain periods, and social similarity facilitates trust-building. Thus, during a crisis, board-level diversity may incur higher costs than in normal times, potentially hindering trust-building and proving detrimental to the company. Since Kanter (1977) argues that high homogeneity within a group performs better during a crisis, it remains to be clarified whether this homogeneity includes gender diversity.

When the business landscape and context vary, does a gender-diverse board contribute more effectively? Similar to the idea that corporate governance mechanisms may not manifest their effects during normal times but become crucial in a crisis, it is questioned whether, during a crisis, women outperform their male counterparts. A well-governed company with diversity on its board may recover more swiftly in a crisis. While gender diversity in the boardroom may not always demonstrate its value in ordinary times, female directors are known to consider decisions from the perspective of stakeholders. They tend to prioritize motivation (Andreoni & Vesterlund 2001), charity, public welfare, integrity, compassion, and generality (Adams & Funk 2012), traits that may not be apparent or valued in regular circumstances. This might explain the past discrepancies in studying the correlation between female directors and company performance. In challenging business environments, a diverse board may have more opportunities to showcase its value. Based on these considerations, we propose the following hypothesis:

Hypothesis: When a company faces challenging operational conditions, a gender-diverse board can bring value to the company.

3. Methodology

In the exploration of the causal relationship between female directors and firm performance, it is essential to address the potential endogeneity issue arising from the fact that female directors may choose to serve on the boards of companies based on their specific performance characteristics. Alternatively, certain types of companies may exhibit a propensity to hire female directors, potentially creating a reverse causality situation. To mitigate this concern, we employ the DiD methodology.

The exogenous shock utilized in our analysis stems from the inclusion of female directors in corporate governance evaluation criteria by the TWSE for the first time in 2015. In alignment with global trends and to promote gender equality, the TWSE introduced the criterion "Boards of directors in

companies should include at least one female director" in the "Second Corporate Governance Evaluation" in 2015. This criterion was introduced with the intent of fostering greater diversity in the composition of corporate boards.

Publicly listed companies place significant emphasis on their corporate governance evaluations. To achieve favorable scores in these evaluations, companies strive to meet the criteria outlined in governance guidelines. Consequently, the inclusion of female directors in the corporate governance evaluation criteria is regarded as an exogenous shock. It influences the number of female directors within a company, but it is not explicitly correlated with the internal decision-making and behavior of the firms themselves.

This study primarily utilizes data from publicly listed companies in Taiwan, with the main data source being the TEJ database. The data span the period from 2002 to 2020. By leveraging this unique and compelling dataset in the context of the DiD methodology, we aim to comprehensively examine the impact of the introduction of female directors on firm performance while effectively addressing the endogeneity concerns that may have confounded prior research in this domain.

In terms of research variables, this study employs market and accounting performance metrics to assess company performance. These performance metrics encompass stock return (RET), industry-adjusted RET, ROA, and ROE.

Regarding the female director variables, we consider several aspects:

(1) Number of Female Directors: This variable quantifies the count of female directors serving on a company's board.

(2) Proportion of Female Directors: This variable represents the percentage of female directors in relation to the total number of directors on a company's board.

(3) Number of Female Independent Directors: This variable calculates the count of female independent directors within a company's board structure.

(4) Proportion of Female Independent Directors: This variable quantifies the percentage of female independent directors in comparison to the overall number of directors.

Additionally, to address the notion of achieving a critical mass of female directors on the board, this study introduces three binary variables:

(1) Presence of Three or More Female Directors: This variable is a binary indicator, which assumes a value of 1 when the number of female directors on the board exceeds three, signifying the attainment of a substantial representation of female directors.

(2) Presence of 20% or More Female Directors: This binary variable assumes a value of 1 when the proportion of female directors on the board reaches or exceeds 20%, underlining a significant level of gender diversity within the board composition.

(3) Presence of 35% or More Female Directors: This binary variable assumes a value of 1 when the proportion of female directors on the board reaches or exceeds 35%, underlining a significant level

of gender diversity within the board composition.

The study assesses whether companies face severe operational conditions from a risk perspective, with a focus on the financing policy of the companies (Coles *et al.* 2006). The financing policy includes: (1) debt ratio (total debt/total assets); (2) leverage ratio (long-term and short-term liabilities/(long-term and short-term liabilities + equity)).

To investigate our central research question concerning the potential value contributed by female directors to firms confronting challenging operational conditions, we categorize the sample companies into two subgroups based on their respective levels of operational risk – high and low. We employ a DiD regression model, drawing inspiration from methodologies applied in earlier studies (Li *et al.* 2022; Zhang 2023). The model is presented as follows:

$$Y_{i,t}=\alpha+\beta_1 Post_t \times Treatment_i + \beta_2 Post_t + \beta_3 Treatment_i + \beta_4 Female\ director_{i,t} + \theta \boldsymbol{X}_{i,t-1} + Industry\ FE_i + Year\ FE_t + \varepsilon_{i,t}, \quad (1)$$

where *i* signifies the individual firm, and *t* represents the specific year under consideration. The dependent variable *Y* represents either firm value or firm performance. The binary variable *Post* assumes a value of 1 for years subsequent to 2016 (including the year 2016), signifying the years following the inclusion of female directors in the corporate governance evaluation criteria. *Treatment* is a binary construct, assuming a value of 1 when a firm appoints one or more female directors after the year 2015 (including the year 2015), and a value of 0 otherwise. This variable captures the essential factor under examination, specifically, the impact of female director appointments on firms' value and performance.

The focal point of our investigation lies in the estimation of the DiD coefficient, denoted as ($Post \times Treatment$). It is this coefficient that holds the key to understanding the influence of female director appointments within high-risk firms. Our expectation is that a positive coefficient in high-risk firms would lend support to our research hypothesis. Furthermore, X represents a set of control variables. These encompass a comprehensive range of financial and organizational factors, including company profitability (EBITDA divided by total sales), natural logarithm of company size, market-to-book value ratio, property, plant, and equipment (PPE), capital expenditure ratio (capital expenditure divided by total assets), company age, board size, managerial ownership, and the square of managerial ownership. These controls serve to account for potential confounding factors and ensure the robustness of our analysis. The detailed definitions of these variables can be found in Appendix A.

4. Empirical results

Based on the descriptive statistics presented in Table 2, the average stock return for companies is 4.85%, with mean values of 0.04 and 0.06 for ROA and ROE, respectively. Following the inclusion of female directors in the evaluation criteria, 35.39% of companies have appointed one or more female directors. On average, the number of female directors in sample companies is less than one, with a maximum of three. However, the proportion of boards with three or more female directors, i.e., reaching critical mass, is only 3%. Boards with more than 20% female directors account for 20.5%, while those with over 35% female directors represent only 0.4%. The overall proportion of female directors is low, at 9%, with independent female directors even lower at 2.9%. Regarding the correlation analysis results, except for a slightly elevated correlation coefficient of 0.723 between company size and real estate, plants, and equipment, no severe collinearity issues were identified. For detailed correlation analysis results,

please refer to Appendix B.

Table 3 presents the results of the DiD analysis. We measure operational risk using the debt ratio, with companies having a ratio greater than or equal to the median of the overall study sample considered crisis companies, and others as non-crisis companies. The dependent variable is stock return, and we initially use both the number and proportion of female directors.

Results from the crisis company subgroup show that the coefficient of the *Post×Treatment* interaction term is significantly positive at the 5% level. However, in the non-crisis company subgroup, the coefficients of the interaction term are not statistically significant. Specifically, the coefficients of the interaction term in crisis companies are 5.00 and 5.05, indicating that, following the inclusion of female directors in the evaluation criteria, if crisis companies (i.e., those with high debt ratios) appoint one or more female directors, the stock return is expected to increase by around 5%. Robustness tests using cluster standard errors yield consistent results.

5. Robustness checks

In our robustness tests, we conducted numerous examinations considering variations in the dependent variable measurement, the measurement of female directors, methods for distinguishing crisis and non-crisis companies, and the measurement of operational risk.

5.1. Industry-adjusted stock returns

In Table 4, we adjusted the dependent variable to industry-adjusted stock returns while keeping other variables constant. The results for crisis companies remain unchanged, showing that the coefficient of the *Post×Treatment* interaction term is still significantly positive at the 5% level. However, for non-crisis companies, the coefficient of the interaction term now becomes significantly negative at the 10% level. This suggests that, following the inclusion of female directors in the evaluation criteria, if crisis companies (i.e., those with high debt ratios) appoint one or more female directors, the industry-adjusted stock returns are expected to increase. Conversely, if non-crisis companies (i.e., those with low debt ratios) appoint one or more female directors, the industry-adjusted stock returns are anticipated to decrease. This contrasting effect may stem from the observed phenomenon in previous research, where the appointment of female directors is associated with an over-supervision effect (Adams & Ferreira 2009).

5.2. Critical mass

Continuing with the model, we consider different measures for female directors to address the concept of achieving a critical mass on the board. We incorporate variables indicating whether the number of female directors is three or more, the proportion of female directors is 20% or more, and the proportion of female directors is 35% or more. The dependent variable remains the industry-adjusted stock returns.

As shown in Table 5, the analysis results remain consistent. In the crisis company subgroup, the coefficients of the interaction term remain significantly positive at the 5% to 10% level, while in the non-crisis company subgroup, the coefficients are either not significant or significantly negative at the 10% level. Changing the measurement of female directors to critical mass does not alter the previously

observed results.

5.3. Industry medians

Originally, the classification of crisis and non-crisis companies was based on the overall sample's median. We have now revised this approach to use the median within each industry. The dependent variable remains the industry-adjusted stock returns, and the model includes seven different female director variables. In addition to the previously mentioned five female director variables, we also consider two additional variables: the number and proportion of independent female directors. The analysis results are presented in Table 6.

In the crisis company subgroup, the coefficients of the interaction term remain significantly positive at the 5% to 10% level. Conversely, in the non-crisis company subgroup, the coefficients are not statistically significant. This result indicates that changing the classification method to use industry medians for distinguishing crisis and non-crisis companies does not alter the observed outcomes.

5.4. Leverage ratio

The original model used the debt ratio to measure operational risk. In Table 7, we have changed the measure to leverage ratio and, similar to the previous approach, used the industry median to distinguish between crisis and non-crisis companies. We estimated the same model as presented in Table 6, with the dependent variable remaining as industry-adjusted stock returns. The results are highly similar to those in Table 6, indicating that using the leverage ratio to measure operational risk does not alter our conclusions.

6. Risk Indicator

Drawing inspiration from the risk aversion index proposed by Faccio *et al.* (2016), this study constructs a risk index using four risk variables:

(1) Company Leverage Ratio: Calculated as the ratio of long-term and short-term liabilities to the sum of long-term and short-term liabilities plus equity. The leverage ratio gauges a company's financing decisions, and higher leverage indicates lower resilience to negative impacts. If a company's leverage ratio is within the top 20% of the industry distribution, it is assigned a value of 1; otherwise, it is assigned 0.

(2) Company Profit Volatility: Measured as the standard deviation of stock returns, calculated based on the standard deviation of daily returns over the past three years. If a company's profit volatility is within the top 20% of the industry, it is assigned a value of 1; otherwise, it is assigned 0.

(3) Company Age: Represents the operational risk associated with a company. Younger companies are considered to have a higher risk and lower survival probability. If a company's age is within the lowest 20% of the industry, it is assigned a value of 1; otherwise, it is assigned 0.

(4) Company Size: Smaller companies are generally associated with higher risks. If a company's size is within the smallest 20% of the industry, it is assigned a value of 1; otherwise, it is assigned 0.

The sum of these four values yields the risk index (ranging from 0 to 4), with a higher value indicating higher overall risk.

For the purpose of analysis, companies with a risk index of 2 or higher are considered high-risk (crisis companies), while those with a risk index below 2 are considered low-risk (non-crisis companies). The model is re-estimated, with company performance now measured using accounting metrics, ROA and ROE. The results are presented in Tables 8 and 9. In the crisis company subgroup, the coefficients of the interaction term are significantly positive at the 10% level, while in the non-crisis company subgroup, the coefficients are not statistically significant. This result indicates that, following the inclusion of female directors in the evaluation criteria, crisis companies appointing female directors not only enhance market performance but also improve accounting performance.

7. Conclusions

This research investigates the influence of female directors on the performance of Taiwanese publicly listed companies, particularly in the context of challenging business conditions following the inclusion of female directors in corporate governance evaluation criteria in 2015. The study highlights lower percentages in Asia compared to the global average. It provides insights into the regulatory environment, with European countries leading in implementing quotas while Taiwan adopts a more lenient approach, encouraging voluntary gender diversity goals.

The research underscores Taiwan's efforts to enhance gender diversity in corporate boards, with the Financial Supervisory Commission actively promoting female director appointments based on gender equality plans. Additionally, it acknowledges the commendable leadership of female executives in handling the COVID-19 pandemic in countries like Denmark, Finland, Iceland, New Zealand, Germany, and Taiwan. A central hypothesis posits that a gender-diverse board can bring value to a company, especially during challenging operational conditions. The methodology employs the DiD approach, addressing potential endogeneity issues, and utilizes market and accounting performance metrics for assessment.

Empirical results reveal a significantly positive impact of female directors on stock returns for companies facing high operational risk (crisis companies), supporting the research hypothesis. This positive effect is observed post the inclusion of female directors in corporate governance evaluation criteria. Robustness checks, including adjustments for industry medians, critical mass of female directors, and different measures of operational risk, consistently affirm the positive impact of female directors on crisis companies' stock returns. A risk index, considering factors like leverage ratio, profit volatility, company age, and size, further supports the notion that crisis companies appointing female directors enhance both market and accounting performance. In summary, the research highlights the potential value of gender-diverse boards, particularly in times of crisis, emphasizing the significance of female representation in corporate leadership.

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Appendix A. Definitions of variables

Variable	Definition
RET	Stock return: $R_t = \frac{\ln(P_t \times (1+\alpha+\beta)+D)}{(P_{t-1}+\alpha \times C)} \times 100\%$ where P_t is the closing price at time t (Index), α is the rights subscription rate for the period, β is the bonus issue rate for the period, C is the cash subscription price for the period, and D is the cash dividend for the period.
Ind_RET	Industry-adjusted RET: Stock return for the current year adjusted by subtracting the industry average
ROA	Return on Assets: $\frac{(Operating\ Income + Financial\ Cost \times (1 - Tax\ Rate))}{Average\ Total\ Assets} \times 100\%$
ROE	Return on Equity: $\frac{Operating\ Income}{Average\ Equity} \times 100\%$
Post	Time Point: A dummy equals 1 if after 2016 (inclusive); 0 if before 2015 (inclusive)
Treatment	A dummy equals 1 if the company appoints one or more female directors after 2015 (inclusive); 0 otherwise
Female	Number of Female Directors: Total number of female directors
Female%	Proportion of Female Directors: Proportion of female directors to the total number of directors
Ind female	Number of Independent Female Directors: Total number of independent female directors
Ind female%	Proportion of Independent Female Directors: Proportion of independent female directors to the total number of independent directors
Female 3+	Female Directors Seats >= 3: A dummy equals 1 if the number of female directors is three or more; 0 otherwise
Female 20%+	Female Directors Proportion >= 20%: A dummy equals 1 if the proportion of female directors is 20% or more; 0 otherwise
Female 35%+	Female Directors Proportion >= 35%: A dummy equals 1 if the proportion of female directors is 35% or more; 0 otherwise
Profitability	Company Profitability: EBITDA over total sales
Ln_Asset	Company Size: Natural logarithm of total assets
MB	Market-to-Book Ratio: $\frac{(Total\ Assets - Total\ Liabilities)}{Common\ Shares\ Outsdanding}$
Ln PPE	Property, Plant, and Equipment: ln(Property, Plant, and Equipment+1)
CAPEX	Capital Expenditure Ratio: Capital expenditure over total assets
Ln Age	Company Age: ln(Company age+1)
Ln Board size	Board Size: ln(Board size+1)
Mgt own	Managerial Ownership: Managerial ownership over total issued shares

Appendix B. Correlation coefficients

	(1) Female	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(2) Ind female	0.0639 ***														
(3) Female%	0.9368 ***	0.0395 ***													
(4) Ind female%	0.0357 ***	0.9701 ***	0.0376 ***												
(5) Female 3+	0.5299 ***	0.0327 ***	0.4115 ***	0.0047											
(6) Female 20%+	0.6933 ***	0.0101	0.7973 ***	0.0263 ***	0.3317 ***										
(7) Female 35%+	0.0015	0.2508 ***	0.0134	0.2558 ***	-0.0113	0.0214 **									
(8) Profitability	0.0108	-0.0192 **	-0.0165 *	-0.0368 ***	0.0511 ***	-0.0142	-0.0277 ***								
(9) Ln_Asset	0.0458 ***	-0.0206 **	-0.0424 ***	-0.0713 ***	0.0732 ***	-0.0829 ***	-0.0204 **	0.2688 ***							
(10) MB	0.0160 *	0.0803 ***	-0.0006	0.0805 ***	0.0091	-0.0175 *	0.0025	0.0231 **	-0.0780 ***						
(11) Ln PPE	0.0163 *	-0.0405 ***	-0.0462 ***	-0.0769 ***	0.0577 ***	-0.0797 ***	-0.0151 *	0.2130 ***	**0.7230** ***	-0.1082 ***					
(12) CAPEX	-0.0527 ***	0.0116	-0.0524 ***	0.0064	-0.0385 ***	-0.0583 ***	-0.0029	0.0467 ***	0.0050	-0.0311 ***	0.2786 ***				
(13) Ln Age	0.0407 ***	-0.1281 ***	0.0651 ***	-0.1190 ***	0.0503 ***	0.1042 ***	-0.0012	0.0210 **	0.0813 ***	-0.1874 ***	0.2092 ***	-0.0117			
(14) Ln Board size	0.1352 ***	0.0216 **	-0.0252 ***	-0.0444 ***	0.1271 ***	-0.1303 ***	-0.0342 ***	0.0895 ***	0.3460 ***	-0.0069	0.3254 ***	0.0488 ***	-0.0203 **		
(15) Mgt own	-0.0090	-0.0002	0.0403 ***	0.0289 ***	-0.0313 ***	0.0637 ***	0.0212 **	-0.0189 **	-0.2415 ***	0.0081	-0.1516 ***	-0.0494 ***	0.0439 ***	-0.1498 ***	
(16) Mgt own^2	0.0184 **	0.0035	0.0554 ***	0.0274 ***	-0.0171 *	0.0647 ***	0.0136	-0.0112	-0.1671 ***	0.0031	-0.1011 ***	-0.0339 ***	0.0242 ***	-0.0989 ***	0.9212 ***

***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

Table 1 Proportion of Female Directors and Female Independent Directors in Listed and OTC Companies from 2010 to 2020.

	Listed companies			OTC companies		
Year	Female directors %	Female independent directors %	N	Female directors %	Female independent directors %	N
2010	9.25%	6.95%	342	8.89%	5.85%	220
2011	9.74%	7.11%	389	9.16%	6.71%	248
2012	10.18%	7.16%	427	10.22%	7.54%	308
2013	10.51%	8.10%	484	11.09%	8.59%	371
2014	11.07%	8.18%	590	12.04%	9.28%	470
2015	11.64%	9.49%	730	13.04%	9.77%	582
2016	12.38%	10.23%	873	14.27%	10.98%	702
2017	13.25%	10.74%	923	14.55%	10.85%	760
2018	13.73%	12.06%	938	14.59%	11.62%	774
2019	14.14%	11.89%	941	15.32%	11.88%	779
2020	14.34%	12.26%	941	15.35%	13.49%	773

Table 2 Summary statistics

	Mean	Median	Max	Min	Std	N
RET	4.8472	4.2737	137.2185	-125.8813	46.4714	14786
Ind_RET	0.5232	-0.6173	99.9336	-93.4296	33.0919	14752
ROA	0.0421	0.0424	0.2666	-0.3344	0.0826	16633
ROE	0.0617	0.0738	0.4282	-0.878	0.1588	16621
Post	0.5055	1	1	0	0.5	16634
Treatment	0.3539	0	1	0	0.4782	16634
Female	0.6625	0	3	0	0.7978	16634
Female%	0.0921	0	0.4286	0	0.1113	16634
Ind female	0.2118	0	2	0	0.4603	15660
Ind female%	0.0291	0	0.2857	0	0.0644	15660
Female 3+	0.0328	0	1	0	0.1782	16634
Female 20%+	0.2052	0	1	0	0.4038	16634
Female 35%+	0.0038	0	1	0	0.0613	15660
Profitability	0.116	0.1151	0.8049	-1.8715	0.2738	14266
Ln_Asset	15.4841	15.2323	20.6943	12.494	1.597	14266
MB	1.6014	1.23	8.63	0	1.4354	14266
Ln PPE	13.6895	13.667	18.5288	7.4783	1.8984	14266
CAPEX	0.0343	0.0259	0.2156	0.0002	0.034	14266
Ln Age	3.0849	3.1355	4.1431	0	0.5744	14266
Ln Board size	2.0556	2.0794	2.7726	0	0.2552	14266
Mgt own	0.0448	0.0217	0.2864	0	0.0582	14266
Mgt own^2	0.0054	0.0005	0.082	0	0.0128	14266

The data covers Taiwan-listed companies from 2002 to 2020 and is sourced from TEJ.

Table 3 Baseline model

	Crisis company		Non-crisis company	
	(1)	(2)	(3)	(4)
Female	-0.6847		-0.2821	
	(-0.87)		(-0.35)	
Female%		-6.8116		-2.2514
		(-1.24)		(-0.40)
Post×Treatment	5.0013 **	5.0469 **	-2.0443	-2.0484
	(2.09)	(2.12)	(-0.82)	(-0.83)
Post	0.7962	0.6106	19.3012 ***	19.2511 ***
	(0.19)	(0.14)	(5.95)	(5.93)
Treatment	-1.8303	-1.8044	0.4447	0.4549
	(-1.07)	(-1.06)	(0.25)	(0.25)
Profitability	8.4430 **	8.4322 **	6.8713 ***	6.8708 ***
	(2.53)	(2.53)	(3.22)	(3.22)
Ln_Asset	3.1119 ***	3.0886 ***	2.5015 ***	2.4928 ***
	(4.92)	(4.88)	(3.44)	(3.42)
MB	0.7824 *	0.8729 *	1.3540 ***	1.3531 ***
	(1.65)	(1.65)	(3.08)	(3.08)
Ln PPE	-0.6160	-0.6089	-0.9835 *	-0.9813 *
	(-1.12)	(-1.11)	(-1.68)	(-1.68)
CAPEX	-22.7957	-22.754	-19.3685 ***	-19.4192
	(-1.02)	(-1.02)	(-0.98)	(-0.99)
Ln Age	5.3293 ***	5.3225 ***	4.4014	4.4043 ***
	(4.69)	(4.69)	(3.58)	(3.59)
Ln Board size	-0.3109	-0.6197	0.2856 *	0.1221
	(-0.12)	(-0.24)	(0.11)	(0.05)
Mgt own	14.8601	14.9000	45.5403	45.4741 *
	(0.51)	(0.51)	(1.77)	(1.77)
Mgt own^2	-29.5442	-28.1329	-174.7608	-174.1731
	(-0.22)	(-0.21)	(-1.60)	(-1.59)
Constant	-41.9415 ***	-40.7659 ***	-44.6683 ***	-44.1908 ***
	(-3.95)	(-3.84)	(-4.48)	(-4.42)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.0075	0.0776	0.0565	0.0565
N	6,230	6,230	6,286	6,286

The dependent variable is stock return. *Post* takes on a value of 1 for years starting from 2016 (inclusive), indicating the period following the incorporation of female directors in the corporate governance assessment criteria. *Treatment* is a binary variable, with a value of 1 if a company appoints one or more female directors after 2015 (including 2015), and 0 otherwise. Operational risk is assessed using the debt ratio, categorizing companies with a ratio greater than or equal to the median of the overall study sample as crisis companies, and the rest as non-crisis companies. Variable definitions are detailed in Appendix A. All models include industry and year fixed effects. Values in parentheses denote *t*-statistics based on White's heteroskedasticity robust standard errors. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

Table 4 Industry-adjusted stock returns

	Crisis company		Non-crisis company	
	(1)	(2)	(3)	(4)
Female	-0.4548		-0.0123	
	(-0.79)		(-0.02)	
Female%		-4.2441		-0.2089
		(-1.07)		(-0.05)
Post×Treatment	4.2744 **	4.2889 **	-2.9661 *	-2.9587 *
	(2.40)	(2.43)	(-1.68)	(-1.69)
Post	9.2432 **	9.1526 **	-1.6124	-1.6176
	(2.81)	(2.79)	(-0.62)	(-0.62)
Treatment	-1.4747	-1.4623	0.4739	0.4760
	(-1.27)	(-1.26)	(0.40)	(0.40)
Profitability	6.0444 **	6.0356 **	5.6296 ***	5.6291 ***
	(2.56)	(2.55)	(3.42)	(3.42)
Ln_Asset	3.3190 ***	3.3050 ***	3.0011 ***	2.9999 ***
	(6.77)	(6.74)	(5.63)	(5.62)
MB	0.7320 *	0.7317 *	0.9928 ***	0.9925 ***
	(1.93)	(1.93)	(2.90)	(2.89)
Ln PPE	-0.7202 *	-0.7165 *	-1.3769 ***	-1.3765 ***
	(-1.68)	(-1.67)	(-3.10)	(-3.10)
CAPEX	-19.8723	-19.9082	9.2191	9.1928
	(-1.22)	(-1.22)	(0.62)	(0.62)
Ln Age	3.3205 ***	3.3135 ***	1.8348 **	1.8372 **
	(3.88)	(3.88)	(2.06)	(2.07)
Ln Board size	-0.5482	-0.7485	0.7133	0.7047
	(-0.27)	(-0.38)	(0.39)	(0.39)
Mgt own	24.1006	24.1261	47.4727 **	47.4595 **
	(1.10)	(1.10)	(2.52)	(2.52)
Mgt own^2	-76.9580	-76.2109	-201.6358 **	-201.5283 **
	(-0.74)	(-0.74)	(-2.40)	(-2.40)
Constant	-51.7082 ***	-50.9865 ***	-35.9914 ***	-35.9517 ***
	(-6.38)	(-6.30)	(-4.73)	(-4.72)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.0276	0.0277	0.0205	0.0205
N	6,218	6,218	6,283	6,283

The dependent variable is industry-adjusted stock return. *Post* takes on a value of 1 for years starting from 2016 (inclusive), indicating the period following the incorporation of female directors in the corporate governance assessment criteria. *Treatment* is a binary variable, with a value of 1 if a company appoints one or more female directors after 2015 (including 2015), and 0 otherwise. Operational risk is assessed using the debt ratio, categorizing companies with a ratio greater than or equal to the median of the overall study sample as crisis companies, and the rest as non-crisis companies. Variable definitions are detailed in Appendix A. All models include industry and year fixed effects. Values in parentheses denote *t*-statistics based on White's heteroskedasticity robust standard errors. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

Table 5 Critical mass

	Crisis company			Non-crisis company		
	(1)	(2)	(3)	(4)	(5)	(6)
Female 3+	2.4560			-2.1906		
	(0.99)			(-0.93)		
Female 20%+		-0.3286			0.0914	
		(-0.29)			(0.09)	
Female 35%+			8.8411			-12.3585 ***
			(1.13)			(-3.01)
Post×Treatment	3.9235 **	4.0932 **	3.4206 *	-2.8780 *	-2.9836 *	-2.7136
	(2.23)	(2.32)	(1.9)	(-1.65)	(-1.71)	(-1.54)
Post	9.2794 ***	9.2017 ***	3.8936	-1.5697	-1.5954	10.2491 ***
	(2.82)	(2.8)	(1.03)	(-0.6)	(-0.61)	(3.11)
Treatment	-1.5776	-1.5216	-0.9208	0.4933	0.4626	0.3743
	(-1.36)	(-1.32)	(-0.76)	(0.42)	(0.39)	(0.31)
Profitability	5.9975 **	6.0222 **	5.2891 **	5.6704 ***	5.6304 ***	6.4979 ***
	(2.54)	(2.55)	(2.2)	(3.43)	(3.42)	(3.93)
Ln_Asset	3.3266 ***	3.3157 ***	3.5955 ***	3.0008 ***	3.0032 ***	3.0645 ***
	(6.78)	(6.76)	(7.08)	(5.63)	(5.64)	(5.58)
MB	0.7072 *	0.7228 *	0.7918 **	0.9890 ***	0.9935 ***	0.8918 **
	(1.87)	(1.9)	(2.04)	(2.89)	(2.9)	(2.57)
Ln PPE	-0.7380 *	-0.7250 *	-0.8095 *	-1.3777 ***	-1.3772 ***	-1.4167 ***
	(-1.72)	(-1.69)	(-1.82)	(-3.1)	(-3.1)	(-3.1)
CAPEX	-19.5425	-19.9163	-15.1721	8.6338	9.2932	3.7442
	(-1.2)	(-1.22)	(-0.89)	(0.58)	(0.63)	(0.24)
Ln Age	3.2299 ***	3.2905 ***	3.5015 ***	1.8904 **	1.8258 **	1.9179 **
	(3.78)	(3.85)	(4.03)	(2.14)	(2.05)	(2.13)
Ln Board size	-0.7862	-0.7439	-0.3733	0.9323	0.7323	0.2136
	(-0.39)	(-0.37)	(-0.18)	(0.51)	(0.4)	(0.12)
Mgt own	24.0926	24.1617	29.5817	47.5115 **	47.4950 **	49.5382 **
	(1.1)	(1.1)	(1.3)	(2.52)	(2.52)	(2.53)
Mgt own^2	-79.5375	-78.5781	-101.8389	-202.0261 **	-201.8272 **	-211.9457 **
	(-0.77)	(-0.76)	(-0.95)	(-2.4)	(-2.4)	(-2.41)

Constant	-50.9987 ***	-51.2384 ***	-50.4937 ***	-36.4118 ***	-36.0778 ***	-41.2725 ***
	(-6.27)	(-6.32)	(-5.91)	(-4.78)	(-4.72)	(-5.26)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.0276	0.0275	0.0295	0.0206	0.0205	0.0245
N	6,218	6,218	6,218	6,283	6,283	6,283

The dependent variable is industry-adjusted stock return. *Post* takes on a value of 1 for years starting from 2016 (inclusive), indicating the period following the incorporation of female directors in the corporate governance assessment criteria. *Treatment* is a binary variable, with a value of 1 if a company appoints one or more female directors after 2015 (including 2015), and 0 otherwise. Operational risk is assessed using the debt ratio, categorizing companies with a ratio greater than or equal to the median of the overall study sample as crisis companies, and the rest as non-crisis companies. Variable definitions are detailed in Appendix A. All models include industry and year fixed effects. Values in parentheses denote *t*-statistics based on White's heteroskedasticity robust standard errors. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

Table 6 Industry medians

Panel A: Crisis company							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.5450						
	(-0.91)						
Ind female		0.9204					
		(0.88)					
Female%			-4.8585				
			(-1.19)				
Ind female%				-4.8585			
				(0.85)			
Female 3+					2.3749		
					(0.88)		
Female 20%+						-0.2788	
						(-0.24)	
Female 35%+							5.9482
							(0.80)
Post×Treatment	3.9139 **	3.0981 *	3.9269 **	3.9269 *	3.4883 *	3.6670 **	3.1549 *
	(2.15)	(1.69)	(2.18)	(1.70)	(1.95)	(2.04)	(1.72)
Post	4.7473	5.0703	4.6227	4.6227	4.7240	4.6746	5.2389
	(1.30)	(1.33)	(1.26)	(1.33)	(1.29)	(1.28)	(1.37)
Treatment	-1.1607	-0.7005	-1.1556	-1.1556	-1.2459	-1.2129	-0.6968
	(-0.97)	(-0.56)	(-0.97)	(-0.56)	(-1.05)	(-1.02)	(-0.56)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.027	0.0285	0.0271	0.0285	0.027	0.0269	0.0285
N	6,180	5,866	6,180	5,866	6,180	6,180	5,866

Panel B: Non-crisis company							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	0.0618						
	(0.11)						
Ind female		0.9953					
		(0.98)					
Female%			0.3377				
			(0.09)				
Ind female%				7.6426			
				(1.05)			
Female 3+					-1.3713		
					(-0.63)		
Female 20%+						0.1039	
						(0.1)	
Female 35%+							-10.7015 **
							(-2.43)
Post×Treatment	-2.2003	-2.0903	-2.1891	-2.0709	-2.1195	-2.1195	-2.0204
	(-1.28)	(-1.21)	(-1.28)	(-1.2)	(-1.24)	(-1.24)	(-1.17)
Post	4.9020	4.7433	4.9143	4.7563	4.9482	4.9482	4.9748
	(1.55)	(1.45)	(1.56)	(1.46)	(1.57)	(1.57)	(1.53)
Treatment	-0.0616	-0.1404	-0.0614	-0.1485	-0.0312	-0.0312	-0.1579
	(-0.05)	(-0.12)	(-0.05)	(-0.12)	(-0.03)	(-0.03)	(-0.13)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.0187	0.0203	0.0187	0.0203	0.0187	0.0187	0.0205
N	6,321	5,968	6,321	5,968	6,321	6,321	5,968

The dependent variable is industry-adjusted stock return. *Post* takes on a value of 1 for years starting from 2016 (inclusive), indicating the period following the incorporation of female directors in the corporate governance assessment criteria. *Treatment* is a binary variable, with a value of 1 if a company appoints one or more female directors after 2015 (including 2015), and 0 otherwise. Operational risk is assessed using the debt ratio, categorizing companies with a ratio greater than or equal to the median within each industry as crisis companies, and the rest as non-crisis companies. Variable definitions are detailed in Appendix A. All models include control variables, as well as industry and year fixed effects. Values in parentheses denote *t*-statistics based on White's heteroskedasticity robust standard errors. ** and * represent significance at the 5% and 10% levels, respectively.

Table 7 Leverage ratio

Panel A: Crisis company							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.5450						
	(0.364)						
Ind female		0.9204					
		(0.88)					
Female%			-4.8585				
			(-1.19)				
Ind female%				6.4964			
				(0.85)			
Female 3+					2.3749		
					(0.88)		
Female 20%+						-0.2788	
						(-0.24)	
Female 35%+							5.9482
							(0.8)
Post×Treatment	3.9139 **	3.0981 *	3.9269 **	3.1140 *	3.4883 *	3.6670 **	3.1549 *
	(2.15)	(1.69)	(2.18)	(1.7)	(1.95)	(2.04)	(1.72)
Post	4.7473	5.0703	4.6227	5.0916	4.7240	4.6746	5.2389
	(1.3)	(1.33)	(1.26)	(1.33)	(1.29)	(1.28)	(1.37)
Treatment	-1.1607	-0.7005	-1.1556	-0.6986	-1.2459	-1.2129	-0.6968
	(-0.97)	(-0.56)	(-0.97)	(-0.56)	(-1.05)	(-1.02)	(0.578)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.027	0.0285	0.0271	0.0285	0.027	0.0269	0.0285
N	6,180	5,866	6,180	5,866	6,180	6,180	5,866

Panel B: Non-crisis company							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	0.2976						
	(0.53)						
Ind female		1.1641					
		(1.2)					
Female%			2.0833				
			(0.52)				
Ind female%				8.6297			
				(1.26)			
Female 3+					-4.0185 *		
					(-1.75)		
Female 20%+						0.0485	
						(0.04)	
Female 35%+							-15.6215 ***
							(-3.27)
Post×Treatment	-0.4688	-0.0687	-0.4454	-0.0416	-0.1366	-0.3166	-0.0124
	(-0.27)	(-0.04)	(-0.25)	(-0.02)	(-0.08)	(-0.18)	(-0.01)
Post	0.9525	1.2407	1.0012	1.2743	1.1132	0.9643	1.4595
	(0.31)	(0.4)	(0.33)	(0.41)	(0.37)	(0.32)	(0.47)
Treatment	-0.4950	-0.6763	-0.4983	-0.6909	-0.3931	-0.4664	-0.6765
	(-0.41)	(-0.54)	(-0.41)	(-0.55)	(-0.33)	(-0.39)	(-0.54)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.0185	0.0199	0.0185	0.02	0.0188	0.0184	0.0204
N	6,264	5,916	6264	5,916	6,264	6,264	6,264

The dependent variable is industry-adjusted stock return. *Post* takes on a value of 1 for years starting from 2016 (inclusive), indicating the period following the incorporation of female directors in the corporate governance assessment criteria. *Treatment* is a binary variable, with a value of 1 if a company appoints one or more female directors after 2015 (including 2015), and 0 otherwise. Operational risk is assessed using the leverage ratio, categorizing companies with a ratio greater than or equal to the median within each industry as crisis companies, and the rest as non-crisis companies. Variable definitions are detailed in Appendix A. All models include control variables, as well as industry and year fixed effects. Values in parentheses denote *t*-statistics based on White's heteroskedasticity robust standard errors. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

Table 8 Risk indicator

Panel A: Crisis company				
	(1)	(2)	(3)	(4)
Female%	-0.0274			
	(-1.21)			
Ind female%		-0.0189		
		(-0.52)		
Female 20%+			-0.0160	
			(-2.56)	
Female 35%+				-0.0061
				(-0.19)
Post×Treatment	0.0175 *	0.0196 *	0.0184 *	0.0195 *
	(1.71)	(1.82)	(1.82)	(1.81)
Post	-0.0618 ***	0.0513	-0.0647 ***	0.0507
	(-3.29)	(1.62)	(-3.44)	(1.60)
Treatment	-0.0178 **	-0.0217 **	-0.0174 **	-0.0218 **
	(-2.15)	(-2.38)	(-2.11)	(-2.40)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.3264	0.3281	0.3285	0.328
N	1669	1566	1669	1566
Panel B: Non-crisis company				
	(1)	(2)	(3)	(4)
Female%	-0.0058			
	(-1.11)			
Ind female%		0.0149		
		(1.48)		
Female 20%+			-0.0033 **	
			(-2.29)	
Female 35%+				-0.0197 ***
				(-2.98)
Post×Treatment	-0.0035	-0.0033	-0.0035	-0.0032
	(-1.51)	(-1.41)	(-1.49)	(-1.38)
Post	-0.0297 ***	-0.0364 ***	-0.0300 ***	-0.0359 ***
	(-6.77)	(-6.94)	(-6.84)	(-6.87)
Treatment	-0.0018	-0.0028	-0.0017	-0.0028
	(-1.08)	(-1.6)	(-0.99)	(-1.63)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.3255	0.3308	0.3257	0.3309
N	12,597	12,011	12,597	12,011

The dependent variable is ROA. *Post* takes on a value of 1 for years starting from 2016 (inclusive), indicating the period following the incorporation of female directors in the corporate governance assessment criteria. *Treatment* is a binary variable, with a value of 1 if a company appoints one or more female directors after 2015 (including 2015), and 0 otherwise. Operational risk is assessed using the risk indicator, categorizing companies with a risk index of 2 or higher as crisis companies, and the rest as non-crisis companies. Variable definitions are detailed in Appendix A. All models include control variables, as well as industry and year fixed effects. Values in parentheses denote *t*-statistics based on White's heteroskedasticity robust standard

errors. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

Table 9 Risk indicator

Panel A: Crisis company				
	(1)	(2)	(3)	(4)
Female%	-0.0091			
	(-0.17)			
Ind female%		-0.0461		
		(-0.54)		
Female 20%+			-0.0285	
			(-1.95)	
Female 35%+				0.0770
				(1.03)
Post×Treatment	0.0394 *	0.0453 *	0.0446 *	0.0439 *
	(1.64)	(1.80)	(1.88)	(1.74)
Post	-0.0851 **	0.0788	-0.0905 **	0.0776
	(-1.92)	(1.53)	(-2.04)	(1.51)
Treatment	-0.0418 **	-0.0468 **	-0.0409 **	-0.0474 **
	(-2.16)	(-2.20)	(-2.12)	(-2.23)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.2865	0.2893	0.2882	0.2896
N	1,663	1,561	1663	1561
Panel B: Non-crisis company				
	(1)	(2)	(3)	(4)
Female%	-0.0015			
	(-0.15)			
Ind female%		0.0261		
		(1.41)		
Female 20%+			-0.0030	
			(-1.15)	
Female 35%+				-0.0131
				(-1.14)
Post×Treatment	-0.0086 **	-0.0082 *	-0.0083 *	-0.0082 *
	(-1.99)	(-1.9)	(-1.93)	(-1.88)
Post	-0.0445 ***	-0.0541 ***	-0.0450 ***	-0.0534 ***
	(-4.23)	(-5.47)	(-4.26)	(-5.41)
Treatment	-0.0017	-0.0026	-0.0015	-0.0026
	(-0.53)	(-0.81)	(-0.46)	(-0.81)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.2778	0.2826	0.2779	0.2825
N	12,593	12,007	12,593	12,007

The dependent variable is ROE. *Post* takes on a value of 1 for years starting from 2016 (inclusive), indicating the period following the incorporation of female directors in the corporate governance assessment criteria. *Treatment* is a binary variable, with a value of 1 if a company appoints one or more female directors after 2015 (including 2015), and 0 otherwise. Operational risk is assessed using the risk indicator, categorizing companies with a risk index of 2 or higher as crisis companies, and the rest as non-crisis companies. Variable definitions are detailed in Appendix A. All models include control variables, as well as industry and year fixed effects. Values in parentheses denote *t*-statistics based on White's heteroskedasticity robust standard

errors. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

新加坡管理大學(Singapore Management University, SMU)是一所領先的商學和管理學院，其多樣化的學生和教職員工使其成為來自世界各地的學者的有吸引力的目的地。以下說明這次受 Professor Cheng 的邀請至 SMU 進行移地研究的重點：

1. 與 SMU 教授合作：此次訪問 SMU，與 Professor Cheng 與其他教授進行交流，訪問其實驗室，瞭解實驗室資源與研究環境，討論其研究議題與方向，商討合作研究議題與共同執行研究計畫的機會。
2. 商討研究議題 : SMU 設有 Women in sustainability and environment (WISE)，WISE 與本人目前正在執行的研究主題「從女性董事談女性經濟賦權」有高度相關，也與申請中的 112 年度性別與科技研究計畫有關，透過移地研究可以更深入瞭解該組織的運作與研究，以便作為後續研究議題的延伸。
3. 網路和建立關係：訪問 SMU 期間，與資訊財金相關領域的其他學者和專業人士會面和建立聯繫，開啟未來新的合作與研究機會。
4. 參加講座活動：SMU 定期與不定期舉辦學術會議、研討會和其他活動，聚集來自世界各地的學者。此次的移地研究，參與了 SMU 舉辦的講座活動，與該校教授、學生，以及至 SMU 進行訪問的其他國外學者有良好的互動，並建立聯繫關係。

基於以上說明，這次在 SMU 的移地研究有很豐碩的收穫。

111年度專題研究計畫成果彙整表

計畫主持人：丁秀儀	**計畫編號：**111-2629-H-027-001-
計畫名稱：從女性董事談女性經濟賦權(L07)	

成果項目			量化	單位	質化 （說明：各成果項目請附佐證資料或細項說明，如期刊名稱、年份、卷期、起訖頁數、證號...等）
國內	學術性論文	期刊論文	0	篇	
		研討會論文	1		投稿中
		專書	0	本	
		專書論文	0	章	
		技術報告	0	篇	
		其他	0	篇	
國外	學術性論文	期刊論文	1	篇	投稿中
		研討會論文	1		投稿中
		專書	0	本	
		專書論文	0	章	
		技術報告	0	篇	
		其他	0	篇	
參與計畫人力	本國籍	大專生	0	人次	
		碩士生	2		協助資料蒐集與分析
		博士生	0		
		博士級研究人員	0		
		專任人員	0		
	非本國籍	大專生	0		
		碩士生	0		
		博士生	0		
		博士級研究人員	0		
		專任人員	0		
其他成果 （無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。）					