SCHOOL OF ECONOMICS AND MANAGEMENT

The Impact of Board Gender Diversity on Firm Capital Structure

A Quantitative Study on S&P 500 firms

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Abstract

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Key Words: board gender diversity, capital structure, critical mass, female risk aversion, leverage, debt-to-capital, trade-off theory, pecking order theory, agency theory.

Purpose: The objective of this study is to determine whether or not board gender diversity influences the capital structures of S&P 500 firms. This is done based on the premise of female risk aversion and conventional capital structure and agency issues theories. With this foundation, we intend to close the knowledge gap regarding the effects of gender diversity on corporate boards.

Methodology: In this study, a panel dataset is analysed using ordinary least squares (OLS) regressions. OLS regressions include both pooled OLS and fixed effects. In addition, robust standard errors clustered by firm id are employed to address heteroskedasticity issues. The DTC dependent variable and the main explanatory variable board gender diversity are finally subjected to a robustness test.

Theoretical Perspectives: This investigation is grounded in conventional theories of capital structure, such as trade-off theory and pecking order theory. In addition, it includes a conventional theory, namely agency theory, as well as a relatively contemporary theory known as critical mass. These theoretical channels have been discussed previously in either capital structure or gender diversity research. To establish the relationship between board gender diversity and capital structure and these theories, we include the following.

Empirical Foundation: The data sample is 354 firms listed on S&P 50 from 2015-2022.

Conclusions: This paper's findings support the notion that board gender diversity is negatively related to the debt in a firm's capital structure, which is consistent with both previous empirical findings on this topic and psychological literature describing the risk-averse behaviour of women. In addition, the results support the critical mass literature, as we find strong evidence that there must be a threshold of women on the board for them to have a significant impact on corporate decision-making.

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1. Introduction

The introductory chapter provides context for the study by describing the research topic and the approach taken by previous studies. Afterwards, both general problems and gaps in prior research are described, followed by the purpose of the study, the empirical findings, and the anticipated contribution.

1.1 General Background

Corporate governance has been a ubiquitous topic in business and finance discussions (Keasey et al., 2005). The board of directors of a firm plays a critical role in corporate governance, including strategic decision-making and solvency considerations (Platt and Platt, 2012). The underrepresentation of women in corporate boardrooms has become a significant issue, with recent research indicating that male directors still outnumber female board members in S&P 1500 firms, and common male names surpassing the total number of female directors (EY, 2022). This disparity has prompted scholars to investigate the potential impact of board gender diversity (BGD) on financial performance and board governance.

Numerous discussions have called for the inclusion of more women on boards, leading to increased attention on the effects of BGD on firm performance. Gender quotas have been implemented in some countries, such as Norway, demonstrating their potential benefits (Nielsen and Huse, 2010). Studies have shown that female characteristics such as transparency and risk aversion may positively impact board performance, leading to improved decision-making and outcomes (Francoeur et al., 2008; Lucas-Pérez et al., 2015). To promote greater female representation, larger firms have enacted regulations to increase the number of women on boards, including Nasdaq's approval of disclosure requirements for board diversity data (Semuels, 2022).

Despite the abundance of discussions regarding BGD's relation to firm performance, its relation to capital structure remains unclear. Understanding the capital structure of a firm is essential for determining how operations are financed and the mix of debt and equity employed. Numerous capital structure theories have been advanced to explain the financing decisions made by firms. Firstly, the trade-off theory suggests that firms seek an optimal capital structure by balancing the tax benefits of debt with the costs and risks associated with financial distress (Myers, 1984). Secondly, the pecking order theory posits that firms prioritise internal financing, followed by debt, and then equity, based on the availability and costs of different funding sources (Myers and Majluf, 1984). Furthermore, the agency theory has been discussed in a similar manner to these capital structure theories, as it emphasises the role of stakeholder conflicts of interest, and how they influence capital structure decisions (Jensen and Meckling, 1976). For instance, the composition of a firm's capital structure can be a crucial factor for assessing its financial health and risk profile among shareholders. Thus, considering that previous studies have found that women are less risk tolerant than men (Dohmen et al., 2011), a gender-diverse board could suggest less risk-taking and, consequently, a lower default risk.

The few prevailing studies within BGD and capital structure have demonstrated validation towards the conventional capital structure theories. For instance, Ben Saad and Belkacem (2022) and Coleman and Rob (2009) have discovered a negative relationship between BGD and leverage, proving the validity of established theories. This validation not only supports the notion of female risk aversion, but also suggests that gender-diverse boards may exhibit a reduced appetite for risk, resulting in a lower default risk. Nevertheless, a number of studies have produced contradictory findings, indicating either a positive relationship (Nisiyama and Nakamura, 2018) or no relationship (Mori, 2014) between these variables. Such inconsistency contributes to the ambiguity surrounding this research field. Therefore, additional research is necessary to clarify the relationship between BGD and capital structure. In order to address this knowledge gap, this paper examines the relationship between BGD and capital structure within the context of S&P 500 firms.

1.2 Problem Discussion

In recent decades, there has been a substantial increase in scholarly interest in corporate governance, particularly concerning the impact of the board of directors on the strategic decisions and performance of a firm. While extensive research has been conducted on the impact of board diversity on a firm's performance, the relationship between BGD and the capital structure of firms in this context has received relatively less attention.

Studies on capital structure have reached a consensus that leverage is positively correlated with firm size. For instance, Rajan and Zingales (1995) and Titman and Wessels (1988) concur that larger firms tend to be more leveraged, although their probability of default remains low. Prior BGD research has considered the possibility that firm size moderates firm performance, where a negative effect has been identified (Li and Chen, 2018). However, they do not appear to have considered its impact on the capital structure. Due to stakeholder pressure, larger firms are more likely to appoint women to their boards (Nahavandi and Malekzadeh, 1993; Papadakis, 2006). Smaller firms, on the other hand, may have greater flexibility in their board structures due to their less bureaucratic nature (Xie, 2014).

Regarding the impact of BGD on capital structure, the majority of research in this area demonstrated mixed results. For instance, Ben Saad and Belkacem (2022) and Coleman and Rob (2009) discovered that a more diverse board is associated with lower leverage. The former study indicates that increased board diversity increases firm transparency while decreasing risk appetite. This premise is supported by other academics, albeit from diverse perspectives. For instance, Barua et al. (2010) and Francis et al. (2015) hypothesise that female CFOs tend to implement risk-averse, conservative corporate policies. In a similar vein, Schopol et al. (2021) found that female CFOs in the UK can successfully reduce leverage in firms, particularly when the board is diverse and the CEO is not overly dominant. Other studies, however, find inconclusive or contradictory evidence. For instance, Nisiyama and Nakamura (2018) found a positive relationship between board diversity and leverage, whereas Mori (2014) found no significant association between these variables.

As suggested by Byrnes et al. (1999), a possible explanation for the negative relationship between BGD and leverage found in numerous studies is women's greater risk aversion. Women may be more circumspect in their decision-making, resulting in a preference for lower debt levels. According to research conducted by Peni and Vähämaa (2010), diverse boards prioritise a greater number of stakeholders than non-diverse boards. This consideration of multiple perspectives and interests may impact the capital structure decisions of the organisation. In a similar vein, Bilimoria and Piderit (1994) found that gender-diverse boards prioritise cash reserves and conservative financing strategies, thereby enhancing the firm's liquidity position and reducing financial risk.

The effect of critical mass theory is a second perspective that has been applied within this field of research, but is relatively understudied. Harris (2014), one of the few who has investigated this in relation to BGD, suggests that achieving a minimum of 25 percent female representation on the board is necessary for exerting a significant influence over the capital structure and decision-making processes of the firm. Even though Harris (2014) discovered intriguing evidence, she used a relatively small sample of 78 firms during 2012-2013. Furthermore, to our best knowledge, few other empirical studies appear to have linked BGD and the capital structures of firms to the critical mass theory, especially on S&P 500 firms. Thus, it is essential to investigate the relationship between BGD and firms' capital structure in order to supplement existing literature, validate or challenge capital structure theories, and gain new insights into the topic.

1.3 Purpose and Research Question

Consequently, the purpose of this paper is to empirically examine the effect that BGD has on the capital structure of a firm. As a means of defining the scope of this study, the American market has been chosen for investigation in order to facilitate greater comparability with previous studies, the majority of which have focused on this market. This will be accomplished using panel data on 354 publicly traded firms from the S&P 500 from 2015 to 2022. The current time frame has been selected on account of its historically reduced interest rates, which are anticipated to impact the board's inclination towards risk and their resultant choices. Furthermore, it enables an examination of trends and dynamics over an extended period, encompassing both pre- and post-pandemic periods, which may have had implications for both board composition and financing decisions. In order to address the objective of the study, the following research questions are posed:

- ***How does board gender diversity impact S&P 500 firm's capital structure?***
- ***How does a critical mass of female board members impact S&P 500 firm's capital structure?***
- ***How does firm size moderate the relationship between board gender diversity and capital structure?***

1.4 Contribution

This paper contributes to the existing literature by extending a small body of research that seeks to bridge the gap in scientific understanding concerning the relationship between the ongoing debate regarding BGD and its influence on firms financing choices. By analysing a vast dataset, the study improves the understanding of the factors that influence capital structure decisions, a crucial aspect of corporate financial decision-making. In addition, the findings shed light on how BGD may influence firms' financing choices, such as debt and equity ratios, with significant implications for risk management, cost of capital, and overall firm performance. To the best of our knowledge, this is the first study to investigate the relationship between gender diversity, critical mass, and capital structure in S&P 500 firms and to analyse firm size as a moderating effect on capital structure. In addition, we incorporate the currently unstudied moderating effect of firm size on capital structure, in relation to BGD. We use econometric techniques such as pooled OLS and fixed effects. Furthermore, despite the existence of a small number of studies with contradictory findings, there is an absence of a comprehensive understanding of the effect of BGD on a firm's capital structure.

1.5 Outline

As the study's introduction, the first chapter provides an overview of the study's context, problem statement, purpose, and research question. The second chapter provides a framework for understanding the conventional theories underlying capital structure and agency concerns. In addition, it includes a relatively new theory prevalent in gender diversity research on a broad scale. To better understand and articulate the study's hypotheses, the third chapter provides pertinent empirical literature from the field. The fourth chapter describes the sample universe, including sample description and selection, dependent, explanatory, and control variables. This chapter also includes explanations of the primary econometric methodology and statistical tests utilised in the study. The fifth chapter presents descriptive statistics and correlation analyses, followed by regression models, a robustness test, and a discussion of endogeneity. In addition, it is coupled with an analysis from both a theoretical and literary standpoint. The sixth chapter concludes with findings-based conclusions and suggestions for future research.

2. Theoretical Framework

The ambiguity of the BGD and capital structure research findings suggests that no single theory adequately explains their interrelationships. This has been acknowledged by Carter et al. (2003), and as a result, the focus of the second chapter will be divided into two sections: capital structure and board diversity. The chapter will begin by discussing theories pertaining to the capital structure of a firm, namely trade-off theory and pecking order theory, and complemented by the agency theory. The chapter will conclude with a discussion of board diversity, which will lay the foundation for the premise regarding female risk aversion, board diversity studies in general, and the studies regarding critical mass.

2.1 Capital Structure

2.1.1 Trade-off Theory

The trade-off theory posits that firms seek a combination of equity and debt financing that maximises the benefits of debt issuance while minimising its drawbacks. The tax shield is a tax advantage provided by debt financing, which can be advantageous. However, Modigliani and Miller (1963) proposed that firms could achieve the optimal capital structure through the use of 100 percent debt financing, a strategy that is rarely implemented.

Moreover, the relationship between shareholders, creditors, and managers, which is impacted by BGD, can influence capital structure decisions involving trade-offs. The presence of gender diversity on boards influences the association between leverage and financial distress costs (Jensen and Meckling, 1976; Kraus and Litzenberger, 1973). Higher debt levels increase the probability of incurring financial distress costs, such as bankruptcy costs, sales loss, and goodwill. Considering the potential impact on the firm’s image and stakeholder relationships, gender-diverse boards may advocate for a cautious debt financing strategy. These factors may result in a more balanced capital structure that minimises financial distress costs while maximising the tax benefits of debt financing.

2.1.2 Pecking Order Theory

The pecking order theory challenges the notion that firms strive for the optimal combination of debt and equity to minimise their cost of capital. Instead, the theory posits that firms have a predetermined preference for various financing sources. According to this theory, retained earnings, or funds generated internally, are the preferred source of capital. Retained earnings are popular due to their perceived ease of access and the absence of associated issuance costs. When retained earnings are insufficient, external financing through bank loans becomes the second option, and issuing equity is the final alternative (Donaldson, 2000).

When analysing its connection to BGD, the presence of information asymmetries becomes a crucial factor. Myers (1984) contends that the cost of equity issuance is influenced by the information asymmetry between managers and public investors. Myers and Majluf (1984) note that debt and equity in the pecking order are more sensitive to information asymmetry than retained earnings. Thus, higher levels of information asymmetry are typically accompanied by a greater reliance on retained earnings as a source of funding, due to adverse selection and signalling issues that are associated with the other financing options. When additional funds are required, these firms may prefer to issue less financing sources, such as short-term debt, rather than long-term debt or equity at a substantial discount (Myers, 1984).

The implications of the pecking order theory for BGD are noteworthy. Diverse boards can contribute to increased information transparency and decreased information asymmetries (Carter, et al., 2003; Erhardt, et al., 2003). With increased gender diversity, boards may be in a better position to bridge the gap between managers and public investors, thereby reducing information asymmetry. Consequently, firms with more gender-diverse boards may be in a better position to access and rely on external financing options, deviating from the strict pecking order preference.

2.1.3 Agency Theory

Agency theory posits that when the interests of principals (e.g., shareholders) and agents (e.g., managers) diverge, agents may prioritise their own interests over those of the principals, resulting in agency costs. Governance mechanisms such as incentives, monitoring, and governance structures have been proposed to mitigate these costs (Jensen and Meckling, 1976). The board of directors plays a crucial role in monitoring and directing management actions among these mechanisms (Fama and Jensen, 1983).

Extensive research in the field of corporate governance has highlighted the significance of gender diversity on boards. It has been discovered that gender-diverse boards improve corporate performance, thereby influencing a firm's capital structure. According to research by Adams and Ferreira (2009) and Carter et al. (2010), gender-diverse boards are associated with greater firm value and financial performance. Additionally, they are associated with lower debt levels and higher equity values. Several factors can be attributed to this relationship. First, gender-diverse boards are more likely to represent diverse stakeholder interests and provide a variety of perspectives, resulting in better decision-making (Carter et al., 2010). Second, such boards are more effective at monitoring management, thereby improving corporate governance and firm performance (Adams and Ferreira, 2009). Moreover, gender-diverse boards tend to demonstrate greater social responsibility, resulting in enhanced reputation and financial performance (Terjesen et al., 2016). However, according to the agency theory, characteristics such as firm size influence managerial behaviour and the associated agency costs (Jensen and Meckling, 1976), which are unstudied in relation to BGD at present.

Agency theory also explains the relationship between BGD and capital structure, as it can reduce agency costs by aligning principal and agent interests. For instance, gender-diverse boards can be more effective at monitoring management, leading to improved financial performance and decreased agency costs (Hillman and Dalziel, 2003). In turn, this can result in a more optimal capital structure, as managers are less likely to pursue their own interests at the expense of shareholders. According to existing research, this is a result of the conservatism, risk aversion, and ethical behaviour exhibited by women. Srinidhi et al. (2011) discovered that gender-diverse boards are associated with superior earnings, which can be attributed to the members' "value-commitment" and the resulting "disciplining incentive". Based on the premise that BGD reduces agency costs, one might anticipate an inverse relationship between BGD and leverage, since debt is not required as a disciplinary mechanism to constrain managers' behaviour.

2.2 Board Diversity

2.2.1 Female Risk Aversion

Numerous studies in the field of behavioural finance have demonstrated that females exhibit a greater inclination towards risk aversion as compared to males. As per the findings of Dohmen et al. (2011), it has been observed that women exhibit lower risk-taking behaviour and possess a comparatively lower risk tolerance than men. Additional empirical investigation suggests that females exhibit a greater propensity to evade unfavourable consequences and augment their sense of safety (Byrnes et al., 1999; Cumming et al., 2015). Research has shown that there are gender differences in investment behaviour. Specifically, female investors tend to exhibit a lower tolerance for risk compared to their male counterparts (Barber and Odean, 2001). Additionally, female investors tend to prioritise risk reduction in their portfolio investments (Olsen and Cox, 2001) and tend to favour less risky assets in their retirement plans (Agnew et al., 2003). Huang and Kisgen (2013) contend that women are perceived as less attractive borrowers due to their risk aversion, potentially leading to less advantageous conditions and constraining their ability to secure external funding. This is the case, particularly for investors (lenders) seeking higher yields. In contrast to the aforementioned claim, Powell (1990) posits that there are no noteworthy disparities between male and female entrepreneurs.

Peni and Vähämaa (2010) have noted a significant gender-based difference in risk aversion and decision-making, as previously documented in management and psychology literature. According to the authors, there exists a tendency for women to exhibit greater risk aversion and caution in scenarios that require decision-making when compared to men. Several studies have investigated the impact of the difference in gender representation on corporate governance and its potential implications. Specifically, these studies have explored the effects of female executives on a firm's financial performance and market value. The study conducted by Zlata et al. (2022) aimed to examine the potential differences in risk aversion and ethical behaviour between female CEOs and their male counterparts. The authors propose that female CEOs exhibit a greater tendency towards risk aversion in comparison to their male counterparts. Nevertheless, their investigation yielded no substantiation to suggest that women in this position demonstrate a higher level of ethical conduct than men.

2.2.2 Board Gender Diversity

"With corporate governance, the concept of diversity relates to board composition and the varied combination of attributes, characteristics, and expertise contributed by individual board members in relation to board process and decision making"

*(*Van der Walt & Ingley, 2003*)*

Considerable research has been conducted on boardroom diversity, particularly as it relates to observable characteristics such as gender, race, and educational background (Milliken and Martins, 1996; Pelled, 1996). Scholars from all over the world, including Adams and Ferreira (2009), Campbell and Mnguez-Vera (2008), Reguera-Alvarado et al. (2017), and Terjesen et al. (2016), have investigated the connection between board diversity, corporate governance, and performance. Although the social justifications for increasing board diversity are clear, the emphasis on financial justifications has led to more ambiguous assessments.

Nielsen and Huse (2010) studied the implementation of gender quotas in countries like Norway and discovered positive outcomes for firms. In Norway, quotas improved discussions, environmental monitoring, benchmarking, and relationships with stakeholders. Research indicates that gender-diverse boards enhance economic performance and support efficiency (Lucas-Pérez et al., 2015). Spain also adopted quotas. Mentioning gender-specific characteristics such as risk aversion and transparency, Francoeur et al. (2008) assert that firms operating in complex environments benefit from a higher proportion of women on boards. Other researchers, however, have discovered insufficient support for quotas (Bhren and Strm, 2010; Ferreira, 2015) and, in some instances, unfavourable outcomes (Ahern and Dittmar, 2012; Labelle et al., 2015).

2.2.3 Critical Mass

The theoretical framework of critical mass posits that the impact of a particular subset is contingent upon the attainment of a specific numerical threshold of members. The concept of critical mass in relation to gender diversity on corporate boards refers to the minimum number of female directors that must be present in order to exert a discernible influence on the performance of the firm. According to Terjesen et al. (2009), firms that have only one female board member tend to perceive her as a symbolic figure with negligible influence on financial results. Bilimoria (2006) and Simpson et al. (2010) proposed that the presence of a critical mass of women on the board should be utilised as a metric to evaluate the extent to which women are perceived as authentic contributors to the upper echelon of the executive team. According to Harris (2014), it is argued that a minimum of 25 percent of board members should be comprised of women directors in order to achieve critical mass. Consequently, upon meeting the threshold, it is probable that their viewpoints could impact the decision-making process, despite potential disparities with the majority of the board.

Numerous empirical investigations have provided evidence in favour of the critical mass theory within the framework of BGD. Post and Byron's (2015) research revealed that the presence of at least three women on a board had a favourable effect on board monitoring in relation to gender diversity. Conversely, Harris (2014) discovered that when the threshold of 25 percent was reached, a negative relationship with leverage was observed. Oyotode-Adebile and Raja (2019) found that firms with a board composition of at least 29 percent females exhibit lower yields, higher ratings, larger issue size, and shorter maturity on their corporate bonds. The statement posits that the attainment of a significant number of female directors is not solely crucial for the purpose of promoting diversity and inclusivity, but also yields concrete advantages for the performance of the firm.

3. Literature Review and Hypothesis Development

The third chapter establishes a connection between the concept and theories introduced in the theoretical background and previously conducted empirical studies in the field of board gender diversity and its relationship to firm operations. The chapter will consist of a literature review pertaining to BGD and capital structure, as well as whether or not the findings of previous studies confirm or contradict conventional theories. Lastly, the hypotheses are developed based on the theoretical framework and related empirical papers.

3.1 Board Gender Diversity and Capital Structure

Carter et al. (2003) and Erhardt et al. (2003) argue that diverse boards may contribute to increased information transparency and, consequently, reduced information asymmetries. This premise suggests that gender-diverse boards favour external financing options over retained earnings, thereby deviating from the strict pecking order preference (Myers, 1984). Furthermore, the preference of women towards debt financing over equity, as a manifestation of risk aversion, may establish a conceivable association between BGD and capital structure. According to Coleman and Robb's study (2009), female-led firms exhibit a lower reliance on debt financing compared to their male-led counterparts. This statement suggests that women may exhibit a greater degree of hesitancy towards incurring debt and the potential hazard that may accompany it. Chen et al. (2016) posits that gender-diverse boards tend to enhance the risk management of the firm. Moreover, it suggests that equity appears to be the preferred form of financing over debt in gender-diverse boards.

Ben Saad and Belkacem (2022) conducted a study on non-financial firms in France during the timeframe of 2006-2019. Through the implementation of various empirical methodologies, including the Chow test, a cohort of 282 French firms were analysed, revealing a negative relationship between boards that exhibit gender diversity and leverage. The research indicates that firm transparency and risk-taking are significant factors, with gender diversity on the board having an impact. Specifically, the study found that the presence of women on boards is associated with an increase in firm transparency and a decrease in risk-taking. Additionally, the research suggests that gender diversity on boards is unlikely to result in an increase in debt, as firms seek to avoid bankruptcy (ibid.). The theory of pecking order posits that financing preferences of firms are influenced by information asymmetry between them and capital markets, as suggested by Myers (1984). This statement aligns with previous research that has indicated a positive relationship between board diversity and increased transparency and supervision of management reporting. This, in turn, may mitigate information asymmetry and promote a greater inclination towards equity financing (Ahmed et al., 2017; Gul et al., 2011; Srindhi et al., 2011).

Moreover, academics have addressed the viewpoints on BGDs effect on corporate bond financing. Li and Zhang (2019) conducted an analysis of the debt maturity structures in relation to female directors. The study utilised a sample of 1379 firms from S&P 1500, during the period of 1997-2016. The authors posit a hypothesis and subsequently provide evidence to suggest that firms with a higher percentage of female board members are more inclined to utilise short-term debt as a mechanism for monitoring. Moreover, the authors suggest that the relationship between BGD and short-term debt declines among financially restricted firms, as determined by factors such as Altman Z-score and firm size. Harris et al. (2019) argues that female directors, owing to their lower risk preference, contribute to a reduction in financing costs by causing less financial stress.

There is a growing body of evidence indicating that gender-based risk preference is manifested in the decision-making processes of firms, particularly at the senior management level. According to Barua et al. (2010) and Francis et al. (2015), firms that are headed by female CFOs tend to implement corporate policies that are less risky and exhibit financial reporting practices that are more conservative. Schopol et al. (2021) conducted a study to investigate the relationship between female CFOs and firm leverage in the UK. The researchers have discovered noteworthy outcomes, suggesting that female CFOs do, in fact, decrease the leverage of firms. Furthermore, it is argued that firms with diverse boards in terms of gender, nationality, and age, and where the CEO's influence is not overly dominant, female CFOs are more effective in reducing leverage. The study conducted by Bilimoria and Piderit (1994) provides further confirmation of conventional theories regarding female risk aversion. The study indicates that gender-diverse boards tend to prioritise cash reserves and conservative financing strategies, i.e., equity, which can improve a firm's liquidity position and decrease financial risk.

Empirical findings from other studies suggest that the influence of BGD on the financial leverage of firms may be insignificant. In a study conducted by Mori (2014), a sample of 105 board directors from 63 firms in Kenya, Tanzania, and Uganda was analysed. The results indicated that there was no significant relationship between the performance of board members and their respective firms. In addition, the study conducted by Nisiyama and Nakamura (2018) revealed that BGD has a favourable impact on monitoring efficiency. Notably, the study also established a positive relationship between BGD and leverage. Therefore, it is apparent that a consensus regarding this topic has not been reached.

3.2 Hypothesis Development

Two primary theories of capital structure are extensively covered in the literature on corporate finance: the trade-off theory (Jensen and Meckling, 1976) and the pecking order theory (Myers and Majluf, 1984). As mentioned previously, the trade-off theory proposes a balance between the costs and benefits of various financial strategies, highlighting the tax advantages of debt, and suggesting a balanced capital structure (Jensen and Meckling, 1976). On the other hand, the pecking order theory argues for a strict preference of financing options, where internal financing is preferred over external financing options, as those are more costly (Myers and Majluf, 1984). On the basis of the latter theory alone, one would assume that firms rely more on internal financing and debt and less on equity. Interestingly, Myers (1984) complements the pecking order theory by adding that firms with high information asymmetry mainly rely on internal financing, as the external financing sources are more sensitive towards adverse selection and signalling issues.

The impact of corporate governance on capital structure has also been studied by using the agency theory, which elucidates the connection between agents (such as managers) and principals (such as shareholders) (Jensen and Meckling, 1976). According to scholarly discourse, there is a contention that BGD can improve the process of decision-making and managerial opportunism (Hillman and Dalziel, 2003). Additionally, it is posited that BGD can foster greater alignment between the interests of the board and a wider range of stakeholders, thereby mitigating agency problems (Adams and Ferreira, 2009).

Carter et al. (2003) and Erhardt et al. (2003) support this claim by arguing that diversifying boards increases information transparency, thereby reducing information asymmetry. Furthermore, the results from previous research challenge the conventional theories within capital structure by revealing a negative relationship between BGD and leverage (Coleman and Robb, 2009; Chen et al., 2016). In turn, this suggests that firms with a more diverse board rely more on conservative financing options, such as retained earnings and equity, rather than on debt, despite equity being more costly than debt. Scholars have proposed that the relatively lower risk aversion exhibited by women, as supported by studies conducted by Dohmen et al. (2011) and Peni and Vahämää (2010), may play a role in explaining this association. Chen et al. (2016) suggest that female board members may prioritise risk management and adopt more conservative capital structures in order to mitigate financial distress costs and reduce the likelihood of bankruptcy (Ben Saad and Belkacem, 2022).

In contrast, other studies provide results that contradict its related empirical papers on BGD and female risk aversion, thereby supporting the conventional theories of capital structure. For instance, Mori (2014) found no relationship between BGD and leverage, while Nisyama and Nakamura (2018) discovered a significant relationship between BGD and leverage. Based on the findings of these studies, it would appear that there is either no significant relationship between the two variables, or that the pecking order theory may have some validity.

Evidently, there exists some ambiguity within the subject of BGD and its relationship to capital structure. Given that the prevailing view among scholars is that there exists an inverse relationship between BGD and the degree of debt in the capital structures of firms, the initial hypothesis posited is as follows:

H1: There is a negative relationship between board gender diversity and firm leverage.

In addition to examining the relationship between BGD and capital structure, few studies have examined the influence of a threshold of women on boards on the latter variable. One of the few to do so is Terjesen et al. (2009), who argued in their study that having one female board member is perceived as a symbolic figure with negligible impact on financial results. In a later study, Harris (2014) argued that it is imperative that the board comprises a minimum of 25 percent female members to ensure their perspectives are adequately represented in the decision-making process. This idea is supported by Post and Byron (2015), who found that boards with at least three women had a positive effect on monitoring efficiency. In light of this premise, boards that meet the criterion may not deem it necessary to issue additional debt as a disciplinary mechanism to restrict manager conduct. Therefore, it is essential to evaluate whether the fulfilment of a threshold amplifies the impact on the firm's capital structure. As such, the second hypothesis can be formulated as follows:

H2: There exists a stronger negative relationship between boards consisting of at least 25 percent women, and firm leverage.

The empirical research on capital structure suggests that the size of a firm may be indicative of its capital structure. Rajan and Zingales (1995) and Titman and Wessels (1988) concur that, in general, larger firms have more leverage than smaller ones and are also less likely to go bankrupt. Evidently, firm size could moderate the decision-making processes of firms (Damanpour, 2010). Due to stakeholder pressure, Nahavandi and Malekzadeh (1993) and Papadakis (2003) argue that larger firms tend to appoint more women to their boards. In contrast, Xie (2014) argues that smaller firms may have a less bureaucratic nature and, consequently, more flexible board structures.

Prior BGD research has focused primarily on firm size as a moderator of firm performance, and to the best of our knowledge, none has examined firm size in relation to capital structure. The agency theory asserts that characteristics, such as firm size, influence managerial behaviour and the associated agency costs (Jensen and Meckling, 1976). However, it is unclear to what extent these characteristics may influence the firm's capital structure with respect to BGD. In the absence of a consensus on the relationship between the moderating effect and capital structure in relation to BGD, we incorporate the moderating effect in order to precisely isolate the effect of BGD on leverage. As such, the third hypothesis can be formulated as follows:

H3: Firm size has a negative moderating effect on the relationship between board gender diversity, and firm leverage.

4. Data and Methodology

The chapter will begin with an introduction and description of the scientific approach applied, followed by a description of the sample formation and data sources. Next, the econometric models implemented are presented. Lately, descriptive statistics from the data set are displayed.

4.1 Introduction and Scientific Approach

The primary objective of this research was to determine the impact of BGD on the capital structure of firms listed on the S&P 500. Consistent with prior scholarship, as evidenced by Ben Saad and Belkacem (2022) and Coleman and Robb (2009), the present investigation employed a deductive framework and utilised quantitative methods to examine the impact of BGD on capital structure.

The present study utilised a six-step methodology (see figure 1) to investigate the board structure of firms listed in the S&P 500. The primary focus of the study was on the gender composition of the board and its potential influence on the capital structure. Furthermore, as a component of the research methodology, we conducted an analysis and assessment of pertinent pre-existing literature pertaining to this subject matter. The scarcity of research on the specific relationship and the lack of a cohesive agreement regarding its significance are noteworthy findings among the empirical studies. The existing literature suggests that there is a predominantly adverse relationship between BGD and capital structure. This trend is largely attributed to the risk-averse nature of females.

4.2 Sample formation and data sources

Initially, the study included the entire S&P 500, yielding 4 000 observations between 2015-2022. However, firms from the financial and utility sectors were excluded as they operate in regulated industries characterised with confounding variables. For instance, capital regulations imposed on banks can make it challenging to assess the impact of other factors, such as board diversity, on their capital structure. Thus, it is customary to exclude financial firms. In addition, observations with missing values were eliminated from the analysis. This left 2 743 observations remaining in total. The sample size was reduced from 500 to 354 after excluding financial and utility firms. Capital IQ was used to collect the data, and STATA was used to compute all regression results and other statistical tables. The calculation of BGD involved a manual determination of the proportion of female board members to the total number of board members, based on data extracted from annual reports. In addition, the remaining control variables were computed utilising the S&P Capital IQ add-on, except for the BGD variables.

4.2.1 Dependent Variable

Debt-to-Capital

In order to investigate if there exists any relationship between capital structure and BGD, it is necessary to introduce a sufficient dependent variable, which in this case will be Debt-to-Capital ratio (DTC). It is constructed through calculating total debt divided by total capital in the specific firm, for each year between 2015-2022. This variable is aimed to be utilised as a proxy for risk, as generally, higher debt ratios are related to higher risk appetite (Ben Saad and Belkacem, 2022; Chen et al., 2016). Conversely, the limitation of this variable is mainly that it may not provide a comprehensive overview of a firm's entire financial risk. We use the level form of DTC since this seems to be the consensus amongst prior researchers who use leverage ratios as the dependent variable (e.g., Ben Saad and Belkacem, 2022; Adusei and Obeng, 2019; Nisiyama and Nakamura, 2018).

4.2.2 Main Explanatory Variables

Board Gender Diversity

Using prior research (e.g., Ben Saad and Belkacem, 2022; Chen et al., 2016), we operationalize BGD as the proportion of female board directors at the end of each fiscal year, which is the study's first main explanatory variable. Ideally, female directors should be used to complement gender diversity on boards. However, Capital IQ does not provide access to this information. This study's board gender diversity variable is computed as percentage of female directors.

Critical Mass

Critical mass is the second explanatory variable in our model, in accordance with prevalent research (see e.g., Bilimoria, 2006; Simpson et al., 2010; Harris, 2014). The primary purpose of this variable is to determine whether a threshold must be met for women on boards to have a meaningful impact on a firm's capital structure. Therefore, it is incorporated as a dummy variable with a value of 1 if the board contains 25 percent or more women and 0 otherwise. Similar to the argument for BGDs influence on corporate leverage, we anticipate a negative relationship in this case as well.

4.2.3 Control Variables

Women dummy

Observing prior research (e.g., Ben Saad and Belkacem, 2022; Chen et al., 2016), we find that it is common to use a female dummy variable as one of the control variables when analysing the relationship between BGD and leverage ratios. Thereby, we choose to implement a female dummy equal to 1 if there are at least three female board members, and 0 otherwise.

Board Size

The board size is included as a variable because it can influence the dynamics of board decision-making (see e.g., Adams and Ferreira (2009), Ben Saad and Belkacem (2022), and Harris (2014)). This is a crucial factor to consider in the study's analysis, as larger boards may be better equipped to accommodate diversity. On the other hand, larger boards may encounter communication issues that lead to over-monitoring, which then results in negative financial outcomes (Harris, 2014).

4.2.4 Firm Specific Variables

Size

Wald (1999) argues that firm size influences transaction costs and, consequently, firm size indirectly influences capital structure. The primary argument presented is that larger firms have less information asymmetries than the smaller ones. This is said to reduce risk and, consequently, external financing costs. Therefore, larger firms should have a greater proportion of debt finance than smaller firms, as debt is a less expensive method for larger firms to acquire capital (pecking order theory).

Multiple studies have utilised the natural logarithm of total assets as a size proxy. Several studies have discovered that size has a substantial impact on capital structure (Wald, 1999; Scherr et al.,1993; Cassar and Holmes, 2003; Michaelas et al., 1999; Swinnen et al., 2005). Therefore, we have chosen to include firm-specific size as a variable in the model.

Profitability

Operating Return on Assets (ROA) is a recognised indicator of a firm's profitability as it reveals how much value is created from its assets. A firm that can utilise its assets more efficiently will have a higher ROA and thus be more valuable. A firm that can exploit its assets more efficiently will have a higher ROA and consequently be more profitable. Operating ROA was utilised by Cassar and Holmes (2003) and Titman and Wessels (1988) as a proxy for profitability. Comparable to the Operating ROA, Swinnen et al. (2005) estimated the profitability with two-year averages of pre-tax earnings over total assets. According to the Pecking Order Theory, there should be a negative relationship between profitability and leverage, as an increase in internal funds reduces the need for external financing (debt). According to the trade-offs theory we would anticipate a beneficial relationship, as higher profitability indicates a lower risk of insolvency.

Growth opportunities

According to the pecking order theory, firms with greater growth opportunities should raise more capital to invest in growth (Smith, 2010). The theory posits that firms will incur debt when internal funds are insufficient to finance business expansion investments. Accordingly, the theory anticipates a positive relationship between growth opportunities and leverage. According to the agency theory, growth opportunities and leverage have a negative relationship (Kayo and Kimura, 2011). The theory suggests that as a firm's growth opportunities increase, so does its agency cost of debt. This is due to the fact that management may be inclined to invest in high-risk projects, which increases the risks associated with financial distress. In response, lenders demand higher interest rates and/or more covenants which discourages firms from taking on debt. Therefore, the agency argues that firms with more growth opportunities are likely to have lower leverage ratios.

Extensive research has been conducted regarding the relationship between growth opportunities and leverage. For instance, Rajan and Zingales (1995) find a positive relationship between growth opportunities and leverage, confirming the pecking order theory. In contrast, Huang and Song (2006) and De Jong et al (2008) establish a negative relationship between growth opportunities and leverage, confirming the agency theory. In the majority of research papers, "market to book" serves as a proxy for growth opportunities. Thus, in this study, it is also incorporated as a proxy for growth opportunities.

Tangibility

Although to a lesser extent than for other variables, the authors of previous studies have employed a variety of proxy variables to measure the impact of the asset structure of the firms. The relationship between tangibility and leverage is anticipated to be positive, given that collateral increases debt accessibility. Swinnen et al. (2005) proxied the asset structure with intangible assets over fixed assets, a method also employed by other researchers (Friend and Lang, 1988; Michaelas et al., 1999). Another method for simulating the asset structure involved dividing fixed assets by total assets. Cassar and Holmes (2003), Chittenden et al. (1996), and Van der Wijs and Thurik (1993) all employ this technique. This will result in a value illustrating the allocation of value among the relevant asset types of the S&P 500 sample firms. We have prioritised fixed assets over total assets in this research paper in anticipation of a positive correlation between tangibility and leverage. This is because the idea underlying the asset structure connection to the pecking order theory is that these assets will be used as collateral, reducing the firm's information asymmetry effect.

Liquidity

Liquidity is measured in this study using the current ratio (cash and cash equivalents/current liabilities). Prior research indicates a negative relationship between liquidity and firms' debt ratios. This relationship is explained by the pecking order theory, which states that firms with greater cash reserves require fewer external funds (Smith, 2010). Nonetheless, other findings suggest a positive relationship between liquidity and debt ratios, with the rationale that firms with greater liquidity also have a greater capacity for borrowing. Therefore, our outlook regarding the effect of liquidity on leverage remains neutral.

Tax Deductibility

In order to develop a proxy for measuring the tax benefits of non-debt tax shields, the prior literature and all other firm-specific variables were reviewed. Using depreciation over total assets appears to be the predominant method for calculating the non-debt tax shield effect. This method is utilised by e.g., Harris (2014), Michaels et al. (1999) and Titman and Wessels (1988). The latter also employ investment tax credits and a non-debt tax shield over total assets. We chose depreciation over total assets as a proxy for measuring the benefits of non-debt tax shields because we were unable to collect data for the latter two methods. A positive relationship is expected between debt tax shield and leverage (trade-off theory).

Altman Z-score

In line with Li and Zhang (2019), we employ the well-known Altman Z-score as a proxy for default risk. We anticipate a negative relationship between the variable and BGD based on the fact that the probability of default rises with increasing leverage and female risk aversion. Lastly, it is a dummy variable, which takes the value of 1 if Z-score is greater than 1,81, and 0 otherwise.

4.2.5 Interaction Terms

Interaction terms can be used to determine if the partial effect of one explanatory variable on the dependent variable, depends on the magnitude of yet another explanatory variable (Woolridge, 2016). Several academic papers employ interaction terms when utilising board composition variables. Yaram and Adapa (2022) study the impact of corporate social responsibility (CSR) and BGD on business risk. The researchers use interaction terms between CSR and BGD to include the effects of females on boards interacting with CSR.

Another example is a study conducted by Li and Chen (2018) who use several interaction terms when conducting research on the relationship between BGD and firm performance. The authors use an interaction term between BGD and firm size. Thereby, we include the following interaction terms:

BGDxSize

When studying the effect of BGD on leverage, an interaction term between the former and firm size can help address any endogeneity issues that may arise. For instance, firms with greater leverage may be more likely to appoint women to their boards, leading to a spurious relationship between BGD and leverage. Using interaction terms between BGD and firm size when studying the impact of board gender diversity on leverage can help capture the effect of board gender diversity that varies by firm size.

BGDxBoard

The purpose of including an interaction term between BGD and board size when examining the relationship between board gender diversity and leverage is to determine if the effect of gender diversity on leverage is contingent on board size. Beyond their individual effects, the interaction term can help to capture the joint effect of board size and gender diversity on leverage. For instance, if gender diversity has a stronger positive effect on leverage for larger boards, then the interaction term would be positive and significant. Conversely, if gender diversity has a weaker effect on leverage for larger boards, then the interaction term would be negative and significant.

CriticalxWomen

The inclusion of an interaction term between critical mass and Womadummy (a female dummy equal to 1 if there are at least 3 women on the board, and 0 otherwise) is intended to capture the effect of the two variables on leverage jointly. A critical mass of women on the board is a percentage of women serving on a board of directors. The interaction term CriticalxWomen is intended to capture the moderating effect that having three females on the board has on the relationship between a critical mass of female directors and DTC. For instance, if the interaction term beta coefficient is statistically significant and negative, it would suggest that having three females on the board reduces the impact that a critical mass of female board directors has on DTC.

CriticalxSize

An interaction term between critical mass and firm size can help address any endogeneity issues that may arise when studying the effect of the former on leverage. For instance, firms with greater leverage may be more likely to appoint women to their boards, resulting in a spurious relationship between critical mass and leverage. By incorporating an interaction term between critical mass and firm size, researchers can control for these potential endogeneity issues and more precisely isolate the effect of critical mass on leverage.

CriticalxBoard

The interaction between critical mass of female directors and board size acknowledges that the effect of critical mass on capital structure may vary depending on size of the board. Incorporating an interaction term enables one to determine whether the impact of critical mass on capital structure varies for firms with larger or smaller boards. This enables a more nuanced analysis that accounts for potential heterogeneous effects and provides insights into how the combined influence of critical mass and board size affects capital structure decisions.

4.3 Econometric models

This study's primary objective is to assess the impact of BGD and Criticalmass on the capital structure of all S&P 500 firms (excluding financial and utility firms). To achieve this goal, the following general models are estimated using two common panel data estimation techniques; pooled OLS and firm fixed effects (FE) techniques:

H1: There is a negative relationship between board gender diversity and firm leverage.

H3: Firm size has a negative moderating effect on the relationship between board gender diversity, and firm leverage.

$DTC_{it} = \beta_0 + \beta_1 BGD_{it} + \beta_2 Womendummy_{it} + \beta_3 BGD_{it} * Size_{it} + \beta_4 Board_{it} +$

$$\beta_5 BGD_{it} * Board_{it} + \beta_6 Size_{it} + \beta_7 ZScore_{it} + \beta_8 ROA_{it} + \beta_9 MTB_{it} + \beta_{10} TANG_{it} +$$

$$\beta_{11} Liquidity_{it} + \beta_{12} TaxDeduct_{it} + \varepsilon_{it}$$

H2: There exists a stronger negative relationship between boards consisting of at least 25 percent women, and firm leverage.

$$DTC_{it} = \beta_0 + \beta_1 Criticalmass_{it} + \beta_2 Womendummy_{it} + \beta_3 Critical * women_{it} + \beta_4 Board_{it} +$$

$$\beta_5 Criticalmass_{it} * Board_{it} + \beta_6 Criticalmass_{it} * Size_{it} + \beta_7 Size_{it} + \beta_8 ROA_{it} +$$

$$\beta_9 ZScore_{it} + \beta_{10} MTB_{it} + \beta_{11} TANG_{it} + \beta_{12} Liquidity_{it} + \beta_{13} TaxDeduct_{it} + \varepsilon_{it}$$

This study employs two separate regressions. The objective of the first regression was to examine the relationship between the proportion of women on boards and leverage *(H1)*. Our third hypothesis has also been integrated into the first regression model with the interaction term "$\beta_3 BGD_{it} * Size_{it}$" with the objective of establishing the moderating impact size has on the relationship between BGD and DTC (*H3*). The objective of the second regression was to examine the relationship between critical mass and firm leverage (*H2*).

For the first regression model (*H1 & H3*) a total of 4 models are created. The first being pooled OLS without control variables and interaction terms. The second being pooled OLS adding all other variables (control and interaction terms). Both of these models include year and industry controls. The third model is a FE model (all variables included) without year and industry controls. The fourth model is a FE model with year and industry controls. The same is applied for the regression model 2 (*H2*). Previous studies which examine the relationship between board gender diversity and capital structure implement pooled OLS and FE regression techniques (e.g., Adusei and Obeng, 2019; Ben Saad and Belkacem, 2022; Mori, 2014).

The reasoning for including year dummy variables is to control for time-related factors that may affect the capital structure of firms. These factors could for example be changes in regulation or changes in business cycles. Year dummies control for these unobserved factors which reduces omitted variable bias. The same logic is applied with regards to industry control variables. Different industries can be characterised by different factors (e.g. risk profiles) which affect capital structure choices. Industry dummies address the issue of unobserved heterogeneity across industries.

DTC is the capital structure measurement and all other variables represent board composition effects and firm-specific variables. The regression models under *H1* and *H3* are identical. We decided to integrate *H3* into the same regression model used in *H1*. The reason for this was that the interaction term "$\beta_3 BGD_{it} * Size_{it}$" is present in both models. Excluding the interaction term between BGD and firm size in *H1* would lead to potential omitted variable bias, misspecification of the model and loss of explanatory power.

Appendix 1 provides a summary of the variable measures, their respective definitions, and their respective data sources. All of the data is gathered from annual reports and Capital IQ. The data has been downloaded to excel. Own calculations have been made for certain variables using STATA (see appendix 2).

4.4 Data and descriptive statistics

Appendix 3 presents summary statistics for the main variables utilised in the two regression models. Interaction terms are omitted from the statistical summary. In statistical models, interaction terms are employed to describe the relationship between two or more variables and their combined effect on the outcome of interest. Typically, they are included in regression models and other advanced statistical analyses, but not in summary statistics. Including interaction terms in the summary statistics contributes nothing of value to the analysis. As a comparison, Yaram and Adapa (2022) exclude interaction terms between BGD and corporate social responsibility from summary statistics and correlation tables.

The first summary statistic exhibited observable extreme values, hence histograms were used to conduct graphical inspections. Extreme values can diminish the statistical validity of regressions. In order to account for outliers, the variables debt-to-capital (DTC), market-to-book (MTB), return on assets (ROA), and tangibility (TANG) have been winsorized at the 1st and 99th percentiles. This is done to improve the precision and interpretation of the results. To account for outliers, the majority of academic papers within empirical finance tends to systematically winsorize accounting variables. In the regression models, the independent variables firm size and board size are expressed in logarithmic form.

As shown in Appendix 3, the DTC-ratio has a wide range between 0 and 7.94. The difference between the mean and the median DTC-ratios appears to be minimal (2 percent). This indicates that more than 50 percent of firms have a DTC-ratio below 50 percent. In our regression models, the main independent variables are board gender diversity (BGD) and critical mass. There appears to be a small disparity between the mean and median values for BGD. The median percentage of women on the board is 25 percent, while the average is 24 percent.

The matrix of *Perason's Correlation* is shown in Appendix 4. The correlation analysis examines the relationships between all variables in regression models. There does not appear to be a specific rule defining what constitutes a high or low correlation. According to Haat et al. (2008) and Hair et al (2010), multicollinearity is problematic if the correlation between the independent variables is greater than 0.8. Since none of the independent variables in Appendix 4 have a correlation coefficient greater than 0.8, there are no multicollinearity issues with the regression.

5. Empirical Results & Analysis

This chapter begins with the Hausman test to determine whether Fixed Effects or Random Effects is sufficient. Next, we present the results of our regressions. Additionally, robustness tests are conducted. In conclusion, an analysis of the results is conducted.

5.1 Hausman test

The Hausman (1978) specification test indicates that the p-value for the first regression model is less than one percent (see Appendix 5). The null hypothesis is that the random effects model (RE) is the preferred model. The alternative hypothesis states that the fixed effects (FE) model is the preferred model. It examines the correlation between the unique errors (u) and the regressors. The null hypothesis suggests that they are not. As the probability of incorrectly rejecting the null hypothesis is below one percent, the alternative hypothesis is accepted. The most accurate model is the one with FE. According to Appendix 6, the same holds true for the second regression model. Both regression models favour the FE model. Therefore, the two methodologies applied will be pooled OLS and FE.

5.2 Results

The results of the first regression model using pooled OLS and FE are presented in Appendix 7. The primary explanatory variable is BGD, as measured by the percentage of female directors. This variable is significant at the 5 percent level of statistical significance in the FE model D. In the pooled OLS models, board gender diversity lacks statistical significance. This is the case in both the pooled OLS model excluding control variables and interaction terms and in the model where these variables are added (see appendix 7, models A & B). In the FE model D, BGD is statistically significant. It is significant at the 5 percent level in the FE model which includes year and industry dummy variables. There appears to be a significant negative relationship between the percentage of women on boards and the debt-to-capital ratio. According to the second FE model (model D), a one percent increase in female proportion (BGD) would result in a 1.04 percent decrease in debt to capital (on average), all else equal. Since a common threshold for statistical significance in many previous studies within the finance field is a p-value of 5 percent or lower, BGD is not considered significant in model C (without year and industry effects).

In the pooled OLS model (including control variables) the variables size, Z-score, MTB and TANG are statistically significant. In the fixed effect model excluding year and industry dummies, Z-score and MTB are significant at the 1 percent level. TANG is significant at the 5 percent level. Z-score displays a negative impact which corresponds with theory. MTB displays a positive relationship in accordance with Rajan and Zingales (1995) findings and TANG displays a positive relationship in accordance with our expectation (trade-off Theory). We see similar results in the second FE model that takes into account control variables and interaction terms. The magnitude and direction of these variable coefficients are more or less the same. Tax deductibility (TaxDeduct) is significant at the 1 percent level in model D and at the 5 percent level in model B. The coefficient shows the expected positive sign (trade-off theory).

The interaction term BGDxSize is also significant at the 5 percent level in the FE model D. The moderating effect of firm size on the relationship between board gender diversity and debt to capital is captured by the coefficient associated with the interaction term "BGDxSize". Since the coefficient is statistically significant we can say that the relationship between BGD and capital structure varies depending on firm size. The effect of BGD on leverage seems to be weaker for larger firms given the negative coefficient "-0.128". For every one unit increase in the product of BGD and firm size, the DTC ratio of the average firm decreases by 0.128 units, all else equal. The presence of BGD has a diminishing impact on DTC as the average firm grows.

Standard errors are clustered at the firm level to take into account the effects of serial correlation in residuals on the computation of standard errors. R-squared shows an increase from 0.05 to 0.38 in model B compared to model A. Adding theoretically and empirically justified control variables and interaction terms reduces omitted variable bias. Control variables also enhance the explanatory power of the model, thereby increasing R-squared. A large increase in R-squared is also observable in model D compared to model C. Adding year and industry dummy variables increase R-squared from 0.08 to 0.24 in the FE models.

Appendix 8 displays the outcomes of the regression analysis utilising pooled OLS and FE methodologies for the second regression model. The coefficient pertaining to critical mass, which is the primary variable in the second model for *H2*, exhibits statistical significance at the 5 percent level across models F and H (see Appendix 8). Model F includes all control variables and interaction terms. Model H differs from model G since it includes year and industry control variables. In models E and G, the main variables lack statistical significance. The women's dummy variable lacks significance in all models.

According to the pooled ordinary least squares (OLS) model F, it is anticipated that the average reduction in the debt to capital ratio will be 0.0779 percent in the presence of a critical mass of 25 percent female board members, holding all other factors unchanged. According to the FE model H, it is anticipated that the debt to capital ratio will decline by 0.0644 percent in response to a critical mass, all other factors held unchanged. The findings indicate a negative relationship between board gender diversity and the proportion of debt to capital, implying a negative association between female representation on boards and capital structure

Z-score, MTB (market-to-book) and TANG (tangibility) display statistical significance at the 1 percent and 5 percent levels in models F through H (see Appendix 8). Size is the only significant model H, at the 5 percent level. TaxDedct (tax deductibility) is significant at the 1 percent level in the FE model that excludes year and industry controls (model G). The direction of the control variables coefficients show the expected signs. R-squared shows the same pattern as in the results for *H1*, increasing when adding control variables.

5.3 Robustness test

To determine the robustness of the negative association between BGD and DTC for S&P 500 firms, we re-estimate the regression models with robust standard errors that account for industry clustering. Capital IQ classifies industries via two-digit SIC codes. Due to the collinearity between firm and industry fixed effects, several industry dummies were omitted from the original models, necessitating the estimation of the robustness test with SE (standard errors) clustered by industry (instead of firm id). We conduct new regressions with industry-specific SE clustering because we have not been able to resolve this issue (collinearity).

The results are detailed in Appendix 9. We observe no sign of variation in BGD or critical mass (*H1* & *H2*). These variables continue to have a statistically significant negative effect on leverage. However, the magnitude of the beta coefficients has changed marginally. In models C* and D*, BGD remains statistically significant at the 1 and 5 percent levels, respectively, and is negatively related to DTC. There has been no change in the beta coefficient direction. Models C* exhibit a slight increase in the magnitude of the BGD coefficient in comparison to model D* displayed in Appendix 9. Model D* demonstrates a greater reduction in the effect of BGD on DTC than model D (see Appendix 7 & 9). The pooled OLS Model B* was statistically significant at the 5 percent level, divergent from the case in the original model with standard errors clustered by firm id. The beta coefficient for "criticalmass" exhibits the same sign and magnitude in model F* as it does in model F. At the 5 percent significance level, the beta coefficient is still statistically significant. The same holds true for the "criticalmass" coefficient in the FE model with controls for industry and year (model H*). The "criticalmass" coefficient lacks statistical significance in all FE models excluding controls for year and industry. The statistical significance of the interaction term "BGDxSize" is demonstrated in models B*, C*, and D*. Given the displayed negative relationship, *H3* is accepted. However, the relationship's strength has diminished compared to model D.

In conclusion, the effect of our main explanatory variables are comparable in magnitude (with the exception of "BGDxSize") and direction to that of earlier models with standard errors clustered by firm id. Clustering by industry does not appear to alter the relationship between BGD and DTC.

In Appendix 10, a second robustness test is conducted. The objective of the second test is to determine if the results differ when net debt is used as the dependent variable (rather than DTC). Similar to the original models, this regression utilises robust standard errors clustered by firm id. The natural logarithm of net debt is used in place of the level form (which is used for DTC). Adusei and Obeng (2019) investigate the effect of BGD on capital structure using the logarithmic form of borrowings. This transformation is employed to mitigate the effect of extreme values on the results.

Appendix 10 presents log-level models (Woolridge, 2016), so the coefficients must be interpreted differently than in the previous models. The coefficient is significant at the 5 percent level in model B**, and at the 1 percent in models C** and D**. In model B** (pooled OLS), a 1 percent increase in BGD is associated with an average 2,5 percent reduction in net debt (all else equal). A 1 percent increase in BGD is associated with a 1,6 percent reduction in net debt in model C** (FE without year and industry dummies). A 1 percent increase in BGD is associated with a 1,8 percent reduction in net debt in model D** (FE with year and industry dummies). The magnitude and direction of the results of the BGD coefficient in model D, with DTC as the dependent variable, are comparable to those of model D**. This increases the result's reliability. However, models B and C are not statistically significant.

The coefficient for the second main independent variable, critical mass (*H2*), is statistically significant in models F**, G**, and H**. In model F** (pooled OLS), a critical mass of 25 percent female representatives results in a 2 percent reduction in net debt, all else equal. In models G** and H** (FE models), the presence of 25 percent female board members is associated with a 5 percent reduction in net debt. The coefficient of the critical mass variable has a much greater impact on net debt than on DTC. The coefficients for the third main independent variable "BGDxSize" (*H3*) is statistically significant in models B** and D**. According to model D, the moderating effect of firm size on the relationship between BGD and net debt appears to be negative. In other words, the effect of BGD on net debt appears to diminish with increasing firm size.

In general, the results of the robustness check confirm the reported original results. The robustness tests confirm the negative relationship between BGD and firm leverage. The robustness tests with net debt as the dependent variable revealed comparable coefficient values for gender diversity on boards. We conclude that the negative association between BGD and capital structure is robust.

5.4 Analysis

5.4.1 Board Gender Diversity and Capital Structure

The purpose of the study was to examine the effect of BGD on capital structure. This was accomplished by testing three separate hypotheses. In the case of the first hypothesis (see section 3.2), the proportion of women on boards, as represented by the variable BGD, is statistically significant, according to the fixed and random effects models. We can assert with 95 percent certainty that gender diversity is negatively related to leverage. Therefore, we accept *H1* and reject the null hypothesis stating that BGD and leverage are unrelated.

Females exhibit less risk-taking behaviour than their male counterparts, as previously discussed (Dohmen et al., 2011). Additional empirical evidence suggests that this behaviour emanates primarily from the private investment portfolios of women, who tend to favour less risky assets (Olsen and Cosen, 2001). This behaviour also extends to their professional conduct, as it has been found that female executives have a strong propensity to avoid exposing the firms to additional risky situations (Barua et al., 2010; Francis et al., 2015; Schopol et al., 2021). Our findings indicate that BGD and leverage have a negative relationship for S&P 500 firms. As a result, the results support the vast majority of previous research findings regarding female risk aversion, and challenge the converse findings of, e.g. Powell (1990).

Using conventional theories to conceptualise our findings, the pecking order theory asserts that there is a ranked order for firms' sources of financing, i.e., internal funds, debt, and then equity. This research cannot confirm whether internal funds are the preferred source of financing. However, the results provide some evidence against the claim that debt is favoured over equity, as they demonstrate a negative relationship between BGD and leverage. As a result, our findings suggest that the greater presence of women on corporate boards favours equity over debt. This observation is consistent with the underlying premise of female risk aversion (Zlata et al., 2022) and prior research in this field (e.g., Ben Saad and Belkacem, 2009), arguing for females' tendency to avoid additional risk. Furthermore, our results could imply, and, thus, support Coleman and Rob’s (2009) notion that women exhibit a greater degree of hesitancy towards issuing more debt. It could also lend support to Chen et al’s. (2016) claim that gender-diverse boards enhance risk management of firms, in this case by maintaining low levels of leverage.

Even though the results do not confirm the usage of internal funding as a prioritised financing option, it can yet be considered as an indirect confirmation of Bilimoria and Piderit's (1994) conclusion that a positive association exists between BGD and cash reserves. Furthermore, this may also be a result of women's reluctance towards the potential risk associated with issuing higher levels of debt, such as higher risk of bankruptcy (Ben Saad and Belkacem, 2022; Chen et al., 2016). As anticipated, this is also reflected in the fact that all three regression models (figures 4 and 5) indicate a negative relationship between DTC and the Altman Z-score. Another implication may be that BGD results in improved firm performance (see, e.g. Adams and Ferreira, 2009), thereby reducing the need for external capital in the form of debt and increasing the reliance on internal funding.

In addition, the results could be interpreted in accordance with Carter et al. (2003) and Erhardt et al. (2003)'s notion that a greater degree of gender diversity in boards results in increased information transparency and, consequently, a reduction in information asymmetry. If our findings indicate a greater reliance on internal financing, this would contradict Myers' (1984) assertion that increased information asymmetry typically results in a greater reliance on retained earnings due to adverse selection and signalling concerns related to external financing options. Inasmuch as our findings are unable to prove this assertion, it may, on the other hand, indicate that gender-diverse boards may be better able to access external financing options beyond retained earnings, thus deviating from the strict pecking order preference.

Similarly, the trade-off theory suggests that firms weigh the benefits and costs of issuing debt (Jensen and Meckling, 1976). Even though there are tax benefits associated with issuing more debt, it is asserted that higher levels of debt increase the risk of default. Our findings suggest that different boards place greater emphasis on avoiding direct and indirect bankruptcy costs than on transferring operational risk to creditors, based on this premise. This could be interpreted as confirmation of Barua et al. (2010) and Francis et al. (2015)'s claim that there is a positive relationship between female executives and conservative corporate policies. As stated previously, the probability of default increases as debt levels rise. Consequently, while it is true that operational risk can be transferred to creditors through increased leverage up to a certain threshold, the potential risk of default remains a major concern for managers who place a premium on the firm's reputation and their employment security. As such, this could also serve as an explanation to why gender-diverse boards are less leveraged, which is consistent with the premise that women have a lower risk appetite than men.

According to agency theory, misaligned interests between principal and agent can result in agency costs (Jensen and Meckling, 1976). There may be a misalignment of incentives between the board and the shareholders if operational risk is not transferred from shareholders to creditors. Scholars contend, however, that gender-diverse boards can be more effective at monitoring management, thereby reducing agency costs (Hillman and Dalziel, 2003). Maintaining lower levels of debt reduces the agency costs of debt and leaves more room for debt in crisis situations where the firm may require capital. This may be an explanation for our findings, which are consistent with Carter et al.'s (2010) assertion that greater board gender diversity is associated with lower DTC levels. In addition, the need for debt may be reduced in gender-diverse boards because debt can be used as a form of board discipline against managers. However, as monitoring effectiveness increases in gender-diverse boards, this may become unnecessary.

Furthermore, Srinidhi et al. (2011), states that gender-diverse boards behave more ethically and are associated with "value-commitment" attributes. In addition, they are associated with superior earnings, which may indicate that there is no misalignment, but rather that they place a greater emphasis on operational performance than on exposing the firm to greater financial risks. In light of these assertions, it may be plausible to argue that a greater degree of BGD can result in lower agency costs, which is consistent with the beliefs of previous scholars (e.g. Hillman and Dalziel, 2003). However, it is important to keep in mind that our results cannot refute nor confirm Huang and Kigsen's (2015) claim that women are less attractive borrowers than men, resulting in difficulty obtaining external financing. Given this, the negative outcome between BGD and DTC may also reflect this argument. Nevertheless, Powell (1990) posited that this could be an abstract conclusion as well.

Although our results suggest a negative relationship between BGD and leverage, we cannot determine what form of debt the firm has. Li and Zhang (2019) found in their study that gender diverse boards have a higher propensity of short-term debt and utilise it as a mechanism for monitoring, which our results can neither confirm nor reject. However, Mori (2014) and Nisiyama and Nakamura (2018) stated in their respective studies that there was no significant relationship and a positive relationship between BGD and capital structure, respectively, which our findings contradict. Notably, Mori's (2014) study was conducted in several African countries, whereas Nisiyama and Nakamura's (2018) research was conducted in Brazil. Thus, it raises the question of whether females from different cultures and countries exhibit divergent risk aversion, or whether other factors may influence the differences in results.

5.4.2 Critical Mass

H2 (see section 3.2) is also supported by the statistically significant negative relationship between critical mass and leverage. The relationship is negative at the 5 percent FE model level model level, when utilising the 25 percent threshold of females on boards, suggested by Harris (2014). The findings of this study supports her conclusion that a negative relationship exists between board gender diversity and leverage, which emphasises the fact that there must be a minimum threshold of women in the board for them to have a significant impact on the firm.

Many of the aforementioned arguments presented in the analysis of *H1* concerning the conceptualisation of our findings are also applicable to *H2*. In contrast to the results of *H1*, *H2* demonstrates a stronger negative relationship with DTC when the threshold is met. In this way, the results not only corroborate previous findings (Dohmen et al., 2011; Olsen and Cosen, 2001; Schopol et al., 2021; Zlata et al., 2022), but they also provide convincing evidence of female risk aversion within corporate boards. In other words, the results demonstrate that the risk-aversion of female board members becomes more apparent the more women are present, which is in line with Billimoria (2006) and Simpson et al's (2010) findings.

In light of the trade-off theory, the boards of S&P 500 firms' appear to place greater emphasis on avoiding leveraged induced risk, such as financial distress costs, and thus, evade from transferring operational risk to creditors. This could also, as in *H1*, be interpreted as support for the claim made by Barua et al. (2010) and Francis et al. (2015) that there is a positive relationship between female executives and conservative corporate policies. Financial distress is one of the most significant costs of issuing debt, which increases as debt levels rise. Therefore, firms may be hesitant to increase leverage if they believe their risk of financial distress to be excessive. Greater gender diversity on corporate boards have been linked to improved firm performance, including reduced risk-taking behaviour (e.g., Ben Saad and Belkacem, 2009; Coleman and Rob, 2009). Consequently, our findings suggest that firms with a threshold of 25 percent female board representation are more likely to engage in cautious decision-making and risk management when weighing the costs and benefits of various financing sources.

According to agency theory, the relationship critical mass and leverage can be explained by the potential conflicts of interest between managers and shareholders. Research demonstrates that gender-diverse boards are more likely to hold managers accountable, closely monitor their decisions, and to make more independent and well-informed decisions. For instance, Post and Byron (2015), identified a positive relationship between critical mass and board monitoring. Thus, a board with greater diversity may also have a wider variety of perspectives, experiences, and skills, which can result in more effective decision-making. Consequently, a negative relationship between critical mass and DTC may suggest that firms with more diverse boards are better able to mitigate the agency costs of debt by implementing more conservative, or alternatively, effective governance strategies (Hillman and Dalziel, 2003). In other words, a board with greater diversity may be more effective at monitoring management and ensuring that decisions about leverage are aligned with the interests of shareholders.

5.4.3 Moderating Effect

Our findings indicate that the presence of BGD has a diminishing effect on DTC-ratios as firm size increases. Negative is the moderating effect of firm size on the relationship between BGD and leverage. This is indicated by the interaction term "BGDxSize" in model D's fixed effects. Consequently, *H3* (see section 3.2) is accepted. Conclusion: the larger the firm, the greater the importance of factors other than BGD in determining capital structure choices. Despite being more leveraged than smaller firms, Rajan and Zingales (1995) and Titman and Wessels (1988) argue that larger firms are less likely to declare bankruptcy. Therefore, default risk may be one of the factors that is more significant than BGD for smaller firms.

Due to the lack of prior research on the moderating effect of firm size on BGD and capital structure, it is not possible to conduct a comparative analysis. There are, however, comparable studies that investigate the impact of the size-moderating effect on BGD and firm performance. For instance, Li and Chen (2018) find that firm size moderates the relationship between BGD and firm performance negatively.

According to the agency theory, characteristics such as firm size have an effect on managerial behaviour and associated agency costs (Jensen and Meckling, 1976), which our findings support. Larger firms tend to have more intricate organisational structures, which may influence how managers behave within the organisation. Our findings regarding the moderating effect of firm size suggest that larger firms are more likely to have corporate governance structures in place that can lead to more favourable debt terms and/or capital accessibility than board gender diversity. BGD may have a greater impact on the capital structure of smaller firms, as it may signal a commitment to diversity, thereby enhancing their reputation.

6. Conclusion

Prior empirical research in the field of board gender diversity (BGD) has produced contradictory arguments regarding its relationship with the capital structure of firms. The general perception is that women are more risk-averse than men in both personal and professional situations (Olsen and Cox, 2001; Peni and Vähämaa, 2010). This would suggest that women are more likely to avoid risk-increasing decisions and are more cautious in their decision-making, such as when the firm issues more debt. This premise contradicts conventional theories such as the pecking order theory and its strict order of preference for funding sources (Donaldson, 2000). Conversely, the vast majority of research demonstrates a negative relationship between BGD and DTC-ratio (see, e.g., Ben Saad and Belkacem, 2022: Coleman and Robb, 2009). In similar cases, other academics find either no relationship (Mori, 2014) or a positive relationship (Nisiyama and Nakamura, 2018), which adds some ambiguity to this topic. Consequently, the purpose of this paper is to shed light on this relationship and to provide some new theoretical and empirical perspectives.

The objective of the study will be met by analysing the relationship between BGD and capital structure of S&P 500 firms. We are utilising a panel of 354 publicly traded firms between 2015 and 2022. In addition, pooled OLS and FE regression techniques were used to determine the magnitude and direction of the primary variables' coefficients.

The empirical findings of this paper demonstrates that there is, in fact, a negative relationship between BGD and the debt levels in firms' capital structure; however, the OLS model does not support *H1*. The findings support the premise of female risk aversion, while partially contradicting theories of capital structure. Although the results do indicate a female reluctance to incur debt within the firm, they cannot confirm or refute the pecking order theory's hypothesis that retained earnings are a preferred source of financing (Donaldson, 2000). (Carter et al., 2003; Erhardt et al., 2003) However, previous research has shown that BGD increases firm transparency, thereby reducing information asymmetry. This contradicts the premise of Myers's (1984) pecking order theory, which states that firms with high information asymmetries rely more on internal than external financing. Moreover, our findings lend support to the notion that BGD may improve the alignment between the managers and shareholders of a firm, as maintaining lower levels of debt reduces the agency costs of debt and, consequently, increases financial flexibility in potentially dire circumstances. In addition, debt may not be required as a disciplining device in these cases, as the monitoring efficacy has been shown to increase in gender-diverse boards.

Furthermore, *H2* is accepted, which is consistent with prior research indicating that there must be a minimum number of women on boards for them to have a significant impact on the firm's capital structure. This is further supported by the fact that the results of *H2* demonstrate a stronger negative relationship with DTC than *H1*'s results. Even after grouping standard errors by industry, these results remained unchanged, increasing their reliability. In addition, the results suggest that a higher proportion of women on boards may result in more conservative corporate policies within the firm, and that greater diversity may lead to more effective debt management and increased risk management, which is in line with the interests of shareholders. This is consistent with previous research (e.g., Barua et al., 2010) and makes sense, as excessive debt levels result in a greater risk of insolvency, which would affect all firm stakeholders.

Lastly, *H3* is accepted. Our study establishes a relationship between BGD, firm size, and capital structure decisions. We find that firm size reduces the effect of BGD on DTC-ratios, indicating that as firms grow larger, other factors become more significant. Existing research indicates that, despite greater leverage, larger firms have a lower risk of bankruptcy. This suggests that for smaller firms, considerations such as default risk may outweigh the impact of BGD. Due to insufficient prior research, it is not possible to conduct a comparative analysis of the moderating effect of firm size. Nonetheless, comparable studies on the effect of BGD on firm performance yield comparable results, highlighting the importance of firm size as a moderating variable. In support of theory, firm characteristics, such as size, appear to influence managerial behaviour and agency costs. Larger organisations with complex organisational structures typically have established governance mechanisms that overshadow the influence of BGD on capital structure decisions. In contrast, BGD may be more significant for smaller companies, as it demonstrates a commitment to diversity and enhances their reputation.

Overall, the findings of this study indicate that gender-diverse boards in firms in the S&P 500 are associated with a reduction in debt in the firm's capital structure. The outcomes were consistent with previous research in the field of female risk aversion, BGD, and capital structure. This would suggest that incorporating a gender-diverse board, in a contemporary U.S. setting, could increase the effectiveness of board management and decision making, decrease information asymmetries, and thus increase the likelihood of all stakeholders' interests being aligned.

Several opportunities have been identified throughout the paper, providing a foundation for future research presented in this section. Future research could incorporate additional perspectives on board diversity by incorporating cultural and institutional factors, which may vary between cultures and institutional settings. Therefore, it would be a fascinating topic to investigate how these factors influence the capital structure of businesses. Additionally, board diversity could be expanded to include racial and ethnic diversity in addition to gender.

In addition, the absence of a debt structure analysis in relation to BGD is a limitation of this study, which may serve as a suggestion for future research. This is because gender-diverse boards favour short-term debt because it can be used as a monitoring tool. Therefore, analysing the firm's debt and loan structure could shed light on this claim. In addition, the scope of this study is restricted to capital structures of firms. Consequently, it may be intriguing to investigate BGD and funding sources such as internal funds in relation to the pecking order theory. This may shed light on the assertion of female risk aversion and the pecking order theory, according to which internal funds are the preferred and less risky source of financing. The topic of female risk aversion can also be applied to firm risk management by comparing the hedging strategies of female corporate risk officers to those of their male counterparts.

Appendix

Figure 1:

Deductive Research Approach; Source: Bell, Bryman and Harley (2019)

Appendix 1

Definition of variables

Dependent variable	***Description***	***Measure***	***Data source***
DTC	Ratio of total debt to capital	Total debt/capital	Capital IQ
Main explanatory variables			
BGD	Proportion of female board members	Females/Total board size	Capital IQ and own calculations
Criticalmass	Dummy variable with value of 1 if the board has > 25% females, 0 otherwise	Dummy variable = 1 if the % of females is above 25%	Capital IQ and own calculations
Control BGD independent variables			
Womendummy	Dummy variable with value of 1 if the board has > 3 females, 0 otherwise	Dummy variable with value of 1 if the board has > 3 females, 0 otherwise	Capital IQ and own calculations
Board	Board size	Natural log of total board members	Capital IQ and own calculations
Firm specific control variables			
Size	Firm size	Natural logarithm of total assets	Capital IQ and own calculations
ROA	Return on assets	Net result/total assets	Capital IQ
MTB	Market to book (growth opportunities)	Market capitalization/total equity	Capital IQ

TANG	Asset tangibility (collateral measure)	PPE/total assets	Capital IQ and own calculations
Liquidity	Solvency ratio = Current ratio	Cash and cash equivalents/current liabilities	Capital IQ and own calculations
TaxDeduct	Non debt tax shields	Depreciation/Total assets	Capital IQ and own calculations
Z-score	Altman Z score: Measure of business risk	*Dummy variable is equal to 1 if Z-score is above 1.8, and 0 otherwise*	Capital IQ
Interactions terms			
BGDxSize	Interaction term between proportion of female directors and firm size	BGD * natural log of total assets	Own calculations
BGDxBoard	Interaction term between proportion of female directors and board size	BGD * natural log of total board members	Own calculations
CriticalxWomen	Interaction term between critical mass and woman dummy	Critical mass * womendummy	Own calculations
CriticalxBoard	Interaction term between critical mass and total board members	Critical mass * natural log of total board members	Own calculations
CriticalxSize	Interaction term between critical mass and firm size	Critical mass * natural log of total assets	Own calculations

Note: All our "own calculations" have been done through excel and STATA using data from Capital IQ and annual reports. For our main explanatory variable BGD, we have taken data from annual reports to find the amount of females on the boards of the sample firms. Then we have divided the amount of females by the total number of board members for each year manually in excel. For our second main explanatory variable "Critical mass", we have made our own calculation using dummy variable functions in STATA. The same applies for the variable "Wommendummy". Our own calculation of the board size has been computed with the log function in STATA. The same applies for the firm specific variable "Size". PPE/total assets, Cash and cash equivalents/current liabilities and Depreciation/Total assets has been computed in excel with data from Capital IQ which provides data for PPE, total assets, cash and cash equivalents, etc. For more details on "own calculations" see Appendix 2.

Appendix 2

Own Calculations

Variable	***Symbol***	***Measure (proxy***	***Software***
Women dummy	Womendummy	Dummy variable with value of 1 if the board has > 3 females, 0 otherwise	Stata
Board size	Board	Natural log of total board members	Stata
Firm Size	Size	Natural logarithm of total assets	Stata
Tangibility	TANG	PPE/total assets	Stata
Liquidity	Liquidity	Cash and cash equivalents/current liabilities	Stata
Tax Deductibility	TaxDeduct	Depreciation/Total assets	Stata
BGDxSize	BGDxSize	BGD * natural log of total assets	Stata

BGDxBoard	BGDxBoard	BGD * natural log of total board members	Stata
CriticalxWomen	CriticalXwomen	Critical mass * womendummy	Stata
CriticalxBoard	CriticalxBoard	Critical mass * natural log of total board members	Stata
CriticalxSize	CriticalxSize	Critical mass * natural log of total assets	Stata

Appendix 3

Summary statistics

Variable	Mean	Median	SD	Min	Max
(1) DTC	.45	.44	.28	0	7.94
(2)BGD	.24	.25	.13	0	1
(3)Womendummy	.15	0	.36	0	1
(4)Criticalmass	.16	0	.37	0	1
(5) Board size	9	9	2.67	1	20
(6) Size	9.73	9.12	1.25	5.10	13.22
(7) ROA	.07	.06	.05	-.28	.32
(8) Z-score	.85	1	.36	0	1
(9) MTB	7.18	4.13	14.31	.56	191.79
(10) TANG	.26	.16	.25	.01	.98
(11) Liquidity	.57	.35	.77	0	13.33
(12) TaxDeduct	.21	.15	.22	0	2.73

Note: The variables included in the table are (1) DTC(Debt to capital) (total interest bearing debt divided by total interest bearing debt plus shareholders equity) (2) BGD (proportion of females in the board) (3) Womendummy (Dummy variable is equal to 1 if there are at least 3 women on the board, and 0 otherwise) (4) Criticalmass (Dummy variable is equal to 1 if there are at least 25 percent female directors on the board, and 0 otherwise) (5) Board (Natural logarithm of total amount of board members) (6) Size (Natural logarithm of firm's total assets) (7) ROA (Net result divided by total assets) (8) Z-score ((1.2(working capital / total assets) + 1.4*(retained earnings / total assets) + 3.3*(earnings before interest and tax / total assets) + 0.6*(market value of equity / total liabilities) + 1.0*(sales / total assets)) (Dummy variable is equal to 1 if Z-score is above 1.8, and 0 otherwise) (9) MTB (Market to book) (Market capitalization divided by book value of equity) (10) TANG (Net property, plant and equipment divided by total assets) (11) Liquidity (Cash and cash equivalents divided by short term liabilities) (12) TaxDeduct (Depreciation divided by total assets).*

Appendix 4

Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) DTC	1.000											
(2) BGD	0.049**	1.000										
(3)Womendummy	0.040**	0.509***	1.000									
(4) Criticalmass	0.021	0.686***	0.599***	1.000								
(5) Board	0.045**	0.053***	0.305***	-0.024	1.000							
(6) size	0.183***	0.195***	0.161***	0.123***	0.199***	1.000						
(7) ROA	-0.109***	0.028	0.052***	0.017	0.003	-0.210***	1.000					
(8) Z-score	-0.207***	-0.023	0.020	0.005	0.006	-0.249***	0.369***	1.000				
(9) MTB	0.214***	0.034*	0.082***	0.035*	0.004	-0.146***	0.220***	0.094***	1.000			
(10) TANG	0.049**	-0.011	-0.037*	-0.021	0.006	0.136***	-0.167***	-0.113***	-0.029	1.000		
(11) Liquidity	-0.216***	-0.046**	-0.027	-0.041**	-0.056***	-0.234***	0.057***	0.107***	-0.007	-0.089***	1.000	
(12) TaxDeduct	0.069***	-0.011	-0.056***	-0.010	-0.036*	0.119***	-0.066***	-0.090***	0.033*	0.591***	-0.079***	1.000

Note: Pearson's Correlation Matrix. The variables included in the table are (1) DTC(Debt to capital) (total interest bearing debt divided by total interest bearing debt plus shareholders equity) (2) BGD (proportion of females in the board) (3) Womendummy (Dummy variable is equal to 1 if there are at least 3 women on the board, and 0 otherwise) (4) Criticalmass (Dummy variable is equal to 1 if there are at least 25 percent female directors on the board, and 0 otherwise) (5) Board (Natural logarithm of total amount of board members) (6) Size (Natural logarithm of firm's total assets) (7) ROA (Net result divided by total assets) (8) Z-score ((1.2(working capital / total assets) + 1.4*(retained earnings / total assets) + 3.3*(earnings before interest and tax / total assets) + 0.6*(market value of equity / total liabilities) + 1.0*(sales / total assets)) (Dummy variable is equal to 1 if Z-score is above 1.8, and 0 otherwise) (9) MTB (Market to book) (Market capitalization divided by book value of equity) (10) TANG (Net property, plant and equipment divided by total assets) (11) Liquidity (Cash and cash equivalents divided by short term liabilities) (12) TaxDeduct (Depreciation divided by total assets).*

**** p<0.01, ** p<0.05, * p<0.1*

Appendix 5

Hausman (1978) specification test (regression model 1)

	Coef.
Chi-square test value	78.286
P-value	0

Appendix 6

Hausman (1978) specification test (regression model 2)

	Coef.
Chi-square test value	71.928
P-value	0

Appendix 7

H2 and H3 Regression results

	Pooled OLS models		**Fixed Effects models**	
Model	A	B	C	D
(1) *Dep. Variable*	DTC	DTC	DTC	DTC
Main Ind. variables				
(2) BGD	-0.0262	-0.611	-0.727*	-1.040**
	(0.0865)	(0.505)	(0.771)	(0.741)
(3)Womendummy	0.0270	0.0109	0.00643	0.00664
	(0.0259)	(0.0226)	(0.0144)	(0.0139)
Control Variables				
(4) Board		-0.0156	0.0216	-0.0101
		(0.0329)	(0.0357)	(0.0322)
(5)Size		0.0276*	0.000263	-0.0548
		(0.0162)	(0.0344)	(0.0384)
(6)ROA		0.159	-0.195	-0.234
		(0.250)	(0.224)	(0.218)
(7)Z-score		-0.0270***	-0.0208***	-0.0224***
		(0.00349)	(0.00338)	(0.00329)
(8)MTB		0.00527***	0.0105***	0.0200***
		(0.00118)	(0.00317)	(0.00687)
(9)TANG		0.216***	0.440**	0.354**
		(0.0589)	(0.171)	(0.162)
(10)Liquidity		-0.0140	0.00196	-0.000539
		(0.00988)	(0.00593)	(0.00596)

(11)TaxDeduct		0.0969**	0.149*	0.136***
		(0.0478)	(0.0867)	(0.0498)
Interaction terms				
(12)BGDxSize		-0.0465	-0.115	-0.128**
		(0.0534)	(0.0741)	(0.0744)
(13)BGDxBoard		-0.0370	0.0859	0.00175
		(0.0813)	(0.105)	(0.0722)
Constant	0.529***	0.424**	0.242	0.929**
	(0.0402)	(0.192)	(0.324)	(0.372)
Observations	2,743	2,743	2,743	2,743
Standard errors	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)
Industry controls	Yes	Yes	No	Yes
Year controls	Yes	Yes	No	Yes
R-squared	0.05	0.38	0.08	0.24

*Robust standard errors in parenthesis (clustered by firm id) *** p<0.01, ** p<0.05, * p<0.1*

Note: This regression table reports the results for the regression models with pooled-OLS and Fixed Effects with the goal of analysing the effect of board gender diversity on capital structure. Debt to capital is used as a proxy for capital structure in all four models. Panel A shows a Pooled OLS regression model including only the main explanatory variables. Panel B shows a pooled OLS model which includes all variables. Panels C displays a FE model without year and industry controls. Panel D displays a FE model with year and industry control variables. The variables included in the table are (1)DTC (Debt to capital) (total interest bearing debt divided by total interest bearing debt plus shareholders equity) (2)BGD (proportion of females in the board) (3)Womendummy (Dummy variable is equal to 1 if there are at least 3 women on the board, and 0 otherwise) (4)Board (Natural logarithm of total amount of board members) (5)Size (Natural logarithm of firm's total assets) (6)ROA (Net result divided by total assets) (7)Z-score ((1.2(working capital / total assets) + 1.4*(retained earnings / total assets) + 3.3*(earnings before interest and tax / total assets) + 0.6*(market value of equity / total liabilities) + 1.0*(sales / total assets)) (Dummy variable is equal to 1 if Z-score is above 1.8, and 0 otherwise) (8)MTB (Market to book) (Market capitalization divided by book value of equity) (9)TANG (Net property, plant and equipment divided by total assets) (10)Liquidity (Cash and cash equivalents divided by short term liabilities) (11)TaxDeduct (Depreciation divided by total assets) (12)BGDxSize (BGD * natural log of total assets) (13)BGDxBoard (BGD * natural log of total board members)*

Appendix 8

H2 Regression results

Model	Pooled OLS models E	F	Fixed Effects models G	H
(1) *Dep. Variable*	DTC	DTC	DTC	DTC
Main variables				
(2) Criticalmass	0.00251	-0.0779**	0.146	-0.0644**
	(0.0205)	(0.0349)	(0.182)	(0.0283)
(3) Womendummy	-0.00173	-0.000517	0.0263	-0.00416
	(0.0193)	(0.0208)	(0.0196)	(0.0171)
Control Variables				
(4) Board		-0.0283	-0.0488	-0.0122*
		(0.0223)	(0.0226)	(0.0241)
(5) Size		0.00389	-0.0178	-0.0794**
		(0.00983)	(0.0315)	(0.0360)
(6) ROA		0.471*	-0.190	-0.240
		(0.258)	(0.207)	(0.203)
(7) Z-score		-0.0224***	-0.0159***	-0.0173***
		(0.00431)	(0.00356)	(0.00365)
(8) MTB		0.00469***	0.0104***	0.0214***
		(0.00111)	(0.00327)	(0.00660)
(9) TANG		0.218***	0.454***	0.369**
		(0.0594)	(0.158)	(0.151)
(10) Liquidity		-0.00206	0.000310	-0.00116
		(0.00861)	(0.00532)	(0.00544)
(11) TaxDeduct		0.152***	0.147*	0.0559
		(0.0441)	(0.0863)	(0.0901)

Interaction terms				
(12) CriticalxWomen		0.0170	0.00688	-0.0579**
		(0.0296)	(0.0249)	(0.0327)
(13) CriticalmasxBoard		0.00400	-0.0324	-0.0233*
		(0.0351)	(0.0429)	(0.0254)
(14) CriticalmassxSize		-0.00882	-0.00563	-0.00696
		(0.0118)	(0.0110)	(0.0311)
Constant	0.179***	0.671***	0.367	1.133***
	(0.0232)	(0.136)	(0.286)	(0.343)
Observations	2,743	2,743	2,743	2,743
Standard errors	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)
Industry controls	Yes	Yes	No	Yes
Year controls	Yes	Yes	No	Yes
R-squared	0.24	0.39	0.08	0.46

Robust standard errors in parentheses(clustered by firm id)

*** p<0.01, ** p<0.05, * p<0.1

Note: This regression table reports the results for the regression models with pooled-OLS, Random Effects and Fixed Effects with the goal of analysing the effect of board gender diversity on capital structure. Debt to capital is used as a proxy for capital structure in all three models. Panel E shows a Pooled OLS regression model including only the main explanatory variables. Panel F shows a pooled OLS model which includes all variables. Panels G displays a FE model without year and industry controls. Panel H displays a FE model with year and industry control variables. The variables included in the table are (1)DTC(Debt to capital) (total interest bearing debt divided by total interest bearing debt plus shareholders equity) (2)Criticalmass (Dummy variable is equal to 1 if there are at least 25 percent female directors on the board, and 0 otherwise) (3)Womendummy (Dummy variable is equal to 1 if there are at least 3 women on the board, and 0 otherwise) (4)Board (Natural logarithm of total amount of board members) (5)Size (Natural logarithm of firm's total assets) (6)ROA (Net result divided by total assets) (7)Z-score ((1.2(working capital / total assets) + 1.4*(retained earnings / total assets) + 3.3*(earnings before interest and tax / total assets) + 0.6*(market value of equity / total liabilities) + 1.0*(sales / total assets)) (Dummy variable is equal to 1 if Z-score is above 1.8, and 0 otherwise) (8)MTB (Market to book) (Market capitalization divided by book value of equity) (9)TANG (Net property, plant and equipment divided by total assets) (10)Liquidity (Cash and cash equivalents divided by short term liabilities) (11)TaxDeduct (Depreciation divided by total assets) (12)CriticalXwomen (Critical mass * womendummy) (13)CriticalmasXboard (Critical mass * natural log of total board member) (14) CriticalmassXsize (Critical mass * natural log of total assets)*

Appendix 9

Robustness test 1

Model	Pooled OLS H1 & H3 A*	 B*	Fixed Effects H1 & H3 C*	 D*	Pooled OLS H2 E*	 F*	Fixed Effects H2 G*	 H*
(1) *Dep. Variable*	DTC	DTC	DTC	DTC	DTC	DTC	DTC	DTC
Main variables								
(2) BGD	-0.871	-0.611**	-0.778***	-0.571**				
	(0.0256)	(0.209)	(0.220)	(0.180)				
(3) Criticalmass					0.00251	-0.0842**	-0.0743	-0.0659**
					(0.0144)	(0.0331)	(0.0704)	(0.0261)
(4) Womendummy3	-6.63e-06	0.00302	-0.00167	0.0174	-0.00173	0.0235	0.0116	0.0135
	(0.00851)	(0.0103)	(0.00911)	(0.00982)	(0.0128)	(0.0163)	(0.0164)	(0.0144)
Control Variables								
(5) Board		-0.0278**	-0.0239**	-0.0328*		-0.0408	-0.0188	-0.0208
		(0.0114)	(0.00975)	(0.0166)		(0.0247)	(0.0162)	(0.0325)
(6) Size		0.0162***	0.00850**	0.0153***		0.00133	0.000567	-0.0806**
		(0.00438)	(0.00312)	(0.00415)		(0.00805)	(0.00376)	(0.0398)
(7) ROA		0.478**	0.565***	0.474**		0.470*	0.466**	-0.223
		(0.156)	(0.0931)	(0.159)		(0.239)	(0.152)	(0.222)
(8) Z-score		-0.0224***	-0.0259***	-0.0223***		-0.0224***	-0.0225***	-0.0173***
		(0.00160)	(0.00150)	(0.00161)		(0.00459)	(0.00158)	(0.00414)
(9) MTB		0.00463***	0.00511***	0.00465***		0.00469***	0.00473***	0.0214***
		(0.000342)	(0.000258)	(0.000330)		(0.00125)	(0.000297)	(0.00729)
(10) TANG		0.216***	0.111***	0.214***		0.220***	0.220***	0.355**
		(0.0345)	(0.0108)	(0.0348)		(0.0717)	(0.0355)	(0.175)
(11) Liquidity		-0.00276	-0.0153**	-0.00283		-0.00266	-0.00201	-0.00211
		(0.00474)	(0.00543)	(0.00472)		(0.00858)	(0.00447)	(0.00437)

(12) TaxDeduct		0.151***	0.00609	0.150***		0.154***	0.153***	0.0575
		(0.00738)	(0.0150)	(0.00771)		(0.0331)	(0.00770)	(0.0942)
Interaction terms								
(13) BGDxSize		-0.0683***	-0.0695**	-0.0645***				
		(0.0176)	(0.0199)	(0.0158)				
(14) BGDxBoard		0.0226	-0.0416	0.00130				
		(0.0375)	(0.0379)	(0.00824)				
(15) CriticalxWomen						-0.0950***	-0.0318	-0.0586**
						(0.0352)	(0.0226)	(0.0231)
(16) CriticalmasxBoard						-0.00197	0.0183	-0.0212
						(0.0318)	(0.0399)	(0.0224)
(17) CriticalmassxSize						-0.000895	-0.0148	0.00471
						(0.00609)	(0.0153)	(0.00542)
Constant	0.417***	0.558***	0.433***	0.512***	0.179***	0.717***	0.626***	1.077**
	(0.00896)	(0.0737)	(0.0274)	(0.0439)	(0.0379)	(0.112)	(0.0265)	(0.405)
Observations	2,743	2,743	2,743	2,743	2,743	2,743	2,743	2,743
Standard errors	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)
Industry controls	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Year controls	Yes	Yes	No	Yes	Yes	Yes	No	Yes
R-squared	0.06	0.392	0.217	0.38	0.246	0.38	0.14	0,52

Robust standard errors in parenthesis (clustered by industry classification SIC code)
*** p<0.01, ** p<0.05, * p<0.1

Note: This regression table reports the results for the regression models with pooled-OLS Fixed Effects with the goal of analysing the effect of board gender diversity on capital structure. Debt to capital is used as a proxy for capital structure in all three models. Panels A and E* show a Pooled OLS regression model including only the main explanatory variables. Panels B* and F* show a pooled OLS model which includes all variables. Panels C* and G* display a FE model without year and industry controls. Panel D* and H* display a FE model with year and industry control variables. The variables included in the table are (1) DTC(Debt to capital) (total interest bearing debt divided by total interest bearing debt plus shareholders equity) (2)BGD (proportion of females in the board) (3) Criticalmass (Dummy variable is equal to 1 if there are at least 25 percent female directors on the board, and 0 otherwise) (4) Womendummy (Dummy variable is equal to 1 if there are at least 3 women on the board, and 0 otherwise) (5)Board (Natural logarithm of total amount of board members) (6)Size (Natural logarithm of firm's total* *assets) (7)ROA (Net result divided by total assets) (8)Z-score ((1.2*(working capital / total assets) + 1.4*(retained earnings / total assets) + 3.3*(earnings before interest and tax / total assets) + 0.6*(market value of equity / total liabilities) + 1.0*(sales / total assets)) (Dummy variable is equal to 1 if Z-score is above 1.8, and 0 otherwise) (9)MTB (Market to book) (Market capitalization divided by book value of equity) (10)TANG (Net property, plant and equipment divided by total assets) (11)Liquidity (Cash and cash equivalents divided by short term liabilities) (12)TaxDeduct (Depreciation divided by total assets) (13)BGDxSize (14)BGDxBoard (15)CriticalXwomen (16)CriticalmasXboard (17)CriticalmassXsize*

Appendix 10

Robustness test 2

	Pooled OLS H1 & H3		Fixed Effects H1 & H3		Pooled OLS H2		Fixed Effects H2	
Model	A**	B**	C**	D**	E**	F**	G**	H**
Dep. Variable	Net debt	Net debt	Net debt	Net debt	Net debt	Net debt	Net debt	Net debt
Main variables								
BGD	0.219*	-0.0253**	-0.0164***	-0.0182***				
	(0.454)	(1.793)	(1.462)	(1.447)				
Criticalmass					0.0531	-0.0208**	-0.0518***	-0.0526***
					(0.0984)	(0.482)	(0.311)	(0.308)
Womendummy3	0.160	-0.0458	0.0106	0.00412	-0.00173	0.0235	0.0116	0.0135
	(0.122)	(0.0648)	(0.0424)	(0.0433)	(0.0128)	(0.0163)	(0.0164)	(0.0144)
Control Variables								
Board		-0.0327	0.139*	0.0808		0.00852	0.136*	0.0568
		(0.0891)	(0.0811)	(0.0803)		(0.0821)	(0.0778)	(0.0778)
Size		1.008***	1.241***	1.150***		0.955***	1.209***	1.133***
		(0.0487)	(0.0818)	(0.0969)		(0.0348)	(0.0782)	(0.0975)
ROA		4.234***	0.00725	-0.117		4.172***	-0.0128	-0.154
		(0.931)	(0.596)	(0.603)		(0.920)	(0.597)	(0.603)
Z-score		-0.162***	-0.140***	-0.142***		-0.0163***	-0.0138***	-0.0141***
		(0.0225)	(0.0320)	(0.0329)		(0.0225)	(0.0315)	(0.0325)
MTB		0.0152***	0.0381***	0.0543***		0.0155***	0.0402***	0.0590***
		(0.00474)	(0.00668)	(0.0112)		(0.00476)	(0.0107)	(0.0145)
TANG		0.00198	1.750***	1.594***		0.00279	0.0177***	0.0162***
		(0.195)	(0.355)	(0.359)		(0.195)	(0.354)	(0.359)
Liquidity		-0.354***	-0.465***	-0.466***		-0.0350***	-0.0462***	-0.0463***
		(0.0635)	(0.0472)	(0.0476)		(0.0640)	(0.0474)	(0.0478)

TaxDeduct		-0.0667	0.296**	0.166		-0.0733	0.299**	0.166
		(0.133)	(0.129)	(0.147)		(0.137)	(0.127)	(0.149)
Interaction terms								
BGDxSize		-0.0028***	-0.0026*	-0.0027**				
		(0.0176)	(0.142)	(0.143)				
BGDxBoard		0.0226	-0.0432	-0.147				
		(0.0375)	(0.193)	(0.157)				
CriticalxWomen						0.0314	-0.00198	-0.00512
						(0.0895)	(0.0676)	(0.0668)
CriticalmasxBoard						-0.0641	-0.0258	-0.0334
						(0.111)	(0.0941)	(0.0910)
CriticalmassxSize						-0.0992**	-0.0493*	-0.0510*
						(0.0408)	(0.0284)	(0.0285)
Constant	6.676***	-2.424***	-4.383***	-3.188***	0.179***	0.717***	0.626***	1.077**
	(0.170)	(0.556)	(0.837)	(1.042)	(0.0379)	(0.112)	(0.0265)	(0.405)
Observations	2,743	2,743	2,743	2,743	2,743	2,743	2,743	2,743
Standard errors	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)	Robust (clustered)
Industry controls	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Year controls	Yes	Yes	No	Yes	Yes	Yes	No	Yes
R-squared	0.32	0.793	0.533	0.538	0.329	0.794	0.533	0.538

Robust standard errors in parenthesis (clustered by firm id)
*** p<0.01, ** p<0.05, * p<0.1 *Note: This regression table reports the results for the regression models with pooled-OLS Fixed Effects with the goal of analysing the effect of board gender diversity on capital structure. Net debt is used as a proxy for capital structure in all three models. Panels A** and E** show a Pooled OLS regression model including only the main explanatory variables. Panels B** and F** show a pooled OLS model which includes all variables. Panels C** and G** display a FE model without year and industry controls. Panel D** and H** display a FE model with year and industry control variables. The variables included in the table are (1) DTC(Debt to capital) (total interest bearing debt divided by total interest bearing debt plus shareholders equity) (2)BGD (proportion of females in the board) (3) Criticalmass (Dummy variable is equal to 1 if there are at least 25 percent female directors on the board, and 0 otherwise) (4) Womendummy (Dummy variable is equal to 1 if there are at least 3 women on the board, and 0 otherwise) (5)Board (Natural logarithm of total amount of board members) (6)Size (Natural logarithm of firm's total assets) (7)ROA (Net result divided by total assets) (8)Z-score ((1.2*(working capital / total assets) + 1.4*(retained earnings / total assets) + 3.3*(earnings before interest and tax / total assets) + 0.6*(market value of equity / total liabilities) + 1.0*(sales / total assets)) (Dummy variable is equal to 1 if Z-score is above 1.8, and 0 otherwise) (9)MTB*

(Market to book) (Market capitalization divided by book value of equity) (10)TANG (Net property, plant and equipment divided by total assets) (11)Liquidity (Cash and cash equivalents divided by short term liabilities) (12)TaxDeduct (Depreciation divided by total assets) (13)BGDxSize (14)BGDxBoard (15)CriticalXwomen (16)CriticalmasXboard (17)CriticalmassXsize

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