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Critical Mass & Masculinity

A cross-country study on the relationship between board gender diversity and firm performance, and the moderating role of national culture

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Abstract

In this study, we investigate a non-linear relationship between board gender diversity and firm performance as suggested by the critical mass theory. Further, we examine the moderation of national culture based on institutional theory. Using panel regression models on a dataset of 62 countries between 2013 and 2021, we find a positive relation between board gender diversity and firm performance. Moreover, the shape of the relationship differs depending on if firm performance is measured using the market-based measure Tobin's Q or the accounting-based measure return on equity. We further find that the positive relationship between board gender diversity and firm performance is diminished in national cultures characterized by a higher degree of masculinity. Lastly, we argue that critical mass theory may only hold in highly masculine cultures when measuring firm performance as return on equity. We believe this study contributes to understanding the relationship between board gender diversity and firm performance.

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1. Introduction

1.1 Background

Corporate governance, particularly the role of the board of directors, has received wide attention in recent years. Concerns about corporate governance after scandals such as Enron and Worldcom have made the board of directors a focus for extensive academic research (Adams, Renee B. et al., 2010). According to Mace (1971), the role of the directors is to "serve as a source of advice and counsel, serve as some sort of discipline, and act in crisis situations" if a change in CEO is deemed necessary. The composition and characteristics of the corporate board have often been studied under the assumption that differences in board structure are associated with differences in board conduct, and that these differences in behavior might impact firm performance (Adams et al., 2010).

As past financial crises have partly been attributed to corporate boards lacking independence, transparency, and diversity, the research area of board gender diversity has gained further attention (Nguyen, Thi Hong Hanh et al., 2020). It is widely known that women are under-represented in the boardroom (Reddy & Jadhav, 2019). A forecast based on the 10-year growth rate of the ranks of female directors in Fortune 500 firms suggests that it could take approximately 200 years for females to become equally represented in corporate boardrooms (Elgart, 1983). As a consequence, several countries have enacted gender quota legislations and reforms over the past three decades to increase the number of female directors on boards (Hoobler et al., 2018). For instance, Norway established a 40% female quota in 2003, followed by Spain in 2007 and as of 2019, countries such as Belgium, Finland, France, Iceland, Israel, Italy, India, and Kenya have followed (Reddy & Jadhav, 2019). As early evidence indicates that these reforms have led to a stable increase in female directors (Deloitte, 2017; Lee et al., 2015), there is a need to address the impact of female directors on corporate decision-making and, in turn, on organizational performance (Nguyen et al., 2020). Moreover, the gender quota legislation aims to address the ethical aspect of the underrepresentation of women on corporate boards (Terjesen et al., 2015). However, Karen J. Curtin, executive vice president of Bank of America, suggests that at least two critical aspects to the issue of board gender diversity exist:

"There is real debate between those who think we should be more diverse because it is the right thing to do and those who think we should be more diverse because it actually enhances shareholder value. Unless we get the second point across, and people believe it, we're only going to have tokenism" (Brancato & Patterson, 1999).

Board gender diversity's association with financial performance is one of the more researched areas, yet previous studies have rendered inconclusive (Baker et al., 2020). Resource dependence and agency theory are some of the more common theories used when describing the positive effects of female directors on the outcomes of the board. For instance, gender diversity is said to offer the board additional perspectives (Ali et al., 2014; Carter, David A. et al., 2010; Post & Byron, 2015), greater connection with the external environment (Bear et al., 2010; Liao et al., 2018) and an enhanced monitoring ability, viewed as an important corporate governance control mechanism (Campbell & Mínguez-Vera, 2008).

Contrary, few studies have used critical mass theory to explain the ambiguous research results of the association between board gender diversity and firm performance (Joecks et al., 2013; Kramer et al., 2006; Nguyen, Tuan et al., 2015). The critical mass theory suggests that the relationship is U-shaped (convex), as the beneficial effects of board gender diversity on firm performance are, due to tokenism, not realized until the board has reached a critical level of female representatives (Joecks et al., 2013). Despite the usefulness of critical mass theory, it has rarely been used to explain the effect of female directors on firm performance (Nguyen et al., 2020).

In addition, few studies in this research area have conducted cross-country studies examining the role country-contextual factors, such as national culture, might play in this relationship (Grosvold & Brammer, 2011; Nguyen et al., 2020; Post & Byron, 2015; Terjesen et al., 2009). Nonetheless, previous research indicates that national culture impacts the presence of female directors on corporate boards (Carrasco et al., 2015). Scholars have suggested that intervening variables on this relationship need to be further explored to understand how, when and if, gender diversity improves performance (Kochan et al., 2003).

1.2 Purpose

In light of the inconclusive results on the relationship between board gender diversity and firm performance and the lack of research on country-specific factors influencing this relationship, our study serves three purposes. Firstly, our study aims to test the critical mass theory, postulating that the presence of female directors is required to reach a certain threshold to sufficiently influence the firm's performance. Hence, we aim to test whether the relationship between board gender diversity and firm performance follows a U-shape (convex). Secondly, we wish to extend the current research by testing the theory in a broader context. Therefore, we include 62 countries in our study. Thirdly, through institutional theory, we aim to examine the potential moderating effect of culture on the relationship between board gender diversity and firm performance. We use the masculinity dimension in Hoftede's cultural dimension theory to distinguish national cultures. Our research question is thus:

Is there evidence for a non-linear relationship between board gender diversity and firm performance in a multinational context, and is this relationship moderated by national cultural characteristics?

1.3 Contribution

Through this study, we wish to contribute to the existing literature by providing an enhanced understanding of the relationship between board gender diversity and firm performance. Previous studies investigating critical mass theory concerning this relationship have foremost been done in a national context. Moreover, few studies have investigated whether this relationship is U-shaped. Thus, there is an evident need for further cross-national studies examining the effect of country-specific factors, such as national culture, on this relationship. To our best knowledge, this is the first study to combine these research areas.

Apart from the academic contribution, we hope this study can support societal change in the form of an equal gender representation within corporate boards and other decision-making levels in the corporate world. In line with the Sustainable Development Goal 5 – "Achieve gender equality and empower all women and girls" – we hope to contribute to shedding light on the important matter of gender equality in all societies.

1.4 Delimitation

A handful of delimitations was deemed necessary in order for the study to be within the realm of our capabilities. First, our study is delimited to publicly listed firms between the years 2013 and 2021. Second, the study is investigating diversity in regards to gender rather than diversity due to age, race, education, or other parameters related to the broader concept of diversity. Third, this study is delimited to one of Hofstede's six dimensions to measure culture, namely the masculinity dimension. Fourth, the scope of this study is limited to 62 countries based on the intersection between our three datasets. Fifth and final, our study is delimited to stream 3 of Kirsch's streams of board gender diversity studies, namely how the board's composition affects organizational outcomes (Kirsch, 2018).

1.5 Disposition

The remainder of the study is organized as follows. Section 2 presents a review of the relevant literature on the relationship between board gender diversity and firm performance. Then, the theoretical framework on which we base our hypotheses is set forth, together with the development of our hypotheses. The method, including research design, variables, and sample selection, are explained in section 3. Section 4 presents our findings and interpretations of our analyses. Section 5 contains a discussion of our findings and their robustness. Finally, section 6 concludes the study and describes its limitations as well as suggestions for future research.

2. Literature and Theory

2.1 Literature Review

2.1.1 The Effect of Gender Diversity on Corporate Boards

According to Adams, Renée B. & Ferreira (2009), if gender diversity is to affect the board, it must be that a) female directors behave differently than male directors in some aspects, and b) the presence of the female directors affects the behaviors of the board. A large amount of literature suggests that females and males differ in certain aspects. For instance, female and male directors have been shown to differ in risk attitudes and core values, although in ways that differ from the gender differences present in the general population (Adams, Renée B. & Funk, 2012). The genders can also differ regarding their human capital, consisting of accumulated skills and

knowledge. As such, the presence of females on the board will yield a more diverse human capital and thus bring a more diverse set of perspectives and knowledge to the board. In turn, this will improve the board's decision-making processes (Carter, David A. et al., 2010) and the quality of their decisions (Hillman et al., 2007). Indeed, a review by Terjesen et al. (2009) of 400 publications investigating women directors on corporate boards finds that board gender diversity contributes to more effective corporate governance through various board processes and individual interactions.

In contrast, another strand of research does not argue that gender differences entail different behaviors of the directors nor that women affect the behaviors of the board. Instead, these studies draw on signaling theory to argue that appointing female directors signals to stakeholders that the firm adheres to social laws. As such, the firm signals legitimacy and may gain status among the public as these signals affect the decisions of stakeholders, such as investors, employees, and customers, which in turn affects organizational outcomes (Kirsch, 2018). Moreover, board gender diversity can also send positive signals to the labor and product market (Hillman et al., 2000) and can signal to the external environment that the corporation complies with equality policies (Ali et al., 2014; Isidro & Sobral, 2015).

2.1.2 Board Gender Diversity and Firm Performance

A stream of researchers suggests that board gender diversity has a positive association with firm performance. For instance, a study conducted on US firms by Carter, D. A. et al. (2003) finds a positive relationship between the fraction of women or minorities on the board and firm value, as measured by Tobin's Q. To fill the gap of studies on board gender diversity on non-US data, Campbell & Mínguez-Vera (2008) conducted a study on Spanish firms. Through panel data analysis, the authors conclude that there is a positive association between board gender diversity and firm performance. A study of over 2000 Chinese listed firms finds a significant relationship between board gender diversity and firm performance for legal person-controlled firms. Moreover, the authors find that the positive effect of board gender diversity on firm performance is primarily attributable to the female directors' executive effect rather than their monitoring effect (Liu et al., 2014).

Contrary, He & Huang (2011) finds a negative link between board gender diversity and firm financial performance on US manufacturing firms, and Adams, Renée B. & Ferreira (2009)

finds a negative effect of gender diversity on firm performance on average. Adams, Renée B. & Ferreira (2009) conclude that board gender diversity only has a positive effect on firm performance in firms with weak shareholder rights. They argue that diverse boards entail benefits in terms of greater monitoring, making firms with weak governance experience enhanced firm value. Regarding firms with strong governance, the increase in gender diversity may instead lead to over-monitoring and thus negatively impact firm value. Furthermore, a diverse board may result in more interference by directors in decision-making. A diverse board could thus impede the communication between directors and managers, leading to worse performance (Adams, Renée B. & Ferreira, 2007).

Whereas these previous studies have found an association between board gender diversity and firm performance, other studies have not found this relationship at all (e.g., Carter, David A. et al., 2003; Dwyer et al., 2003; Francoeur et al., 2008; Miller & del Carmen Triana, 2009; Rose, 2007). Researchers have come up with several theories to explain the equivocal evidence of this association. These arguments include differences regarding the selection of performance measures (Campbell & Mínguez-Vera, 2008), a lack of controls for endogeneity (Adams, Renée B., 2016), as well as a lack of attention given to power dynamics or to the positions held by female directors (Triana et al., 2014).

According to the German study by Joecks et al. (2013), the varying study results may be attributable to the variation in female representation on boards. The authors argue that if the relationship between board gender diversity and firm performance is U-shaped (convex), studies conducted on boards with relatively low female representation would likely find a negative relationship between board gender diversity and firm performance. Correspondingly, studies on boards with high female representation would instead find this relationship positive, and studies covering boards with both high and low female representation would likely not find a relationship at all. Indeed, their study on 151 listed German firms shows a negative association between board gender diversity and firm performance up until the female representation on the board reaches a critical mass of approximately three female directors, or 30%. After this threshold, the relationship instead becomes positive as the females are no longer seen as tokens.

Interviews with women directors, CEOs, and corporate secretaries from Fortune 1000 companies revealed that women who had been the sole female on the board had experienced

tokenism. They had felt like outsiders and as mere representatives of their gender, which had hindered them from influencing the board. The perception of being a token vanished as the number of female directors reached three, where they suddenly experienced being able to influence the board's decision-making to a more considerable extent (Kramer et al., 2006).

However, previous studies, such as Mahadeo et al. (2012), have found a positive effect of female directors on financial performance despite the female representation on corporate boards being lower than what is deemed a tokenistic representation. Their study measured firm performance by return on assets and was conducted on 42 companies listed on the Stock Exchange of Mauritius. Findings revealed that board's with one female representative had a higher firm performance compared to boards with no gender diversity. The authors argue that the symbolic effect of the female director might be sufficient to alter the perspectives of the board and thereby improve the firm's performance. Similarly, evidence from Vietnam (Nguyen et al., 2015), a country characterized by an underdeveloped corporate governance system, indicates that board gender diversity has an initial positive effect on firm performance. As the number of female directors increases, the effect increases marginally until female directors represent approximately 20% of the board. The authors suggest that the breakpoint occurs as the costs of increased board gender diversity outweigh its benefits.

In summary, there is an ongoing theoretical and empirical debate regarding the potential existence of a critical mass influencing the relationship between board gender diversity and firm performance, as previous studies drawn from different contexts have shown different results regarding this matter (Nguyen et al., 2020). While few studies have investigated the potential shape of this relationship (Joecks et al., 2013), there is a need for future studies on this matter.

2.1.3 Board Gender Diversity and Contextual Factors

A strand of research argues that corporate governance needs to be understood in an institutional context (Aguilera & Jackson, 2003). According to Aguilera & Jackson (2003), when institutional contexts are nationally distinct, isomorphic processes make corporate governance practices converge within countries and increase the differences between countries. Similarly, Lubatkin et al. (2007) develop a theoretical model to argue that the country of operation shapes governance practices through its national institutions. In line with this reasoning, Terjesen & Singh (2008) used data from 43 countries to investigate what factors in the environment, such as the social,

political, and economic structures of individual countries, are associated with firms' levels of board gender diversity. Their findings suggest that countries with a long history of female political representation are less likely to have high levels of female directors. In contrast, countries with high board gender diversity are more likely to have females in senior management levels. Moreover, countries with higher board gender diversity are more likely to have higher income gender equality.

Moreover, research argues that informal institutional factors also influence women's access to boards and, thus, the level of board gender diversity (Kirsch, 2018). For instance, national culture has been shown to significantly affect the shape of corporate board demography (Adams, Susan M. & Flynn, 2005; Hofstede, 1983), and Grosvold & Brammer (2011) have shown that national culture is an important factor in shaping board gender diversity. The authors studied 38 countries to examine the role of national institutional systems in explaining cross-country variations in board gender diversity. The study included five frameworks of national institutional systems, where one framework centered on institutional systems related to national cultural characteristics. Findings suggest that a country's institutional environment affects female directors' prevalence and barriers or facilitators to board gender diversity. More specifically, the authors show that half of the variation of female directors across countries is attributable to institutional factors and that cultural and legal institutions play the most significant role in shaping board gender diversity.

Previous studies have used Hofstede's framework of cultural dimensions to compare national cultures and the effect of these on board composition (e.g., Carrasco et al., 2015; Li & Harrison, 2008). Based on institutional theory and through the use of Hofstede's framework of cultural dimensions, Li & Harrison (2008) show in their study that culture significantly influences the board of directors' structure. Carrasco et al. (2015) conducted a cross-country study with 32 countries to investigate the influence of national cultural dimensions on board gender diversity. Their findings suggest that countries with less board gender diversity tend to have the largest tolerance for inequalities in the distribution of power, meaning that an unequal distribution of power in institutions and organizations is accepted within the country. In addition, countries that value the traditional gender-role of men tend to exhibit a lower level of board gender diversity.

2.1.4 The role of Context for Board Gender Diversity and Firm Performance

The study by Low et al. (2015) is one of few studies assessing the relationship between board gender diversity and firm performance in a cross-country context. The study draws from a sample of firms in Hong Kong, Malaysia, South Korea, and Singapore, specifically selected to represent a range of Asian cultures in which women experience different levels of political and socio-economic empowerment. When measuring firm performance as return on equity, the authors find that an increasing number of female directors positively affect firm performance. However, their findings suggest that the positive effect of female directors may be diminished in countries with higher female economic participation and empowerment. The authors believe this may be due to cultural resistance and tokenism being more severe in Asian countries that have tried to conform to the Anglo-American ideal of gender equality through, for instance, gender quotas.

Due to the ambiguous research area of board gender diversity and firm performance, Post & Byron (2015) combined the results from 140 studies between the period 1989 to 2014 to examine whether the mix of findings can be explained by differences in firms' regulatory and sociocultural contexts. The authors find evidence for a positive effect of board gender diversity on accounting performance, where the effect is even stronger in countries with more robust shareholder protection. Regarding the effect of board gender diversity on market performance, the results suggest that that effect is near zero. However, the relationship is positive in countries with greater gender parity and negative in countries with lower gender parity. The authors believe that this result is attributable to societal gender differences in human capital, which may influence investor's evaluations of future earnings of firms with a higher board gender diversity.

Although studies have shown that the context is an important determinator for the presence of female directors, existing studies in the area of board gender diversity and firm performance have foremost been conducted within one country, examining firm-level and industry-level antecedents of board gender diversity rather than country-level antecedents. As a result, the research area is lacking cross-country studies and studies investigating how country-specific variables are associated with board gender diversity (Byron & Post, 2016; Grosvold & Brammer, 2011; Nguyen, Thi Hong Hanh et al., 2020; Terjesen & Singh, 2008).

2.2 Theoretical Perspective and Hypotheses

2.2.1 Resource Dependence Theory

Resource dependence theory (Pfeffer & Salancik, 2003) posits that a corporation is an open system dependent on contingencies in the external environment for its survival. As a result, this dependency entails risks and uncertainty for the corporation. To reduce this risk, corporations seek to control and secure these resources by using directors, who act as boundary-spanners between the corporation and the external environment. According to the resource dependence theory, directors provide four types of resources to the corporation through their linkages with the environment. Firstly, they provide information to the corporation through strategic advice and counsel, which contributes to the corporation's survival and performance. Secondly, they provide access to channels of communication between the corporation and the environmental contingencies. Thirdly, directors provide preferential access to resources, and lastly, they provide legitimacy.

An extended version of resource dependence theory suggests that diverse directors provide diverse beneficial resources to the corporation. For instance, diverse directors may hold diverse information, skills, and perspectives that can improve strategic counsel, advice, and decision-making, which in turn can improve the corporation's financial performance (Hillman et al., 2000).

2.2.2 Agency Theory

According to agency theory (Jensen & Meckling, 1976), the monitoring function of the board plays an essential role in mitigating agency costs and principal-agent conflicts, which may affect firm performance. Agency theory rests on the notion that an information asymmetry exists between managers (the agents) and shareholders (the principals). This asymmetry allows managers to decide which information to share with the board. As managers may have a self-interest that diverts from the interests of the shareholders, they can exclude vital information from the shareholders to benefit themselves. As a consequence, the role of the board is to resolve potential agency problems between shareholders and managers and ensure that shareholders are provided with reliable information, which requires monitoring of managers. Resolving these can be done through decisions to replace managers that have not created shareholder value or by setting appropriate compensation policies.

Following these arguments, board independence is vital if the board is to pursue its role in the relationship between the managers and the shareholders. Research suggests that a diverse board will experience increased independence and improve its abilities to monitor executives (Carter et al., 2003), as different directors' characteristics and backgrounds will enable the board to better question the original system compared to traditional boards. In this regard, board diversity can reduce agency costs through fewer agency problems (Hillman & Dalziel, 2003).

Moreover, Adams, Renée B. & Ferreira (2009) argue that female directors are generally better at monitoring. In their study of US firms, female directors were found to have better attendance records than male directors. The female directors were also more likely to join and be assigned to monitoring committees such as audit, nominating, and corporate governance committees. Moreover, firms with one or more female directors on the board had significantly higher audit fees, and male directors on diverse boards had fewer attendance problems. Although a board with a high female representation may lead to over-monitoring and negatively impact firm performance, a gender diverse board representing both genders may still improve the firm's performance by strengthening the monitoring function of the board.

2.2.3 Tokens and Critical Mass Theory

Critical mass theory has its origins in token theory (Liao et al., 2018). Token theory (Kanter, 1977) suggests that a lone female director will be viewed as an outsider and a token, in other words, a representative of females as a minority demographic group. The token status will create a distinction between the token and the majority of the group, which often leads to the token being disliked, judged and criticized to a larger extent. The token is also viewed as a threat to the mindset and behaviors of the group, and pressure is put on the token member to adapt to the majority, which often consists of men. According to the theory, the token status will force the female to assimilate into the majority and distance herself from other females in the category she represents. Due to gender stereotypes of female directors, she will be perceived as someone unfitting as a leader. As a result, she will possess limited power to impact the board's decision-making. As the number of female directors increases, they, as a minority group, will gain trust and the board as a whole can benefit from the resources females contribute. Eventually, the minority group reaches a certain size making it no longer viewed as a token group. According to critical mass theory, this threshold is referred to as the critical mass and is due to

appear at approximately 30%, or three female directors (Kramer et al., 2006; Torchia et al., 2011).

The study by Joecks et al. (2013) suggests that the effect of board gender diversity on firm performance is U-shaped (convex). According to the study, board gender diversity negatively affects firm performance when the amount of females on the board is below 30%. As females exceed approximately 30% of the board, firm performance is higher than the firm performance of boards solely constituted by males. Moreover, Liu et al. (2014) found in their study of Chinese listed firms that boards with three or more female directors have a stronger effect on firm performance than boards with two or less female directors. These studies strongly support the critical mass theory, postulating that "one is a token, two is a presence, and three is a voice" (Kristie, 2011). Hence, although the board's gender diversity increases with one or two women, the board may not derive the full benefit of this increased diversity when the number of females is less than a certain threshold. This would suggest a U-shaped (convex) relationship between board gender diversity and firm performance. Therefore, we propose the following:

H0: There is a linear or inverted U-shape (concave) relationship between board gender diversity and firm performance.

H1: There is a U-shape (convex) relationship between board gender diversity and firm performance.

2.2.4 Institutional Theory

Institutional theory posits that corporate activities are based on norms in the institutional environment in which the corporation operates (Meyer & Rowan, 1977). Organizations need to adapt their organizational structures to conform to these rules, norms, and social expectations in order for them to acquire legitimacy, gain resources and survive (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). As culture is one of the institutional forces within a society, cultural beliefs and values influence corporate structures, including board structures, according to institutional theory (Carrasco et al., 2015; Li & Harrison, 2008). Therefore, cultural differences between countries affect corporations' shape and functioning (Hamilton & Biggart, 1988). As differences in board structure often is assumed to be associated with differences in board conduct (Adams et al., 2010), one might expect that the institutional environment not only influences the

presence of board gender diversity, but also the effect of board gender diversity on firm performance.

2.2.5 Hofstede's Cultural Dimensions Theory

Hofstede (1980) defines culture as the set of values, beliefs, principles and attitudes that are collectively shared by members of a group or community. Hofstede's cultural dimensions model was first developed in a cross-country study on employee value scores gathered within IBM offices between the years 1967 and 1973 with the purpose to compare cultural conditions across countries. The model aims to describe the content of culture through the use of several dimensions which provide a framework for comparing critical aspects of national cultures (Hofstede, 1980). Over the years, Hofstede's cultural dimension theory has become the primary theoretical framework to distinguish national cultures (Robbins, 2004). Using one of Hofstede's cultural dimensions as a way to put a metric on culture, we can compare national cultures to investigate national cultures' effect on the relationship between board gender diversity and firm performance.

The masculinity dimension concerns the degree of distinctiveness of social gender roles within a society. In masculine cultures, these roles are clearly separated (Hofstede, 1980). While men should possess characteristics such as being assertive and tough, women are preferred as tender and modest. Contrastingly, in more feminine cultures with lower degrees of masculinity, the social role of men versus women is less distinguished as both sexes are supposed to be tender and modest and highly value the quality of life (Hofstede, G., 1991). According to token theory (Kanter, 1977), the distinction between the minority group and the majority group, enhanced through strong stereotypes, makes female directors perceived as tokens. One could thus expect national cultures characterized by a high degree of masculinity to have a diminishing effect on the relationship between board gender diversity and firm performance, as the female tokens would be less likely to influence the board. Indeed, Low et al. (2015) indicates that tokenism and cultural resistance might explain their findings of a diminished positive effect of female directors on firm performance. Hence, we propose the following hypothesis:

> *H2: The cultural dimension Masculinity diminishes the relationship between board gender diversity and firm performance.*

3. Method

3.1 Research Design

3.1.1 Applied Models

To investigate the relationship between board gender diversity and firm performance and the moderating role of culture, we use the multiple regression model. The multiple regression model allows us to use composite variables, which are required not only to construct the quadratic term necessary to test for a U-shaped relationship, but also to test if culture moderates the relationship between board gender diversity and firm performance. However, one drawback of the multiple regression model is that it requires additional assumptions (Newbold et al., 2013). These are discussed in sections 4.1.1 and 4.1.2. If these assumptions are violated, the explanatory value of the model might be compromised.

We employ a panel regression model with a longitudinal time dimension, as we observe the same subjects over multiple years, and a cross-sectional dimension, where the firm is the smallest unit to cluster on. The cross-sectional dimension can be amalgamated to form clusters other than firms, such as industries, countries, or both. For the main regressions, only industry fixed effects are used. The other combinations are a part of the robustness test. The panel regression model allows us to control for the omitted variable problem (Joecks et al., 2013). However, it requires additional tests to use the most appropriate form (Wooldridge, 2010), which is discussed in section 4.1.3.

After the main regression, we employ the test for a U-shaped relationship as proposed by Lind & Mehlum (2010) to identify extreme points, concavity, and the overall test of presence for a U-shaped relationship. The results of this test are the basis for evaluating our first hypothesis and if there is evidence for critical mass theory. The second hypothesis will be examined according to the frameworks proposed by Haans et al. (2016) on interpreting the coefficients of interaction terms on a U-shaped or inverted U-shaped relationship.

3.1.2 Model for Hypothesis 1

For our first hypothesis, we investigate whether the relationship between board gender diversity (*BGD*) and firm performance (*FP*) is U-shaped (convex). The regression model used to test the first hypothesis looks as follows:

$$FP_{i,t} = \beta_0 + \beta_1 BGD_{i,(t-1)} + \beta_2 BGD^2_{i,(t-1)} +$$

$$\sum \beta GOVERNANCECONTROLS_{i,(t-1)} + \sum \beta FIRMCONTROLS_{i,t} + FE_{i,t} + \varepsilon_{i,t}$$

The subscript *"i"* denotes the firm, and *"t"* denotes the year. For governance variables, the data from the previous year is used. The coefficients $\widehat{\beta_1}$ and $\widehat{\beta_2}$ are analyzed after the regression using the U-test as proposed by Lind & Mehlum (2010).

3.1.3 Model for Hypothesis 2

For our second hypothesis, we investigate if the relationship between board gender diversity (*BGD*) and firm performance (*FP*) is moderated by a country contextual factor, namely masculinity in national culture. Hofstede's dimension of masculinity in culture (*MAS*) is used as a proxy to construct the interaction terms between board gender diversity and national culture. The model looks as follows:

$$FP_{i,t} = \beta_0 + \beta_1 BGD_{i,(t-1)} + \beta_2 MAS_i BGD_{i,(t-1)} + \beta_3 BGD^2_{i,(t-1)} + \beta_4 MAS_i BGD^2_{i,(t-1)} + \beta_5 MAS_i +$$

$$\sum \beta GOVERNANCECONTROLS_{i,(t-1)} + \sum \beta FIRMCONTROLS_{i,t} + FE_{i,t} + \varepsilon_{i,t}$$

The subscript *"i"* denotes the firm, and *"t"* denotes the year. For governance variables, the data from the previous year is used. The significant parts of the composite coefficients, $\widehat{\beta_1} + \widehat{\beta_2} MAS$ for the linear term and $\widehat{\beta_3} + \widehat{\beta_4} MAS$ for the quadratic term, will be analyzed for different values of *MAS* after the regression, as suggested by Haans et al. (2016).

3.2 Variables

3.2.1 Dependent Variables

In order to measure firm financial performance, one market-based and one accounting-based performance measure is included. Similar to previous studies examining the effect of board gender diversity on firm performance (e.g., Adams, Renée B. & Ferreira, 2009; Campbell & Mínguez-Vera, 2008; Hoobler et al., 2018; Hutchinson et al., 2015), Tobin's Q (*TQ*) is used as the measurement for market-based performance. To proxy for Tobin's Q, the market-to-book ratio is used as it is considered to adequately capture the relation between the market value and

the book value. Hence, we replicate the variable construction of previous studies (Adams, Renée B. & Ferreira, 2009). Return on equity (*ROE*) is used for our accounting-based performance measure. This measure captures the company's return from the shareholders perspective and has been used in similar studies (e.g., Adams & Ferreira, 2009; Joecks et al., 2013; Liu et al., 2014).

3.2.2 Independent Variable

Similar to previous studies (e.g., He & Huang, 2011; Joecks et al., 2013; Miller & del Carmen Triana, 2009), the Blau index (Blau, 1977) is used to measure board gender diversity (*BGD*) by categorizing the heterogeneity of a group. The Blau index is considered a good proxy for diversity based on four criteria; (1) it has a zero point to represent complete homogeneity, (2) larger numbers indicate greater diversity, (3) the index does not assume negative values, and (4) the index is not unbounded (Konrad et al., 2005). The formula used to calculate the Blau index looks as follows:

$$Blau = 1 - \sum_{n=1}^{k} s_n^2$$

Where *"k"* is the number of subgroups within the group and *"s"* is the subgroup's proportion of the overall group. For the purpose of this study, gender is assumed binary, resulting in the variable having a possible range of 0 to 0.5. To address the endogeneity problem, as is consistent with other studies investigating the board of directors relationship with firm performance (e.g., Farrell & Hersch, 2005; Joecks et al., 2013), we use the Blau index of the previous year. The variable is included in its linear and quadratic form to test for a U-shaped relationship.

3.2.3 Interaction Term

To test for cultural moderation, we use an interaction term between the variable board gender diversity (*BGD*), both linear and quadratic form, and the cultural dimension masculinity (*MAS*). The interaction term is the product of the culture variable and the board gender diversity variable, as described by Haans et al. (2016).

3.2.4 Governance Control Variables

The selection of governance control variables is based on potential influencing extraneous variables. Following previous adjacent literature (e.g., Adams & Ferreira, 2009; Carrasco et al.,

2015; Carter et al., 2003; Hutchinson et al., 2015; Labelle et al., 2015; Li & Harrison, 2008; Liu et al., 2014; Low et al., 2015) we include board size (*BS*), independent board members (*IBM*), average board tenure (*AVBT*) and CEO duality (*CEOD*). Similar to Joecks et al. (2013), all governance variables are used in their lagging form to address the endogeneity issue.

3.2.5 Firm Control Variables

The financial control variables are selected to mimic previous similar studies (e.g., Carter et al., 2003; Li & Harrison, 2008; Song et al., 2020). First, average total assets (*SIZE*) control for the size of the company. Second, the debt-to-equity ratio (*LEV*) control for the capital structure of the company. Third, revenue growth (*REVG*) is a proxy to control for the growth opportunities of the company.

As this is a cross-country study, we include a control variable related to the domestic economic outlook each company faces. Hence, similar to Li & Harrison (2008), we include the Gross Domestic Product per Capita (*GDPC*) to control for this contextual factor. Further, we include masculinity in culture (*MAS*) as a control when testing our second hypothesis.

3.3 Sample Selection

3.3.1 Data Collection

We conducted the analysis at the intersection of three different datasets. The first and largest dataset is extracted from Thomson Reuters Refinitiv Eikon database. This set includes governance and financial data per firm and fiscal year. We selected publicly listed firms for the type of firm mainly due to data availability. The last ten fiscal years of available data were extracted, which allows for a time series of 9 years to be examined due to the use of lagged variables.

We extracted the first dataset from the Thomson Reuters Refinitiv Eikon database using the application “Screener” and the universe “Publicly listed firms”. Several filters were added to limit the data. First, we filtered on “Country of Headquarter”, which generated a result of 67,602 different companies. Second, we filtered to only include firms with at least one firm-year observation for the board gender diversity variable, generating a result of 10,803 companies. Third, the necessary explanatory and control variables were added in time-series format for the last ten fiscal years. Lastly, “Date of Report” was added in order to distinguish what actual year

each fiscal year observation corresponded to. The dataset was then downloaded in three batches due to data extraction limitations. The extracted sample contains an imperfect set of 108,030 firm-year observations on 10,803 different firms from 90 different countries.

The second dataset was extracted from the World Bank's website. This set contains observations of the Gross Domestic Product per Capita (*GDPC*) for 266 countries between the years of 1960 and 2021. The data is based on World Bank National accounts data and OECD National Accounts data files (The World Bank, 2022).

The third dataset was extracted from Geert Hofstedt's website. This set contains his combined findings for the six dimensions of culture for 111 countries. We use version "2015 12 08". The database only contains one value per country as culture is assumed to change slowly (Grosvold & Brammer, 2011; Hofstede, 2022).

3.3.2 Sample Construction

We initiated the sample construction by merging the three datasets presented in section 3.3.1. The primary dataset was first transformed from wide to long format based on the explanatory variables "Fiscal Year" and "Identifier", where the former range between "FY-0" and "FY-9" and the latter is unique for each firm, thus resulting in 108,030 rows of unique firm-year observations. Using the parameter "Date of report", a variable named "Year" was constructed by subtracting the numerical component of the fiscal year variable from the year of report, enabling the translation of the fiscal year into an actual year.

The second dataset containing the GDPC data was merged into each firm-year observation based on the explanatory variables "Country of Headquarter" and "Year". As there was some discrepancy in the naming of countries, a few manual adjustments were made to align the two datasets.

The third dataset containing cultural dimensions was merged to each firm-year observation based on the explanatory variables "Country of Headquarter". As with the GDPC dataset, a few manual adjustments concerning the naming of countries was necessary to merge the data. Further, some countries were grouped in the culture dataset, namely "Arab countries", "East Africa", and "West Africa". Hence, all countries within these regions and without individual data points share the same value for the cultural dimension.

The sample was then filtered to achieve firm-year observations with all data points necessary for the regressions. In Table 1, the churn for different criteria is presented. The sample construction resulted in an unbalanced panel dataset and the distribution of firm-year observations by country and year is presented in Appendix 1. Meanwhile, the geographical coverage of our study is depicted in Appendix 8. From this filtered sample, we constructed the composite variables, such as return on equity. To ensure repeatability, the variables' names and definitions from Eikon and the formulas used for the constructed variables are presented in Appendix 2.

Table I. Sample Selection

Criteria	*Countries represented*	*Firms represented*	*Total Firm-Year Observations*
Full sample	90	10 803	108 030
Descriptive data			
Between the years 2013-2021	89	10 633	95 578
With GICS data	89	10 577	95 086
Governance data (FY-1)			
Board Gender Diversity	86	9 217	47 891
Board Size	86	9 216	47 887
Independent Board Members	86	9 216	47 875
CEO-Duality	86	9 216	47 875
Average Board Tenure	85	8 876	46 033
Financial data (FY)			
Total Assets	85	8 866	45 947
Total Liabilities	85	8 866	45 946
Total Debt	85	8 862	45 935
Revenue	82	8 016	41 486
Net Income	82	8 015	41 485
Market Capitalization	82	8 012	41 432
Merging with World Bank Data (FY)			
GDPC	77	7 844	40 255
Merging with Culture Data			
Masculinity Index	62	7 766	39 886
	62	**7 766**	**39 886**

4. Findings and Analysis

4.1 Description of Data

4.1.1 Descriptive Statistics

To avoid our analysis being driven by outliers, we examined each variable individually for extreme values. The variables most kurtosis, namely Tobin's Q (*TQ*), return on equity (*ROE*), average total assets (*SIZE*), debt-to-equity ratio (*LEV*), and revenue growth (*REVG*), were truncated by the 1st and 99th percentile. Board size (*BS*) and average board tenure (*AVBT*) were truncated at the 99th percentile. The reasoning for a one-sided truncation is that extreme values were only present at the upper limit of the spectrum. More specifically, a board size of 1 or an average board tenure of 0 was considered possible scenarios where the exclusion could be deceptive. The truncations could be an issue regarding selection bias, but it was deemed necessary to avoid our result being driven by extreme values and counteract outlier bias.

Similarly, the most skewed variables were transformed before the regressions using the natural logarithm transform to achieve an approximately normal distribution and avoid skewness to drive the results. The transformation was deemed necessary for *TQ* and *SIZE*. Gross Domestic Product per Capita (*GDPC*) was transformed to counteract the large standard deviation. Since we transform the dependent variable *TQ*, the relationship observed in our regression model is related to the transformed variable. As such, our findings might not be comparable to other studies that have handled the variable differently. In Table II, both the values before and after transformation are presented. Unless stated otherwise, the transformed version will be what we refer to after this section.

Table II provides the number of observations, means, standard deviation, minimum, 25th percentile, 50th percentile, 75th percentile, and maximum for all variables included in the study. *TQ* has an average value of approximately 3.1 before the transformation. This value can be compared to values obtained by Adams & Ferreira (2009) on US firms (2.1). The average value for *ROE* is 7.7% in our sample, which can be compared to the 9.4% reported in the German study by Joecks et al. (2013).

Board gender diversity (*BGD*), as measured by the Blau index, has a mean of 0.24, which translates to roughly 15% women (for reference, see Appendix 3). Less than 1% (i.e. 324

firm-year observations) of our sample have more than 50% women on their board. Due to this, the minor subgroup will be referred to as women. For comparison, the German study by Joecks et al. (2013) presented an average Blau index of 0.13, the U.S study by He & Huang (2011) an average value of 0.16, and the US study by Miller & del Carmen Triana (2009) an average of 0.21.

Table II. Descriptive Statistics

Variables	*N*	*Mean*	*Std*	*Min*	*p25*	*p50*	*p75*	*Max*
TQ	39,090	3.114	3.817	-9.749	1.101	1.946	3.674	32.38
ROE	39,087	0.0772	0.282	-1.918	0.0290	0.0998	0.177	1.540
BGD	39,886	0.244	0.165	0	0.133	0.260	0.375	0.500
BS	39,606	9.502	3.045	1	7	9	11	20
IBM	39,886	0.596	0.254	0	0.400	0.625	0.818	1,00
AVBT	39,488	7.096	3.572	0	4.471	6.450	9.164	19.82
CEOD	39,886	0.361	0.480	0	0	0	1	1
SIZE	39,090	13.31	28.64	0.047	1.262	3.804	11.47	266.0
LEV	39,089	0.899	1.406	-5.052	0.183	0.545	1.119	11.83
REVG	39,090	1.076	0.274	0.261	0.950	1.042	1.155	3.259
GDPC	39,886	45,647	21,654	798.6	38,475	49,882	62,805	135,683
MAS	39,886	59.65	16.65	5	56	62	66	95
log(TQ)	38,394	0.742	0.911	-11.12	0.124	0.687	1.315	3.478
log(SIZE)	39,090	22.04	1.662	17.66	20.96	22.06	23.16	26.31
log(GDPC)	39,886	10.50	0.834	6.683	10.56	10.82	11.05	11.82
BGD^2	39,886	0.0869	0.0775	0	0.0176	0.0678	0.141	0.250
MASxBGD	39,886	13.90	10.08	0	2.449	14.51	21.75	47.50
$MASxBGD^2$	39,886	4.841	4.531	0	0.794	3.707	8.126	23.75

Notes: TQ Tobin's Q; ROE return on equity; BGD board gender diversity measured using the Blau index ("0" if only one gender is represented, "0,5" if both genders are equally represented); BS Board Size in total number of board members at the end of the fiscal year; IBM independent board members in percentage according to the company; AVBT average board tenure in number of years each board member has been on the board; CEOD CEO duality ("1" if CEO is simultaneously the chairman of the board or if the chairman of the board has been the CEO of the company, "0" otherwise); SIZE average total assets in billions US$*; LEV leverage as calculated by the debt-to-equity ratio; REVG revenue growth total revenue divided by total revenue the previous year; GDPC gross domestic product per capita; MAS masculinity index as defined in Hofstede's cultural dimension model; log(TQ) the natural logarithm of Tobin's Q; log(SIZE) the natural logarithm of SIZE; log(GDPC) the natural logarithm of GDPC;* BGD^2 *the quadratic form of BGD; MASxBGD the linear interaction term;* $MASxBGD^2$ *the quadratic interaction term*

The average board size (*BS*) consists of 9.50 members, similar to what previous studies have obtained. For instance, Carrasco et al. (2015) conducted a cross-country study of 32 countries and obtained an average board size of 9.63. The mean of independent board members (*IBM*) indicates that, on average, 59.6% of the board is considered independent. Our value is higher than what the Chinese study by Liu et al. (2014) obtained (29.4%) but lower than what Adams & Ferreira (2009) reported from their U.S sample (63.0%). The mean of average board tenure (*AVBT*) suggests that the average tenure time in our sample is 7.10 years. For comparison, Labelle et al. (2015) reported an average value of 7.59 years in their study conducted on a sample from 17 countries. The CEO-duality (*CEOD*) has a mean of 36.1%, indicating that separation is more common in our sample. Contrastingly, Li & Harrison (2008) reported in their cross-country study of 15 industrial countries that a consolidation of the chairman and the CEO is more common (62.0%) than not.

The average total assets (*SIZE*) show that the book value of the firms in our sample range between US$ 10's million to US$ 100's billion, and the mean balance sheet is $13.3 billion. For comparison, Carter et al. (2003) also found the average total assets of the US firms in their sample to be $13.3 billion. The leverage variable (*LEV*) shows that the average debt-to-equity ratio in our sample is 89.9%. Comparably, Song et al. (2020) reported a value of 50.6% for their sample of US firms. The revenue growth (*REVG*) ranges from a maximum of +226% to a minimum of -74.9%. The average revenue growth rate in our sample is +7.6%, which can be compared to the value of +18.5% of U.S firms obtained by (Song et al., 2020).

Gross domestic product per capita (*GDPC*) ranges from US$ 799 (Uganda as of 2019) to US$ 135,683 (Luxembourg as of 2021). The average GDP per capita of this sample is US$ 45,647. According to the GDPC dataset, the world average *GDPC* as of 2021 is US$ 12,263. Our mean for all firm-year observations ranging between 2013 and 2021 being higher than the world average of the last year indicate that our sample is skewed towards the more developed part of the world. This is further discussed in section 6.2.

Lastly, we observe the Masculinity index (*MAS*) to range from 5 to 95, with the mean at roughly 59.7. Our value can be compared to the average value obtained by Li & Harrison (2008) of 63.7.

4.1.2 Correlation and Multicollinearity

Tables III and IV present the correlation between our variables and the Variance Inflation Factor (VIF). The tables differ as Table III examines the performance measure Tobin's Q (*TQ*) whereas Table IV examines the performance measure return on equity (*ROE*).

From the two tables, we observe that board gender diversity (*BGD*) is positively correlated with our two measures for firm performance; *TQ* (r=0.14) and *ROE* (r=0.04). Moreover, our leading independent variable *BGD* is positively correlated to independent board members (*IBM*; r=0.33) and GDP per capita (*GDPC*; r=0.18). That is, firms with more independent board members are characterized by a higher degree of board gender diversity. Similarly, firms operating in countries with higher GDP per capita are associated with a slightly higher degree of board gender diversity. Further, board gender diversity is negatively correlated to the variable masculinity (*MAS*; r=-0.25). The interpretation is that, on average, firms operating in countries with a more masculine culture have fewer female directors on the board.

Further, we conclude that all of our variables are linearly correlated at varying degrees, fulfilling the assumptions of a linear relationship between dependent and independent variables necessary for the multiple regression model. We also observe low VIF-values (VIF < 5) (Menard, 2002) for all of our variables, which is why we deem multicollinearity to not be an issue. From this analysis, we conclude no evident need to exclude any variables from the model going forward.

Table III. Correlation and VIF, Tobin's Q

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	VIF
(1) TQ	1.000											
(2) BGD	0.144	1.000										1.22
(3) BS	-0.069	0.082	1.000									1.44
(4) IBM	0.170	0.334	-0.159	1.000								1.41
(5) AVBT	0.082	-0.001	0.029	0.151	1.000							1.10
(6) CEOD	0.084	-0.007	0.045	0.129	0.249	1.000						1.11
(7) SIZE	-0.190	0.046	0.508	-0.060	-0.005	0.074	1.000					1.42
(8) LEV	0.047	0.028	0.100	0.016	-0.035	0.034	0.233	1.000				1.07
(9) REVG	0.154	-0.005	-0.095	0.040	-0.039	0.013	-0.069	-0.011	1.000			1.01
(10) GDPC	0.083	0.179	-0.158	0.381	0.106	0.132	-0.106	-0.034	0.037	1.000		1.24
(11) MAS	-0.041	-0.246	0.119	-0.216	0.017	0.061	0.073	-0.019	-0.007	0.043	1.000	1.15

Table IV. Correlation and VIF, ROE

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	VIF
(1) ROE	1.000											
(2) BGD	0.042	1.000										1.22
(3) BS	0.095	0.082	1.000									1.44
(4) IBM	-0.041	0.334	-0.159	1.000								1.40
(5) AVBT	0.096	-0.001	0.029	0.151	1.000							1.10
(6) CEOD	0.023	-0.007	0.045	0.129	0.249	1.000						1.10
(7) SIZE	0.162	0.046	0.508	-0.060	-0.005	0.074	1.000					1.43
(8) LEV	-0.006	0.028	0.100	0.016	-0.035	0.034	0.233	1.000				1.07
(9) REVG	0.104	-0.005	-0.095	0.040	-0.039	0.013	-0.069	-0.011	1.000			1.01
(10) GDPC	-0.096	0.179	-0.158	0.381	0.106	0.132	-0.106	-0.034	0.037	1.000		1.24
(11) MAS	-0.013	-0.246	0.119	-0.216	0.017	0.061	0.073	-0.019	-0.007	0.043	1.000	1.15

4.1.3 Panel Regression Tests

The sample was tested to identify the most fitting panel regression model. First, a Breusch-Pagan Lagrange Multiplier test was conducted showing significance. Hence, the use of an Ordinary Least Square model was deemed unsuitable. Second, a Hausman test was conducted showing significance. Therefore a fixed effect model was chosen over a random effect model. Third, the year parameter was tested, and the results indicated that year fixed effects should be included in all regressions. Lastly, a modified Wald test was used to test for groupwise heteroskedasticity. The test showed significance, and as a result, robust standard errors are used for all regressions. Amalgamated, we employ a fixed effect panel regression model with year fixed effects and robust standard errors.

4.2 Hypotheses Testing

4.2.1 Hypothesis 1 – Findings

In Table V, the main regressions to test our first hypothesis, namely if there is a U-shaped (convex) relationship between board gender diversity and firm performance, are presented. The regressions employ the model specified in section 3.1.2. Regressions (1) and (2) examine Tobin's Q (*TQ*), where the former accounts for year fixed effects and the latter for both year and industry

fixed effects. Similarly, regressions (3) and (4) examine return on equity (*ROE*) where the former accounts for year fixed effects and the latter accounts for year and industry fixed effects.

The linear coefficient of board gender diversity (*BGD*) is of positive sign for all four regressions, with a significance level of 1% for regression (1) and (2) with *TQ* as the dependent variable, and 5% for the regressions (3) and (4) with *ROE* as the dependent variable. This indicates that board gender diversity has a positive relationship with firm performance.

We observe the quadratic coefficients of board gender diversity (BGD^2) to be significant at the 1% level and of negative sign for regression (1) and (2). This suggests that the relationship between board gender diversity and Tobin's Q is curved and concave. For regression (3), we find the quadratic coefficient significant at the 5% level and of positive sign suggesting a convex relationship. For regression (4), we observe the quadratic coefficient as positive, but it is not significantly different from zero why we can not rule out a linear relationship.

Lastly, using the methodology of the U-test, we evaluate the curve characteristics of our four regression models. We observe that all four tentative extreme points occur outside the domain of possible values for board gender diversity.

4.2.2 Hypothesis 1 – Analysis

From testing our first hypothesis, we observe the primary relationship between board gender diversity and firm performance to be positive. Hence, our findings align with previous studies that support the business case of board gender diversity.

Two main criteria must be fulfilled for a relationship to be U-shaped (convex). First, the quadratic coefficient needs to be significant and positive, which entails a convex curvature on the line of best fit. Second, the relationship needs to have an extreme point on the interval to be a U-shape. If these criteria are met, the so-called U-test can be conducted to test if the overall presence of said shape is statistically significant (Lind & Mehlum, 2010).

We observe that the quadratic coefficient differs in sign depending on if we examine the market-based performance measure Tobin's Q or the accounting-based performance measure return on assets. Hence, our theoretical prediction only holds valid when firm performance is measured as return on equity.

Table V. Regressions & U-test Hypothesis 1

Performance Measure	TQ	TQ	ROE	ROE
Regression	(1)	(2)	(3)	(4)
BGD	1.101***	0.873***	0.0645**	0.0624**
	(0.0918)	(0.0824)	(0.0259)	(0.0253)
BGD^2	-0.790***	-0.636***	0.123**	0.0776
	(0.192)	(0.172)	(0.0552)	(0.0540)
BS	0.0214***	0.00802***	-0.00194***	-0.00232***
	(0.00170)	(0.00157)	(0.000447)	(0.000444)
IBM	0.356***	0.372***	-0.0426***	-0.0157***
	(0.0202)	(0.0186)	(0.00569)	(0.00563)
AVBT	0.0150***	0.0135***	0.00794***	0.00699***
	(0.00132)	(0.00121)	(0.000364)	(0.000362)
CEOD	0.132***	0.0489***	-0.00271	-0.00375
	(0.00991)	(0.00892)	(0.00293)	(0.00288)
SIZE	-0.141***	-0.0786***	0.0238***	0.0216***
	(0.00344)	(0.00327)	(0.00119)	(0.00119)
LEV	0.0735***	0.101***	-0.00856***	-0.0117***
	(0.00456)	(0.00459)	(0.00211)	(0.00230)
REVG	0.518***	0.467***	0.120***	0.135***
	(0.0212)	(0.0184)	(0.00784)	(0.00748)
GDPC	-0.00719	-0.0444***	-0.0274***	-0.0279***
	(0.00640)	(0.00598)	(0.00149)	(0.00153)
Constant	2.538***	1.912***	-0.309***	-0.243***
	(0.103)	(0.0974)	(0.0286)	(0.0295)
N	36,127	36,127	36,645	36,645
R^2	0.125	0.310	0.067	0.129
Industry Fixed Effect	No	Yes	No	Yes
Firm Fixed Effect	No	No	No	No
Year Fixed Effect	Yes	Yes	Yes	Yes
Curve Characteristics				
Extreme point	0.697	0.686	-0.262	-0.402
Slope – Lower Bound	1.101	0.873	0.064	0.062
Slope – Upper Bound	0.311	0.237	0.188	0.140
Overall Shape	Concave	Concave	Convex	Convex

*Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

However, since we find the tentative extreme point to occur outside the domain of possible values for board gender diversity, namely [0, 0.5], we can conclude that the relationship observed is not U-shaped (nor inverted U-shaped). The interpretation of this is that while we observe the relationship to be curved, this could potentially result from an exponential relationship rather than a quadratic one. As such, we have a trivial failure to reject our null hypothesis, and we do not find support for our first hypothesis with this regression model. The relationship between board gender diversity and firm performance, as suggested by our different regression models using the model introduced in 3.1.2, is graphically illustrated in Appendix 4.

4.2.3 Hypothesis 2 – Findings

Table VI presents the main regressions using the model specified in section 3.1.3. These regressions test Hypothesis 2, namely, if the culture in terms of its masculinity diminishes the relationship between board gender diversity and firm performance. Regressions (5) and (6) examine Tobin's Q (*TQ*), where the former accounts for year fixed effects and the latter for year and industry fixed effects. Similarly, regressions (7) and (8) examine return on equity (*ROE*), where the former accounts for year fixed effects and the latter accounts for year and industry fixed effects.

We observe the linear coefficient of board gender diversity (*BGD*) to be of positive sign and significant at the 1% level for all four regressions, suggesting that the primary trend of the relationship between board gender diversity and firm performance is positive. We also observe the quadratic coefficient (BGD^2) to have a negative sign at varying levels of significance for all regressions, suggesting an initial convex relationship before accounting for the moderating effect of masculinity.

Further, we observe the coefficients for the linear interaction term (*MASxBGD*) to be of negative sign and significant at 10% for regression (5), 5% for regression (6) and (8), and 1% for regression (7). This suggests that when masculinity increases, the composite linear coefficient, introduced in section 3.1.3, diminishes. Lastly, we observe the coefficients for the quadratic interaction term ($MASxBGD^2$) to be positive and significant at the 1% level for regression (7) and (8) examining *ROE*. This suggests that when masculinity increases, the composite quadratic coefficient, introduced in section 3.1.3, grows.

Table VI. Regressions Hypothesis 2

Performance Measure	TQ	TQ	ROE	ROE
Regression	(5)	(6)	(7)	(8)
BGD	1.656***	1.553***	0.263***	0.222***
	(0.314)	(0.285)	(0.0761)	(0.0765)
BGD^2	-0.959	-1.602***	-0.302*	-0.340**
	(0.629)	(0.562)	(0.159)	(0.159)
MASxBGD	-0.00829*	-0.0105**	-0.00323***	-0.00264**
	(0.00478)	(0.00433)	(0.00113)	(0.00115)
$MASxBGD^2$	0.00175	0.0137	0.00677***	0.00656***
	(0.00991)	(0.00886)	(0.00250)	(0.00250)
MAS	0.00356***	0.000734	-0.000143	-0.000502***
	(0.000474)	(0.000454)	(9.94e-05)	(0.000106)
BS	0.0199***	0.00796***	-0.00182***	-0.00205***
	(0.00171)	(0.00159)	(0.000449)	(0.000447)
IBM	0.404***	0.377***	-0.0467***	-0.0248***
	(0.0221)	(0.0202)	(0.00614)	(0.00606)
AVBT	0.0149***	0.0134***	0.00791***	0.00695***
	(0.00132)	(0.00121)	(0.000365)	(0.000362)
CEOD	0.129***	0.0504***	-0.00209	-0.00306
	(0.00992)	(0.00892)	(0.00293)	(0.00288)
SIZE	-0.142***	-0.0781***	0.0241***	0.0222***
	(0.00345)	(0.00330)	(0.00119)	(0.00120)
LEV	0.0751***	0.101***	-0.00873***	-0.0120***
	(0.00458)	(0.00460)	(0.00211)	(0.00230)
REVG	0.520***	0.467***	0.120***	0.135***
	(0.0211)	(0.0184)	(0.00784)	(0.00747)
GDPC	-0.0193***	-0.0454***	-0.0262***	-0.0257***
	(0.00677)	(0.00624)	(0.00156)	(0.00158)
Constant	2.443***	1.860***	-0.316***	-0.246***
	(0.105)	(0.0988)	(0.0291)	(0.0297)
N	36,127	36,127	36,645	36,645
R^2	0.126	0.310	0.067	0.130
Industry Fixed Effects	No	Yes	No	Yes
Firm Fixed Effect	No	No	No	No
Year Fixed Effect	Yes	Yes	Yes	Yes

*Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

4.2.4 Hypothesis 2 Analysis – Moderation of Masculinity on Tobin's Q

Similar to our first regression model, we find the tentative shape of the relationship to be concave when examining Tobin's Q. However, we only observe this curvature as significant when accounting for year and industry fixed effects.

We evaluate the interaction term using the framework by Haans et al. (2016). From the negative coefficients of the linear interaction term (*MASxBGD*), we understand that increased masculinity diminishes the positive relationship between board gender diversity and Tobin's Q. These findings support our second hypothesis with a significance level of 10% for regression (5) and 5% for regression (6). The relationship between board gender diversity and Tobin's Q, as suggested by regression (5) and (6), is graphically illustrated in Appendix 5.

The theoretical implication of these findings is that firms operating in an institutional environment characterized by a higher degree of masculinity in national culture would observe a lower marginal benefit of increased diversity compared to firms operating in less masculine environments. These findings strengthen the notion that contextual factors are essential to account for when investigating said relationship.

4.2.5 Hypothesis 2 Analysis – Moderation of Masculinity on ROE

In Table VII, the results of regression (7) are further examined as it showed the coefficients for both the linear and the quadratic interaction terms to be significant. As such, we need to analyze both to understand the combined effect on the composite coefficients. The negative linear coefficient will diminish the relationship, as discussed in section 4.2.4. These findings support our second hypothesis, proposing that the masculinity of the national culture diminishes the effect of board gender diversity on firm performance at a significance level of 1% for regression (7) and 5% for regression (8).

The positive coefficient of the quadratic interaction term ($MASxBGD^2$) alters not only the overall trend but also the concavity of the relationship. As a result, we observe a shape-flip, as named by Haans et al. (2016), on the domain of possible values for masculinity. We find this to occur when the value of masculinity is 44.6 for regression (7). That is, the shape of the relationship is concave for low values of masculinity. When masculinity approaches 44.6, the

shape of the relationship approaches linearity. At values of masculinity above 44.6, the shape is instead convex.

Table VII - Curve Characteristics for Different Values of MAS

MAS	5 (min)	56 (p25)	66 (p75)	95 (max)
Extreme Point	0.460	−0.532	−0.172	0.064
Slope – Lower Bound	0.247	0.082	0.050	−0.044
Slope – Upper Bound	−0.021	0.159	0.195	0.297
Overall Shape	Concave	Convex	Convex	Convex

Notes: The composite coefficients from regression (7) evaluated for different values of MAS using the criterias from the U-test. Shape flip when MAS = 44.6

That the extreme point occurs within possible values of board gender diversity when masculinity is at its maximum indicates that we observe a U-shape. However, as the U-test is not specified for including interaction terms, we can not test the statistical significance of the overall presence of said shape using the method proposed by Lind & Mehlum (2010). The implication of our shape-flip findings is that the critical mass theory, suggesting a U-shape (convex) relationship, may only hold true within institutional contexts characterized by a high degree of masculinity in its culture. The relationship between board gender diversity and return on equity, as suggested by regression (7), is graphically illustrated in Appendix 6.

Table VIII - Curve Characteristics for Different Values of MAS

MAS	5 (min)	56 (p25)	66 (p75)	95 (max)
Extreme Point	0.340	−1.355	−0.257	0.051
Slope – Lower Bound	0.209	0.074	0.048	−0.029
Slope – Upper Bound	−0.098	0.102	0.141	0.254
Overall Shape	Concave	Convex	Convex	Convex

Notes: The composite coefficients from regression (8) evaluated for different values of MAS using the criterias from the U-test. Shape flip when MAS = 51.8

Table VIII further examines the results from regression (8). As the coefficients are of the same signs and similar magnitude as for regression (7), we observe a similar relation. However, for regression (8), we find the shape flip to occur at a higher value of *MAS*, namely 51.8. The relationship between board gender diversity and return on equity, as suggested by regression (8), is graphically illustrated in Appendix 7.

The theoretical implication of these shape-flipping findings is that our null hypothesis, suggesting a linear or inverted U-shape (concave) relationship between board gender diversity and firm performance, could be supported in samples with lower values of masculinity. Moreover, our first hypothesis, stating that the relationship is U-shaped (convex), could potentially be supported in samples with higher values of masculinity. This finding could explain why we observed a significant convex shape in regression (3) but not in regression (4). The mean masculinity in our sample is 59.65, and as the suggested inflection point is lower when only account is taken for year fixed effect, the convex shape would be more distinct for regression (3).

The difference in shape depending on masculinity in culture may provide explanatory value to the discrepancy from previous studies in this field. Our findings suggest that not only is the marginal benefit of increased diversity dependent on the current level of board gender diversity but also that the shape of the relationship depends on the institutional environment in which the board operates. Accounting for this additional moderation could explain the ambiguous findings on the relationship between board gender diversity and firm performance.

4.2.6 Control Variables

Board size (*BS*) has positive coefficients for all regressions examining *TQ* and negative coefficients for all regressions examining *ROE*. This suggests that while the market might value a larger board, a larger board does not improve accounting-based performance. We observe the same pattern for independent board members (*IBM*), CEO duality (*CEOD*), leverage (*LEV*), and masculinity (*MAS*). Hence, our findings suggest that these variables have a positive relationship with the market-based performance measure Tobin's Q and a negative relationship with the accounting-based performance measure return on equity. The opposite relationship is found for the control variable average total assets (*SIZE*). The positive coefficient for *ROE* could be explained by economies of scale, suggesting that there are benefits from being a larger firm. The negative coefficient of *TQ* could be understood by smaller firms being more prone to speculative trading and over-valuation.

We observe positive coefficients for average board tenure (*AVBT*) and revenue growth (*REVG*). The accumulation of knowledge from the board members could explain the positive relationship for AVBT. The positive relationship for revenue growth could be understood by the fact that firms that grow are performing well, as per ROE, and have a positive outlook from the

markets, seen through Tobin's Q. For GDP per capita (*GDPC*), we observe an overall negative relationship which could be explained by selection bias. As our sample is skewed to the more developed part of the world, it is plausible that we include both high and low-performing firms from the developed part of the world. In contrast, it is plausible that only the highest-performing firms from the less developed part of the world are present in our sample.

4.2.7 Goodness-of-Fit

We observe our model's goodness-of-fit (R2) to be higher for the regressions analyzing Tobin's Q compared to those analyzing return on equity. Furthermore, we observe it to be higher when accounting for industry fixed effects. Comparing the R2 from testing our first and second hypotheses, we observe that the improvements of including the moderation of culture are only noticeable by the third decimal, if at all. Hence, we receive the notion that culture only marginally improves the explanatory value of our model.

4.3 Summary of Results

4.3.1 Hypothesis 1

Similar to previous studies on the relationship between board gender diversity and firm performance, we find support for an overall positive relationship, strengthening the business case for board gender diversity. However, regarding the shape of the relationship, our results are ambiguous. For return on equity, our findings suggest the relationship to either be linear or non-linear and convex. For Tobin's Q, our findings suggest a non-linear and concave relationship. A non-linear relationship implies that the marginal benefit of increased diversity varies depending on the current level of diversity in the board. Due to the difference in shape between Tobin's Q and return on equity, we find that the relationship may differ depending on whether a market-based or accounting-based performance measure is examined. These differences are further discussed in section 5.2. In summary, we did not find the presence of a U-shape and thus no evidence of the relationship as suggested by the critical mass theory. As such, we fail to reject H0 for our first model.

4.3.2 Hypothesis 2

For our second hypothesis, we investigated whether the masculinity dimension of culture, as proposed by Hofstede, has a diminishing moderating effect on the relationship between board

gender diversity and firm performance. Our findings support this hypothesis at varying levels of significance. This suggests that the positive relationship between board gender diversity and firm performance is diminished when the degree of masculinity the national culture inhibits is higher.

Further, we found that degree of masculinity within a culture could moderate the overall shape of the relationship between board gender diversity and return on equity. The implication is that the U-shaped (convex) relationship, as predicted by the critical mass theory, may only be present for accounting-based performance measures in contexts where the national culture is more masculine. This is further discussed in section 5.1.

5. Discussion

5.1 Discussion of Results

In this cross-country study, we investigated the shape of the relationship between board gender diversity and firm performance and the potential moderating effect of national culture. The theoretical foundation on which we based our hypotheses was drawn from resource dependence theory, agency theory, critical mass theory, institutional theory, and Hofstede's theory of cultural dimensions.

We find support for resource dependence theory and agency theory as our findings suggest that board gender diversity positively influences firm performance. Thus, board gender diversity may provide the board with a broader set of resources, information, skills, and perspectives, as resource dependence theory stipulates (Hillman et al., 2000). It may also improve the independence and monitoring skills of the board (Carter et al., 2003) and leads to reduced agency costs and improved performance.

However, for our first hypothesis, our cross-country study does not provide evidence that the shape of the relationship is U-shaped (convex). That is, we do not find support for critical mass theory, suggesting that board gender diversity only positively affects firm performance after a certain threshold. As such, our multinational study differs from previous national studies, which found evidence for the critical mass theory in Germany (Joecks et al., 2013) and in China (Liu et al., 2014). Nonetheless, our results indicate a curvature. This strengthens the rationale that the relationship between board gender diversity and firm performance should not be

investigated as a linear relationship but instead as a curvilinear relationship. This implies that the level of board gender diversity is important to consider when investigating the relationship between board gender diversity and firm performance, as it may influence the impact board gender diversity has on firm performance.

Further, we find evidence in line with the institutional theory, as the cultural dimension of masculinity, defined by Hofstede's cultural dimension theory, diminishes the relationship between board gender diversity and firm performance. We argued that highly masculine cultures, characterized by strong gender stereotypes, are more vulnerable to tokenism. Hence, it would be more difficult for a few female directors to impact the board's decisions and, in turn, the firm's financial performance. Firms operating in countries with a highly masculine culture will thus experience a diminished effect of board gender diversity on firm performance compared to firms operating in more feminine national cultures.

As such, we find that the institutional environment of a firm, which includes the national culture, influences the relationship between board gender diversity and firm performance. Moreover, we find that the relationship between board gender diversity and return on equity shifts shape depending on the masculinity of the national culture in which the firm operates. For high feminine-low masculine cultures, the relationship is concave. Meanwhile, for cultures with high masculinity-low femininity, the relationship between board gender diversity and return on equity is instead convex.

The finding of shape-shifting has interesting implications for understanding critical mass theory. Our findings suggest that the U-shape (convex) relationship that the theory suggests between board gender diversity and firm performance may only be present for the accounting-based performance measure return on equity in cultures with high masculinity. In our study, we found the inflection point (i.e., the point where the curve changes from being concave to convex) to occur at 44.6 when accounting for year fixed effects and 55.8 when accounting for year and industry fixed effects. Further, we observe that as the masculinity value continues to increase, the shape becomes increasingly convex. When evaluating the relationship for our maximum value of masculinity, we observe that the tentative shape of the relationship is U-shaped as suggested by the theory.

Hence, we argue that the critical mass theory may hold true but only in contexts where the culture is characterized by high masculinity. This might explain why Joecks et al. (2013) and Liu et al. (2014) found evidence for critical mass theory in Germany and China, two countries which both, according to Hofstede's model, have a national culture with a masculinity index of 66. As they investigate the relationship within an institutional context where masculinity is above our suggested inflection point, we would expect them to observe a convex shape. Similarly, Nguyen et al. (2015) found an initial positive effect of board gender diversity on firm performance, suggesting a concave shape of the relationship. As the national culture of Vietnam has a masculinity index of 40, it is below our inflection point and thus in line with our findings.

The result of a convex shape present only in highly masculine cultures may be due to these cultures being more vulnerable to tokenism. As critical mass theory and token theory argues that tokenism prevents female directors from influencing the board, a critical mass of female directors might be needed in order for them to have an impact on the board in these cultural settings. Meanwhile, firms in more feminine national cultures may not fall victim to such a severe degree of tokenism and, thus, be able to impact the firm despite being a minority. Although tokenism and gender stereotypes might explain the convex shape of the relationship, it provides little understanding of why this shape is only present when firm performance is measured as return on equity.

5.2 Discussion of Tobin's Q versus Return on Equity and their Implications

Tobin's Q and return on equity represent two different measures to capture a firm's financial performance. Whereas accounting returns refer to how well a firm utilizes its investments and assets to generate earnings (Combs et al., 2005) market performance refers to the behavior of an asset or security in the marketplace (Thaler, 2004). Due to the different nature of these performance measures, it is plausible that different underlying mechanisms drive them, making them respond differently to the same situation.

Indeed, previous studies have also found ambiguous results on the relationship between board gender diversity and firm performance depending on what financial performance measure is used. For instance, Carter et al. (2010) and Post & Byron (2015) find a positive relationship between board gender diversity and accounting measures but do not find a relationship between board gender diversity and market performance. Moreover, Isidro & Sobral (2015) concluded

that an increased board gender diversity has positive and direct effects on return on assets and return on sales, but only indirect effects on firm value. According to the authors, part of the indirect effect comes from females improving the firm's compliance with ethical and social policies, which positively affects the firm.

As Tobin's Q is a market-based performance measure that incorporates expectations of a firm's future or long-term value (Thaler, 2004), incorporating one female on the board may have instant positive effects as it sends beneficial signals to the market. For instance, diverse directors can signal that the firm adheres to social laws and values (Miller & del Carmen Triana, 2009). In cultures where diversity is an accepted norm, such as in the United States, firms are more inclined to signal adherence to these cultural norms of diversity (Fondas, 2000). Hence, the presence of the first female director might send stronger positive signals to the market and thus increase the firm's market value more, compared to the signal of adding a female to a board that is already quite gender-diverse.

Similarly, van der Walt & Ingley (2003) reasons that female directors may enhance a firm's legitimacy, suggesting that as long as the firm has a token number of female directors, their legitimacy will not increase by appointing more females. Meanwhile, accounting returns represent past or short-term financial performance (Combs et al., 2005) and as such, these measures of firm performance are not influenced by the market's expectations. Instead, the effect of female directors might include more of how females impact the board's decisions rather than how the female directors influence the firm's reputation.

The differences between the two performance measures could explain the ambiguous findings from our study where the shape of the relationship between board gender diversity and firm performance differ depending on if we examine the market-based performance measure Tobin's Q or the accounting-based performance measure return on equity. When no account is taken for masculinity, we find the marginal effect of board gender diversity on Tobin's Q diminishes as diversity increases. Similarly, for return on equity, we find the marginal effect to be increasing or constant depending on which fixed effects are used when we do not account for masculinity.

5.3 Discussion of Robustness

We repeated the regressions with different fixed effects and controls to test the robustness of our findings. All combinations of firm, industry, and country fixed effects were tested as well as the exclusion of first firm controls and second all controls. Further, as the United States of America accounts for roughly one-third of our sample, the regressions were repeated, with the U.S. excluded from the sample.

We observed the linear coefficient for board gender diversity (*BGD*) to be positive and significant for most regressions, supporting the argument for an overall positive relationship between board gender diversity and firm performance. The linear coefficient was never observed to be significant and negative. For the quadratic coefficients (BGD^2), we observed some variation in sign and significance for our first regression model. Hence, our conclusions on the curvature of the relationship should be regarded as tentative.

For our second regression model, testing hypothesis two, we observed the quadratic coefficients (BGD^2) to be predominantly negative, suggesting the relationship is concave when masculinity is low. Moreover, we found the coefficient for the linear interaction term (*MASxBGD*) to be negative and significant for most regression, supporting our argument for a diminishing moderating effect of masculinity in culture. We also observed the coefficient for the quadratic interaction term ($MASxBGD^2$) to be of positive sign but varying in significance for most regressions, supporting the argument for a shape flip in the relationship dependent on masculinity in culture. These controls for robustness support the strength of our findings regarding our second hypothesis.

Lastly, we tested the other five dimensions of Hofstede's cultural dimensions theory individually, using the same method as we did when testing for masculinity. We observed that the dimensions of power distance and long-term orientation have some significant moderation on the relationship between board gender diversity and firm performance, which could contribute to the overall moderating effect of culture on the relationship between board gender diversity and firm performance. Albeit, these findings were considered beyond the delimitations of this thesis and are left for future research to explore.

6. Conclusion

6.1 Contribution

While countries are increasingly incorporating gender quota legislation to solve the ethical issue of the worldwide underrepresentation of females on corporate boards (Carrasco et al., 2015), the need to investigate the effects of board gender diversity increases as female directors may risk falling victim to mere tokenism. Previous research on the effects of board gender diversity on firm performance has been rendered inconclusive, and demand has been placed on investigating intervening variables to create further understanding of this relationship (Kochan et al., 2003).

To answer this call, we have conducted a cross-country study investigating the shape of the relationship between board gender diversity and firm performance and the potential moderating effect of national culture on said relationship. Our research question was: "*Is there evidence for a non-linear relationship between board gender diversity and firm performance in a multinational context, and is this relationship moderated by national cultural characteristics?"*. While we find evidence for a convex relationship between board gender diversity and firm performance, we only find evidence for a U-shaped relationship for firms operating in highly masculine national cultures when measuring firm performance as return on equity. Moreover, we find evidence that the national culture moderates the relationship between board gender diversity and firm performance, such that the masculinity of the culture diminishes the positive relation between board gender diversity and firm performance.

Our study has contributed to the extant literature in several ways. First, it has investigated the relationship between board gender diversity and firm performance in a multinational setting, thereby contributing to an area lacking research (Byron & Post, 2016; Nguyen, Thi Hong Hanh, Ntim et al., 2020). Second, it has tested for a non-linear relationship, as argued by the critical mass theory, a useful theory yet rarely used in the research area (Nguyen et al., 2020). Third, it has investigated the moderating role of national culture on said relationship, providing further research on potential intervening variables. To our best knowledge, this is the first study to combine these three areas of research. We believe this increased understanding of the relationship between board gender diversity and firm performance will shed light on the important matter of gender equality, represented in Sustainable Development Goal 5.

6.2 Limitations and Suggestions for Future Research

Our study has several limitations.

Firstly, our sample is skewed towards the more developed parts of the world, as evident from Appendix 1 and graphically depicted in Appendix 8. Hence, certain regions of the world are underrepresented in our study. Future research is needed on cross-country studies with more representative data on developing countries. Further, these studies should incorporate semi- and nonparametric analyses to increase the robustness of these findings.

Secondly, our study only investigates the moderation of one of Hofstede's cultural dimensions, namely masculinity. This provides a limited assessment of the differences in national cultures. Moreover, although Hofstede's cultural dimensions theory has been widely used in previous studies (Carrasco et al., 2015) it has also been criticized as culture is a complex concept that may not be adequately captured in quantitative dimensions. Future research should investigate if other methods of measuring culture give similar results. Moreover, investigating the organizational culture could further increase the understanding of contextual factors that affect the relationship between board gender diversity and firm performance. Overall, our findings of the moderating role of national culture on the relationship advocate future research on contextual factors.

Thirdly, the endogeneity problem may prevail in our study despite our efforts to reduce the endogeneity bias. Hence, our findings should be interpreted with caution. According to Adams (2016), endogeneity problems arise when omitted variables, reverse causality, and measurement errors are present. Adams, Renée B. & Ferreira (2007) find a positive association between board gender diversity and firm value when no attempts are made to control for omitted variables and reverse causality problems and no association when controls for endogeneity are incorporated into the model. The authors suggest that previous studies with findings of a positive relationship between board gender diversity and firm performance have failed to address endogeneity problems adequately. As such, future research should incorporate more extensive controls for these issues. Moreover, our finding of a non-linear relationship between board gender diversity and firm performance indicates that future research should be taking the shape of the relationship in consideration.

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Appendix

Appendix 1. Masculinity index and Firm-Year observation distribution, by country

Country	*Masculinity*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*Total*
Argentina	56	0	0	0	0	4	10	14	22	24	74
Australia	61	37	192	225	242	258	270	289	308	327	2 148
Austria	79	11	12	13	13	13	14	25	30	33	164
Bahrain	53	0	0	0	1	3	3	3	3	6	19
Belgium	54	16	19	19	22	23	25	37	42	43	246
Brazil	49	36	43	48	51	54	57	64	72	84	509
Canada	52	161	180	194	207	222	235	248	297	364	2 108
Chile	28	13	14	16	20	26	28	30	30	32	209
China	66	99	113	120	130	139	289	348	593	845	2 676
Colombia	64	5	6	6	7	10	13	14	15	15	91
Costa Rica	21	0	0	0	0	0	0	0	0	1	1
Czech Republic	57	1	1	1	1	1	1	1	1	1	9
Denmark	16	18	20	20	22	23	26	36	40	53	258
Egypt	53	2	2	2	2	2	2	3	3	3	21
Finland	26	22	23	23	23	23	25	30	42	69	280
France	43	70	76	77	80	82	92	122	133	150	882
Germany	66	60	64	70	77	82	95	139	163	214	964
Greece	57	6	6	6	7	7	7	9	12	13	73
Hong Kong	57	77	87	92	97	101	112	118	135	141	960
Hungary	88	3	3	3	3	3	3	4	4	4	30
India	56	5	68	76	80	85	89	96	126	143	768
Indonesia	46	22	24	29	31	34	36	36	39	43	294
Ireland; Republic of	68	15	25	28	31	32	32	37	40	46	286
Israel	47	10	10	10	11	13	17	20	22	28	141
Italy	70	22	23	25	26	28	34	54	70	90	372
Japan	95	54	358	367	371	382	387	393	400	417	3 129
Kenya	41	0	0	0	0	1	1	1	1	1	5
Korea; Republic	39	58	70	75	80	77	76	94	101	111	742
Kuwait	53	1	1	1	3	3	3	4	4	0	20
Luxembourg	50	6	7	8	9	12	15	16	25	32	130
Malaysia	50	34	39	41	44	44	48	50	54	60	414
Malta	47	0	0	0	0	1	1	4	4	7	17
Mexico	69	16	19	22	25	27	30	32	33	35	239
Morocco	53	1	1	1	1	1	1	1	1	1	9

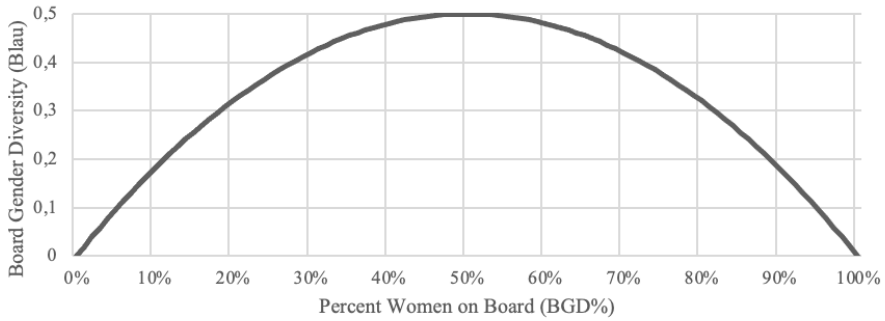
Appendix 1. Masculinity index and Firm-Year observation distribution, by country

Country	*Masculinity*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*Total*
Netherlands	14	27	29	31	34	38	40	57	63	67	386
New Zealand	58	0	12	14	28	43	46	49	52	53	297
Norway	8	16	16	17	18	18	22	38	50	60	255
Oman	53	0	0	0	3	4	4	4	4	4	23
Pakistan	50	0	0	0	0	0	0	1	1	1	3
Panama	44	1	1	1	1	1	1	1	1	1	9
Peru	42	2	2	2	2	15	27	26	26	27	129
Philippines	64	16	16	18	21	21	21	21	22	23	179
Poland	64	15	15	19	19	19	21	24	28	30	190
Portugal	31	6	5	5	5	5	6	9	12	12	65
Qatar	53	0	1	3	4	5	5	5	6	16	45
Romania	42	0	0	0	0	0	0	0	0	1	1
Russia	36	25	27	27	30	31	31	36	40	34	281
Saudi Arabia	53	1	1	1	4	5	5	11	19	19	66
Singapore	48	26	33	33	34	35	36	38	74	81	390
Slovenia	19	0	0	0	0	0	1	1	1	1	4
South Africa	63	48	95	95	95	97	99	100	107	109	845
Spain	42	32	33	34	37	37	41	55	62	61	392
Sweden	5	38	40	42	50	56	61	107	154	269	817
Switzerland	70	55	62	62	63	63	69	113	134	171	792
Thailand	34	14	20	22	23	25	29	33	58	98	322
Turkey	45	6	8	10	11	14	16	30	35	50	180
Uganda	41	0	0	0	0	0	0	1	1	1	3
United Arab Emirates	53	0	0	3	5	5	6	6	7	0	32
United Kingdom	66	144	214	219	238	253	269	305	348	451	2 441
United States of America	62	585	689	701	995	1 503	1 956	2 154	2 310	2 534	13 427
Uruguay	38	0	0	0	0	2	2	2	2	2	10
Vietnam	40	0	0	0	0	0	0	0	2	12	14
Total		1 938	2 825	2 977	3 437	4 111	4 891	5 599	6 482	7 612	39 886

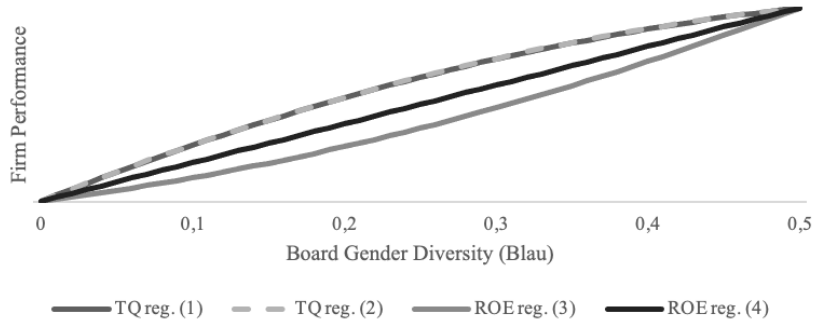
Appendix 2. Variable construction and Eikon identifiers

Name	Abbreviation	Formula	Composites	Eikon - Name	Eikon - Definition
Tobin's Q	TQ	$\frac{Mcap}{E}$ where $E = TA - Lia$	Mcap	"Company Market Cap"	"The Company Market Capitalization represents the sum of market value for all relevant issue level share types. The issue level market value is calculated by multiplying the requested shares type by the latest close price. This item supports Default, Free Float and Outstanding shares types. The default shares type is the most widely reported outstanding shares for a market and it is most commonly Issued, Outstanding, or Listed shares."
			TA	"Total Assets, Reported"	"Represents the total assets of a company"
			Lia	"Total Liabilities"	"Represents the sum of: Total Current Liabilities, Total Long-Term Debt, Deferred Income Tax, Minority Interest and Other Liabilities, Total"
Return on Equity	ROE	$\frac{NI}{(E_{FY}+E_{FY-1})/2}$ where $E = TA - Lia$	NI	"Net income"	"Represents the sum of provision for income tax and income before tax"
			TA	"Total Assets, Reported"	"Represents the total assets of a company"
			Lia	"Total Liabilities"	"Represents the sum of: Total Current Liabilities, Total Long-Term Debt, Deferred Income Tax, Minority Interest and Other Liabilities, Total"
Board Gender Diversity (Blau)	BGD	$1 - \sum_{n=1}^{2} s_n^2$ where $s_1 = BGD\%$, $s_2 = 1 - BGD\%$	BGD%	"Board Gender Diversity, Percent"	"Percentage of females on the board"
Board Size	BS	N/A	BS	"Board Size"	"The total number of board members at the end of the fiscal year"
Independent Board Members	IBM	N/A	IBM	"Independent Board Members"	"Percentage of independent board members as reported by the company"
Average Board Tenure	AVBT	N/A	AVBT	"Average Board Tenure"	"Average number of years each board member has been on the board"
CEO Duality	CEOD	N/A	CEOD	"CEO Chairman Duality"	"Does the CEO simultaneously chair the board or has the chairman of the board been the CEO of the company?"
Average Total Assets	SIZE	$\frac{TA_{FY}+TA_{FY-1}}{2}$	TA	"Total Assets, Reported"	"Represents the total assets of a company"
Debt-to-equity ratio	LEV	$\frac{Debt}{TA-Lia}$	Debt	"Total Debt"	"Represents total debt outstanding, which includes: Notes Payable/Short-Term Debt, Current Portion of Long-Term Debt/Capital Leases and Total Long-Term Debt"
			TA	"Total Assets, Reported"	"Represents the total assets of a company"
			Lia	"Total Liabilities"	"Represents the sum of: Total Current Liabilities, Total Long-Term Debt, Deferred Income Tax, Minority Interest and Other Liabilities, Total"
Revenue Growth	REVG	$\frac{Revenue_{FY}}{Revenue_{FY-1}}$	Revenue	"Total Revenue"	"Represents revenue from all of a company's operating activities after deducting any sales adjustments and their equivalents"

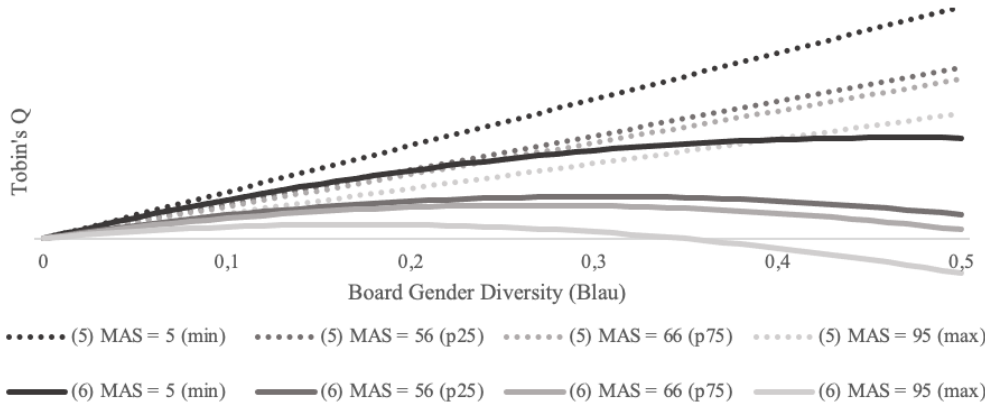
Appendix 3. Blau – Board Gender Diversity percentage relationship



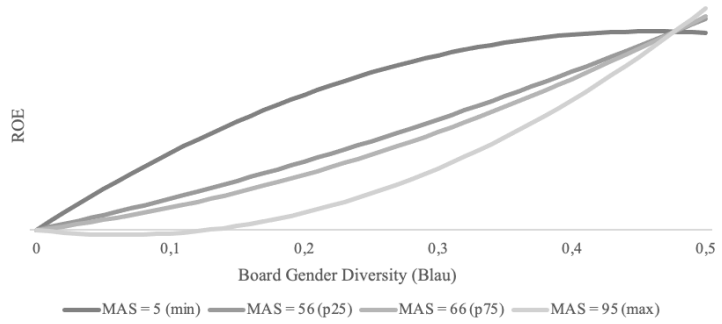
Appendix 4. Normalized relationship between board gender diversity and firm performance as proposed by regression (1), (2), (3), and (4)..



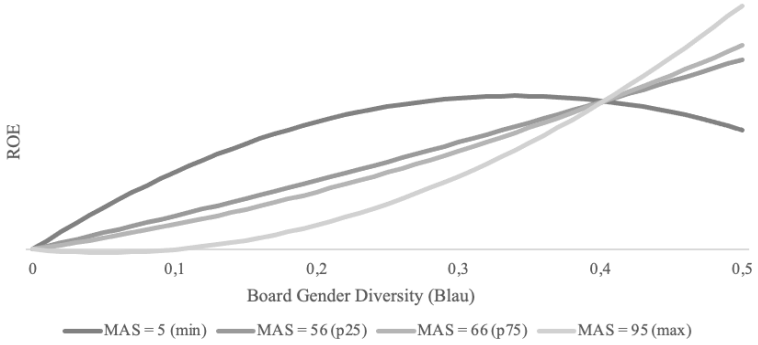
Appendix 5. The relationship between board gender diversity and Tobin's Q as proposed by regressions (5) and (6) for different values of Masculinity.



Appendix 6. The relationship between board gender diversity and return on equity as proposed by regression (7) for different values of Masculinity.



Appendix 7. The relationship between board gender diversity and return on equity as proposed by regression (8) for different values of Masculinity.



Appendix 8. Graphical presentation of this study's geographical coverage. Shade corresponds to firm-year observations. Lightest shade represents no observations.