Do Women on Boards, Education Diversity and Corporate Governance affect Firm Risk and Firm Performance in Thailand?

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An Independent Study Submitted in Partial Fulfillment of the Requirements

for the Degree of Master of Science in Finance

Department of Banking and Finance

FACULTY OF COMMERCE AND ACCOUNTANCY

Chulalongkorn University

Academic Year 2020

คณะกรรมการเพศหญิง ความหลากหลายทางการศึกษา และ การกำกับดูแลกิจการ ส่งผลกระทบต่อ
ความเสี่ยงและผลการดำเนินงานของบริษัทในประเทศไทยหรือไม่

น.ส.จุฑามาศ กล่อมขาว

สารนิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการเงิน ภาควิชาการธนาคารและการเงิน
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2563

Independent Study Title	Do Women on Boards, Education Diversity and Corporate Governance affect Firm Risk and Firm Performance in Thailand?
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Field of Study	Finance
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Accepted by the FACULTY OF COMMERCE AND ACCOUNTANCY, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Science

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จุฑามาศ กล่อมขาว : คณะกรรมการเพศหญิง ความหลากหลายทางการศึกษา และ การกำกับดูแล
กิจการ ส่งผลกระทบต่อความเสี่ยงและผลการดำเนินงานของบริษัทในประเทศไทยหรือไม่. (Do
Women on Boards, Education Diversity and Corporate Governance affect Firm Risk
and Firm Performance in Thailand?) อ.ที่ปรึกษาหลัก : ผศ. ดร.สุภารัตน์ ตันทนงศักดิ์กุล

การศึกษานี้มีวัตถุประสงค์ เพื่อศึกษาความสัมพันธ์ของคณะกรรมการเพศหญิง ความหลากหลายทาง
การศึกษา และการกำกับดูแลกิจการ ต่อความเสี่ยงและผลการดำเนินงานของบริษัทจดทะเบียนในตลาด
หลักทรัพย์แห่งประเทศไทย โดยเก็บข้อมูลตั้งแต่ปี พ.ศ. 2553-2562 ซึ่งจากผลการศึกษากลับไม่พบความสัมพันธ์
อย่างมีนัยสำคัญระหว่างคณะกรรมการเพศหญิงและความเสี่ยงของบริษัท ทั้งในส่วนของความเสี่ยงรวมและความ
เสี่ยงเฉพาะตัว นอกจากนี้ผลการศึกษายังแสดงให้เห็นว่าคณะกรรมการเพศหญิงช่วยส่งเสริมและพัฒนาผลการ
ดำเนินงานทางบัญชีอย่างมีนัยสำคัญ โดยใช้อัตราผลตอบแทนต่อสินทรัพย์ (ROA) เป็นตัวชี้วัด แต่อย่างไรก็ตาม
ผลการดำเนินงานทางตลาด ซึ่งใช้ Tobin's Q เป็นตัวชี้วัดกลับลดลงอย่างมีนัยสำคัญ ในส่วนของความ
หลากหลายทางการศึกษา พบว่าตัวแปรดังกล่าวไม่มีความสัมพันธ์ที่มีนัยสำคัญกับผลการดำเนินงานของบริษัททั้ง
ในทางบัญชีและทางตลาด ทั้งนี้งานศึกษาดังกล่าวได้ค้นพบเพิ่มเติมว่าผลกระทบที่เพิ่มขึ้นของคณะกรรมการเพศ
หญิงผู้ซึ่งมีความหลากหลายทางการศึกษาจะช่วยส่งผลในเชิงบวกต่อผลการดำเนินงานทางตลาด(Tobin's Q)
เท่านั้น นอกจากนี้ผลการศึกษายังชี้ให้เห็นว่าผลกระทบของการกำกับดูแลกิจการที่มีคณะกรรมการเพศหญิงเพิ่ม
สูงขึ้นจะทำให้ความสัมพันธ์เชิงบวกของการกำกับดูแลกิจการที่ต่อผลการดำเนินงานทางบัญชี (ROA) นั้นลดลง
แต่จะไม่มีผลต่อผลการดำเนินงานทางตลาด (Tobin's Q) ซึ่งโดยรวมนั้นแสดงให้เห็นว่าผลการศึกษาจะมีความ
แตกต่างกันออกไปขึ้นอยู่กับประเภทของตัวชี้วัดที่ใช้ในการวัดผลการดำเนินงานของบริษัท

สาขาวิชา	การเงิน	ลายมือชื่อนิสิต ....
ปีการศึกษา	2563	ลายมือชื่อ อ.ที่ปรึกษาหลัก ....

6284007026 : MAJOR FINANCE

KEYWORD:

Juthamard Klomkhao : Do Women on Boards, Education Diversity and Corporate Governance affect Firm Risk and Firm Performance in Thailand?. Advisor: Asst. Prof. SUPARATANA TANTHANONGSAKKUN, Ph.D.

The purposes of my study are to investigate the relationship among women on boards, education diversity, and corporate governance on firm risk and/or firm performance of listed companies in Thailand during 2010-2019. Surprisingly, I find an insignificant relationship between the proportion of female directors and firm risk (both total risk and idiosyncratic risk). Moreover, the findings show that women on boards strongly improve ROA, but significantly reduce Tobin's Q. For education diversity, there is no significant relationship on any measures of firm performance. This study further discovers that an incremental effect of female education diversity on women directorship positively affects only Tobin's Q. In addition, the result also suggests that an incremental effect of women directorship on corporate governance lowers a positive effect of corporate governance on ROA, but not on Tobin's Q. Overall, all of these findings appear to vary depending on the type of firm performance measures used.

Field of Study:	Finance	Student's Signature ....
Academic Year:	2020	Advisor's Signature ....

ACKNOWLEDGEMENTS

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1. INTRODUCTION

1.1) Background and Motivation

Human is a social animal and undeniable that each individual is different in many aspects. In business world and corporate governance, the famous story over the years is also 'diversity'. Hermalin and Weisbach (2003) indicate in their studies that one of the key determinants for organizational performance and governance mechanism is 'board compositions'; therefore, board diversity become more prominent in the worldwide. In recent years, women on the boards have extensively played a significant role in the boardroom because this characteristic is likely to increase more creativity and competitive advantage leading to convey greater women representation in the society including U.S., Europe and Asia (Campbell and Mínguez-Vera (2008);Low et al. (2015)).

According to economics and psychological studies, Croson and Gneezy (2009) suggest that women are more risk averse and better balance excessive risk-taking than men in U.S.; thus, this attribute results in lowering volatility and strengthening more wealth for shareholders. In case of European countries, Campbell and Mínguez-Vera (2008), and Nadeem et al. (2019) find that women directorship in Spain and UK could moderate corporate risk, since higher women inclusion may advocate effective risk management and prudent decision-making leading to greater firm performance. In addition, even if Asian countries have different cultural environment from U.S. and Europe, Liu et al. (2014) interestingly reveal that Chinese firms with higher proportion of women on the board result in a positive correlation with firm performance. This outcome is also consistent with Low et al. (2015), which have examined in Hong Kong, South Korea, Singapore, and Malaysia.

Nonetheless, Adams and Ferreira (2009) and Ahern and Dittmar (2012) argue that more gender-diverse boards result in lowering firm performance due to mandatory female director quotas in U.S. and Norway, respectively. Corporations are indirectly compelled hiring non-qualified women to comply with the regulations. As a result, firm would have unproductive directors leading to worse returns. Hence, policy makers should consider carefully how to retain firm value while increasing proportion of female directors on corporate board. Accordingly, women directorship seems to be inconclusive findings depending on different environments.

Apart from women directorship, academic qualification could be considered as a proxy of individual's capability in order to properly appoint board of directors, suggested by Darmadi (2013). According to Burgess and Tharenou (2002), investment in education following human capital theory advocates women's professional skills leading to directors' promotion. Additionally, board members having diverse educational backgrounds potentially utilize their skills to improve firm value (Kim and Lim (2010)). In contrary, Petrovic (2008) reveals that boards with high education diversity seem to be overconfident on their abilities and insist on their different perspectives which probably lead to controversy and bad dynamic in the boardroom.

Besides, corporate governance is also a significant mechanism for companies recognized by shareholders, stakeholders, and regulators (Donaldson, 2003) . Since regulators have not strictly enacted governance frameworks, it may have potential gaps of agency problems in which shareholders can lose their own wealth. Consequently, Gompers et al. (2003) indicate that better firm value and performance have caused from better-governed companies with strong shareholder rights.

In a view of Thailand, men are more likely to dominate women in the business world because females are frequently perceived as lacking competencies and adhering to major

opinions in order to be acceptable and avoid conflict among other members (Pimpa (2012)). Unexpectedly, The Economist Intelligence Unit (2019) has ranked the first place of the highest gender-diverse board for Thailand at 20.4 percent in ASEAN, but much lower across Europe and U.S. However, the related government sectors inactively proceed on the women quotas' regulation comparing to Malaysia and Philippines. Besides, Low et al. (2015) have ever anticipated that Asian stereotype may influence roles of women directors to only express as a symbolic signal for board diversity in practice; nevertheless, Chotiyaputta and Yoon (2018), investigating the large market capitalization firms, have surprisingly found a positive relationship with both accounting and market based firm performance. Further, Sitthipongpanich and Polsiri (2013) have also found a positive relationship between diverse academic major and firm value in the boardroom using data during 2001-2005. Regarding corporate governance, Limpaphayom and Connelly (2004) have published that good quality of corporate governance in Thailand consistently results in enlarging market-based firm performance in 2002.

According to the inconsistent relationships of women on the boards and education diversity on firm performance mentioned previously, these issues seem to have research gaps to further examine on my study. First, Adams and Ferreira (2009) specify that relationship between women directorship and firm performance is somewhat complicated, which may need to bring other than demographic characteristics to widen this linkage. Then, I have adapted education diversity as cognitive attribute in accordance with human capital theory to incorporate with women directorship. Schmidt (2019) has ever studied the effect of education level in female board members regarding to firm performance in Europe; as a result, the literature could not find any significant relationship from this testing. According to this inconclusive outcome, I would like to additionally investigate by using academic majors instead to represent education diversity, and

study how the higher education diversity in women directors affect the firm performance in Thailand.

Likewise, women directorship relatively encourages better corporate governance within the corporations, which may imply the higher women on the board would strengthen their governance mechanism and performance, suggested by Virtanen et al. (2012). On the other hand, Adams and Ferreira (2009) discover that larger female directors positively associates with performance of firms having weak governance, whereas the companies with strong governance has been diminished probably due to their extremely stringent on gender quota in U.S. Thus, I will collaborate a level of women representation on the board in corporate governance mechanism to study how the effect of women directorship in governance relates to firm performance in Thailand. The papers inspecting both collaborations which are "women directorship with education diversity", and "women directorship with corporate governance" relative to firm performance are still limited because those studies have been only taken in Europe and U.S., but no empirical testing has been taken in Thailand, which has different cultures and business structures.

In accordance with the above reasons, I decide to select Thailand as a sample to study relationship of women on the boards, education diversity and corporate governance regarding to firm risk and/or performance. Also, I will further examine the collaborations of these factors so as to add more value in my paper, since they are not much performed yet, especially in this country.

1.2) Objectives

- To study an impact of women directorship on firm risk and performance.
- To inspect an impact of education diversity on firm performance.

- To examine an incremental effect of female education diversity on women directorship regarding to firm performance

- To investigate an incremental effect of women directorship on corporate governance regarding to firm performance

2. RESEARCH CONTRIBUTIONS

This research makes two perspectives of contributions as follows:

- In a view of academic, the relationship of women directorship, education diversity and corporate governance on firm risk and/or performance has been mostly examined in Europe countries such as UK, Spain, and Norway in which diversity topics are widely prominent in their business environments (Campbell and Minguez-Vera (2008)). However, previous studies of such topic like education diversity (Cheng et al. (2010)) still faced inconclusive findings because they majorly use education level as a measurement. Also, environments and cultural settings are plausible to affect relationship between education diversity and firm performance in different countries. As a result, this seems interesting to ascertain the ambiguous relationship using Thailand as a sample and apply academic majors to represent education diversity instead whether the outcome would be similar to prior studies or not.

Moreover, my study will further examine to potentially perceive new ideas from synthesizing the conditions of diversity such as education diversity in female directors, or women representation on the boards in corporate governance environment. These empirical testing are quite scarce, and only a few examinations have been done in Western (Schmidt, 2019). Hence,

my paper is likely to add more value demonstrating the relationship among these factors in Thailand which have different cultural settings and business environments.

- In a perspective of practical contribution, I intensively explore whether women in the boardroom having much wider education diversity would positively advocate corporate financial performance. According to previous literatures, the major authors examine only gender factor on firm risk and/or performance. Therefore, applying resource dependence theory, I decide to add diversity on academic majors to examine the effect on firm performance whether this experiment can indicate any new interesting relationship. Furthermore, I also inspect whether more gender-diverse boards in the corporate governance mechanism would result in any significant effect on financial performance. Accordingly, my research would usefully contribute to several counterparties such as regulators, corporations, and shareholders etc. These outcomes would be beneficial for organizational level to consider whether they need to reform boards' qualifications for the upcoming appointment or restructure the policy regarding female participation in the corporations so that every business sector can utilize my findings to complement their value creation in the long run.

3. LITERATURE REVIEWS

3.1) Theoretical Background

- *Agency Theory*

In general, major shareholders' concerns are agency conflicts of managers' self-interest. According to the agency theory, it is plausible that management team use their professional capability to slightly receive more operational control which may not be the best shareholders' interest. As a result, shareholders have appointed board of directors to fundamentally monitor

and control their action (Jensen and Meckling (1976)). Board of directors is considered as a significant mechanism of shareholder, since this position appears to be their representative to make significant decisions on behalf of them. Therefore, effective and independent directors are very essential for the organization to achieve firm's target and maximize financial corporate performance. According to Fama and Jensen (1983), separation of responsibility could help more efficient independent control between managers and directors. For instance, management is responsible for initiating and implementation on firm's strategy, whereas board of directors have ratified and closely monitored the executives. This mechanism would contribute to positive consequence on firm performance.

Virtanen et al. (2012) reveal that female directors tend to actively participate in the meeting, question interesting issues, well collaborate their skills, and embrace corporation to be more ethical compared to male board members. Even though the paper indicated by Carter et al. (2003) has mentioned that board independence can enhance board diversity in order to better control the executive team, the linkage between corporate performance and board diversity is not strongly advocated by agency theory as does a resource dependence perspective.

- *Resource Dependence Theory*

A principle of resource dependence theory is considered as one of the prestigious theories to study regarding board composition. Pfeffer and Salancik (1978) explain that environmental dependencies are associated with the organization and external resources. Additionally, it is essential for the corporations to effectively manage uncertainty; thus, board members may need to link external resources such as skills, information, key counterparties (buyers, suppliers, or other regulators etc.) in order to mitigate irresolution. Furthermore, another

consequence from this external connection is lowering transaction costs relating to this interdependency.

According to this theory, the resource-rich board members is necessary and could become crucial directors of the organization. Some environments illustrate that sometimes size of the board seems to be obstacle while the board interlocks (the number of other directorships held by each director) would be more beneficial. Therefore, the number of boards may not matter as much as their type and connections (Boyd, 1990).

Moreover, board diversity is advocated by resource dependence theory. As information granted by board of directors is different depending on the type of directors, all of these characteristics like gender or ethnicity will also create sets of unique information and support the directors to better have decision-making for the firms. In addition, their different attributes positively result in beneficial resources of the firms because their diversity can signify broader perspective or nontraditional solutions from the consensus. As a result, the more diverse board members are likely to reflect stronger firm performance owing to their different cultures and various network linkages. (Carter et al. (2010)).

- *Human Capital Theory*

In terms of human capital theory, the various stock of characters like education, expertise, and experience attribute to complement cognitive individual abilities and benefit the companies so as to achieve their organizational goals (Carter et al. (2010)). In the past, women have been traditionally designated as less education and experience, reflecting in lower compensation comparing to men (Tharenou et al., 1994). A common assumption is held that men would be more acceptable as leader of business corporation due to their credibility in human capital for board position than women. This dimension reflects that women's right on

directorship is still lacked, since they do not have much business experience. Nevertheless, the paper by Singh et al. (2008) argues that women have turned to focus more on education like MBA degree in UK which partly nullify the old stereotype of their characteristics. As a result, under the human capital theory, board diversity could influence either positive or negative direction on financial firm performance.

3.2) Empirical Studies

- *Women on boards*

Brennan and McCafferty (1997) discover that different gender characteristics can help the organizations to obtain uncommon problem solutions from female directors. In addition, another prominent point is risk-taking perspectives because women are generally more risk averse than men leading to more prudent investment decisions. Therefore, the less risky investment may result in fewer large returns but also fewer big losses, implying to gain more stable firm performance, suggested by Perryman et al. (2016). Moreover, Nadeem et al. (2019) has further studied on firm risk and return relationship relating to women on the boards in UK. Then, they discover female directors not only mitigate firm risk, but also enhance corporate profitability due to carefully considering the project before making a decision which results in prospering their profitability.

According to the prior studies, Carter et al. (2003) and Campbell and Mínguez-Vera (2008) show that women directorship is mostly highlighted in U.S. and European countries. These papers examine women proportion on the boards which positively associate with firm value and favorably lead to release their governance codes relating to women representation as a gender quota. All of these outcomes appear to imply that those countries have not only emphasized on

the presence of women directors, but they would like to stimulate the percentage of females to lessen the gender gap together with improving their firm values.

Afterwards, Liu et al. (2014) discover an increasing women directorship in China boardroom has significantly improved corporate performance. This paper indicates that the number of female directors is also essential for the financial outcomes in which three or more women could influence stronger firm performance. Moreover, other Asian countries such as Hong Kong, Korea, Singapore also result in the same direction with Europe and U.S. in which percentage of women inclusion positively correlate with firm performance measured by return of equity (ROE) (Low et al., 2015). In addition, Chotiyaputta and Yoon (2018) mention that Thai women directorship is also positively correlated to both accounting and market based firm performance same as the aforementioned studies.

In contrary, Ahern and Dittmar (2012) dispute that firm values in Norway have been damaged owing to their compulsory women quota for board of directors, in which the result is also aligned with Adams and Ferreira (2009) in U.S. These inconsistences are presumably caused by the regulatory requirement to employ a large number of females even though the qualified women supply seems to be limited. As a result, companies are automatically forced to hire more females with less managerial skills to reach the condition, but this action seems to negatively affect their operating performance. In addition, Hagendorff and Keasey (2012) also discover that women on the boards do not significantly create firm value same as directors with heterogenous expertise in U.S. Banking industry. Therefore, it can signify that benefit of women inclusion on the board on firm performance has not been a consensus yet.

- *Educational Diversity*

Apart from women representation on the boards, one of the most crucial board characteristics is 'education'. Previous studies recommended by Cheng et al. (2010) in China, mention that higher education level (e.g. Master or Ph.D. degree) of directors is likely to serve as greater intellectual capability which can determine better decision making and enlarge their firm performance. However, Bennouri et al. (2018) interestingly reveal that education level of female directors affects positively on accounting-based performance, but negatively on market-based performance. In addition, Schmidt (2019) has not found any significant influence between female education level and corporate performance. Thus, levels of education appear to be inconclusive relating to firm performance; hence, diversity of academic fields is studied as a horizontal education diversity to reflect skill base of individual (Østergaard et al., 2011). The representatives should have potential skills to develop strategies, present professional solutions, and enhance firm performance. On the other hand, an empirical testing by Darmadi (2013) states that Indonesian firms consist of two types of boards which are the Board of Commissioners (BOC) and the Board of Directors (BOM). The findings dispute that the financial degree on BOC, monitoring the management, does not significantly influence firm value, while BOM negatively affect market-based performance. This result may signify that board members are able to perceive their financial knowledge not only from the formal education, but from their working experiences. As a result, I can see that a relationship between directors' education and corporate performance is likely to be ambiguous.

Referring to previous Thai paper examined by Sitthipongpanich and Polsiri (2013), education level negatively affects firm value, whereas the outcome of study majors sampled during 2001-2005 is beneficial for the corporations in which results the same direction with

Korean studies by Kim and Lim (2010). According to these findings, this may imply that diversity on human capital resources influences director qualifications for appointing those representatives in order to strengthen firms' competitive advantages and board dynamics in the future (Carter et al. (2010)).

- *Corporate Governance*

Committee on the Financial Aspects of Corporate Governance and Cadbury (1992) mentions that one of the board of directors' roles is improving corporate governance structure so that firms will be managed in the appropriate direction. Also, the directors, representatives of shareholders, should actively monitor firms' activities in order to mitigate firm risk and maximize shareholders' interests. This relationship demonstrates that strong corporate governance can advocate firm's value creation and risk control; therefore, all stakeholders should not ignore this advantageous system before implementing any strategy. This paper is written by Chang et al. (2015) using evidence from Taiwan, which also has a similar aftermath to Thai scholars by Limpaphayom and Connelly (2004).

On the other hand, referring to the Indonesian study of Naimah and Hamidah (2017), only corporate governance index comprising of transparency, independence, and accountability is positively linked to firm valuation while board characteristics, a part of governance mechanisms, do not significantly correlate with firm performance. Therefore, all stakeholders become aware of the significance of corporate governance which can alleviate agency conflicts and augment firms' value in the long run.

4. RESEARCH HYPOTHESIS

The relationship among women directorship, education diversity, and corporate governance in regard to firm risk and performance are considered as my main purpose of this study. Therefore, I propose the hypotheses as follow:

H_1 : Women directorship is likely to negatively associate with firm risk in Thailand.

'Women directorship' is one of the most well-known in the board characteristics. The empirical study by Croson and Gneezy (2009) states that risk appetite of women is generally lower than men; however, corporate risk managed by higher female directors seems to be more competitive advantage. Thus, gender-diverse board of directors are recommended due to more compromised decision-making which could mitigate volatility in corporate performance, indicated by Schubert (2006). In addition, Nadeem et al. (2019) imply that risk-aversion in females looks like cautiously consider before making decision which is beneficial for business. Thereby, I expect that firm risk can be lower with higher women representation as board of directors.

H_2 : Women directorship is likely to positively associate with firm performance in Thailand.

In accordance with the resource dependency theory, higher proportion of female directors may advantage organizations to access wider non-traditional opinions and solutions (Carter et al. (2010)). Furthermore, women attitudes seem to better understand their key stakeholders, or raise challenge questions in the meetings which may alter business direction together with more prudent consideration resulting in more effective firm performance (Campbell and Mínguez-Vera (2008)). However, some U.S. and Danish studies discover negative or no significant association between corporate profitability and women directorship (Rose (2007);

Adams and Ferreira (2009)), since new women directors may follow conventional boards to be acceptable and avoid the conflicts from different thoughts.

Interestingly, companies in Asia like Hong Kong, South Korea, Malaysia and Singapore, have discovered a positive relationship on firm performance with the higher proportion of female directors similar to the consensus (Low et al., 2015). Additionally, Chotiyaputta and Yoon (2018) reveal that Thai corporate performance is also enlarged due to higher women representation on the board. As a result, I predict that performance of Thai firms is likely to positively associate with women on boards.

H_3 : Education diversity held by board of directors is likely to positively associate with firm performance.

Board members with various academic majors are prone to help managers with extensive suggestions; as a result, Korean firm performance is enlarged due to education diversity, reported by Kim and Lim (2010). Nonetheless, Darmadi (2013) reports that boards graduating in financial major negatively affect firm performance in Indonesia. Therefore, relationship between education diversity of board members and firm performance seems to be vague due to the different environment in each country. In addition, Sitthipongpanich and Polsiri (2013) have ever examined Thai academic major diversity during 2001-2005 resulting in positive impact with firm value. Accordingly, I anticipate that education diversity on the board will augment firm performance.

H_4 : An incremental effect of female education diversity on women directorship is likely to increase firm performance

Relationship between women directorship and corporate performance has shown distinct findings. Major scholars disclose that women characteristics help moderate level of rashness in making decision resulting in positive correlation with firm performance (Carter et al. (2003)); however, some of them report negative or no significant effect, indicated by Ahern and Dittmar (2012) and Rose (2007), respectively. Further, prior paper in Thailand (Chotiyaputta and Yoon (2018)) and my aforementioned assumption are directed in a way of positive relationship similar to the majority. According to these contradictions, variables in women directorship and firm performance may be mediated by some factors in which further investigation is plausible to reveal much wider relationship, suggested by Miller and Del Carmen Triana (2009).

According to human capital theory (Carter et al., 2010), investment in education has complemented individual's skills and capacities which can lead to progressive working positions and also advantage their corporations. As a result, diversification in academic majors could advocate firm performance recommended by Kim and Lim (2010) in Korea, and Sitthipongpanich and Polsiri (2013) in Thailand. Therefore, I expect that firm performance is likely to enlarge due to the higher education-diverse in female directors.

H_5 : An incremental effect of women directorship on corporate governance is likely to positively motivate firm performance.

Regulators, academics, and stakeholders trust that stronger corporate governance resulting in better firm performance and also enhancing investor confidence. (Donaldson, 2003) Since improving board effectiveness becomes widespread in many countries, women directorship is viewed as one of the integral factors towards good corporate governance. (Yong Kim et al.,

2017). If the higher female representation can reinforce board monitoring and management control, greater proportion of female directors seem to build up broader perspectives in decision-making which lead to better firm performance in a view of agency theory (Virtanen et al., 2012). Nevertheless, Phillips and O'Reilly (1998) reveal that corporate performance is diminished owing to more women directors on the board. The higher female proportion leads to emotional controversy and more time-consuming during the meetings resulting in higher cost and less effective decision making comparing to more homogeneous members.

In the meantime, Asian corporations including Thailand are benefited from more women representation, despite slower growth diversity than global trend, reported by Deloitte Global Center for Corporate Governance (2019). Further, Limpaphayom and Connelly (2004) show that corporate governance rating also advocates firm performance in Thailand. Thereby, I predict that more women directorship in corporate governance mechanism is likely to contribute better firm performance in Thailand.

5. SAMPLE AND DATA

The sample of my study is collected from Thai listed companies on the Stock Exchange of Thailand (SET) over the past 10 years (2010-2019), simply reflecting various stages of corporate life cycle.

All of sample data is drawn from three data sources. Firstly, market data like daily stock return, and accounting information are extracted from Bloomberg database. For list of board of directors, and other board of directors' characteristics such as gender, academic major, and number of directors can be compiled from SETSMART, form 56-1, or annual reports in which all listed companies are required to provide every year. Lastly, I collect corporate governance score

in Thai IOD report provided by Thai Institute of Directors Association (Thai IOD) issued on their website.

6. METHODOLOGY

My study has included three different sets of regression models. First, I will inspect the direct relationship between women directorship and education diversity on firm risk and/or firm performance. Additionally, I further expand the condition to investigate education diversity in women directorship, and women directorship in corporate governance effect on firm performance. According to these empirical testing, I will use fixed effect estimation model to run regression as panel data.

- **Firm risk and women directorship**

The objective of this empirical testing is to investigate whether the proportion of female directors in the companies will result in lower firm risk.

By following, Nadeem et al. (2019), the regression model is as follows:

$$Risk_{i,t} = \beta_1(\text{Women Directorship}_{i,t}) + \beta_2(\text{Education Diversity}_{i,t}) + \beta_3(\text{CG Score}_{i,t})$$

$$+ \beta_4(\text{Board Size}_{i,t}) + \beta_5(\text{Board Independence}_{i,t}) + \beta_6(\text{CEO Duality}_{i,t})$$

$$+ \beta_7(\text{Firm size}_{i,t}) + \beta_8(\text{Leverage}_{i,t}) + \beta_9(\text{Market to Book ratio}_{i,t})$$

$$+ \beta_{10}(\ln(\text{CAPEX})_{i,t}) + \beta_{11}(\text{Sales Growth}_{i,t}) + \beta_{12}(\text{Firm Age}_{i,t})$$

$$+ \text{Year Dummies} + \eta_i + \varepsilon_{i,t} \qquad\qquad .... (1)$$

Dependent variable **(Risk)** in the model (1) is calculated in two measures which are **Total Risk** measured by standard deviation of daily stock returns and converted to yearly basis, and **Idiosyncratic Risk** recognized from standard deviation of $\varepsilon_{i,t}$ from the following model: $r_{i,t} = \alpha_{i,t} + \beta(r_{m,t}) + \varepsilon_{i,t}$ where $r_{i,t}$ represents stock daily return, and $r_{m,t}$ is market return. As

regards independent variable, **Women Directorship** is defined as the proportion of female board members over the total number of directors in each year.

Regarding control variables of board structures, **board size** (number of board members) and **board independence** represents the percentage of independent directors which result in higher shareholder-focused decisions. To control for board leadership whether have any effect to firm risk, **CEO duality** is used as a proxy. This dummy variable is measured by equal to 1 in case of CEO serving as a chairperson, and 0 otherwise.

In addition, other financial control variables at firm level are also added in this study. First, **Firm size** is calculated from natural logarithm of total assets to determine driver of profitability. **Leverage** computed from total debt divided by total assets which is added to control for the managers' decision and agency costs because the higher level on leverage may stimulate managers to take riskier decision. In addition, as investment and growth opportunities could reach to risky firm decision, I incorporate **Market to Book ratio** computed from market value divided by book value of equity, **CAPEX** is natural logarithm of capital expenditure extracted from Bloomberg, and **Sales Growth** calculated from current sales deduct prior sales divided by prior sales as proxy variables. **Firm Age** is a period computed since the first date which companies registered in SET until the end of 2019. **Year Dummies** is added by equal to 1 for a particular year, and 0 otherwise. Also, η_i is represented of firm fixed effects to address any other time-invariant firm characteristic, and $\varepsilon_{i,t}$ represents error term for company i at time t.

- **Firm performance and women directorship / education diversity**

The primary objective is to inspect proportion of female directors and/or academic major diversity of board members whether it will result in any significant direction with firm performance referring to hypothesis H_2 and H_3, respectively.

According to Nadeem et al. (2019), the regression model is as follows:

$$ROA_{i,t} \text{ or } Q_{i,t} = \alpha_1\big(\text{Women Directorship}_{i,t}\big) \ + \ \alpha_2\big(\text{Education Diversity}_{i,t}\big)$$

$$+ \ \alpha_3\big(\text{CG Score}_{i,t}\big) \ + \ \alpha_4\big(\text{Board Size}_{i,t}\big) \ + \ \alpha_5\big(\text{Board Independence}_{i,t}\big)$$

$$+ \ \alpha_6\big(\text{CEO Duality}_{i,t}\big) \ + \ \alpha_7\big(\text{Firm size}_{i,t}\big) + \ \alpha_8\big(\text{Leverage}_{i,t}\big)$$

$$+ \ \alpha_9\big(\text{Market to Book ratio}_{i,t}\big) \ + \ \alpha_{10}\big(\ln(\text{CAPEX})_{i,t}\big) \ + \ \alpha_{11}\big(\text{Sales Growth}_{i,t}\big)$$

$$+ \ \alpha_{12}\big(\text{Firm Age}_{i,t}\big) \ + \text{Year Dummies} + \eta_i \ + \varepsilon_{i,t} \qquad\qquad \text{............ (2)}$$

In model (2), corporate performance is gauged in two approaches. First, **ROA** is return on total assets applied for dependent variable representing accounting-based firm performance, while **Q** variable represents Tobin's Q, a proxy for market-based firm performance. This ratio is measured by market value to book value of assets, where market value is the book value of assets minus the book value of equity plus the market value of equity.

Regarding independent variable besides women directorship, academic majors are classified into five areas which are 1) accounting 2) finance/economics, 3) business-related area (excluded from type1 and 2), 4) engineering/science, and 5) others. Then, **Education Diversity** is calculated in accordance with the Herfindahl Index (HHI), generally used for measuring market concentration, (Sitthipongpanich and Polsiri (2013); Hagendorff and Keasey (2012); Kim and Lim (2010)) as follows:

$$Education\ Diversity_{i,t} \ = \ 1 - \left[\sum_{g=1}^{n}\left(\frac{Major_g}{Total\ number\ of\ academic\ majors\ of\ all\ directors}\right)^2\right]_{i,t}$$

Based on the above equation, $Major_g$ is the number of majors held by all directors in each academic majors. The value of **Education Diversity** is between 0 and 1 in which the larger numbers implying the higher heterogeneity. Control variables are indifferent from the model (1).

- **An incremental effect of female education diversity on women directorship regarding to firm performance**

As aforementioned regression models of direct relationship, I further focus on deeper condition relating to female education diversity in women directorship. Therefore, I create interaction terms of female education diversity and women directorship adding to this model.

Afterwards, in order to classify a level of education diversity in women directors for coding a dummy variable in this model, I will use the median as a proxy method (Sitthipongpanich and Polsiri (2013)) because it seems less influenced by outliers and also applicable for both normal and non-normal distributed data. As a result, the figures of female education diversity above the median will be measured as 'high-level diversity' (equals to 1), while the below median group is classified as 'low-level diversity' (equals to zero).

Then, I run a regression to examine a difference in the effect of women directorship on firm performance between high and low level of female education diversity using this following model:

$$
\begin{aligned}
\text{ROA}_{i,t} \text{ or } Q_{i,t} =\ & \alpha_1\big(\text{Women Directorship}_{i,t}\big) + \alpha_2(\text{FED Dummy}_{i,t}) \\
& + \alpha_3(\text{Women Directorship}_{i,t} * \text{FED Dummy}_{i,t}) + \alpha_4(\text{CEO Duality}_{i,t}) \\
& + \alpha_5(\text{Board Independence}_{i,t}) + \alpha_6(\text{Board Size}_{i,t}) + \alpha_7(\text{Firm size}_{i,t}) \\
& + \alpha_8(\text{Leverage}_{i,t}) + \alpha_9(\text{Market to Book ratio}_{i,t}) + \alpha_{10}(\ln(\text{CAPEX})_{i,t}) \\
& + \alpha_{11}(\text{Sales growth}_{i,t}) + \alpha_{12}(\text{Firm Age}_{i,t}) + \text{Year Dummies} + \eta_i + \varepsilon_{i,t} \dots (3)
\end{aligned}
$$

where **FED Dummy** in model (3) refers to dummy variable of high-level female education diversity, which is calculated in accordance with the Herfindahl Index (HHI) (Kim and Lim (2010); Sitthipongpanich and Polsiri (2013)) as follows:

$$Female\ Education\ Diversity_{i,t}\ =\ 1 - \left[\sum_{g=1}^{n}\left(\frac{Major_g\ of\ Female\ directors}{Total\ number\ of\ academic\ majors\ of\ fenale\ directors}\right)^2\right]_{i,t}$$

If diversity index is higher than the sample median, that variable will be coded as 1, otherwise 'zero'.

- **An incremental effect of women directorship on corporate governance regarding to firm performance**

In this part, I expand a condition relating to women directorship in corporate governance. As a result, interaction terms of women directorship and corporate governance is incorporated in this model.

In order to classify a level of women directorship for creating a dummy variable in this model, I have also applied the same proxy method from the previous model by using the median (Sitthipongpanich and Polsiri (2013)). Therefore, a dummy variable will be equal to 'one' and categorized as 'high-level of women directorship' if the fraction of women directors over all board members is higher than the median. On the other hand, the number below the median would be defined as 'low-level of women directorship' (equals to zero).

Regression model to examine a difference in the effect of corporate governance on firm performance between high and low level of women directorship is as follows:

$$\begin{aligned}
ROA_{i,t}\ or\ Q_{i,t} = \ &\alpha_1\big(Women\ Directoship\ Dummy_{i,t}\big)\ +\ \alpha_2(CG\ Score_{i,t}) \\
&+\ \alpha_3\big(CG\ Score_{i,t} * Women\ Directorship\ Dummy_{i,t}\big)\ +\ \alpha_4\big(CEO\ Duality_{i,t}\big) \\
&+\ \alpha_5\big(Board\ Independence_{i,t}\big)\ +\ \alpha_6\big(Board\ Size_{i,t}\big)\ +\ \alpha_7\big(Firm\ size_{i,t}\big) \\
&+\ \alpha_8\big(Leverage_{i,t}\big)\ +\ \alpha_9\big(Market\ to\ Book\ ratio_{i,t}\big)\ +\ \alpha_{10}\big(\ln\ (CAPEX)_{i,t}\big) \\
&+\ \alpha_{11}\big(Sales\ growth_{i,t}\big)\ +\ \alpha_{12}\big(Firm\ Age_{i,t}\big)\ +\ Year\ Dummies + \eta_i\ +\ \varepsilon_{i,t} \ldots (4)
\end{aligned}$$

In model (4), **Women Directorship Dummy** is created to represent dummy variable of high-level of women directorship in accordance with the earlier mentioned criteria. Also, **CG score** is an index measuring corporate governance efficiency in Thailand provided by Thai IOD. In perspective of other control variables, all of them are the same as prior models.

7. EMPIRICAL RESULTS

- **Descriptive statistics results**

The descriptive statistics of all variables before winsorizing outliers are reported in Table 1 panel A. Since the bias of outlier observations are able to significantly deviate the outcomes of regression to result in non-normal distribution in my study, I endeavor to consider any odd numbers presenting in the summary of statistics so as to eliminate the outliers of those variables comprising of Risk, ROA, Market to Book ratio, and Sales growth. For instance, Market to Book ratio has the maximum value at 2,087.4620 while the minimum value at -16.1774, which should not be generally occurred and also include negative numbers. Additionally, the maximum value of sales growth is stated at 4,473.9860% whereas the minimum value is presented at -269.7860%, which is scarcely appeared in general business.

In a view of firm risk, I decide to remove value equal to zero because those companies are probably suspended for trading during those periods. Furthermore, other remaining variables are winsorized at 1% level (1st and 99th percentile) of total observations, which are illustrated in Table 1 panel B as the descriptive statistics variables after excluding outlier observations. Under this criterion, the statistics data after removing outliers show that the maximum of Market to Book ratio is changed from 2,087.4620 to 9.8064 whereas the minimum value is stepped up from

-16.1774 to 0. Moreover, in aspect of sales growth, the maximum value is dropped from 4,473.9860% to 233.6843% while the minimum value is enlarged from -269.7860% to -63.1698%. Therefore, this obviously indicates that winsorization has helped lowering skewness distribution and reporting figures in the appropriate range. The unit of variables are specified in both panels except some variables such as risk, Tobin's Q ratio, and CG score which are unitless. Further, the number of observations in each variable are not exactly equal due to data availability, so this would be reported as unbalanced panel data.

Table 1: Descriptive statistics of variables

Table1 defines the descriptive statistics of all variables during the period of 2010-2019. This table is separated into two panels. First, panel A contains the summary of descriptive statistics of variables before winsorizing outlier observations while panel B shows the summary of descriptive statistics of variables after winsorizing outlier observations.

Panel A: Descriptive statistics of variables before winsorizing outlier observations

Variables	Observations	Mean	Std. Dev.	Median	Min	Max
Total Risk	5,133	0.3661	0.2775	0.3217	0	5.6576
Idiosyncratic Risk	5,133	0.3449	0.2746	0.2962	0	5.6189
ROA (%)	5,543	2.5033	39.2999	4.2561	-849.5539	231.1885
Tobin's Q ratio	5,289	1.5258	1.3227	1.1585	0.1753	44.4166
No. of Women Directorship	5,040	1.8633	1.4765	2	0	8
Education Diversity	5,040	0.6787	0.0879	0.6944	0	0.8000
CG Score	5,108	3.6083	0.7818	3	2	5
Board size (persons)	5,040	10.1726	2.5301	10	3	21
Board independence (%)	5,040	40.6192	9.6721	37.5000	0	84.6154
CEO Duality	5,040	0.1968	0.3976	0	0	1
Firm size (Billion Baht)	5,544	50.4257	257.9746	4.4981	0.0735	3,293.8900
Leverage ratio	5,544	0.2579	0.3294	0.2047	0	5.2357
Market to Book ratio	5,303	3.2193	32.8223	1.3777	-16.1774	2,087.4620
CAPEX (Billion Baht)	5,536	1.2190	6.6968	0.1063	0	171.4071
Sales growth (%)	5,405	14.4207	111.3153	4.0310	-269.7860	4,473.9860
Firm age (years)	5,327	17.6528	9.9391	18.5425	0.0137	44.7151

Table 1: Descriptive statistics of variables (cont.)

Panel B: Descriptive statistics of variables after winsorizing outlier observations

Variables	Observations	Mean	Std. Dev.	Median	Min	Max
Total Risk	4,990	0.3766	0.2743	0.3270	0.0228	5.6576
Idiosyncratic Risk	4,985	0.3548	0.2722	0.3017	0.0228	5.6189
ROA (%)	5,221	3.9513	8.2423	4.1351	-40.1679	31.7243
Tobin's Q ratio	5,274	1.5264	1.3245	1.1562	0.1753	44.4166
No. of Women Directorship	5,040	1.8633	1.4765	2	0	8
Education Diversity	5,040	0.6787	0.0879	0.6944	0	0.8000
CG Score	5,108	3.6083	0.7818	3	2	5
Board size (persons)	5,040	10.1726	2.5301	10	3	21
Board independence (%)	5,040	40.6192	9.6721	37.5000	0	84.6154
CEO Duality	5,040	0.1968	0.3976	0	0	1
Firm size (Billion Baht)	5,544	50.4257	257.9746	4.4981	0.0735	3,293.8900
Leverage ratio	5,544	0.2579	0.3294	0.2047	0	5.2357
Market to Book ratio	5,099	1.8719	1.5317	1.3769	0	9.8064
CAPEX (Billion Baht)	5,536	1.2190	6.6968	0.1063	0	171.4071
Sales growth (%)	5,297	8.0809	28.2485	4.0310	-63.1698	233.6843
Firm age (years)	5,327	17.6528	9.9391	18.5425	0.0137	44.7151

As shown in Table 1 panel B, the results of descriptive statistics present that during the past 10 years, average total firm risk is 0.3766 while average idiosyncratic risk is slightly lower as shown at 0.3548. In aspect of firm performance, there are two representatives consisting of ROA and Tobin's Q ratio with the mean value of 3.9513% and 1.5264, respectively. Among the total observations in my study, the average number of women on the boards is 1.8633 (median, 2 persons). Education diversity measured by academic majors depicts the mean value at 0.6787 (median, 0.6944). Average CG score in sampled companies is 3.6083. For control variables, in terms of board composition, the board size ranges from three to 21 persons with the mean value almost 10 directors. The average percentage of board independence is around 40.62%, complying with the SEC regulations to appoint at least one third of independent directors out of total board of directors. In addition, the directors who is positioned as CEO and chairman is only

0.1968. Regarding firm characteristics, the firm age since registered in SET is nearly 18 years, on average. The mean value of firm size is 50.4257 billion Baht, whereas the average of CAPEX is 1.2190 billion Baht. Considering the financial ratios, the average market to book ratio is shown at 1.8719, and sales growth is around 8.08%. Lastly, the mean value of leverage ratio accounts for 0.2579.

Moreover, as women directorship is the main independent variable in this study, I would like to ensure that the variation of this variable during the sample period would have an impact on firm risk and/or firm performance. Therefore, I choose two extreme cases of the number of female directors to plot a graph of time series. In the first step, I randomly pick an example firm which has a constant number of female directors over the sample period of 2010-2019. Then, I consider the firms which have a varying number of female directors, and select the largest fluctuating number of female directors as a sample. As a result, Figure 1 demonstrates how female directors have been changed over time between these two scenarios. Initially, a case of fluctuating female directors shows that the number of women on boards continually increase from 3 persons in 2010 to reach a peak of 8 persons in 2013. Since then, the number of female directors has continued to decline and fall to two persons in 2019, whereas another case of constant female directors has consisted of 3 persons throughout the sample period. In addition, Figure 2 presents a histogram of the distribution of the number of female directors for the firm-year observations of 5,040 observations from 2010 to 2019, revealing that 52.8% of total observations have 1-2 women on their boards. Besides, 28.9% of total observations have female directors within a range of 3-8 persons on their board of directors, and the remaining 18.3% of total observations illustrates no women on boards. Hence, both figures are likely to disclose

changes in the number of female directors over time, which appears to reasonably justify the use

of a fixed effect estimation model to run regression as panel data in this study.

Figure 1: Time Series Plot of the number of female directors for two extreme cases

This figure shows a time variation in the number of female directors for two examples of firms, consisting of a firm with constant female directors and a firm with fluctuating female directors over the sample period of 2010-2019.
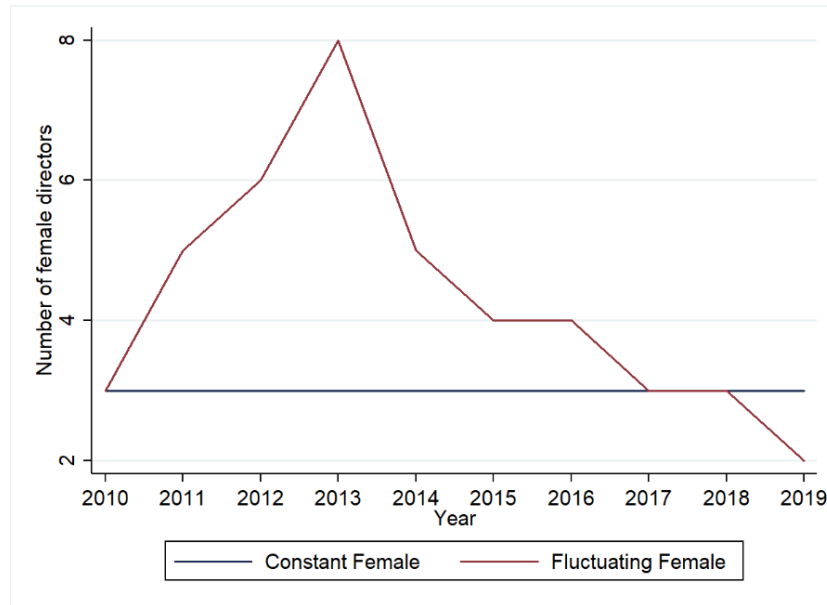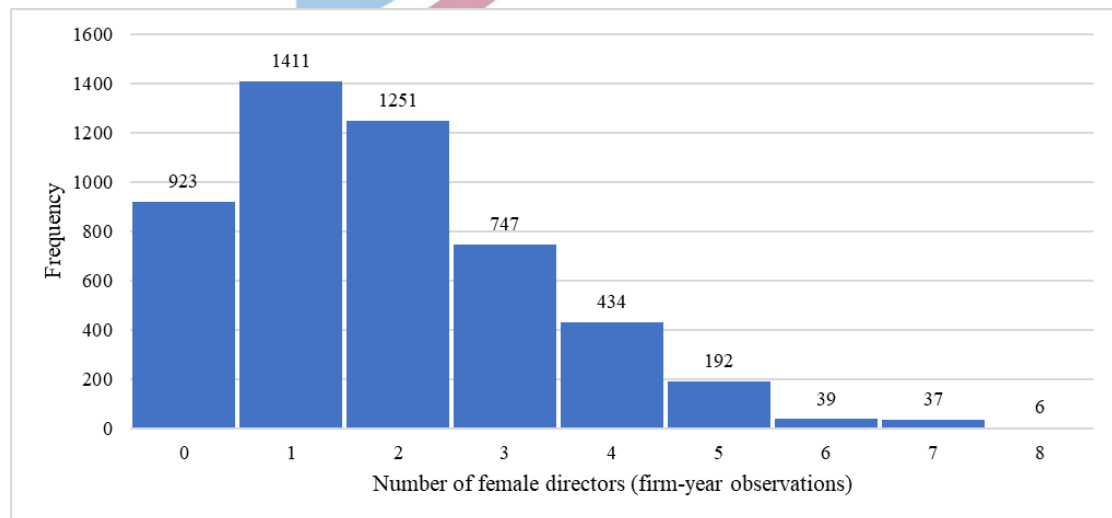

Figure 2: Histogram of the number of female directors (firm-year observations)

This figure presents a histogram of the number of female directors for all Thai listed firms over the sample period of 2010-2019.

- **Analysis of firm risk and women directorship**

In order to analyze the relationship between firm risk and women directorship as mentioned in the first hypothesis (H_1), I regress equation 1 and predict that the proportion of female directors would lower firm risk.

Following Table 2, the empirical results surprisingly capture no significant relationship between women directorship and firm risk (both total risk and idiosyncratic risk). This finding is consistent with the previous study of Sila et al. (2016), who also find none of coefficients on women directorship significantly affect firm risk in U.S. On the other hand, my result is inconsistent with my expected hypothesis and aforementioned studies such as Nadeem et al. (2019), discovering the proportion of female directors is inversely associated with firm volatility. Accordingly, the possible argument is that the influence of women on the boards may not directly lead a direction of the companies. Zimmer (2014) also mentions that the effect of different cultures probably clarifies this inconsistency. Even if more female directors are appointed to represent less discrimination among board of directors, those women are still hindered from full participation in raising their opinions or making any decisions in the companies, which are highly dominated by male directors. Hence, this women inclusion is only characterized as symbolic signal for higher diversity, and comply with legislative requirements. In addition, I further examine the joint effect between women directorship and women CEO on firm risk, and the more extreme case of joint effect between women directorship higher than 50% and women CEO on firm risk. Then, I discover that the results still present an insignificant impact on firm risk, specified in Appendix (Table A3).

Even if there is no significant link between the proportion of women directors and firm risk, I have discovered total risk and firm-specific risk are significantly and negatively affected by

education diversity and corporate governance score at the 5% and 1% level, respectively. Specifically, the coefficient of education diversity in Table2 is reported at -0.1590 and -0.1540 which lead to decrease in total risk and idiosyncratic risk, respectively. Also, corporate governance reveals a significant coefficient of -0.0232 and -0.0237, indicating lower total risk and firm-specific risk, respectively. Consistent with the study of Shalhoub (2019), education diversity would stimulate board members to voice opinions and broaden aspects based on their different specialized backgrounds so as to come up with the optimal decision and lowering the potential firm risk. In addition, the companies with strong corporate governance tend to consider carefully before making any decisions to maximize shareholders' interests and alleviate corporate volatility, recommended by Chang et al. (2015).

Regarding to other control variables in Table 2, I notice that the percentage of board independence is negatively related to firm risk at significant level of 5% which infers that agency problems have been well monitored by independent directors to reduce corporate risk. Besides, the results reveal that firm size has negative coefficients and significant at 1% for both measures of firm risk. This may imply that larger companies can better approach capital markets and borrow on better conditions leading to lower levels of firm risk (Mathew et al., 2016). The impact of market to book ratio and sales growth are positively associated with firm risk at the significant levels of 1% and 5%, respectively. This result is consistent with prior study of Nadeem et al. (2019), explaining that companies will take riskier decisions to enhance their growth opportunities. Further, firm age reveals the negative coefficient and significant at 1% for total risk, and 5% for unsystematic risk. This is compatible with Sila et al. (2016), indicating that longer age of firms tends to have less uncertainty and develop better going concern in the equity market comparing to the younger firms which result in less volatility.

Table 2: The impact of women directorship on firm risk

This table displays the fixed effect estimations of firm risk on the proportion of female directors during the period of 2010-2019, running as unbalanced panel data. The dependent variable in the first column accounts for 'Total Risk' and the other column represents for 'Idiosyncratic Risk'. All variables are defined in Appendix (Table A2).

Variables	Dependent Variables	
	Total Risk	Idiosyncratic Risk
Women Directorship	0.0284	0.0322
	(0.0478)	(0.0470)
Education Diversity	-0.1590**	-0.1540**
	(0.0638)	(0.0627)
CG Score	-0.0232***	-0.0237***
	(0.0069)	(0.0067)
Board Size	0.0038	0.0044
	(0.0036)	(0.0035)
Board Independence	-0.0013**	-0.0012**
	(0.0006)	(0.0006)
CEO Duality	0.0082	0.0082
	(0.0143)	(0.0140)
Firm size	-0.0569***	-0.0597***
	(0.0110)	(0.0108)
Leverage ratio	-0.0064	-0.0006
	(0.0358)	(0.0352)
Market to Book ratio	0.0137***	0.0130***
	(0.0034)	(0.0033)
ln (CAPEX)	-0.0064*	-0.0075**
	(0.0033)	(0.0032)
Sales Growth	0.0003**	0.0003**
	(0.0001)	(0.0001)
Firm Age	-0.0058***	-0.0032**
	(0.0013)	(0.0013)
Constant	1.6140***	1.5900***
	(0.1560)	(0.1530)
Observations	4,634	4,634
Adjusted R-Square	0.057	0.048

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

- **Analysis of firm performance and women directorship/ education diversity**

To examine the relationship between firm performance and women directorship/ education diversity as described in the hypothesis H_2 and H_3, respectively, I regress equation 2 and expect that female directors would significantly increase firm performance. In addition, I also anticipate to find the significant positive relationship between academic major diversity and corporate performance.

According to Table 3, the regression results disclose the association of women directorship on firm performance, which is distinct based on the measures of corporate performance. First, in line with the prior paper of Schmidt (2019), the result shows that women directorship is statistically positive with accounting-based firm performance (ROA) at a significant level of 1%. On the contrary, the proportion of female directors negatively correlates with market-based performance (Tobin's Q) at a significant level of 1%. This result contradicts with my hypothesis and previous studies such as Campbell and Mínguez-Vera (2008). As shown in the table, my findings signify that women directorship strongly enhances ROA whereas reduces Tobin's Q, which can be observed from the coefficient of women directorship at 0.0382 and -0.1900, respectively. As suggested by Bennouri et al. (2018), board of directors are normally responsible for monitoring and rectifying management team in accordance with the agency theory. Women on the boards are likely to deliver their different perspective as well as professional capability which seem to be beneficial for the managers to acknowledge another viewpoint compared to male directors. In addition, female characteristics are prone to remarkably raise more creativity, improve access to information, and develop problem-solving skills, which can lead to have better decision-making in the corporations. As a result, the authors advocate that accounting-based performance is quite connected with the efficient decision-

making and advisory process among board members in which women directorship could help strengthen this power of the advisory function and drive better corporate income within the companies. On the other hand, Adams and Ferreira (2009) indicate that higher women representation probably lead to greater intervention in the boardroom and over monitor on the process of decision-making. Hence, this results in a breakdown in communication and monitoring effectiveness between board of directors and management level; then, this impact would damage shareholder value (Tobin's Q) as shown in the below table.

Besides, education diversity is discovered no significant relationship with any measures of firm performance, including accounting-based (ROA) and market-based (Tobin's Q) performance. Thus, both findings contradict with my expected hypothesis H_3 as mentioned above. The study of Schmidt (2019) suggests that educational background (one of human capital attributes) may be not recognized as momentous factor among board members to drive corporate performance whereas other factors like working experiences, reputation, or network connection, which are indirectly received from the formal education in the university, are likely to be more preferable and influence the companies to increase more creditability and firm performance.

In addition, the relationship between corporate governance and financial performance (ROA) appears to show no significance at any level. In turn, Tobin's Q ratio is negatively affected by corporate governance at significant level of 5%. The coefficient is -0.0183 resulting in a reduction in firm value. This is compatible with the paper of Adams and Ferreira (2009), indicating that too strict governance can weaken firm value.

Regarding the control variables, the outcomes depict that board size and CEO duality insignificantly reflect on both measures of corporate performance. Moreover, the results also indicate the impact of board independence on firm performance in which positively correlates

with ROA at significant level 1%, but negatively associates with Tobin's Q at significant level 10%. This positive relationship with ROA is in line with the prior research of Syed Mohd Fuzi et al. (2016), explaining that independent directors are likely to guarantee firm's assets are efficiently used by the management level to enlarge greater corporate income and also return on assets (ROA). In turn, the greater independent directors are not always advantageous for share prices. Since outsiders are appointed as board members, they no longer become third parties to the firms and tend to make decisions for their best interests, e.g., they may not take too much risks if they are not ensured to gain anything satisfactorily. Firm size is discovered to have a significant positive relationship at 1% level with ROA, but negative relationship with Tobin's Q at the same level. This probably implies that smaller firms are perceived as better performers than larger firms in a view of market's perception, recommended by Fidanoski et al. (2014). Market to book ratio and sales growth are positively correlated with firm performance which could represent that companies with growth opportunities tend to be more valuable. On the contrary, the more leverage ratio adversely reflects the worse corporate performance, suggested by Sitthipongpanich and Polsiri (2013). Interestingly, I find the influence of firm age is negatively correlated with ROA at the significant level of 1%, meanwhile it positively associates with Tobin's Q at the level of 10%. This finding indicates that older firms have more reputation and experience in market access, so they could enhance more investment activity to attract the investors compared to younger firms having more pressures and uncertainty. Nonetheless, the higher ages of firms are plausible to have less gap for growing their huge profitability which result in adverse association with accounting performance. All of these reasons are supported by Coad et al. (2013).

Table 3: The impact of women directorship/ education diversity on firm performance

This table reports the fixed effect estimations of firm performance on the proportion of female directors and/or education diversity during the period of 2010-2019, running as unbalanced panel data. The dependent variables of firm performance comprise of 'ROA' in the first column, and 'Tobin's Q' in the following column. All variables are defined in Appendix (Table A2).

Variables	Dependent Variables	
	ROA	Tobin's Q
Women Directorship	0.0382***	-0.1900***
	(0.0120)	(0.0643)
Education Diversity	0.0247	-0.0811
	(0.0162)	(0.0869)
CG Score	0.0017	-0.0183**
	(0.0017)	(0.0093)
Board Size	0.0007	-0.0008
	(0.0009)	(0.0048)
Board Independence	0.0005***	-0.0014*
	(0.0001)	(0.0008)
CEO Duality	-0.0048	-0.0188
	(0.0036)	(0.0192)
Firm size	0.0140***	-0.0470***
	(0.0028)	(0.0148)
Leverage ratio	-0.1940***	-0.7750***
	(0.0090)	(0.0480)
Market to Book ratio	0.0104***	0.4630***
	(0.0009)	(0.0046)
ln (CAPEX)	0.0005	0.0066
	(0.0008)	(0.0045)
Sales Growth	0.0003***	-0.0001
	(0.0000)	(0.0001)
Firm Age	-0.0038***	0.0032*
	(0.0003)	(0.0018)
Constant	-0.1490***	1.5640***
	(0.0389)	(0.2080)
Observations	4,664	4,688
Adjusted R-Square	0.190	0.730

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

- **Analysis of an incremental effect of female education diversity on women directorship regarding to firm performance**

As I have already investigated the direct relationship between firm performance and women directorship/ education diversity, I additionally combine these two factors to further examine their incremental effect of female education diversity on the women's ratio regarding to firm performance as stated in the hypothesis H_4. The expected result is significantly positive which can be seen from the interaction terms (α_3) of Women Directorship and Female Education Dummy.

The regression result illustrates that the interaction term between the proportion of women on the boards and female education diversity is insignificantly correlated with accounting-based performance (ROA) while an incremental effect of female education diversity on women directorship positively influences on market-based performance measures (Tobin's Q) at significant level of 1%. My finding shows a negative coefficient of women directorship at -0.3660 for firms characterized by low-level of female education diversity. Nevertheless, a significant coefficient of interaction term between women directorship and level of female education dummy (α_3) is 0.2370, which could help lower the negative effect on women directorship regarding firm value, as provided in Table 4. The possible reason is that the higher level of diversity in academic majors held by female directors is likely to valuably enhance more confidence and creditability in the eyes of investors. This combination tends to vanish the idea that female directors seem to be obstruction within the boards, and signalize that those women on the boards could apply their various educational background to improve shareholder value similar to their male peers. Therefore, my finding reflects the positive relationship of this incremental effect on firm performance as disclosed in Table 4. In addition, I have adopted the

same set of control variables for board compositions and financial characteristics which are included in the previous models (Model 1 and 2). The empirical findings presented in Table 4 appear to be compatible with the preceding results in Table 3.

Table 4: An incremental effect of female education diversity on women directorship regarding to firm performance

This table represents the results of a difference in the effect of female education diversity on women directorship regarding to corporate performance by regressing the fixed effect estimations during the period of 2010-2019, running as unbalanced panel data. The dependent variables of firm performance comprise of 'ROA' in the first column, and 'Tobin's Q' in the following column. All variables are defined in Appendix (Table A2).

Variables	Dependent Variables	
	ROA	Tobin's Q
Women Directorship	0.0299*	-0.3660***
	(0.0170)	(0.0910)
Female Education Dummy	-0.0039	-0.0397**
	(0.0038)	(0.0202)
Women * Female Education	0.0120	0.2370***
	(0.0167)	(0.0896)
Board Size	0.0008	-0.0039
	(0.0009)	(0.0048)
Board Independence	0.0005***	-0.0015**
	(0.0001)	(0.0008)
CEO Duality	-0.0047	-0.0186
	(0.0036)	(0.0192)
Firm size	0.0141***	-0.0490***
	(0.0028)	(0.0147)
Leverage ratio	-0.1940***	-0.7730***
	(0.0090)	(0.0480)
Market to Book ratio	0.0104***	0.4630***
	(0.0009)	(0.0046)
ln (CAPEX)	0.0004	0.0067
	(0.0008)	(0.0045)
Sales Growth	0.0003***	-0.0001
	(0.0000)	(0.0001)
Firm Age	-0.0037***	0.0022
	(0.0003)	(0.0017)
Constant	-0.1280***	1.5590***
	(0.0380)	(0.2030)
Observations	4,664	4,688
Adjusted R-Square	0.189	0.730

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

- **Analysis of an incremental effect of women directorship on corporate governance regarding to firm performance**

Since the direct association between firm performance and other independent variables like women directorship and corporate governance has been tested through equation model 2, I further inspect a difference in the effect of corporate governance and firm performance between high and low level of women representation on the boards by interacting CG Score with Women Directorship Dummy terms as illustrated in equation model 4. After regressing this model, I predict that the result would support my hypothesis H_5 which can be observed as significantly positive effect from the interaction term between corporate governance score and women directorship dummy (α_3).

The outcome in Table 5 illustrates an incremental effect of women directorship on corporate governance mechanism negatively influences on ROA at a significant level of 10%, but insignificantly on Tobin's Q ratio. Hence, only the result of accounting-based measures supports my expected hypothesis H_5 which can be observed from the coefficient of the interaction term between CG score and level of women directorship valued at -0.0049. This finding indicates that an incremental effect of women representation on the boards has moderated a positive relationship of corporate governance and accounting-based performance. Consistent with prior study of Adams and Ferreira (2009), the supporting reason often provided is when a higher proportion of female directors are included in a stronger corporate governance, it may signalize over monitoring characteristic in the corporations, and could result in the worse effect on firm performance. As a result, the authors recommend that a larger increase in women directorship in order to automatically drive better firm performance may not always work effectively in every company.

Table 5: An incremental effect of women directorship on corporate governance regarding to firm performance

This table shows the results of a difference in the effect of the proportion of female directors on corporate governance regarding to corporate performance by regressing the fixed effect estimations during the period of 2010-2019, running as unbalanced panel data. The dependent variables of firm performance comprise of 'ROA' in the first column, and 'Tobin's Q' in the following column. All variables are defined in Appendix (Table A2).

Variables	Dependent Variables	
	ROA	Tobin's Q
Women Directorship Dummy	0.0236**	-0.0015
	(0.0102)	(0.0544)
CG Score	0.0043**	-0.0168
	(0.0021)	(0.0114)
CG Score * Women Dummy	-0.0049*	-0.0059
	(0.0027)	(0.0143)
Board Size	0.0008	-0.0011
	(0.0009)	(0.0048)
Board Independence	0.0005***	-0.0013*
	(0.0001)	(0.0008)
CEO Duality	-0.0049	-0.0195
	(0.0036)	(0.0193)
Firm size	0.0140***	-0.0464***
	(0.0028)	(0.0148)
Leverage ratio	-0.1930***	-0.7790***
	(0.0090)	(0.0480)
Market to Book ratio	0.0104***	0.4630***
	(0.0009)	(0.0046)
ln (CAPEX)	0.0004	0.0070
	(0.0008)	(0.0045)
Sales Growth	0.0003***	-0.0001
	(0.0000)	(0.0002)
Firm Age	-0.0037***	0.0028
	(0.0003)	(0.0018)
Constant	-0.1390***	1.4710***
	(0.0381)	(0.2030)
Observations	4,664	4,688
Adjusted R-Square	0.189	0.730

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Besides, the coefficient of corporate governance and the coefficient of the interaction terms regarding accounting-based performance are valued at 0.0043 and -0.0049, respectively, which seems to be cancelled out. As a result, I investigate whether the coefficient between corporate governance and the interaction terms of corporate governance and women directorship is significantly different from zero. By using Chow Test, I discover that corporate governance and the interaction terms are likely to offset each other (p-value equal to 0.7832). In other words, firms with a high level of women directorship appear to have corporate governance that is nearly equal to zero in terms of accounting-based performance (ROA).

8. CONCLUSION

Since diversity of the boards is globally perceived as remarkable trend of corporate governance, my study has investigated both direct relationship and interaction of board characteristics and corporate governance mechanism regarding to firm risk and firm performance. I discover various interesting results which are likely to be beneficial for all related counterparties. First, an association between women on the boards and firm volatility (including both total risk and idiosyncratic risk) is illustrated as no significant relationship whereas major studies (e.g., Nadeem et al. (2019)) present that women directorship tend to alleviate corporate risk.

Besides, this paper establishes attractive outcomes related to firm performance owing to the different measurements of performance. The proportion of female directors statistically increase accounting-based performance (ROA), but in turn significantly reduce market-based performance (Tobin's Q). The potential explanation is that women representation may help empower advisory function and decision making within the boards. However, investors are mostly believed that higher female directors may damage efficiency of communication and monitoring

which negatively influence on their firm value, indicated by Adams and Ferreira (2009). In addition, I discover no significant relationship between a diversity of academic majors and any measures of firm performance. As a result, other characteristics such as experiences or network connection may be more favorable and trustworthy in the eyes of related counterparties to improve firm performance. Nonetheless, these findings appear to be different from prior Thai study like Sitthipongpanich and Polsiri (2013) which probably cause from different scopes of data and timing periods.

Moreover, the extended analysis of incremental effect of female education diversity on women directorship presents a significant positive correlation regarding to Tobin's Q, but insignificant for ROA. This seems to be compatible with Schmidt (2019). In addition, another incremental effect of women directorship on corporate governance is provided that only ROA is negatively correlated by this interaction term. As a result, my findings tend to reflect that higher appointment of female directors in the firms with stronger corporate governance may signify tougher monitoring and cause the more exacerbating effect on firm performance, indicated by Adams and Ferreira (2009). These examinations are still scarce in Thailand in which the findings have provided a beneficial and broader mechanism of this relationship within Thai firms.

In conclusion, I discover that the true relationship between women on boards and firm risk and/or firm performance appears to be more complex as indicated by Adams and Ferreira (2009). The results are not relatively robust in any types of measurement yet. Schmidt (2019) indicates that other board capital attributes such as experiences, networks or reputation may substantially influence on firm performance and volatility. Therefore, it is likely to have some rooms for future study to employ other board characteristics or interact more different attributes to additionally investigate the incremental effect of Thai listed companies.

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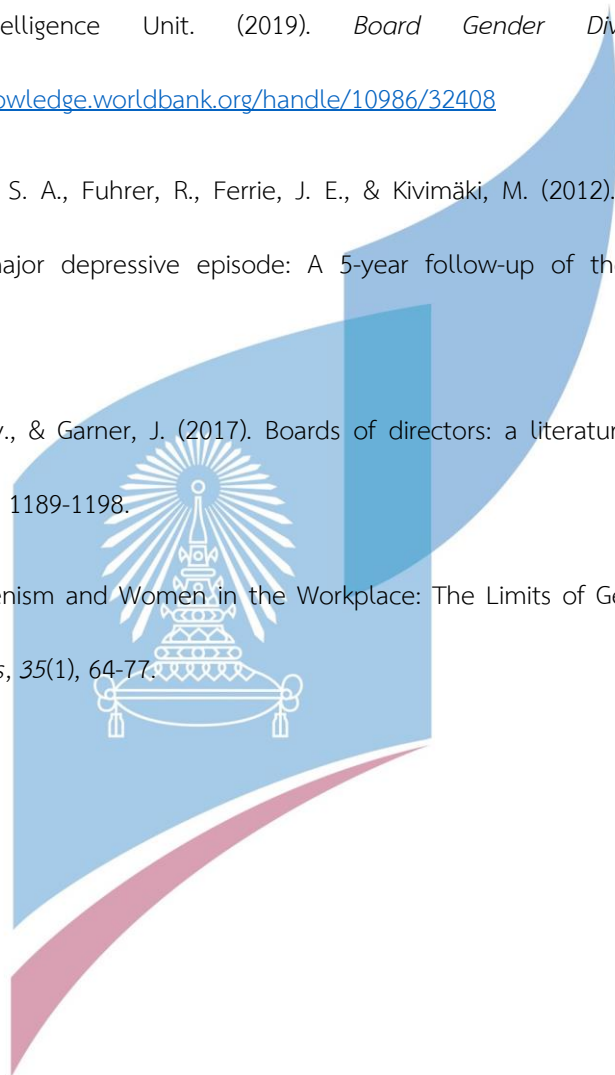
APPENDIX

Table A1: Sample Correlation Matrix

This table presents the correlation matrix of all regression variables after winsorizing outlier observations of Risk, ROA, Market to Book ratio, and Sales growth to reduce non-normal distribution.

Correlation	Total Risk	Idiosyncratic Risk	ROA (%)	Tobin's Q ratio	Women Directorship	Education Diversity	CG Score	Board size (persons)	Board independence (%)	CEO Duality	Firm size	Leverage ratio	Market to Book ratio	ln (CAPEX)	Sales growth (%)	Firm age (years)
Total Risk	1															
Idiosyncratic Risk	0.9946	1														
ROA (%)	-0.1595	-0.1649	1													
Tobin's Q ratio	0.0213	0.0152	0.4462	1												
Women Directorship	0.0207	0.0305	0.0096	0.0197	1											
Education Diversity	-0.0431	-0.0445	0.0360	-0.0205	0.0340	1										
CG Score	-0.2043	-0.2219	0.0987	0.0507	-0.0694	0.0449	1									
Board size (persons)	-0.1569	-0.1641	0.0524	-0.0028	-0.1031	0.1417	0.2431	1								
Board independence (%)	0.0109	0.0008	-0.0181	0.0020	-0.0166	-0.0279	0.1835	-0.1702	1							
CEO Duality	0.0163	0.0196	-0.0371	-0.0534	0.0505	-0.0540	-0.1285	-0.1063	-0.0237	1						
Firm size	-0.2016	-0.2364	0.0111	-0.0306	-0.1616	0.0249	0.4730	0.4022	0.1121	-0.0766	1					
Leverage ratio	-0.0085	-0.0256	-0.2326	-0.1176	-0.0259	0.0088	0.0806	0.0008	0.0502	0.0395	0.2876	1				
Market to Book ratio	0.0240	0.0132	0.3560	0.8804	0.0071	-0.0115	0.1076	0.0308	-0.0062	-0.0492	0.0930	0.0434	1			
ln (CAPEX)	-0.1787	-0.2073	0.1496	0.1533	-0.1513	0.0069	0.3502	0.3319	0.0809	-0.0773	0.6824	0.2120	0.2303	1		
Sales growth (%)	0.0722	0.0644	0.1325	0.0774	-0.0297	0.0123	-0.0180	-0.0073	0.0118	0.0280	0.0478	0.0770	0.1101	0.0607	1	
Firm age (years)	-0.0686	-0.0558	-0.0882	-0.2091	-0.0139	0.0593	0.0702	0.2331	-0.0715	0.0600	0.1271	-0.1859	-0.1973	0.0251	-0.0785	1

Table A2: Variable Definitions

This table describes the definition of all variables used throughout in this study.

Variables	Definition
Dependent Variables:	
Total Risk	Standard deviation of daily stock returns, then annualized it.
Idiosyncratic Risk	Standard deviation of the residuals from the CAPM model.
Return on Assets (ROA)	Net income divided by average of total assets.
Tobin's Q ratio	Market value to book value of assets, where market value is measured by market capitalization plus book value of liabilities.
Independent Variables:	
Women Directorship	The proportion of female directors over the total number of board members during each year.
Education diversity	The diversity of academic majors among board of directors in accordance with Herfindahl Index (HHI).
CG score	Corporate governance score obtained from Thai IOD report.
FED Dummy	A dummy variable of high-level female education diversity, assigning to 1 if this figure is higher than sample median; 0 otherwise.
Women Directorship Dummy	A dummy variable of high-level of women directorship, assigning to 1 if this figure is higher than sample median; 0 otherwise.
Control Variables:	
Board size	Total number of board members.
Board independence	Percentage of independent directors over total board size.
CEO Duality	A dummy variable equal to 1 in case of CEO serving as a chairperson; 0 otherwise.
Firm size	Natural logarithm of total assets
Leverage ratio	A ratio computed from total debt divided by total assets
Market to Book ratio	Market value of equity divided by book value of equity
ln (CAPEX)	Natural logarithm of capital expenditure
Sales growth	Current sales deduct prior sales divided by prior sales
Firm age	A period computed since the first date which companies registered in SET until the end of 2019

Table A3: Additional investigation between firm risk and women directorship

This table displays the results of joint effect between 1) Women Directorship and Women CEO on firm risk and 2) Women Directorship (>50%) and Women CEO on firm risk during the period of 2010-2019, running as unbalanced panel data. The dependent variables consist of 'Total Risk' and 'Idiosyncratic Risk'. All variables are defined in Appendix (Table A2).

Variables	Women Directorship * Women CEO		Women Directorship (> 50%) * Women CEO	
	Total Risk	Idiosyncratic Risk	Total Risk	Idiosyncratic Risk
Women Directorship	0.0363	0.0427	1.5020	1.6560*
	(0.0509)	(0.0501)	(0.9890)	(0.9850)
Women CEO	0.0587*	0.0595*	1.2990	1.4290*
	(0.0334)	(0.0328)	(0.7920)	(0.7880)
Women Directorship *Women CEO	-0.1460	-0.1560		
	(0.1020)	(0.1000)		
Women Directorship (>50%) *Women CEO			-2.0550	-2.2600*
			(1.2710)	(1.2660)
Education Diversity	-0.1650**	-0.1600**	-1.2700	-1.4390
	(0.0639)	(0.0628)	(0.8700)	(0.8670)
CG Score	-0.0233***	-0.0238***	0.0587	0.0581
	(0.0069)	(0.0067)	(0.0422)	(0.0420)
Board Size	0.0037	0.0042	0.0324	0.0318
	(0.0036)	(0.0036)	(0.0302)	(0.0301)
Board Independence	-0.0012**	-0.0011*	0.0014	0.0020
	(0.0006)	(0.0006)	(0.0049)	(0.0048)
CEO Duality	0.0090	0.0090	0.0115	0.0227
	(0.0143)	(0.0140)	(0.0855)	(0.0851)
Firm size	-0.0568***	-0.0597***	-0.0188	-0.0193
	(0.0110)	(0.0108)	(0.0628)	(0.0625)
Leverage ratio	-0.0056	0.0002	-0.0696	-0.0346
	(0.0358)	(0.0352)	(0.2480)	(0.2470)
Market to Book ratio	0.0138***	0.0132***	-0.0021	0.0000
	(0.0034)	(0.0033)	(0.0167)	(0.0166)
ln (CAPEX)	-0.0066**	-0.0077**	-0.0308	-0.0307
	(0.0033)	(0.0032)	(0.0207)	(0.0206)
Sales Growth	0.0003**	0.0003**	-0.0003	-0.0002
	(0.0001)	(0.0001)	(0.0009)	(0.0009)
Firm Age	-0.0059***	-0.0033**	-0.0313***	-0.0299***
	(0.0013)	(0.0013)	(0.0098)	(0.0098)
Constant	1.6130***	1.5900***	1.0360	0.9910
	(0.1560)	(0.1530)	(1.0200)	(1.0160)
Observations	4,634	4,634	111	111
Adjusted R-Square	0.058	0.049	0.342	0.331

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

VITA

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