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The relationship between board gender diversity and firm risk-taking among the S&P 500 firms

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ABSTRACT :

This study examines the relationship between board gender diversity and the risk-taking of the S&P500 firms over the period 2004-2017, aiming to solve the question of whether women's participation in the boardroom can reduce a firm's level of risk-taking.

The theoretical framework is based on the background of corporate governance systems, the mechanism of the board of directors, and existing related theories including agency theory, resource dependence theory, and tokenism theory. In the scope of the theoretical framework, we conduct an empirical review on the board gender diversity and risk-taking. The first section presents empirical evidence of the behavioral differences between men and women in the workplace. In the next section, we focus on existing studies on the impact of board gender diversity on corporate governance. The last section goes through different opinions in the discussions about the relationship between gender diversity and firm risk-taking.

We apply panel data methodology to conduct the empirical part of the thesis. Board gender diversity is measured by the presence of female members and their proportion on the board of directors. The proxy for the firm's risk-taking is the volatility of profitability ratio (ROTA ratio). The regression model is controlled by multiple control variables, including board characteristics and firm performance indicators. Omitted firm characteristics are controlled through firm fixed effects and time fixed effects specifications. We further modify the regressions to address endogeneity concerns through two different approaches: lagged dependent variables with fixed effects and Generalized Moment Methods estimators. The models are verified against robustness by employing alternative measures of board gender diversity (Blau index and Shannon index for diversity) and alternative proxies of firm risk-taking (volatility of profitability adjusted by industry benchmarks and profitability ratio gap).

The findings provide significant evidence that firms having a more gender-diverse board tend to be less risky than others. The presence of at least one woman on board appears to have no impact on corporate risk-taking, which might be explained by inappropriate variable choice and the tokenism theory. The dual position of CEO/ chairperson and the board independence level is negatively related to the volatility of profitability, while the higher leverage ratio is linked to the higher riskiness. However, the models perform poorly in addressing potential endogeneity issues and produce questionable results, which implies that the relationship between gender diversity and firm risk-taking is probably far more complicated than we assume.

KEYWORDS: gender diversity, risk-taking, board of directors, volatility of profitability

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Abbreviations

CEO: Chief Executive Officer

CFO: Chief Financial Officer

EBIT: Earnings Before Interest and Taxes

FE: Fixed Effects

GMM: Generalized Method of Moments

OLS: Ordinary Least Squares

ROTA: Return on Total Assets

SIC: Standard Industrial Classification

U.S.: The United States of America

1 Introduction

Men outnumber women in corporate boardrooms globally. According to MSCI's 2019 annual report on the representation of women on corporate boards, of the 2,765 MSCI ASWI Index companies, in 2019, one in five directors was women (20 percent), up from 17.9 percent in 2018 and 17.3 percent in 2017 (Emelianova & Milhomem, 2019, p.3). Deloitte's Global Center for Corporate Governance (2019, p.5) analyses 8,648 companies in 49 countries and reports that women held 16.9 percent of all global board seats in 2018, up from 15.0 percent in 2016. However, only 5.3 percent of the board chair positions were held by women in 2018.

In the United States, women held 26% of the S&P 500 board seats in 2019, up from 24 percent in 2018 and from 16 percent in a decade ago; all S&P 500 companies have at least one female director on the board (Spencer Stuart, 2019, p.4). As of 2021, 24.4 percent of the board seats of the Russell 3000 companies are held by women, up from 18.5 percent in 2019 and 14.3 percent in 2016. Only 4.2 percent of Russell 3000 companies have an all-men board of directors with no woman representation, decreasing remarkably from 12 percent in 2019 and 24.5 percent in 2016 (Tonello, 2021, p.4).

Following a series of corporate scandals in 2001-2002 and more recently the global financial crisis in 2008-2009 that emerge from corporate governance inefficiency, there has been a rising public call for a better mechanism to monitor the management in public-listed companies. Gender diversity in the boardroom is also considered a tool to mitigate the issues, supported by various academic studies and the mass media (Adams & Ferreira, 2009; Carter, D'Souza, Simkins, & Simpson, 2010). One popular approach of governments to address the underrepresentation of women in the boardroom issue is establishing a "gender quota" system. As of 2013, ten states, including Norway, Spain, Finland, Quebec (Canada), Israel, Iceland, Kenya, France, Italy, and Belgium, have already imposed quotas for female representation on public-listed and/or state-owned firms' boards of directors, ranging from 33 to 50 percent (Terjesen, Aguilera, & Lorenz, 2015,

p.3). In the US, California became the first state to introduce the bill requiring that public companies have at least one female director (Fox, 2018; Senate bill no. 826, 2018).

However, opinions about the gender quota system vary. On the one hand, these policies are often supported by the argument that women's representation on board has a significant effect on corporate governance through their behavioral gender-based differences in perspectives and characteristic traits. On the other hand, the link between board gender diversity and firm performance is still debated (Ferreira, 2011). The most important goal of the gender quota policy is to enhance the risk monitoring role of the board; however, while the relationship between board gender diversity and firm risk-taking has been researched to an extent, there has been no prevalent answer and evidence on this subject. This discussion leads to our research questions, recited as follow:

Q1: "Are firms with more gender-diverse boards of directors less risky?"

Q1: "Does women's inclusion in the boardroom impact firm risk-taking?"

By adopting alternative approaches and measurements, we would like to contribute to the existing literature on board gender diversity and the riskiness of companies.

1.1 Research hypotheses

The purpose of this study is to examine the impact of board gender diversity on firm risk-taking. Based on the literature review and the research questions, we develop the first and second hypotheses, presented as below:

Hypotheses 1: *A firm with a higher proportion of female directors on the board is associated with lower risk-taking.*

Hypotheses 1: *The presence of at least one female director in the boardroom reduces firm risk-taking.*

The thesis has three objectives to guide the study. The first objective is to develop an understanding of corporate governance and narrow the theme towards the board of directors. This objective aims to build a background for different corporate governance systems and mechanisms and to have an overview of various approaches in corporate governance studies. Theoretical literature for the basis of this objective is provided in Chapter 2. The second objective is to conduct an empirical literature review of behavioral differences between men and women in the corporate environment, which is included in Section 3.1. The third objective aims to obtain practical insight into gender diversity and its impact on corporate governance, narrowing the scope to gender diversity in the boardroom and its link with firm risk-taking. The theme is presented in Sections 3.2, 3.3.

1.2 Thesis structure

This thesis contains six chapters. The chapters after the introduction are constructed as follows:

Initially, theoretical frameworks are presented to determine the scope of the study. Based on the background of corporate governance, we discuss existing theories in corporate governance, including agency theory, resource dependence theory, and tokenism. We also report a temporary paradigm of the board diversity research and statistics of several indicators to obtain an overview of the board diversity in corporate governance.

Chapter 3 reviews previous literature related to the researched subject. Firstly, we present empirical evidence of the gender-based behavioral differences between men and women in the workplace. The next section goes through existing studies about the impact of board gender diversity on corporate governance. Lastly, we report different opinions in the discussions about the relationship between board gender diversity and firm risk-taking.

In chapter 4, we present the data collection and research methods of this study. The first section introduces the data sample, followed by a detailed description of variables selected for empirical estimations. Next, we demonstrate regression models construction and approaches to address its potential issues. A statistical description of the variable set is provided in the last section.

The empirical results are demonstrated and analyzed in Chapter 5. We apply various regressions to examine the research subject and report the main statistics in a series of tables. Based on the analysis of results, we detect the problems existing in the model and address the concerns through different approaches. The robustness of regression models is tested by introducing alternative variable specifications.

The last chapter provides a conclusion to this thesis. Following a brief synthesis of the study, we review the empirical results and discuss the theoretical implications gained. Several limitations of this study and suggestions for future research are considered.

2 Theoretical Framework

This chapter presents the theoretical framework which creates the scope of the study, including the background of corporate governance system and board of directors, existing theories in corporate governance: agency theory and resource dependence theory, tokenism, and an overview of board diversity research.

2.1 Corporate governance

Corporate governance is a general concept that covers a collection of systems, processes, and procedures that aim to regulate the relationship between stakeholders, primarily between shareholders and upper management (Baker & Anderson, 2011, p.3). Corporate governance has been studied for a long time; however, it has raised public concerns especially in the last few decades, after a series of corporate scandals which originate from managerial fraud, misconduct, and negligence (Baker & Anderson, 2011, p.1).

2.1.1 Corporate governance system

Corporate governance systems vary due to a range of factors including capitalist structures that corporates base on and different laws and regulations around the world. Corporate governance models are generally classified into the market-oriented Anglo-American system and the network-oriented system of Continental Europe and Japan (Douma, 2008; Baker, Anderson, & Kolb, 2010). The Continental Europe model, the so-called “two-tier board system”, often requires multilevel monitoring. Managers are allegedly monitored by a network of stakeholders including banks and major shareholders, as a means to enhance corporate governance. In contrast, the Anglo-American “model”, also known as the “one-tier board model”, which has been widely applied in the United States, the United Kingdom, and Canada, emphasizes the strong protection of shareholders’ interests. Managers are supposedly under the monitoring of external market forces and boards of directors, which are traditionally dominated by non-executive directors elected by shareholders (Bowen, 2008). Fundamental mechanisms of a corporate

governance system include board of directors, shareholder meetings and voting, and executive compensation.

2.1.2 Board of Directors

The Board of directors is normally considered the apex mechanism of the corporate governance system (Jensen, 1993, p.34). Board of directors, also known as the board of directors and advisors, board of governors, board of regents, board of trustees, or board of visitors, is defined as “a group of people who jointly supervise the activities of an organization” (Robert, 2011). Boards of directors play a crucial role in corporate governance. In theory, they act as the medium between the shareholders, who own the corporation and supply the capital, and the managers, who control the corporation and create value from that capital. Corporates rely on the funding from shareholders but entitle operation rights for management, which creates opportunities for both operational efficiencies and power abuse (Monks & Minow, 2011). Due to finance realization and regulations, the board of directors, as a mechanism to protect shareholders' value, becomes the norm in the late twentieth century (Mitchell & Mitchell, 2011).

In a publicly held company in the United States, directors are often elected to be legal representatives of the shareholders/stockholders - the owners of the company. Many organized investors, including large public and private pension funds as well as activist hedge funds, have been actively involved in the directors’ election process of their portfolio companies, as a method to monitor the governance structure. New York Stock Exchange (NYSE) regulates the director selection procedure in public-listed companies, requiring the nominating committee to “identify individuals qualified to become board members, consistent with the criteria approved by the board” and provide disclosure in the governance guidelines (New York Stock Exchange, 2009). The board election criteria depend on the specific goals and obstacles of the companies. The desired composition and qualifications of the boards may be revised to adapt to the evolving situations. It is recommended that an ideal board should assert both knowledge and experience in accounting and finance, risk management, strategic and business planning, legal and

compliance, human resources, marketing, international trade, and industry-specific research and development (Tonello, 2011).

The board size varies for different industries and companies' scales. According to Tonello (2011), the larger companies tend to have a higher number of directors; however, these numbers mostly range between 9 and 12. Boards need sufficient members to assert necessary qualifications while staying compact enough to be cohesive, flexible, and effectively involved. These factors should be considered in determining the optimal board size. The board size tends to be larger in European countries and Japan, to fulfill the representative role and the decision-making role directed toward a wider range of stakeholder interests. The board in Anglo-American countries is considered as serving more specific roles and involves more focused interests, thus is smaller in size. (Clark, 2017).

Boards of directors may be diversified in many important traits, including educational and professional background, industry experience, social connectedness, insider status, gender, and race. There is an upward trend in introducing more independent directors into the board after a series of corporate scandals in 2001-2002 (Tonello, 2011). NYSE and NASDAQ have imposed practices and guidelines to encourage outside directors to act independently from executives' interests (Nasdaq Listing Center, 2009; New York Stock Exchange, 2009).

The leadership in the board is an important factor that determines the board's impact on the company's operation. While the chairperson can promote good practices and ethics among their colleagues, they can also negatively influence the board's operation. (Clark, 2017). The duality structure in which the CEO presides both the executive board and director board is a common practice among public listed firms in the United States; however, this tradition has been gradually losing its popularity. New regulations and law enforcement, which favor the separation of the chairman position and CEO, have been introduced to mitigate conflicts of interest and power abuse (Tonello, 2011). Opinions about the CEO-chairperson duality are mixed: many people believe that a dual

leadership structure benefits the business, while others argue that it may leave room for interest conflicts to arise, as the CEO is also in the position to monitor their own performance and may act toward their career objectives (Monks, 2011). The author suggests that the separation of two positions can help the evaluation of the CEO more objectively and strengthen the accountability environment inside the firm.

The main functions of the board of directors include controlling and monitoring managers, providing advice to managers, monitoring organizational compliance with applicable rules and legislation, and connecting the organization to the external environment (Jensen, 1993). The legal responsibilities of boards and board members vary across different corporate structures, depending on the nature of the organization and legal frameworks. In general, directors are expected to conduct board operations, including attending board meetings and executive sessions, reviewing related documents, utilizing external consultants, and imposing policies on record keeping and voting (Tonello, 2011).

2.2 Agency theory

In the context of corporate governance, the agency theory, also known as the principal-agent problem, refers to situations where the managers (the "agent") can make decisions that are on the costs of the shareholders (the "principal") and can affect their interests. (Pratt & Zeckhauser, 1985; Eisenhardt, 1989). Unbalanced interests among the agent and the principal may cause the agency loss, which is the gap between the best possible outcome for the principal and the consequences from the acts of the agent (Jensen & Meckling, 1976).

2.2.1 Agency costs

The agents' decisions affect both their own and the principals' welfare, therefore, the agency problems eventually result in losses for the company's shareholders. According to Jensen and Meckling (1976), the agency costs comprise monitoring costs, bonding costs, and residual loss.

Managers are monitored based on their job to maximize shareholders' value, which is evaluated by several measurable indicators. The monitoring process generates monitoring costs. These costs are the principal's expenses to measure, observe, and control an agent's behavior, including audits, drafting executive compensation contracts, and the top managers' recruitment costs.

Fama and Jensen (1983) argue that while the principal bears the costs initially, the final loss payee is the agent because the costs will affect the agent's compensation ultimately. In this case, managers may spend efforts in building trust with shareholders to reduce the monitoring costs. These efforts, which include contractually limiting the managers' decision-making powers, or increasing the transparency of the managers' decision, result in the costs borne by the managers, called the bonding costs (Jensen and Meckling, 1976). In theory, managers may cut on bonding costs if the marginal deduction in monitoring cost does not set off the marginal increase in bonding cost to them (Clacher, Hillier, & McColgan, 2011).

Regardless of efforts on monitoring and bonding from both sides, the conflict of interest between managers and shareholders is unavoidable. Therefore, agents' decisions are not always the optimized options that maximize the welfare of the principal. The net loss borne by the principal, which originates from these decision gaps, is coined as a "residual loss" (Jensen and Meckling, 1976).

2.2.2 Sources of conflict

According to Clacher et al. (2011, p.4), sources of agency conflict are mainly divided into four themes: moral hazard, earnings retention, time horizon, and risk aversion.

Firstly, moral hazard is a major theme of conflict. Krugman (2009, p.63) described moral hazard as "any situation in which one person makes the decision about how much risk to take, while someone else bears the cost if things go badly." In the context of corporate

governance, it refers to the situation where managers are enabled to take additional risks that negatively affect the shareholders, or their decisions tend to benefit themselves rather than maximize shareholders' value. This problem may arise in firms where ownership structure is fragmented and corporate managers are not the large shareholders of their companies, as in the United States and the United Kingdom. Moral hazard also links with the neglect of responsibilities by directors (Clacher et al., 2011, p.5).

Next, conflicts are potentially related to earnings retention. Retained earnings regularly benefit CEOs and upper management through a larger power base, greater privileges, and higher control power over the board, while they can reduce the dependence on outside financing for investment. In other words, by not paying dividends, managers can use corporate earnings for their own interests, at the expense of shareholders, especially the minor shareholders.

Another factor is the timing of cash flows. While shareholders should be concerned with all future cash flows of the company in the indefinite future, which are reflected in the current share price, managers may only focus on company cash flows for their serving terms. This conflict of interest can cause biases toward short-term projects with a high return rather than long-term investments to benefit shareholders' welfare.

Risk aversion arises when managers' salaries are fixed or when they find it difficult to seek another job. Investment decisions with higher risk levels are more likely to lead to bankruptcy, which harms the managers' reputation and their future career opportunities. Therefore, managers tend to avoid risky or innovative projects if they gain little marginal reward or have chances to lose their jobs.

2.2.3 Addressing agency problems

Corporate law provides frameworks to establish a mechanism of corporate governance to alleviate the agency problems, principally through the board of directors, shareholders meeting and voting, and executive compensation (Bhagat, Bolton, & Romano, 2011).

Jensen (1993, p.34) emphasizes the importance of the board as an effective mechanism to mitigate agency problems, arguing that the board of directors is where the problems in corporate internal control systems arise. In theory, the board is ultimately responsible for the firm's operation and policy decisions. Their duties include monitoring and providing consultation to executives; therefore, as an internal control mechanism, the board must direct the organization on the right track before it derails into a crisis stage. Jensen (1993, p.34) also reaffirms that a well-functioning board should promote the organizational culture and supportive environment to address the problems with a defective internal control system. Hillman and Dalziel (2003) agree that the board should play a key role in harmonizing the interests of shareholders and managers.

It is reasonable to consider gender diversity in the boardroom as a tool to reduce agency costs. More diversified boards link with more independence and therefore perform their monitoring role better (Adams & Ferreira, 2009; Carter, D'Souza, Simkins, & Simpson, 2010). A diverse workplace also encourages members of minority sub-groups to be more coordinated and involved, which can help mitigate agency conflict (Adams & Ferreira, 2009; Ntim & Soobaroyen, 2013). Francoeur et al. (2008) observe that gender diversity in top management may reduce agency costs and have a positive effect on stock returns.

2.3 Resource dependence theory

Since the late twentieth century, the board of directors has become a researched subject from diverse perspectives. In the economics approach, boards are viewed as a single entity. Director characteristics are often overlooked, except for the independence status. In contrast, other researchers consider that the board comprises of different individuals having different backgrounds and values, whose behavior is affected by social norms and relations (Ferreira, 2011).

Resource dependence theory, which is developed by Pfeffer & Salancik (1978), emphasizes the role of directors as the resource provider of the firms. The external environment

provides the organization with critical resources, while also being a source of constraints and uncertainty. However, an organization can reduce risks from outside forces and obtain resources through links with its external environment. Directors can serve as these links, connecting firms with sources of external dependency (Hillman, Shropshire, & Cannella, 2007). They may benefit the organization through their connections, advice, and consultation. In this perspective, director diversity should be considered from various dimensions (Ferreira, 2011).

The selection of directors with suitable skills, influence, or connections to external environments can help firms manage environmental dependencies, thus reducing the corporate risk (Hillman et al., 2007). Diverse board compositions bring companies varying connections to the outside resources, for example, competitors, suppliers, investors, politicians, the media, and others. Director traits could influence their capacity and drive to monitor and advise managers, therefore they should be considered in the selection criteria to benefit both management and shareholders.

2.4 Board diversity

Over the last decade, directors are gradually regarded as multi-functional positions in the mainstream view. In addition to monitoring and advising managers, they are also responsible for connecting the company to essential external resources. To balance these multiple roles, directors are normally elected based on their qualifications and characteristics, which should be compatible with companies' structures and strategies. These traits affect how the board behaves, as an entity. Therefore, it is reasonable to consider the board composition based on its member individual characteristics (Ferreira, 2011).

Recently, the board composition and its impact on corporate governance have attracted increasing interest in literature. Research in board diversity has shed light on several limitations in current corporate governance systems, including discrimination in the workplace and tokenism. Studies also imply that board diversity does have certain impacts on

many firm characteristics and outcomes; however, these impacts vary, depending on which industries and which firm characteristics.

2.4.1 Current landscape

We review some board diversity indicators among S&P 500 firms over the last decade to obtain an overview of the board diversity in the United States at the current time. The statistics are presented in Table 1, Table 2, and Figure 1, respectively. Overall, the presence of directors from underrepresented groups tends to grow stably over the period. Newly elected directors from underrepresented racial/ethnic groups have doubled in five years from 2016. In 2021, women's representation on board reaches 30 percent, compared with 28 percent in the previous year and 16 percent a decade ago. All firms have at least one female director on board while just four percent of firms have a single woman on board. This upward trend of the board gender diversity is captured in Figure 1.

Table 2 summarizes the percentage of female directors, the number of female directors on board, and the percentage of members from underrepresented racial/ethnic sorted by certain industry sectors in 2021. As can be seen in the table, the fraction of female directors in certain sectors including communication services, energy, industrial, and information technology is slightly below the average level (30 percent), while companies in the consumer and financials sectors seem to have the most gender-diverse boards. In general, there is no considerable gap in the percentage of female directors across different industries except for the energy sector, which is visualized in Figure 2. The energy sector also has a remarkably low proportion of directors from underrepresented groups (35 percent) as compared to the average number of all sectors (43 percent).

Table 1: S&P 500 Board diversity indicators

This table presents the percentage of female directors, partitioned by industry. Data retrieved from 2021 U.S. Spencer Stuart Board Index, with observations from 493 (2021), 494 (2020), 477 (2016), and 493 (2011) S&P 500 firms for the period 2011–2021.

[a] Data based on proxy year May 28, 2020, through May 13, 2021.

[b] Data based on proxy year May 24, 2019, through May 20, 2020.

[c] Data based on proxy year May 15, 2015, through May 15, 2016.

[d] Data based on proxy year May 15, 2010, through May 15, 2011

**Total underrepresented*, defined as women and Black/African American, Asian, Hispanic/Latino, American Indian/Alaska Native, or multiracial men

	2021[a]	2020[b]	2016[c]	2011[d]	5-year % change	10-year % change
Female directors						
Percentage of female board directors	30%	28%	21%	16%	41%	86%
Board with at least one women director	100%	100%	99%	91%	1%	10%
New director elected	159	114	345	294	32	55
% Women	45%	54%	32%	21%	34%	105%
% From historically underrepresented ethnic/racial groups	65%	25%	15%	14%	213%	235%
% Black/African American	45%	10%	8%	7%	313%	371%
% Asian	13%	12%	2%	4%	250%	75%
% Hispanic/Latino/a	7%	3%	5%	3%	40%	133%
% American Indian/Alaska native	<1%	NA	NA	NA	NA	NA
% Two or more races (multiracial)	<1%	NA	NA	NA	NA	NA
% Female	24%	13%	5%	4%	260%	350%
% Male	41%	12%	10%	10%	200%	200%
Percentage of newly elected directors from underrepresented groups	86%	65%	42%	31%	71%	132%

Figure 1: Board gender diversity indicators of S&P500 firms in 2011, 2016, 2021
Data retrieved from 2021 U.S. Spencer Stuart Board Index, with observations from 493 (2021), 494 (2020), 477 (2016), and 493 (2011) S&P 500 firms over the period 2011–2021.

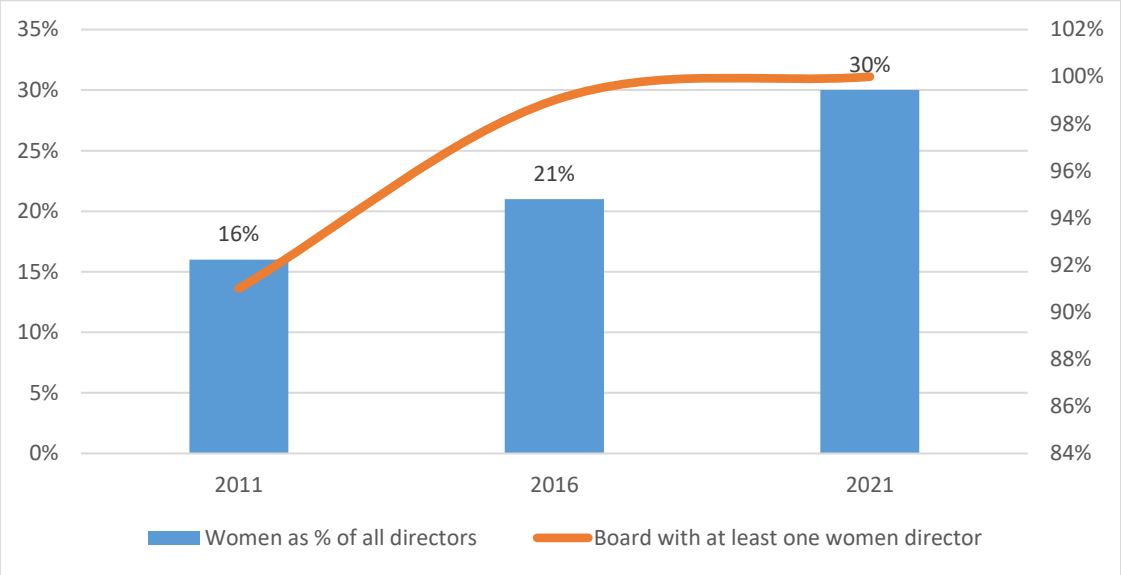

Figure 2: Percentage of female directors in different industries in 2021.

Data retrieved from 2021 U.S. Spencer Stuart Board Index, with observations from 493 S&P 500 firms in 2021.

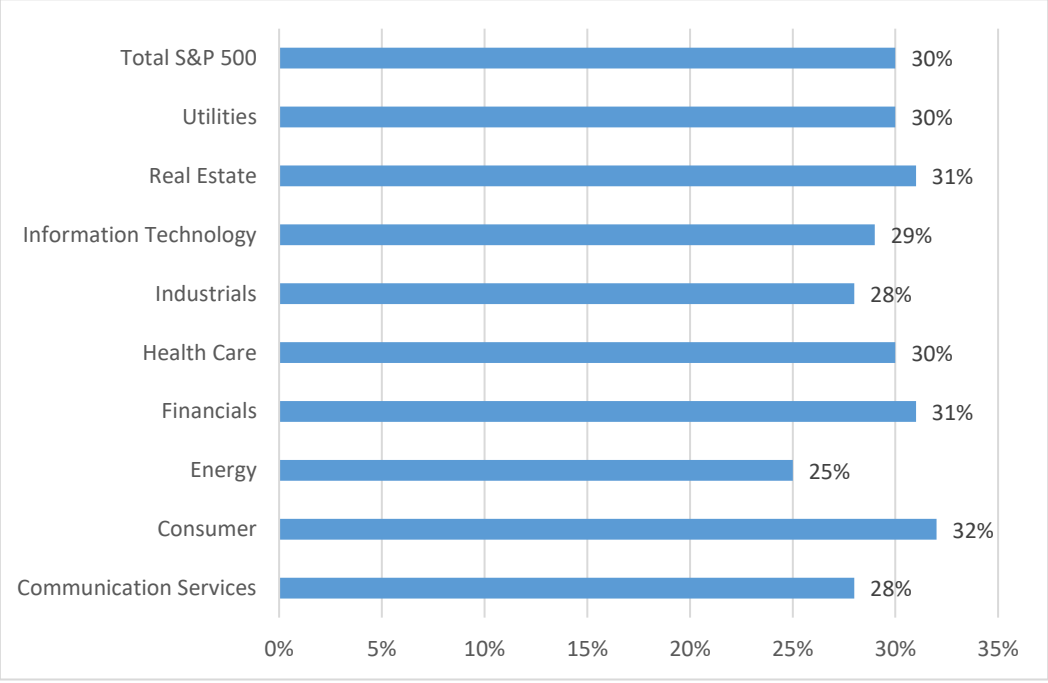

Table 2: S&P 500 Board diversity in 2021, sorted by sector

This table presents the percentage of female directors, the number of female directors on board, percentage of members from underrepresented racial/ethnic groups from 493 S&P 500 firms based on proxy year May 28, 2020, through May 13, 2021, partitioned by sector. The firm sector is determined by two-digit standard industrial classification (SIC) codes. Data retrieved from 2021 U.S. Spencer Stuart Board Index.

**Total underrepresented*, defined as women and Black/African American, Asian, Hispanic/Latino, American Indian/Alaska Native, or multiracial men

Sector	N	Women directors	Has 2+ women directors	Black/ African American	Asian	Hispanic/ Latino	Total under-repre-sented*
Communication Services	22	28%	86%	13%	5%	6%	43%
Consumer	94	32%	96%	11%	4%	6%	45%
Energy	22	25%	100%	7%	3%	4%	35%
Financials	63	31%	100%	12%	4%	5%	46%
Health Care	60	30%	100%	10%	6%	3%	44%
Industrials	101	28%	96%	11%	3%	4%	41%
Information Technology	74	29%	91%	7%	12%	3%	45%
Real Estate	29	31%	100%	9%	4%	4%	41%
Utilities	28	30%	100%	16%	2%	6%	45%
Total S&P 500	493	30%	96%	11%	5%	5%	43%

2.4.2 Benefits and costs analysis

In the case of board gender diversity, while many scholars and media sources often highlight the positive link between certain financial performance indicators and the participation of women on boards to promote gender diversity in the boardroom, Ferreira (2011) expresses the skeptical attitude toward how these arguments contribute to policy advocacy, suggesting this issue should be considered from multi-dimensional views to understand its pros and cons and for studying corporate governance purposes, rather than focusing on the question of whether the presence of women on board is profitable

or not. The author further discusses both merits and demerits of board diversity from the perspective of corporates, as summarized below.

On the one hand, the board diversity may benefit companies in many aspects, including creativity and diverse perspectives, access to various resources and connections, career inspiration through signaling and mentoring toward diverse groups of employees and potential talents, and positive relations with the public and investors. Firstly, individuals with diverse backgrounds and experiences probably have different approaches to address the same problem. Therefore, a more diverse group is more likely to encourage creativity and innovation in problem-solving, while reducing herd mentality phenomena. Secondly, the group may benefit from each member's personal network and accessibility to different resources, such as industry insiders or political connections. Next, the board diversity can help solidify the company's stance on diversity promotion policy, which encourages and attract employees from minority communities. This also helps companies improve their images to fulfill social expectations: having a more diverse board can enhance their credibility in the eye of the public, the media, and the government.

On the other hand, there are several potential costs which should be noticed. The first disadvantage a diverse board may encounter is conflict potential and insufficiency of cooperation and communication. The group may be divided into hidden subgroups by different characteristics traits, which can reduce interactions and sympathy among subgroups and provoke conflicts. Another drawback comes from having directors selected mainly based on their demographic characteristics: the inconsideration of other important characteristics can easily result in choosing one with undesirable experience and qualifications, or one who has already overtasked. In the case of gender diversity, because the proportion of women in the upper management level is still small, the board may end up with female candidates with unsuitable age or experience. There are also limited options for qualified minority candidates, who are more likely to occupy multiple board seats at one time, hence they may be less effective than an average director. The next potential cost of a diverse board arises from conflicts of interests and agenda-

pushing. There are higher chances that a more diverse board be affected by its members pursuing different interests and their own agenda at the expense of the shareholders.

2.5 Tokenism

The term “tokenism” refers to the practice of “making only a symbolic effort” (Merriam-Webster, 2021), more specifically, “recruiting a small number of people from underrepresented groups in order to give the appearance of sexual or racial equality within a workforce.” (Lexico Dictionary, 2021).

Kanter (1977) is the first one to propose the tokenism concept in the corporate environment. A token employee usually belongs to a minority group that accounts for less than 15% of the total employee number of the organization. Due to their small number, token employees are usually overlooked by the dominant group, who apply a stereotype role to them as a symbol for representation. In a company, a small number of women elected to the board of directors may hardly be regarded as the sign of board gender diversity, but probably the result of pure tokenism instead. In this case, female “token” directors may face disrespect and isolation, which prevents them from influencing board decision-making (Kanter, 1977). For almost a half of century, this concept remains relevant and has been widely applied to aspects of race, ethnicity, and national culture in organizations.

The token employee’s experience is strongly influenced by three effects linked to this minority position: visibility, contrast, and assimilation (Kanter, 1977). Firstly, a minority token faces high visibility as compared to their counterparts from dominant groups, which places them under pressure to obtain recognition and avoid being exceptional at the same time. Next, certain stereotypes expect token minorities, women specifically, to identify with limited positions and job types that ultimately hinder their career path. The third phenomenon arises when the dominant group feels threatened or uncomfortable with the token’s presence and solidifies their identity through informal practices that

aim to test the loyalty or exclude “outsiders”. For example, certain social club activities are limited only to their core members with the same background. The dominance is not referred to only the quantity aspect, but also the norm and value that dominates the corporate culture (Simpson and Lewis, 2012).

In comparison with the time Kanter (1977) first introduced the idea of ”tokenism” five decades ago, women's participation in the workforce, particularly in the boardroom, has progressed impressively. However, these changes may probably be limited to the numerical indicators, while structural factors including power and opportunity are still unequal or unjustly distributed (Ibarra, 2004, p.2).

Proposals for gender quotas in the boardroom of publicly listed companies are becoming increasingly prevalent in many states of Europe and North America. In response, firms need to reshape policies to identify, develop, promote, and recruit suitable female candidates for the board seats. However, in many countries, it is not uncommon that the only woman on board remains merely a gender equality symbol (Teijesen et al., 2015, p.3). Guldiken et al. (2019) argue that while firms often comply with public and institutional pressures, they may not be willing to spend further efforts once the quota level is satisfied. In the United States, most public listed firms have at least one female director (Catalyst, 2019); however, this evidence is insufficient to prove that gender diversity has achieved progress. Guldiken et al. (2019) also describe having only a woman on board as problematic, because electing a new female director to comply with regulations, but without sincere intention to increase the board gender diversity, can be viewed as a tokenistic action, which brings no benefit of a more gender-diverse board to companies.

3 Literature Review

In this chapter, we review previous literature related to the researched subject. The first part presents empirical evidence of the behavioral differences between men and women in the workplace. In the next section, we focus on existing studies on the impact of board gender diversity on corporate governance. The last section goes through different opinions in the discussions about the relationship between gender diversity and firm risk-taking.

3.1 Gender-based behavioral differences in the workplace

A large body of previous studies suggests that men and women behave differently in the workplace, particularly in competitiveness, over-confidence attitude, and risk tolerance. These differences are reflected in the decisions that top executives and directors make, which influence the major strategic and financial decisions of their firms.

On the one hand, it is a generally accepted perception that women are more risk-averse, which is supported by many studies about relationships between individual risk preferences and observable characteristics. Powell & Ansic (1997) design computerized laboratory experiments to prove that women are less risk-seeking than men in financial decision-making. Jianakoplos & Bernasek (1998) consider women as having greater risk aversion than men, which is reflected in their financial and investment decisions. This opinion is supported by Bliss (2002), Barber & Odean (2000), and Vandegrift & Brown (2005). The differences in attitudes and characteristics between men and women tend to influence the financial decisions of firms. Men show higher tendencies for risk-taking and overconfidence (Jianakoplos & Bernasek, 1998), while women tend to show more risk-aversion and less competitiveness (Croson & Gneezy, 2009). Charness & Gneezy (2012) collect data from 15 studies using one underlying investment experiment and find strong evidence that women invest less and seem to be more financially risk-averse than men.

On the other hand, it is still argued that women are indeed more risk-averse than their male counterparts. Aggarwal & Boyson (2016) find that hedge funds managed by either men or women are not significantly different in terms of performance, risk, and other fund characteristics, which implies that risk might not be linked to gender diversity. On the contrary, Iqbal et al. (2006) examine the risk-aversion difference between male and female executives through their behavior in response to stock option rewards and conclude male executives are more averse toward risks than their female counterparts, based on their higher diversification-related stock sales.

3.2 Board gender diversity and corporate governance

In general, previous literature suggests that board gender diversity might have a positive impact on corporate governance, as a more gender-diverse board tends to provide better monitoring and accountability, improve decision-making and firm performance, and encourage the ethical and sustainable practice of the corporate.

Catalyst (2020) reviews many studies on board gender diversity and conclude that more gender-diverse corporate boards are associated with more effective risk management, increasing engagement among board members, fewer financial reporting mistakes, fewer controversial business practices (Fan et al., 2019; Wahid, 2018), and more attention to higher audit quality (Lai et al., 2017). Female board member appointments can improve investment efficiency and prevent risky over-investment decisions (Shin et al., 2020), as well as reduce the overconfidence of male CEOs (Chen et al., 2019). Boards with more gender diversity seem to be more active and interactive in an information exchange or conducting tasks after board meetings (Schwartz-Ziv, 2017).

Carter et al. (2010) found that there is a positive relationship between the gender and ethnic diversity of boards and firm value, which is measured by Tobin's Q indicator. They also suggest that diversity provides a more comprehensive view of business and encourages creative thinking in strategies development and problem-solving. Campbell &

Mínguez-Vera (2007) examine the association between the gender diversity of the board and firms' financial performance in Spain. Board gender diversity, weighted by the percentage of women on board and other diversity indices, including the Blau index and Shannon index, appears to positively influence firm value. Srinidhi et al. (2011) use two measures of earnings quality to study the impact of gender-diverse boards on firms' performance and notice that firms having more female directors saw higher earnings.

Nguyen et al. (2015) research board gender diversity among public-listed firms in Vietnam during the period 2008-2011. They find that board gender diversity has a positive impact on firms' financial performance. It is noted that this effect only remains if the percentage of female directors is below 20 percent, which implies a conflict between costs and benefits of board gender diversification. Using a sample of 3,000 US firms from 2007 to 2014, Conyon and He (2016) see a positive relationship between women on boards and firms' performance, as measured by Tobin's Q and ROA. Rhode and Packel (2010) review previous studies on board diversity and conclude that the "empirical research on the effect of board diversity on firm performance is inconclusive," and "the results are highly dependent on methodology" (p. 8); however, they suggest that board diversity improves decision making.

Banahan and Hasson (2018) believe that corporate boards are more likely to identify the needs and interests of different stakeholder groups when they consist of members with diverse backgrounds and experiences, therefore firms with gender-diverse boards appear to perform better in environmental and social governance activities. The representation of female board members may have a positive influence on corporate sustainability practices (Al-Shaer & Zaman, 2016; Nadeem et al., 2017), as female directors tend to show more interest in social issues like human rights, climate change, and income inequality as priorities in corporate strategy (Loop & DeNicola, 2019). More gender-diverse boards are also more likely to adopt more progressive organizational management practices, for example, staff welfare programs (Creek et al., 2017).

3.3 Board gender diversity and corporate risk-taking

The relationship between gender diversity in the corporate environment and firm risk-taking has received growing attention in research over the last decades. Responses to this issue vary and sometimes conflict.

On the one hand, a vast body of studies suggests that gender diversity in high-level management positions may reduce the corporates' risk-taking behaviors. Palvia et al. (2015) examine the relationship between the gender of CEO and Chairperson and the capital ratios and default risk in the banking industry. They find that the female CEOs and board chairwomen have a more risk-averse tendency, which reduces the chance of bankruptcy during the crisis. Faccio et al. (2016) document that firms run by female CEOs have lower leverage, less volatile earnings, and less likelihood to fail than those run by male CEOs. Furthermore, the change in CEO positions from male to female (or vice versa) results in remarkable decreases (increases) in corporate risk-taking. Perryman et al. (2016) notice an association between gender diversity at the top management level and lower firm risk. Firms with more gender-diverse management teams also experience fewer operations-related lawsuits (Adhikari et al., 2019). Using samples from Italian financial institutions, Menicucci and Guido (2020) find that female top executives are considerably less overconfident and less risky than their male counterparts, implying a negative relationship between gender diversity and risk-taking. Peltomäki et al. (2021) conduct a study on S&P 1500 companies and report that having female CEO and/or CFO may reduce firm risk, which is measured by stock return volatility.

Adams and Ferreira (2009) find that U.S firms with more gender-diverse boards tend to have lower stock return volatility, which is used as a proxy for firm risk. de Cabo et al. (2012) notice that the proportion of women on the board is higher in banks with lower risk. Setiyono and Tarazi (2014) use samples from an emerging market (Indonesia) and observe that female directors' presence on board can reduce corporate risk. Board gender diversity seems negatively related to firm risk across both emerging and developed

economies (Saeed et al., 2016). Bernile et al. (2016) found that firms with more gender-diverse boards tend to have lower realized firm risk, higher income, and higher assets growth. These firms are also more likely to pay higher dividends, invest more in research and development and pursue less risky financial policies. Women's inclusion on board is likely to reduce risky over-investment decisions as well as the over-confidence of male CEOs (Chen et al., 2019).

On the other hand, several observations highlight that a more gender-diverse director board may not be the perfect resolution to mitigate risk-taking behavior. Adams and Funk (2012) report that, in the "management" environment, female directors are easier to make risky decisions and cause losses to company value. Sila et al. (2016) suggest that boardroom gender diversity seems to have no impact on corporate risk; however, their results are allegedly driven by unobserved between-firm heterogeneous factors. In the same study mentioned above, Bernile et al. (2016) note that gender diversity of the boards was not always beneficial to firm performance when overall volatility was high, which can be explained by the inability of the board to respond quickly to emergencies due to potential longer decision-making processes. Chen et al. (2017) examine S&P 500 samples from 1997 to 2013 and find no difference in financial risk between firms with gender-diverse boards and firms with gender-homogenous boards.

4 Methodology

This chapter presents the data collection and research methods of this study. Firstly, we introduce the data sample, followed by a detailed description of variables selected for empirical estimations. The next section demonstrates the regression model's construction and different approaches to address its potential issues. Lastly, we provide a statistical description of the variable set.

4.1 Sample selection

Data used in this research is obtained from S&P500 index companies during the period 2004-2017, retrieval date 14 March 2018. The source of data for board characteristics and firm financial statistics is Worldscope Database, Thompson Reuters ESG Asset 4. The board characteristics information is collected manually through firms' annual reports in case it is not available in the database. We omit firms whose data is incomplete for at least 10 years on Worldscope. We also exclude depository institutions (SIC codes between 6000 and 6099), due to high regulations and different financial statement formats in the bank industry, which heavily influences a firm's risk behavior (Faccio et al., 2011).

4.2 Description of variables

4.2.1 Dependent variable

ROTA, or EBIT/ Total Assets ratio, is a measure of profitability, which is defined as the ratio of Earnings before Interest and Taxes to the Average Total Assets. This ratio measures the productivity of the firm's assets, with tax or leverage factors excluded. The ROTA indicates how much money is generated from each dollar invested into the company. The greater ROTA implies more efficiency in the firm's assets being used. Because earning power of its assets is crucial for a firm to survive, this measure often outperforms other profitability measures in determining the risk of corporate failure (Altman, 2000, p.11).

The volatility of profitability is generally used as a proxy of firm risk (John et al., 2008; Cheng, 2008; Boubakri, Mansi, & Saffar, 2013; Faccio et al., 2016). According to John et al (2008), firms with higher volatility in profitability may have a higher level of risk-taking, which is supported by various studies (Faccio et al., 2011; Hilary & Hui, 2009). Based on previous literature, this study adopts the volatility in profitability as the dependent variable *RISK*. *RISK* is calculated as the standard deviation of the profitability over 5-year overlapping windows (2004-2008; 2005-2009; 2006-2010; 2007-2011; 2008-2012; 2009-2013; 2010-2014; 2011-2015; 2012-2016; 2013-2017), structured as follow:

$$RISK_{i,t} = \sigma_{ROTA} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(E_{i,t} - \frac{1}{T}\sum_{t-1}^{T}E_{i,t})^2} \quad \text{(T=t+4)}$$

where $E_{i,t} = \frac{EBIT_{i,t}}{TA_{i,t}}$

$EBIT_{i,t}$ is Earnings Before Interest and Taxes of firm *i* in year *t*

$TA_{i,t}$ is Average Total Assets of firm *i* in year *t*.

4.2.2 Independent variables

Board gender diversity is the main independent variable in this research. Two measures of board gender diversity are considered. The first measure is the percentage of female directors on the board (FEMALE_PERCENT), which is commonly used in previous studies (Campbell & Mínguez-Vera, 2007; Adams & Ferreira, 2009; Nguyen et al., 2015). The latter is the dummy variable (FEMALE_DUMMY), which is equal to 1 if a board has at least a female member or 0 otherwise.

4.2.3 Control variables

Based on previous literature, we employ measurements for other board characteristics and firm characteristics that can influence firm risk-taking to control their potential influence on the outcome.

The first control variable is the board size (BOARD_SIZE). There are mixed reviews on the impact of board size on the board's performance. Jensen (1993) argue that a board functions better and be less influenced by the CEO when it has fewer than seven or eight members. In contrast, Sila et al. (2016) suggest a larger board tends to make less risky decisions. Cheng (2008) also indicates that larger boards may lead to less variable total and abnormal accruals, therefore decreasing firms' risk-taking. BOARD_SIZE is calculated as the natural logarithm of the number of board members.

The presence of the CEO on the board is included in the model (CEO_BOARD). The dummy variable is valued as 1 in case the CEO is also a director, and 0 otherwise. We also employ the dummy variable which indicates whether the CEO and the chairman are the same people (CEO_CHAIR). In the US public listed firms, the CEO traditionally presides the board, although this practice has been declining in recent years (Tonello, 2011). Adams et al. (2005) find that firms run by more powerful CEOs have more variability in stock performance, which implies that the duality in CEO and chairperson positions may be associated with the risk behavior of the board. This variable is equal to 1 if there is no separation between CEO and chairman, and 0 otherwise.

Next, we add the fraction of independent directors on the board (INDEPENDENT) to control the effect of board independence on the volatility of profitability. The board independence from management is regularly studied and supposed to have a certain impact on the board, (Jackling & Johl, 2009; Carter et al., 2010). Many researchers and institutional investors suggest that directors who are independent or "outsiders" are essential in corporate governance to monitor managers (Bhagat et al., 2011). For example, New York Stock Exchange requires listed companies to have independent directors comprising

a majority of the board, to “increase the quality of board oversight and lessen the possibility of damaging conflicts of interest." (New York Stock Exchange, 2009) The board independence is calculated as the proportion of independent directors on the board at the end of year t (Wang & Coffey, 1992).

Other measures of firms’ characteristics and performance should be considered. The firm size is generally used as a control variable in an analysis of financial performance and is proved to be related to market returns by Fama and French (1993), among others. Therefore, we include firm size as the control variable in the regression (FIRM_SIZE). Firm size is determined as the natural logarithm of total assets (Nguyen et al., 2015). We also control the firms’ sales growth (GROWTH_SALE). Sales growth is calculated as the percentage of the difference between the operating income of year t and the operating income of the previous year t-1. The next variable is firms’ asset growth (GROWTH_TA). Asset growth is computed as the percentage of the difference between the total assets of year t and the total assets of the previous year t-1. The probability of a firm experiencing a loss at the end of each year is included as a dummy variable (LOSS), which is equal to 1 if the firm generates the negative earnings at the end of year t, and 0 otherwise. The debt-to-assets ratio (DEBT) is also employed as a control variable. DEBT is measured by the ratio of total debt to total assets. We expect firms with negative net gain (LOSS), a higher proportion of debt (DEBT), higher sales growth (GROWTH_SALE), and size growth (GROWTH_TA) would have higher volatility of profitability.

4.3 Regression model

Based on previous literature, we formulate the original regression model, presented as below:

$$RISK_{i,t} = \alpha_0 + \beta 1\, GENDER\_DIVERSITY_{i,t} + \beta 2\, BOARD\_SIZE_{i,t} + \beta 3\, CEO\_BOARD_{i,t} + \beta 4\, CEO\_CHAIR_{i,t} + \beta 5\, INDEPENDENT_{i,t} +$$

$$\beta 6\ FIRM\_SIZE_{i,t} + \beta 7\ GROWTH\_SALE_{i,t} + \beta 8\ GROWTH\_TA_{i,t} + \beta 9\ LOSS_{i,t} + \beta 10\ DEBT_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where $RISK_{i,t}$ is the risk-taking measure, in this model, volatility of profitability for firm i at year t, $\alpha 0$ is a constant, $GENDER\_DIVERSITY_{i,t}$ is measured by the percentage of female directors on board ($FEMALE\_PERCENT_{i,t}$) or the female dummy variable ($FEMALE\_DUMMY_{i,t}$); $BOARD\_SIZE_{i,t}$ is the number of board members; $CEO\_BOARD_{i,t}$ is the dummy variable of the presence of CEO on the board; $CEO\_CHAIR_{i,t}$ is the dummy variable of CEO and chairman duality; $INDEPENDENT_{i,t}$ is the percentage of independent directors; $FIRM\_SIZE_{i,t}$ is the natural log of firm's total assets; $GROWTH\_SALE_{i,t}$ is the percentage of firm's growth in sales at year t; $GROWTH\_TA_{i,t}$ is the percentage of firm's growth in total assets at year t; $LOSS_{i,t}$ is the dummy variable of firm's loss at year t; $DEBT_{i,t}$ is the firm debt-to-assets ratio at year t, and $\varepsilon_{i,t}$ is an error term. Robust standard errors are included in all regression models to control for serial correlation and heteroscedasticity.

4.4 Endogeneity

Due to omitted unobservable firm characteristics in corporate governance, endogeneity can be a potential problem. Omitted variables that affect both the selection of female directors and governance choices could lead to spurious correlations between board gender diversity and firm characteristics variables. We assume that corporate culture does not vary over the studied time frame and impose firm fixed and time fixed effects to address the concern that omitted firm characteristic is driving our results, whenever possible. The regression model (2) for the OLS with fixed effects is structured as follows:

$$RISK_{i,t} = \alpha_0 + \beta 1\ GENDER\_DIVERSITY_{i,t} + \beta 2\ BOARD\_SIZE_{i,t} + \beta 3\ CEO\_BOARD_{i,t} + \beta 4\ CEO\_CHAIR_{i,t} + \beta 5\ INDEPENDENT_{i,t} +$$

$$\beta 6\ FIRM\_SIZE_{i,t} + \beta 7\ GROWTH\_SALE_{i,t} + \beta 8\ GROWTH\_TA_{i,t} + \beta 9\ LOSS_{i,t} + \beta 10\ DEBT_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

where γ_i is firm-fixed effects and δ_t is the time-fixed effects.

Another concern is the endogeneity between female directors and firm risk-taking since firm performance indicators can affect board female members' recruitment (Adams & Ferreira, 2009). Two alternative model specifications are adopted to address this potential endogeneity concern.

The first approach is introducing one-year lagged board gender diversity measures and one-year lagged board characteristic variables as the alternative variables in the main regression, based on the assumption that it takes time for female directors and board characteristics to influence firm performance (Liu et al., 2014). This alternative model specification is estimated using the panel regression with fixed effects and is referred to as FE with lagged variables method. The regression model (3) for the OLS regression with both cross-sectional and time-fixed effects and lagged board characteristics is structured as follows:

$$RISK_{i,t} = \alpha_0 + \beta 1\ GENDER\_DIVERSITY_{i,t-1} + \beta 2\ BOARD\_SIZE_{i,t-1} + \beta 3\ CEO\_BOARD_{i,t-1} + \beta 4\ CEO\_CHAIR_{i,t-1} + \beta 5\ INDEPENDENT_{i,t-1} + \beta 6\ FIRM\_SIZE_{i,t} + \beta 7\ GROWTH\_SALE_{i,t} + \beta 8\ GROWTH\_TA_{i,t} + \beta 9\ LOSS_{i,t} + \beta 10\ DEBT_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (3)$$

where $GENDER\_DIVERSITY_{i,t-1}$ is defined as the value of the percentage of female directors on board or the female dummy variable at the end of year t – 1. Other lagged variables, including $BOARD\_SIZE_{i,t-1}$, $CEO\_BOARD_{i,t-1}$, $CEO\_CHAIR_{i,t-1}$ and $INDEPENDENT_{i,t-1}$, are determined by the value of introduced board characteristics variables at the end of year t– 1.

Based on previous studies, we assume that the historical value of firm performance indicators affects board composition (Hermalin & Weisbach, 1998; Raheja, 2005; Harris & Raviv, 2008; Wintoki et al., 2012). In the second approach, we adopt lagged risk variable into the main regression and estimate the augmented regression via Generalized Method of Moments (GMM) estimation. According to Wintoki et al. (2012), the dynamic panel GMM estimator, which is contributively developed by (Holtz-Eakin, Newey, & Rosen, 1988; Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998), can improve ordinary least squares (OLS) or traditional fixed-effects estimates in three important perspectives. Firstly, firm-fixed effects can be added to address unobservable heterogeneity issues. Secondly, GMM estimation can inflect past performance influence on current governance. Lastly, variables from the past can be adopted as valid 'internal' instruments, therefore it is unnecessary to seek external instruments. The detailed estimation and choices of variables set will be discussed further in Section 5.3. This specification is referred to as the GMM estimation, structured as follow:

$$RISK_{i,t} = \alpha_0 + \beta 1\, GENDER\_DIVERSITY_{i,t} + \beta 2\, BOARD\_SIZE_{i,t} + \beta 3\, CEO\_BOARD_{i,t} + \beta 4\, CEO\_CHAIR_{i,t} + \beta 5\, INDEPENDENT_{i,t} + \beta 6\, FIRM\_SIZE_{i,t} + \beta 7\, GROWTH\_SALE_{i,t} + \beta 8\, GROWTH\_TA_{i,t} + \beta 9\, LOSS_{i,t} + \beta 10\, DEBT_{i,t} + \mathrm{T}.\lambda + \eta_t + \varepsilon_{i,t} \quad (4)$$

Where $\mathrm{T}.\lambda$ the vector of year dummies, η_t is unobserved firm-specific effects and $\varepsilon_{i,t}$ is the error term in the dynamic model.

4.5 Descriptive statistics

Table 1 provides descriptive statistics for the sample. All variables are winsorized at the 0.01 and 0.99 levels to reduce the effect of possibly spurious outliers. The average volatility of profitability is 3,83 percent, with the median value at 2.35 percent. The minimum value of volatility is slightly above zero (0.20 percent) while the maximum value is remarkably high at 25.72 percent, which shows a considerable variation in the sample data.

Only 5 percent of the firm-year observation experiences a loss in the temporary year t. The average percentage of women in the boardroom is 17.11 percent and the most gender-diverse board has 40 percent members being women. The mean value of the gender dummy variable is 0.92, which can be translated as 92 percent of the sample firms in the temporary year t having at least one female member on the board. Most firms (99 percent) have the CEO being present on board. Three-quarters of boards have the CEO-chairman dual position. The majority of board directors are independent directors, who account for 82.15 percent of board members on average. The mean value of the board size variable is 2.36 (ln), which means that the average board size in the sample is 10.6. There is variation in sales growth and assets growth among firms. The average growth is 8.4 percent and 8.64 percent for sales and total assets, respectively, while there is a sharp difference between the maximum value and the minimum: 373 percent and -309 percent for sales and 163 percent and 28 percent for total assets, respectively.

The correlation matrix is shown in Table 2. The risk-taking variable (RISK) is negatively and statistically significantly related to both board gender variables, as well as other control variables including board size, board independence, CEO's presence in the board, CEO duality, firm assets, profitable ratio, sale growth, and leverage ratio. Board gender variables are highly correlated with each other, which can be easily explained by their nature and does not affect the empirical results since they are imposed in separated regression models. In general, there is a low level of correlation among independent variables, with a notable exception featuring the relationships between the board size and the firm size (48 percent), but not high enough to be problematic.

The distribution of firms in the sample is presented in Appendix I. Firms are categorized into industry groups, based on a 2-digit SIC code. The business services industry (two-digit SIC code 73; 39 firms, or 8.97 percent of the sample) has the highest number of sample firms, followed by electric, gas, and sanitary services (two-digit SIC code 49; 34 firms, or 7.82 percent of the sample). Instruments products (two-digit SIC code 38) and chemicals (two-digit SIC code; 28) share the same next position with 31 firms or 7.13

percent of the sample. There is also a high frequency of firms from the insurance carriers' sector (two-digit SIC code 63; 27 firms, or 6.20 percent of the sample), holdings, and other investments (two-digit SIC code 67; 26 firms, or 5.98 percent of the sample). Meanwhile, heavy construction (two-digit SIC code 16), special trade (two-digit SIC code 17), textile mill products (two-digit SIC code 22), lumber and wood (two-digit SIC code 24), leather (two-digit SIC code 31), pipelines except for natural gas (two-digit SIC code 46), food stores (two-digit SIC code 54), furniture stores (two-digit SIC code 57), real estate (two-digit SIC code 65), motion pictures (two-digit SIC code 78) are the least participated sectors with only one firm or 0,23 percent of the sample.

Table 3: Descriptive Statistics

This table presents the descriptive statistics of all firm and board variables. The sample encompasses 435 firms that are examined within the period 2004-2017. The firm's financial data and board characteristics are obtained from the Worldscope Database and the Thomson Reuters' Aset 4 Database (ESG). All variables are winsorized at the 1st and 99th percentiles.

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
RISK	3.83	2.35	25.72	0.20	4.49	3851
FEMALE_PERCENT	17.11	16.67	40.00	0.00	8.90	3851
FEMALE_DUMMY	0.92	1.00	1.00	0.00	0.27	3851
BOARD_SIZE	2.36	2.40	2.83	1.79	0.20	3851
CEO_BOARD	0.99	1.00	1.00	0.00	0.10	3851
CEO_CHAIR	0.75	1.00	1.00	0.00	0.44	3851
INDEPENDENT	82.15	84.62	93.75	45.45	9.79	3851
FIRM_SIZE	16.48	16.41	20.41	13.08	1.28	3851
GROWTH_SALE	8.43	6.83	373.21	-304.99	66.71	3851
GROWTH_TA	8.64	4.79	162.69	-28.70	22.46	3851
LOSS	0.05	0.00	1.00	0.00	0.23	3851
DEBT	27.58	26.02	79.88	0.00	17.59	3851

RISK is calculated as the volatility over a 5-year period of the ratio of earnings before interest and taxes to total annual average assets. FEMALE_PERCENT is calculated as the ratio of female directors on the board to the total number of board members. FEMALE_DUMMY is the dummy variable which is equal to one if at least one woman is present on the board of directors, and zero otherwise. BOARD_SIZE is the logarithm of the number of board members. CEO_BOARD is the dummy variable which is equal to one if the CEO is present in the board of directors, and zero otherwise. CEO_CHAIR is the dummy variable which is equal to one if the CEO occupies the chairman seat of the board, and zero otherwise. INDEPENDENT is the ratio of independent directors in the board of directors. FIRM_SIZE is the logarithm of the total assets. GROWTH_SALE is the logarithm of the yearly growth in revenue. GROWTH_TA is the logarithm of the yearly growth in total assets. LOSS is the dummy variable that is equal to one if the firm sees a loss in the temporary year t, and zero otherwise. DEBT is calculated by the ratio of financial debt divided by the sum of financial debt plus equity.

Table 4: Correlation Matrix

This table presents the correlation with all the variables that are employed in this study.

		1	2	3	4	5	6	7	8	9	10	11	12
1	RISK	**1.00**											
2	FEMALE_PERCENT	-0.14	**1.00**										
3	FEMALE_DUMMY	-0.10	0.56	**1.00**									
4	BOARD_SIZE	-0.11	0.18	0.33	**1.00**								
5	CEO_BOARD	-0.01	-0.03	0.00	0.08	**1.00**							
6	CEO_CHAIR	-0.10	0.02	-0.01	0.05	0.04	**1.00**						
7	INDEPENDENT	-0.10	0.23	0.14	0.10	0.08	0.00	**1.00**					
8	FIRM_SIZE	-0.18	0.23	0.20	0.48	0.03	0.06	0.13	**1.00**				
9	GROWTH_SALE	-0.08	-0.04	-0.01	0.00	-0.01	0.00	-0.02	-0.01	**1.00**			
10	GROWTH_TA	0.02	-0.08	-0.06	-0.03	0.01	-0.02	-0.05	-0.05	0.14	**1.00**		
11	LOSS	0.41	-0.04	-0.05	-0.04	-0.02	-0.02	-0.03	-0.02	-0.16	-0.11	**1.00**	
12	DEBT	-0.01	-0.01	-0.03	-0.02	0.02	-0.03	0.00	0.00	-0.03	-0.02	0.05	**1.00**

* Refer to Table 3 for detailed variable descriptions.

5 Results

In this chapter, we present the results obtained from empirical estimations. Firstly, we examine the research subject through OLS regressions controlled by time and firm fixed effects. We addressed endogeneity concerns by employing regression specifications through two approaches: fixed effects with lagged dependent variables and Generalized Moment Methods estimators. The robustness of empirical results is checked against several alternative variable specifications, including introducing additional proxies for gender diversity and risk-taking.

5.1 OLS regressions

In the first stage, the OLS regression is applied to test the relationship between the gender diversity of the board and the firm risk proxy (1). The results are reported in Table 3.

Both gender diversity variables appear to be negatively correlated with the firm risk-taking, statistically significant at the 1 percent level. Other board characteristics variables including the CEO duality dummy and the percentage of independent directors on board are negatively related to the risk indicator as well. This also applies to the firm size, sale growth, and debt ratio. Otherwise, total assets growth and the loss dummy are positively correlated with the firm risk. However, adjusted R-squared statistics for both regressions are remarkably low, at 21.6 percent and 21.3 percent, respectively, which can be interpreted as a warning that the model might contain several issues.

Unobserved firm-specific characteristics that influence the relationship between board gender diversity and firm risk may cause biased and inconsistent results. Therefore, both cross-sectional and time-fixed effects are added to the OLS regression to address these potential concerns. The results of OLS regression with fixed effects (2) are presented in Table 5.

After controlling for both firm and time fixed effects, the female director percentage variable is still negatively related to firm risk-taking, statistically significant at 5 percent level, while the dummy variable for women presentation on board shows no statistically significant relationship to risk measure.

There are changes in the coefficients of other control variables after applying fixed effects. In the OLS regression with fixed effects, the board size, and the debt ratio are positively correlated with firm risk. The links of other control variables, which include the dummy for CEO duality, independent directors' percentage, and the loss dummy, with firm risk seem to remain in line with the results of the original OLS regression.

In general, the results of the OLS regression with fixed effects differ remarkably from the previous findings of the pooled OLS regression. However, the board gender diversity measured by the percentage of female directors on board is still negatively related to the firm risk-taking, even after controlling for both cross-sectional and time variation of unobserved variables, which hints that their relationship may not be driven by omitted firm-specific characteristics. This finding is in contrast with (Adams & Ferreira, 2009) and (Sila et al., 2016), both of whom find that after controlling for cross-sectional and time variation, board gender diversity does not affect firm performance (Tobin's Q) and the volatility of daily stock returns respectively.

5.2 FE with lagged dependent variables

Although the examined relationships may not be driven by unobserved firm-specific characteristics, it is still prone to reverse causality problems. According to Liu et al. (2014), there may exist a time delay for the board traits and characteristics to influence the firm performance. Therefore, lagged variables, including one-year-lagged risk proxy, one-year lagged board gender diversity measures, and one-year lagged board characteristic variables, are introduced to the main regression, following Liu et al. (2014); Coles, Daniel, & Naveen (2006) and Berger & Bouwman (2013). The results are shown in Table 6.

As can be seen in Table 6, the percentage of female directors on board in the previous year is negatively related to firm risk-taking, statistically significant at a 10 percent level. This also applies to the possibility of the CEO being the chairman and the ratio of independent directors in the previous year, all statistically significant at a 1 percent level. In contrast, the number of board members in the previous year and the dept ratio positively link to the risk variable.

Overall, the results imply that the firm risk may be influenced by historical board characteristics, including board gender diversity, which is consistent with previous studies of Liu et al. (2014), Coles et al. (2006), and Berger & Bouwman (2013).

Table 5: Pooled Ordinary Square: effects of board gender diversity

This table presents the OLS results of the regression model (1) and (2). Robust standard errors of each coefficient are shown in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively.
Refer to Table 3 for detailed variable descriptions.

	RISK							
		OLS	(1)			OLS with FE		(2)
C	14.770	***	15.341	***	28.439	***	27.696	***
	(1.183)		(1.179)		(3.179)		(3.263)	
FEMALE_PERCENT	-0.040	***			-0.023	**		
	(0.008)				(0.01)			
FEMALE_DUMMY			-0.726	***			-0.355	
			(0.258)				(0.288)	
BOARD_SIZE	-0.028		0.102		0.654	*	0.749	*
	(0.375)		(0.389)		(0.383)		(0.406)	
CEO_BOARD	0.284		0.424		0.119		0.198	
	(0.654)		(0.655)		(0.847)		(0.849)	
CEO_CHAIR	-0.905	***	-0.928	***	-0.729	***	-0.736	***
	(0.148)		(0.148)		(0.193)		(0.195)	
INDEPENDENT	-0.023	***	-0.028	***	-0.028	***	-0.028	***
	(0.007)		(0.007)		(0.008)		(0.008)	
FIRM_SIZE	-0.494	***	-0.531	***	-1.459	***	-1.433	***
	(0.058)		(0.057)		(0.214)		(0.218)	
GROWTH_SALE	-0.002	*	-0.002	*	-0.001		-0.001	
	(0.001)		(0.001)		(0.001)		(0.001)	
GROWTH_TA	0.009	***	0.010	***	0.004		0.004	
	(0.003)		(0.003)		(0.003)		(0.003)	
LOSS	7.891	***	7.922	***	3.330	***	3.327	***
	(0.288)		(0.288)		(1.015)		(1.017)	
DEBT	-0.009	**	-0.009	**	0.028	***	0.028	***
	(0.004)		(0.004)		(0.008)		(0.008)	
R-squared	0.218		0.215		0.701		0.701	
Adjusted R-squared	0.216		0.213		0.661		0.661	
Observations	3851		3851		3851		3851	
Firms	435		435		435		435	
Time Fixed effects	No		No		Yes		Yes	
Firm Fixed effects	No		No		Yes		Yes	

Table 6: FE with lagged dependent variables

This table presents the OLS results of the regression model (3). Robust standard errors of each coefficient are shown in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively.
Refer to Table 3 for detailed variable descriptions.

	RISK			
C	31.235	***	30.738	***
	(3.224)		(3.374)	
FEMALE_PERCENT (t-1)	-0.017	*		
	(0.01)			
FEMALE_DUMMY (t-1)			-0.232	
			(0.327)	
BOARD_SIZE (t-1)	0.693	*	0.759	*
	(0.376)		(0.418)	
CEO_BOARD (t-1)	-0.259		-0.199	
	(0.957)		(0.958)	
CEO_CHAIR (t-1)	-0.725	***	-0.730	***
	(0.223)		(0.224)	
INDEPENDENT (t-1)	-0.031	***	-0.031	***
	(0.009)		(0.009)	
FIRM_SIZE	-1.567	***	-1.552	***
	(0.202)		(0.209)	
GROWTH_SALE	0.001		0.001	
	(0.001)		(0.001)	
GROWTH_TA	0.003		0.003	
	(0.003)		(0.003)	
LOSS	-0.048		-0.040	
	(1.005)		(1.005)	
DEBT	0.018	**	0.018	**
	(0.009)		(0.009)	
R-squared	0.684		0.684	
Adjusted R-squared	0.641		0.641	
Observations	3851		3851	
Firms	435		435	
Time fixed effects	Yes		Yes	
Firm Fixed effects	Yes		Yes	

5.3 GMM estimators

Wintoki et al. (2012) suggest that OLS regressions may be biased upwards due to unobservable heterogeneity and the endogeneity caused by the impact of the past governance on current firm characteristics. Under the assumption that unobserved heterogeneity is time-fixed, we re-estimate the relation between the board gender diversity and firm risk using a dynamic GMM panel estimation. The GMM estimation was introduced by Holtz-Eakin et al. (1988) and Arellano & Bond (1991) and further developed in studies by Arellano & Bover (1995) and Blundell & Bond (1998). Following Wintoki et al. (2012), we re-estimate model (1) via GMM estimation using two-step lagged values of the explanatory variables as instruments for the current explanatory variables. We use historical values of firm performance variables as instruments for current changes in these variables, which include the values of firm size, the sale growth, the size growth, the probability of experiencing a loss, and the debt ratio in the previous year. The result is reported in Table 5.

The coefficient of female directors' percentage is positive; however, there is no statistically significant relationship existing between both board gender diversity variables and firm risk-taking. Coefficients of board member number variable, CEO presence on board dummy variable, firm size variable are all negative and statistically significant. However, these coefficients are unusually large (-19.346, -33.222, and -3.790 respectively), which may hint at some potential issues arising in the estimation. The only positive coefficient is CEO duality, which is oddly large (14.280), statistically significant at a 1 percent level. This result is conflicted with previous regressions and our expectations.

In general, the results of the estimation are highly questionable and hence unreliable. It is implied that the regression using the GMM estimators may be exposed to several serious issues or not be conducted appropriately, which influences its consistency and stability.

Table 7: GMM estimators

This table presents the results of the regression model (4) through Generalized Moment Methods. Robust standard errors of each coefficient are shown in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively.

	RISK			
FEMALE_PERCENT	0.139			
	(0.176)			
FEMALE_DUMMY			-0.574	
			(4.315)	
BOARD_SIZE	-19.346	***	-19.387	**
	(7.427)		(7.785)	
CEO_BOARD	-33.222	**	-28.190	**
	(15.047)		(12.957)	
CEO_CHAIR	14.280	***	13.623	***
	(3.793)		(3.324)	
INDEPENDENT	-0.157		-0.150	
	(0.131)		(0.129)	
FIRM_SIZE	-3.790	**	-2.980	**
	(1.722)		(1.492)	
GROWTH_SALE	-0.004	*	-0.003	*
	(0.002)		(0.002)	
GROWTH_TA	-0.001		-0.002	
	(0.008)		(0.008)	
LOSS	-0.097		0.078	
	(0.944)		(0.922)	
DEBT	-0.201	**	-0.183	**
	(0.082)		(0.075)	
Observations	2976		2976	
Firms	434		434	

Cross-section fixed (first differences)
Instrument list: @Dynamic RISK (t-2); RISK (t-1); FIRM_SIZE (t-1); GROWTH_SALE (t-1), GROWTH_TA (t-1); LOSS (t-1); DEBT (t-1)
Constant is added to the instrument list.

5.4 Robustness tests

In general, the results from previous estimations show statistical evidence of a potential relationship between women's participation in the boardroom the corporate risk-taking. An increase in the percentage of female directors may reduce the volatility of firms' profitability. We found no significant link between the presence of at least one female member on board and firm risk-taking, even after controlling for various control variables, unobservable firm characteristics, the potential delayed effect of board characteristics on the firm's risk policy, and re-estimating by Generalized Moment Methods. There is statistical evidence that the dual position of CEO/chairperson and a higher proportion of independent directors may reduce the firm's risk-taking, while higher leverage possibly links with higher volatility of profitability. The results are generally expected; however, they might be driven by several unidentified issues arising from the model, which requires further robustness checks.

In this section, we consider several alternative interpretations to check the robustness of empirical results. Alternative variable specifications are introduced, including additional proxies for gender diversity and risk-taking.

5.4.1 Alternative proxy for gender diversity

Based on prior literature (Campbell & Mínguez-Vera, 2007; Nguyen et al., 2015; Nadeem et al., 2017), we check the robustness of the estimation by adopting the Blau index and Shannon index for gender diversity as alternative proxies for gender diversity.

Blau index, which is proposed by the sociologist Blau, P (1977), is a popular index for diversity in sociology, psychology, and management studies. In this research, the Blau index is defined as:

$$BLAU = 1 - \sum_{i=1}^{n} p_i^2$$

where Pi is the percentage of board members in each category and n is the total number of board members. Blau index values range from 0 to 0.5, reaching the maximum value when the board has the same number of male and female members.

Shannon's diversity index, which is among the most widely used index for diversity, is introduced by Shannon, C. (1948). In this study, Shannon index is defined as:

$$SHANNON = -\sum_{i=1}^{n} p_i - \ln p_i$$

where Pi is the percentage of board members in each category and n is the total number of board members. The higher (lower) value of the index indicates the higher (lower) the diversity of groups in a particular community. SHANNON index ranges from 0 to 1, where zero value indicates a homogenous community.

We re-estimate model (1) with the newly introduced indexes adopted as gender diversity variables and fixed effects controlled. Results are presented in Table 8. OLS regression with fixed effects shows that both BLAU and SHANNON variables are negatively related to the risk variable, statistically significant at the 5 percent level. Coefficients of the board size variable, loss dummy, and debt ratio, are all positive and statistically significant. CEO duality dummy, independent director percentage, and firm size are negatively linked to the firm risk-taking, all statistically significant at the 1 percent level.

Overall, the results are not conflicted with the original OLS regression (2) which employs the FEMALE_PERCENTAGE variable with fixed effects. They further reaffirm that there might exist a negative relationship between the firm's risk-taking and board gender diversity, as well as the CEO duality, the board’s independence. In contrast, the debt ratio and the loss experience may have a positive impact on firm risk.

5.4.2 Alternative proxies for firm risk

In another approach, we test the robustness by employing other measures for firms' risk. Two measures are considered. The first one is the volatility of profitability adjusted by industry benchmark. The second measure is the difference between the maximum and the minimum values of profitability ratio over a 5-year overlapping window.

Industry-adjusted volatility

We employ the volatility of industry-adjusted profitability, *RISK_adjusted,* as an alternative proxy for firms' risk. The volatility of industry-adjusted profitability is adopted in several studies, including John et al. (2008) and Faccio et al. (2011). Industry-adjusted profitability is defined as the difference between a firm's ROTA ratio and the industry benchmark, which is calculated as the average ROTA across all S&P 500 firms in the same core three-digit SIC industry for each year. Firms operating in higher growth rates industries are more likely to take greater risks, which may raise endogeneity concerns. In theory, by removing the systematic influence of the industry's economic cycle, we may have a cleaner measure of the level of risk-taking resulting from corporate governance. In this study, *RISK_adjusted* is calculated as the standard deviation of the adjusted profitability for each firm over 5-year overlapping windows (2004-2008; 2005-2009; 2006-2010; 2007-2011; 2008-2012; 2009-2013; 2010-2014; 2011-2015; 2012-2016; 2013-2017), a minimum of five observations required. The results are shown in Table 7.

There is no significant relationship existing between any of the gender diversity variables and the adjusted dependent variable. The board size is negatively related to the adjusted volatility, statistically significant at the 1 percent level. The proportion of independent directors and the loss dummy are positively related to industry-adjusted volatility and statistically significant at the 1 percent and 5 percent level, respectively.

Overall, the model performs poorly against the robustness check. The results seem ambiguous and unstable; however, it is possible that the calculation method for adjusted dependent variable value might not be optimized and leads to questionable results.

Profitability ratio gap

We use the profitability ratio gap (*RISK_GAP*), which was previously adopted by (Faccio et al., 2011), as another alternative proxy for the firm risk. *RISK_GAP* is calculated as the difference between the maximum and the minimum value of the ROTA ratio of each firm over the 5-year interval windows (2004-2008; 2005-2009; 2006-2010; 2007-2011; 2008-2012; 2009-2013; 2010-2014; 2011-2015; 2012-2016; 2013-2017). The results of OLS regression with firm and time fixed effects are reported in table 8.

As can be seen in Table 8, the proportion of female directors is negatively correlated with the alternative risk proxy, statistically significant at the 1 percent level. Results for other controller variables are largely consistent with ones from the OLS regression with fixed effects (2) using the original dependable variable. The dummy variable for CEO duality, the percentage of independent directors on board, and the firm size are negatively linked to the ROTA gap, statistically significant at 1 percent level and 5 percent level. The coefficients for the loss dummy and the debt ratio are positive, statistically at the 1 percent level.

These test results support our earlier statement about the negative relationship between the board gender diversity and the firm's risk-taking. The links also stay strong in the cases of CEO duality, the board independence, the loss experience, and the debt ratio, even after checking for robustness.

Table 8: Robustness test: Alternative gender diversity variables

Blau index is defined as $1 - \sum_{i=1}^{n} p_i^2$ where Pi is the percentage of board members in each category and n is the total number of board members. Shannon index is defined as $-\sum_{i=1}^{n} p_i \ -\ln p_i$, where Pi is the percentage of board members in each category and n is the total number of board members. Robust standard errors of each coefficient are shown in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively.

	RISK			
C	28.370	***	28.226	***
	(3.179)		(3.188)	
BLAU	-1.974	**		
	(0.815)			
SHANNON			-4.837	**
			(2.064)	
BOARD_SIZE	0.692	*	0.722	*
	(0.385)		(0.389)	
CEO_BOARD	0.127		0.150	
	(0.842)		(0.84)	
CEO_CHAIR	-0.731	***	-0.735	***
	(0.193)		(0.194)	
INDEPENDENT	-0.027	***	-0.028	***
	(0.008)		(0.008)	
FIRM_SIZE	-1.454	***	-1.447	***
	(0.214)		(0.215)	
GROWTH_SALE	-0.001		-0.001	
	(0.001)		(0.001)	
GROWTH_TA	0.004		0.004	
	(0.003)		(0.003)	
LOSS	3.336	***	3.340	***
	(1.017)		(1.019)	
DEBT	0.028	***	0.028	***
	(0.008)		(0.008)	
R-squared	0.701		0.701	
Adjusted R-squared	0.661		0.661	
Observations	3851		3851	
Firms	435		435	
Time fixed effects	Yes		Yes	
Firm Fixed effects	Yes		Yes	

Table 9: Robustness test: Volatility of industry-adjusted profitability as an alternative dependent variable

RISK_adjusted is calculated as the standard deviation of the adjusted profitability ROTA ratio for each firm over 5-year overlapping windows (2004-2008; 2005-2009; 2006-2010; 2007-2011; 2008-2012; 2009-2013; 2010-2014; 2011-2015; 2012-2016; 2013-2017). Robust standard errors of each coefficient are shown in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively.

	RISK_adjusted			
C	-3.062		-5.454	
	(17.547)		(17.434)	
FEMALE_PERCENT	-0.063			
	(0.052)			
FEMALE_DUMMY			-1.638	
			(1.083)	
BOARD_SIZE	-6.038	***	-5.601	***
	(1.63)		(1.56)	
CEO_BOARD	-0.655		-0.448	
	(1.099)		(1.072)	
CEO_CHAIR	-0.620		-0.647	
	(0.929)		(0.929)	
INDEPENDENT	0.088	***	0.088	***
	(0.033)		(0.033)	
FIRM_SIZE	1.430		1.530	
	(0.986)		(0.985)	
GROWTH_SALE	-0.006		-0.006	
	(0.003)		(0.003)	
GROWTH_TA	0.013		0.012	
	(0.011)		(0.011)	
LOSS	2.577	**	2.570	**
	(1.069)		(1.076)	
DEBT	0.029		0.028	
	(0.02)		(0.02)	
R-squared	0.673		0.673	
Adjusted R-squared	0.630		0.630	
Observations	3851		3851	
Firms	435		435	
Time fixed effects	Yes		Yes	
Firm Fixed effects	Yes		Yes	

Table 10: Robustness test: Profitability gap as an alternative dependent variable

RISK_GAP is calculated as the difference between the maximum and the minimum value of the ROTA ratio over the 5-year interval (2008-2013, 2009-2014, 2010-2015, 2011-2016, 2012-2017). Robust standard errors of each coefficient are shown in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively.

	RISK_GAP			
C	33.586	***	32.281	***
	(6.093)		(6.218)	
FEMALE_PERCENT	-0.040	***		
	(0.015)			
FEMALE_DUMMY			-0.659	
			(0.421)	
BOARD_SIZE	1.188	*	1.364	**
	(0.677)		(0.694)	
CEO_BOARD	-0.160		-0.025	
	(1.256)		(1.268)	
CEO_CHAIR	-1.214	***	-1.227	***
	(0.351)		(0.353)	
INDEPENDENT	-0.030	**	-0.031	**
	(0.015)		(0.015)	
FIRM_SIZE	-1.535	***	-1.488	***
	(0.384)		(0.392)	
GROWTH_SALE	-0.001		-0.001	
	(0.002)		(0.002)	
GROWTH_TA	0.011	*	0.011	*
	(0.006)		(0.006)	
LOSS	5.645	***	5.640	***
	(1.774)		(1.778)	
DEBT	0.047	***	0.047	***
	(0.012)		(0.012)	
R-squared	0.716		0.716	
Adjusted R-squared	0.678		0.678	
Observations	3851		3851	
Firms	435		435	
Time fixed effects	Yes		Yes	
Firm Fixed effects	Yes		Yes	

6 Conclusion

Based on the empirical results, this chapter will discuss the theoretical implications gained from this study, as well as its limitations, which invite future research.

6.1 Theoretical implications

This study examines the link between board gender diversity and risk-taking of S&P500 listed firms over the period 2004-2017, with the exclusion of depository institutions. The theoretical framework is developed on the background of corporate governance systems, the mechanism of the board of directors, and existing related theories including agency theory, resource dependence theory, and tokenism theory. Based on the previous literature related to the subject, we hypothesize firms with more gender-diverse boards of directors would have a lower level of risk-taking. Panel data methodology is applied to examine the impact of board gender diversity, measured by the presence of female members and their proportion on board of directors, on firm risk-taking, measured by the volatility of profitability ratio (ROTA ratio). The model is controlled by multiple control variables, including board characteristics and firm performance indicators. We control omitted firm characteristics through firm fixed effect and time fixed effects applied to the models. Potential endogeneity concerns are addressed by regression specifications added in two approaches: fixed effects with lagged dependent variables and Generalized Moment Methods estimators. The models are checked against robustness by adopting alternative measures of board gender diversity (Blau index and Shannon index for diversity) and alternative proxy of firm risk-taking (volatility of profitability adjusted by industry benchmarks and profitability ratio gap).

On the one hand, estimations with fixed effects report significant evidence that firms having a more gender-diverse board tend to have less riskiness than others, which matches our expectation and is in line with prior literature (Adams & Ferreira, 2009; de Cabo et al., 2012; Setiyono & Tarazi, 2014; Saeed et al., 2016; Bernile et al., 2016; Chen, J. et al., 2019). The higher proportion of female directors in the boardroom and its past

value in the previous year is linked to the lower volatility of profitability. The results remain valid against the robustness checks, which adopt the Blau index and Shannon index as two alternative variables for board gender diversity. The negative relationship between board diversity and firm risk-taking stays stable, even after the gap profitability is added into the model as a new placebo for risk.

On the other hand, the presence of a minimum of one woman on board appears to have no impact on corporate risk-taking. In this case, tokenism theory might contribute a reasonable explanation: the single female director may be regarded as a "token" in a male-dominated boardroom and hardly influence the decision-making process, consequently (Kanter, 1977; Adams & Ferreira, 2009). Another explanation may originate from our variable selection in this study. Most firm-year observations in the sample have at least one female director on board (92 percent), therefore it may cause the results to lose their statistical significance. Boards with only one female member for long consecutive years may not be a good sign for board gender diversity: a company may have a female director appointed to comply with regulations while having no sincere intention to promote the diversity further (Guldiken et al., 2019). Therefore, having at least one female director may fail to be the optimal measure of the presence of women in the boardroom. One person might be not enough to make a difference in the boardroom; however, the scenario can change if the quantity reaches a certain critical number. This observation triggers demand for further research to determine the critical number of women needed on board to eliminate the "tokenism" effect.

Among the most interesting findings is the strong statistical evidence on the negative relationship between the dual position of CEO/ chairperson and the volatility of profitability. Firms with the CEO presiding over the board at the same time may have lower risk-taking, which seems contrary to existing literature (Jensen, 1993, Adam et al. 2015) and arguments behind recent regulations and law enforcement supporting the separation of the chairman position and CEO (Tonello, 2011). The impact of CEO duality on corporate governance has been a debated researched subject for a long time; however, it is clear

that the CEO/chairperson dual-position has enormously influenced the board's operation. CEO/chairperson duality is common among the United States public-listed companies; however, its popularity decreases recently. While the mass media and many academic scholars call for limiting CEO power to prevent conflicts of interests (Monks, 2011), this study shows the evidence from the other perspective. We suggest that research on this subject be extended with alternative multi-dimensional approaches.

The results also imply that firms with a higher fraction of independent directors may have lower volatility of profitability. This would be the advocate argument for the tendency toward outside directors in the boardroom following a series of corporate scandals in 2001-2002. In fact, according to NYSE and NASDAQ's guidelines, independent directors must comprise a majority of the board in a listed company (Nasdaq Listing Center, 2009; New York Stock Exchange, 2009).

It is noted that the higher chances the company experiences loss in the previous year and the higher leverage possibly links to higher riskiness, which is understandable due to the nature of the variable. These results meet our expectations and remain stable through multiple tests.

In our attempt to address potential endogeneity issues, the regressions using GMM estimators perform poorly and lead to questionable results. We expect that Generalized Moment Methods would improve traditional fixed-effects OLS estimation by inflecting the past performance influence on current governance; however, the results are not statistically significant and appear to be abnormal. This failure suggests that there may exist several serious issues in the regression model itself, while potential endogeneity concerns are still untouched. It is also implied that the relationship between gender diversity and firm risk-taking is probably far more complicated than we assume. This sparks the question of whether a single board characteristic should be considered as the critical determinant of corporate governance. In other words, can a single board characteristic

compete with other indexes that consider multiple measures of corporate charter provisions and board characteristics? (Bhagat et al., 2010)

In general, this study provides support for the view that women's increasing participation in high management levels may contribute to preventing firms' risky decisions and behaviors, therefore increasing firms' performance. Evidence shows that gender diversity on boards could practically benefit corporates, not just for mere "social justice" purposes. From the corporate's perspective, it is strongly recommended that companies should consider diversity aspects when making recruitment and appointment decisions. From the public policy perspective, it advocates for the roles of regulators in creating a more friendly working environment for women and promoting gender diversity in high-level positions.

6.2 Limitations and suggestions for future research

The empirical results reported herein should be considered in the light of some limitations, which could be addressed in future research.

The first flaw comes from our selection of variables. The dummy variable for the presence of female directors on board is determined based on having at least one woman in the boardroom. Estimation results show that this criterion might not be the optimal choice for a board gender diversity variable, due to both statistical problems and the tokenism effect. We hope studies in the future provide better evidence and explanation to this phenomenon, as well as creative tools designed to determine how many female directors are on board to reach a critical mass.

Secondly, the models perform poorly in addressing existing endogeneity issues. The estimations with Generalized Moment Methods do not work as we expect and produce questionable results, therefore the model might contain several severe endogeneity concerns which are still untreated. It is implied that the relationship between gender

diversity and firm risk is probably far more complicated than we assume. These problems can be mitigated in several ways, including adopting alternative approaches, re-designing the models, or introducing new controllers.

Finally, due to our limited access to sources and databases, the data sample is bounded within S&P500 companies in the period from 2004 to 2017. A small sample may lead to bias, while the timeframe might become outdated. Therefore, we recommend further research conducted in a more extended and updated data sample.

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Appendix 1. List of industries

Appendix I: List of industries

Sic code	Industries	Frequency	Percent
10	Metal mining	2	0.46
13	Oil and gas	16	3.68
14	Nonmetallic minerals	2	0.46
15	General building	3	0.69
16	Heavy construction	1	0.23
17	Special trade	1	0.23
20	Food products	19	4.37
21	Tobacco products	2	0.46
22	Textile Mill Products	1	0.23
23	Apparel	4	0.92
24	Lumber and wood	1	0.23
25	Furniture	2	0.46
26	Paper products	4	0.92
27	Printing and publishing	2	0.46
28	Chemicals	31	7.13
29	Petroleum and coal	6	1.38
30	Rubber and plastics	3	0.69
31	Leather	1	0.23
33	Primary metal	3	0.69
34	Fabricated metal	6	1.38
35	Machinery and equipment	15	3.45
36	Electronic equipment	24	5.52
37	Transportation equipment	10	2.30
38	Instruments products	31	7.13
39	Misc. manufacturing	2	0.46
40	Railroad transportation	4	0.92

42	Trucking and warehousing	3	0.69
44	Water transportation	2	0.46
45	Transportation by air	5	1.15
46	Pipelines, Except Natural Gas	1	0.23
47	Transportation services	3	0.69
48	Communications	13	2.99
49	Electric, gas, and sanitary services	34	7.82
50	Wholesale trade-durables	9	2.07
51	Wholesale trade-nondurables	6	1.38
52	Building materials and gardening	4	0.92
53	General merchandise stores	6	1.38
54	Food stores	1	0.23
55	Automotive dealers	4	0.92
56	Apparel and accessory stores	6	1.38
57	Furniture stores	1	0.23
58	Eating and drinking places	5	1.15
59	Miscellaneous retail	8	1.84
61	Non-depository Institutions	2	0.46
62	Security and commodity brokers	11	2.53
63	Insurance carriers	27	6.21
64	Insurance agents, Brokers and service	4	0.92
65	Real Estate	1	0.23
67	Holding and other investments	26	5.98
70	Hotels and other lodging places	4	0.92
72	Personal Services	2	0.46
73	Business services	39	8.97
78	Motion Pictures	1	0.23
80	Health services	6	1.38
87	Engineering and Management services	5	1.15
		435	**100**