The Effects of Board Diversity on Firm Risk

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Abstract

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This study aims to determine the combined effects of board diversity in terms of board member age, gender and educational level on firm risk. Composite diversity indices, constructed from a combination of Blau (1977) and Shannon (1948) heterogeneity measures respectively, reflecting each board's composition with respect to the three aspects, are employed for a sample of 3,513 US non-financial and non-utility firms for the years between 2000 and 2017.

The results indicate that both gender and educational diversity amongst board members reduce firm systematic and total risk, measured as a firm's beta and annualized stock return volatility respectively. However, age heterogeneity does not significantly affect firm risk. Additionally, the combined effect of all three diversity aspects as a whole, estimated by the composite diversity indices, is found to be negatively related to firm risk suggesting that a firm's risk tends to decrease as a function of the overall diversity of its board members. Moreover, in high financial volatility periods, larger dissimilarity levels amongst board members reduce firm risk at a lower rate than that noticed under normal market conditions. Therefore, the net effect of board diversity is found to be significantly lower during more volatile market conditions. This suggests that boards fail to accommodate their risk decisions to fluctuating market conditions. This could also be an indication of an increase in inter-member conflicts and disagreements, making it more difficult for boards to agree on business decisions thus reducing the level of risk taken on by firms under normal market conditions.

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1. Introduction

The effect that the diversity of firms' Boards of Directors has on performance, value and risk is a highly controversial topic in Finance which was investigated by many researchers in the late twentieth century. This topic later became the focus of many research papers following an increase in the popularity of Robinson and Dechant's (1997) value-in-diversity proposition and the pressures to incorporate diversity on corporate boards (Daily & Dalton, 2003; Ruigrok, Peck & Tacheva, 2007).

Recent developments in corporate governance research portray an increase in the amount of studies investigating the role and composition of boards of directors. However, a lack of evidence on the effects of the demographic composition of boards still exists. Additionally, the majority of existing scholarly articles fail to account for the consequences of the interaction amongst board members with differing characteristics (Giannetti & Zhao, 2016).

The widening of the candidate pool available to businesses caused by the world's varying demographic composition, legislative changes and cultural developments, ultimately leading to an increase in workplace diversity, justifies the need for a better understanding of this phenomenon from a business perspective.

Contemporary trends in The United States point to an increase in firm board member diversity (Chen, Gramilch & Houser, 2017). The 2020 Women on Boards Gender Diversity Index Report (2018) indicates that the percentage of Fortune 1000 firms where women make up 20% or more of the board of directors' seats grew from 29% in 2011 to 62% in 2018. For S&P 500 firms, 87% reported having at least two or more females on their boards in 2018, up from 56% in 2008. However, the report also shows that women are still under represented on US corporate boards as they occupied only 22% and 21.2% of the board seats of Fortune 1000 and S&P 500 firms respectively in 2018.

Several European countries including Germany, France and Belgium have already enacted legislative quotas pertaining to the percentage of women on the boards of publicly traded companies. California was the first US state to enforce a similar regulation on publicly traded firms in September 2018. Furthermore, Fortune's (2016) report outlines that female US firm board members tend to be younger than their male counterparts, while 45% of female directors are younger than 60. Additionally, the World Bank (2018) provides compelling statistics reflecting higher university graduation rates and higher total years of education amongst females.

In fact, in the US, women's educational achievements have surpassed those of men since the 1980s, and in the twenty-first century, the number of female board members holding Bachelor's, Master's and Doctor's degrees is significantly larger than their male counterparts (Snyder & Dillow, 2011). Consequently, this reflects how current trends are successfully capable of changing board compositions thus altering firm corporate outcomes.

Theories hypothesize that top management team diversity could enhance the efficiency of the decision making processes resulting in better quality strategic decisions and increased creativity and innovation levels. These consequences are likely to affect corporate outcomes including firm value and risk taking. Contrarily, other theories propose that board heterogeneity could lead to increased conflicts and communication problems amongst board members, hindering group dynamics and decision making processes thus adversely affecting corporate performance (Carter, Simkins & Simpson, 2003; Giannetti & Zhao, 2016). In fact, Milliken and Martins (1996) argue that "diversity appears to be a double-edged sword, increasing the opportunity for creativity as well as the likelihood that group members will be dissatisfied and fail to identify with the group" (p.403).

On the other hand, an increase in board heterogeneity may also be attributed to moral and political reasons and management's efforts to reduce discrimination and promote equality and fairness in the workplace in an effort to improve the firm's public image (Erhardt, Werbel, & Shrader, 2003).

Researchers suggest that the group characteristics of boards of directors are likely to alter individual directors' efforts ultimately affecting firm corporate performance and risk (Berger, Kick & Schaeck, 2014). However, existing empirical studies have arrived at inconclusive and conflicting results with regards to the relationship between board diversity and firm performance and risk as some report positive effects while others conclude the presence of negative or insignificant outcomes.

This study aims to determine the effects of board diversity in terms of board member age, gender and educational level on firm risk using panel regression analysis while controlling for factors commonly known to affect firm risk levels. Composite diversity indices, constructed from a combination of Blau (1977) and Shannon (1948) heterogeneity measures respectively, reflecting each board's composition with respect to the three aspects, are employed for a sample of 3,513 US non-financial and non-utility firms for the years between 2000 and 2017.

Relying on social psychology's social identity theory, which postulates that people from diverse cultures, educational backgrounds and experiences portray divergent preferences, perspectives and beliefs, hindering their ability to communicate with each other, this paper believes that increased board member divergence would enhance the probability of having more conflicts and communication problems between board members. This, in turn, is expected to diminish the cohesiveness of business decisions and make it harder for board members to agree on risk choices, emphasizing the need for compromises, thus agreeing on less risky business decisions, decreasing the level of risk taken on by firms and reducing their overall volatility.

The results indicate that both gender and educational diversity amongst board members reduce firm systematic and total risk, measured as a firm's beta and annualized stock return volatility respectively. However, age heterogeneity does not significantly affect firm risk. Additionally, the combined effect of all three diversity aspects as a whole, estimated by the composite diversity indices, is found to be negatively related to firm risk suggesting that a firm's risk tends to decrease as a function of the overall diversity of its board members. Moreover, in high financial volatility periods, larger dissimilarity levels amongst board members reduce firm risk at a lower rate than that noticed under normal market conditions. Therefore, this finding implies that the net effect of board diversity significantly lower during more volatile market conditions as they fail to accommodate their risk decisions to fluctuating market conditions. This could also be an indication of an increase in inter-member conflicts and disagreements, making it more difficult for boards to agree on business decisions thus reducing the level of risk taken on by firms under normal market conditions.

The findings hold under different risk measures, diversity measures and index compositions. Additionally, the effects are robust to endogeneity concerns as firms that are characterized as having high diversity levels amongst their board members exhibit lower risk levels, while those that demonstrate increases (decreases) in the board's overall diversity levels observe decreases (increases) in their respective risk levels indicating that the risk alterations are as a result of the diversity variations.

This research contributes to the existing knowledge and findings in the corporate governance field in various ways. Firstly, it investigates the effects of board diversity using a relative composite index which incorporates both observable and non-observable diversity aspects thus enabling a better understanding of the overall consequences of board member

heterogeneity. Secondly, while a wide range of researchers observe the relationship between a single diversity attribute and firm financial performance, there is a lack of evidence on the combined effect of differing attributes on the firm's risk level. Thus this research provides compelling evidence on the relationship between the overall level of board diversity and firm risk, an aspect that has not been addressed in previous empirical studies, and also has several implications for current and future investors and employees. Thirdly, this study helps settle the disputes and inconsistencies amongst the conflicting findings of a growing body of literature which explores the consequences of board member heterogeneity.

The remainder of this paper is organized as follows: Section 2 provides a definition of diversity, describes the roles of board members as corporate governance mechanisms, and highlights the theoretical frameworks used to explain the effects of board diversity on firm corporate outcomes. It also outlines the advantages and disadvantages of board member heterogeneity and discusses the findings of prior empirical papers used to develop this study's hypotheses. Sections 3 and 4 describe the research design including the data-gathering process and the methodology used to test the hypotheses respectively. The empirical findings are analyzed in section 5. Finally, section 6 concludes by providing practical implications, discussing the limitations of this research and specifying recommendations for further work.

2. Literature Review and Hypothesis Development

2.1 What is Diversity?

Diversity in the board of directors could be defined as a variety in the board of director's composition in terms of any characteristics that members can use to differentiate other members from themselves (Phillips & O'Reilly, 1998; Mahadeo, Soobaroyen & Hanuman, 2012). These characteristics could either be observable, based on demographic aspects such as gender, age, nationality and race, or non-observable, based on cognitive aspects such as level of education, educational field, professional experiences, cultural values and personality traits (Milliken & Martins, 1996; Pelled, 1996; Boeker, 1997; Watson, Johnson & Merritt, 1998; Maznevski, 1999; Kilduff, Angelmar & Mehra, 2000; Petersen, 2000; Timmerman, 2000; Erhardt, Werbel & Shrader, 2003; Kang, Cheng & Gray, 2007).

While the majority of researchers focus on the effects of observable diversity aspects on firm performance, this research incorporates both observable and non-observable aspects by

examining the effects of board members' gender, age and education level on firm risk using a composite diversity index.

2.2 The Role of Boards of Directors

In public companies, shareholders elect members to the board of directors with the legal obligation of representing them and ensuring that management's decisions are in their best interest. Boards of directors thus serve as a link between shareholder and mangers and have a duty to protect the organization's assets and shareholders' investments (Fama & Jensen, 1983). They are responsible for assigning business leaders who would drive the organization in a favourable direction for shareholders, monitoring internal controls and management teams and serving as advisors to the managers to ensure that the decisions taken are beneficial to the shareholders (Forbes & Milliken, 1999).

On the other hand, they also have the duty of setting policies to guide the top management team's actions and overseeing and influencing the business's strategic directions. As such, they direct businesses by setting a vision, mission and business goals, and vote on the best strategies for them, altering the business's stock market performance and risk level, and the returns for the shareholders (Boland & Hofstrand, 2009).

In an attempt to mitigate firm risk, boards should establish clear guidelines and expectations on how they identify, evaluate, manage and adapt to critical risks and engage in risk management activities. They must also effectively communicate these definitions to top management teams through the company's vision and mission statements, thus ensuring that managers are successfully able to adapt the business's operational decisions to its risk profile. Monitoring and reviewing managerial decisions through detailed risk reports would also enable them to ensure that managers are performing their roles as necessary which is a high determinant of firm risk (Deutch, 2005; Delloitte, 2014).

Hence, directors could mitigate firm risk by promoting strong risk management behaviours within the business, rewarding people for managing and mitigating risk and allocating resources and funds to risk management programs. Additionally, they could ensure that all directors engage in decision making and strategic processes. They should also establish whether they have the necessary skills and competencies to thoroughly evaluate strategic decisions from different perspectives and incorporate the associated strategic risks in their decisions. This could be

achieved by nominating a diverse candidate pool and providing professional development programs to existing executives thus benefiting from their varying skills and experiences (Ernst & Young, 2013).

2.3 The Theoretical Frameworks of Firm Corporate Governance

Corporate governance refers to the system that controls and directs firms (Campbell & Mínguez-Vera, 2008). Economic theories assume that boards of directors have various important internal responsibilities and serve as vital corporate governance mechanisms in larger corporations (Fama & Jensen, 1983; Rose, 2007).

The majority of Economics and Finance research papers base their arguments pertaining to the relationship between the board of director's diversity and firm value, performance and risk on the agency theory while other papers support their findings with the resource-based, human-capital and social-identity theories each of which is explained in the following three subsections (Carter at al., 2003).

2.3.1 Agency Theory

Developed by Ross (1973) and Mitnick (1975), the Agency Theory in finance clarifies the relationship between shareholders and managers in business. Jensen and Meckling (1976) describe the agency relationship as a contract under which the principals (shareholders) authorize agents (managers) to make business decisions on their behalf, which are perceived to be in the principals' best interests.

Under these assumptions, boards of directors are used to regulate and monitor managers, with the aim of maximizing firm value in the shareholders' interest, and to prevent managers from engaging in opportunistic behaviours (Fama & Jensen, 1983). Thus, boards help alleviate the agency problem between managers and shareholders by implementing dynamic strategic decisions, such as assigning mangers and deciding on their compensation levels, while dismissing managers that do not act in the shareholders' best interests (Carter et al., 2003).

However, if both the directors and the shareholders aim to maximize their own utility, there is ample evidence to suggest that the directors will not always act in the shareholders' best interest, thus representing the presence of an agency cost (Jensen & Meckling, 1976).

On the other hand, if the agents' utility is dependent on the firm's value, and they aim to maximize their personal utility, agency theory appears to suggest that the agents would be risk averse (Sila, Gonzalez & Hagendorff, 2016). Therefore, agency theory suggests that it is crucial to ensure that directors are independent in order for them to perform their monitoring and controlling tasks which maximize shareholders' value (Carter et al. 2003; Ruigrok et al., 2007).

Carter et al. (2003) and Talavera, Yin and Zhang (2018) suggest that a more diverse board of directors would increase board independence as outsiders from different gender, age, race, and ethnicity may bring up points that other directors may not think of thus enhancing board activity and monitoring. However, Carter et al. (2003) emphasize that board members with differing perceptions might be marginalized, and, as such, they would not be able to perform their monitoring duties. Therefore, they argue that the "agency theory simply does not provide a clear-cut prediction concerning the link between board diversity and firm value" (p.37).

2.3.2 Resource-Based Theory and Human Capital Theory

Barney's (1991) Resource-Based Theory proposes that firms have several resources, which could be used for the implementation of value creating strategies, at their disposition. These include their assets, information, knowledge, social connections, organisational processes and firm specific attributes. Therefore, corporations should be able to utilise these resources, rather than the industry structure, in order to achieve a competitive advantage provided that they are unique to the corporation and difficult to imitate (Barney, 1991; Shrader, Blackburn, & Iles, 1997).

In line with Barney's (1991) Resource-Based Theory, Becker's (1964) Human Capital Theory demonstrates that the human capital of a corporation's employees, managers and board members, which could be advantageous to the firm and difficult to imitate, significantly affects its ability to achieve a competitive advantage. These resources comprise a person's educational background, skills, experiences, training, characteristics and individual knowledge and insights which are unique to each employee (Barney, 1991; Richard, 2000; Carter, D'Souza, Simkins, & Simpson, 2010; Setiyono & Tarazi, 2014; Talavera et al., 2018).

Based on these theories, boards of directors are expected to provide firms with resources in the forms of human and relational capital from their knowledge, skills, experiences, and social ties acquired from their personal and professional lives. This could be used to gain access to

external sources such as funding and new opportunities thus enhancing firm performance (Hillman & Dalziel, 2003; Ruigrok et al., 2007; Setiyono & Tarazi, 2014).

Accordingly, heterogeneous boards would provide firms with a broad combination of exclusive and valuable resources and perspectives that could be used for solving business problems and strategy implementation (Shrader et al., 1997; Ruigrok et al., 2007; Wellalage & Locke, 2013).

2.3.3 Social Identity Theory

Social identity theory assumes that people rely on the social groups they belong to, such as nationality, age, gender, and social class, in order to define their personalities (Tajfel & Turner, 1979; Islam, 2014). Individuals belonging to the same social group are defined as in-group members, while people belonging to other social groups are considered out-group members who would face acceptance and integration difficulties by the in-groups. As such, "individuals prefer to build and maintain relationships with others who are similar to them in the social category membership" (Wellalage & Locke, 2013, p.120).

Under the assumptions of the social identity theory, therefore, it is expected that an increase in a corporation's board of directors' heterogeneity may result in more clashes amongst in-group and out-group directors. This would impede the cohesiveness of board meetings, prolong the time required for the board to make decisions and hinder communication amongst members leading to a weakening of firm performance and reducing firm risk (Byrne, 1971; Phillips & O'Reilly, 1998; Westphal & Bednar, 2005; Wang & Hsu, 2013; Talavera et al., 2018).

2.4 Diversity and Boards of Directors

Compelling evidence concerning why corporations opt to increase their workplace diversity has been provided by Cox and Blake (1991), Robinson and Dechant (1997), Carter et al. (2003), Anderson, Reeb, Upadhyay and Zhao (2011) and Mahadeo et al. (2012). They argue that a diverse workplace would enable a corporation to develop a clearer understanding and stronger integration into markets which are experiencing increases in their overall diversity levels.

Additionally, diverse workplaces would enable corporations to enhance their creativity and innovation levels and improve their problem-solving and leadership styles as they benefit from

the varying experiences, skills and attributes of their members. This would allow them to develop and thoroughly evaluate and understand business solutions, and achieve a competitive advantage. Finally, firms would benefit from improved international relationships as managers and directors develop a better understanding of other cultures based on their social interactions.

On the other hand, Sah and Stiglitz (1991), Adams and Ferreira (2010) and Giannetti and Zhao (2016) explain that large and diverse groups require more time and effort to arrive at a consensus. Therefore, more compromises are made in their decision-making processes and their outcomes tend to be less extreme compared to small groups. This suggests that larger and more diverse boards should exhibit lower performance volatility therefore reducing firm risk (Lenard, Yu, York & Wu, 2014).

Cox and Blake (1991), Cox (1991) and Richard, Murthi and Ismail (2007) justify that firms which fail to integrate diverse workforces would encounter significant costs as a result of higher absenteeism and turnover rates from unsatisfied members and slower decision making processes. Additionally, as boards become more diverse, it is expected that there would be an increase in the differences in individual values and preferences resulting in communication problems and disagreements amongst board members, inhibiting the decision-making process and leading to highly unpredictable decisions, thus increasing performance variability and firm risk (Giannetti & Zhao, 2016).

2.5 Board Diversity and Hypothesis Development

The following three subsections outline the effects of three diversity aspects: gender, age and education on firm performance, value and risk. The fourth and final subsection outlines the overall effects of diversity on firms based on the mixed findings of previous empirical research using different composite diversity indices. This serves as the basis for developing the hypothesis for this research and highlights the need for further research pertaining to the effects of diversity on firm risk.

2.5.1 Gender Diversity

The gender composition of boards of directors is the most commonly researched demographic factor in Finance. Several researchers study the effects of board gender diversity on firm value (e.g. Carter et al., 2003, 2010; Rose, 2007; Campbell & Minguez-Vera (2008);

Darmadi, 2013), performance (e.g. Wellalage & Locke, 2010; Mahadeo et al., 2012; Post& Byron, 2015) and risk (e.g. Berger, Kick & Schaeck, 2014; Lenard et al., 2014; Sityono & Tarazi, 2014; Loukil & Yousfi, 2016; Sila et al., 2016; Jizi & Nehme, 2017; Chen, Gramilch & Houser, 2017). However, their findings are inconsistent, as some document positive effects while others conclude negative or insignificant effects.

From a governance perspective, researchers argue that highly gender diverse boards, compared to those with lower diversity levels, do a better job at monitoring management and accounting. They have also been shown to make better business decisions by enhancing the decision making process and to reflect higher ethicality in their decisions (Post & Byron, 2015; Chen et al., 2017).

Additionally, Simpson, Carter and D'Souza (2010) posit that female directors are more likely to be independent. Therefore, gender heterogeneous boards reflect higher independence levels. Female directors also tend to be more conservative and risk averse than their male counterparts (Srinidhi, Gul & Tsui, 2011).

On the other hand, the earnings of firms with gender diverse boards more accurately reflect economic performance as board gender diversity has been shown to have a positive effect on earnings quality and the accuracy of analyst forecasts (Srinidhi et al. 2011; Gul, Hutchinson & Lai, 2013; Chen et al., 2017).

Konrad and Kramer (2006) argue that women on boards tend to take a larger selection of shareholders' interests into account in their decision making processes. Therefore, diverse boards follow more thorough decision making processes leading to better quality decisions which would alter the firm's risk (Phillips & O'Reilly, 1998; Daily & Dalton, 2003; Colaco, Myers & Nitkin, 2011). Also, female directors have been shown to take ethical standards into consideration in their decision making, and to avoid being part of unethical behaviours when forced by corporations (Wahn, 2003; Roxas & Stoneback, 2004). These arguments thus suggest that corporations with gender diverse boards of directors possess lower risk levels.

A positive relationship between board gender diversity and firm value and performance has been documented by Carter et al. (2003), Campbell and Minguez-Vera (2008) and Mahadeo et al. (2012) who suggest that diversity increases the quality of decisions made by boards due to a variety in the contributed skills and experiences. These findings also suggest that diversity reduces agency costs (Cater et al., 2003).

In line with studies documenting a positive relationship between board gender diversity and firm performance, Lenard et al. (2014), Loukil and Yousfi (2016) and Jizi and Nehme (2017) find a negative relationship between board gender diversity and firm risk amongst firms from three different countries: The United States, Tunisia and The United Kingdom. This suggests that female participation on boards enhances the fulfilment of their fiduciary duties and supports the arguments of the resource-based theory ultimately reducing firm risk.

The presence of females on Indonesian bank boards of directors significantly reduces the banks' risk as was reported by Setiyono and Tarazi (2014). They also provide evidence suggesting that the benefits of gender diversity do not outweigh the integration costs. However, their results are not directly translatable to other industries and countries due to regulatory differences.

Conversely, Adams and Ferreira (2009) and Wellalage and Locke (2013) find a negative relationship between board gender diversity and Tobin's Q as a proxy for firm value. Even though there is evidence of an increase in the monitoring of management intensity amongst the studied firms, the researchers attribute the negative effect to the boards' over monitoring efforts. Interestingly, Darmadi (2013) finds no significant relationship between the proportion of female directors on the board and firm's return on assets, but concludes that a negative relationship between the presence of females on boards and firm performance and value exists. However, the author cautions that the results should not be interpreted as evidence that the presence of female executives is value destroying.

On the other hand, Chen et al. (2017) document that gender diverse boards encourage managers to take on more financial risks which could increase firm value while they discourage them from engaging in actions that could enhance reputational risks thus diminishing share prices. The researchers argue that this suggests that gender heterogeneous boards have a better understanding of firm risk compared to gender homogenous boards. However, this could also be an indication of the presence of communication problems and conflicts amongst board members where it proves to be challenging to arrive at a consensus thus reducing firm risk.

Berger et al. (2014) also find a marginally significant positive relation between the proportion of female directors on German banks' boards of directors and bank portfolio risk. However, Sila et al. (2016) did not find a significant relationship between female boardroom representation and firm risk after accounting for endogeneity, while Rose (2007) and Carter et al.

(2010) fail to find a significant impact of gender diversity on firms' Tobin's Q. Therefore, they conclude that the increase in female boardroom representation is a fairness matter rather than an economic one.

This study expects that as boards become more gender diverse, the probability of encountering conflicts and communication problems between male and female executives will significantly increase as a result of differing characteristics, risk preferences and strategic priorities. This would prolong decision making processes and hinder the board's productivity. However, given the higher ethicality of female decision making processes and their tendency to avoid the engagement in unethical behaviours especially in light of the agency relationship, these directors are expected to voice out their concerns thus altering the firm's strategic decisions and affecting overall risk levels. Therefore, increasing board gender heterogeneity is expected to reduce firm risk.

2.5.2 Age Diversity

As part of investigations by many researchers in various finance papers in the early twenty-first century, inconsistent results on the effects of board age diversity on different firm performance outcomes have been documented. Darmadi (2013) argues that "age could be used as a proxy for experience and risk-taking manner" (p.10).

Age diversity amongst board members possibly enhances the networks, skills, knowledge and experiences at the board's disposition as younger directors exhibit more creativity, recent skills and knowledge, while older directors have more solid experiences, networks and relationships thus enhancing firm performance (MacCrimmon & Wehrung, 1991; Talavera et al., 2018). Firms with younger executives also exhibit higher levels of international diversification (Hermann & Data, 2005). Also, Wellalage and Locke (2013) argue that the average age of board members might affect their business decisions and the amount of risk their firms take on which leads them to exhibit higher financial performance.

Hamrbick and Mason (1984) expect that firms led by younger managers would exhibit higher growth rates than those with older managers which could be associated with the younger managers' interests in career development and willingness to live dynamic work lives (Cheng, Chan & Leung, 2010).

Board age diversity may also constitute a cost to firms due to conflicts amongst members belonging to different age cohorts as a result of cognitive differences and risk-appetite discrepancies. Younger directors exhibit higher risk preferences while older directors are more cautious and conservative with their decisions and resistant to change. This produces communication barriers amongst members and hinders firm performance (Carson, Mosley & Boyar, 2004; Talavera et al., 2018).

Kim and Lim (2010) conclude a positive relationship between age diversity of independent directors and firm value in Korean firms. Relying on the resource-based theory, they argue that younger executives have higher productivity levels while those older have longer and more useful experiences. As such, the combination of both these attributes could create valuable opportunities for firms thus enhancing their performance.

Amongst Indonesian firms, Darmadi (2013) finds that the proportion of young directors on the boards has a significant positive effect on firm performance. However, he fails to find a significant relationship between a Blau gender diversity index and Tobin's Q, suggesting that young directors are highly interested in facing new and challenging tasks and strategies which lead to higher performance (Hambrick & Mason, 1984).

Mahadeo et al. (2012) and Wellalege and Locke (2013) find a positive association between age diversity and firm performance amongst emerging countries. They argued that this could be explained by the division of labour due to differences in the strategic and operational considerations of the various generations.

Based on the arguments of the social identity theory, Hafsi and Turgot (2013), Ali, Ng and Kulik (2014) and Aime and Tarus (2014) find that board age heterogeneity hampers firms' social performance, profitability and decisions pertaining to strategic changes.

Talavera et al. (2018) find that board age diversity has a significant negative effect on the Chinese bank profitability between the years 2007 and 2013. They argue that this is due to a reduction in the boardroom cohesion, causing conflicts and communication problems amongst directors, weakening the board's effectiveness and hindering its ability to monitor management. Rivas (2012) believes that the skills and experiences of older team members would be offset by the risk seeking behaviours of younger members. As such, Rivas (2012) argues that higher levels of age heterogeneity in boards of directors would most likely provide better advice and resources to firms, and lead to a higher inclination to learn and take on more risk.

Moreover, Berger et al. (2014) document that a board change which reduces the board's average age significantly increases German banks' portfolio risk. They argue that this is due to the nomination of younger executives who exhibit lower risk aversion levels thus affecting firms' overall risk.

Finally, amongst Nordic and Swedish firms, Randøy, Oxelheim and Thomsen (2006) and Eklund, Palmberg and Wiberg (2009) fail to find a significant relationship between average director age and firm performance.

This research believes that as age heterogeneity increases amongst directors, conflicts between board members belonging to different age cohorts would increase as a result of diverging opinions and risk tolerance levels. Executives belonging to older age cohorts tend to be more risk averse, while those belonging to the younger age categories are less risk averse. However, since a higher proportion of executives on US corporate boards belong to older age groups, with recent trends pointing to an increase in average director age, it could be argued that older directors would be less acceptable of younger directors' opinions and unwilling to alter their beliefs and risk preferences. As such, the firm's risk level is affected by older director's behaviours, and would reflect their risk preferences. Therefore, it is expected that an increase in board age diversity would reduce firm risk.

2.5.3 Educational Diversity

The effect of the educational diversity of the board of directors on firms has been under researched in finance since the majority of researchers study the effects of demographic diversity factors.

Kesner (1988) believes that excluding educational background from diversity studies is highly problematic as the experiences and skills that executives developed through their education provide them with a better understanding of complex business transactions and biases their business decisions.

The resource dependence and human capital theories assume that education enhances executives' skills, knowledge and value leading to superior organizational performance. Thus, educational diversity amongst board members is expected to lead to wider board perspectives and improved decision making (Setiyono & Tarazi, 2014). Additionally, Milliken and Martins

(1996) argue that educational diversity enhances problem-solving skills thus increasing firm financial performance.

Grable (2000), Cardduci and Wong (2008) and Christiansen, Joensen and Rangvid (2008) argue that individuals with higher educational qualifications tend to make riskier household financial decisions and invest more heavily in stock markets, while Buccoil and Miniaci (2011) fail to find a significant relationship between average household educational level and their risk attitudes. However, these results cannot be directly applied to boards of directors given the differences and importance of the roles and responsibilities of board members.

Bathula (2008), Pohjanen and Bengtsson (2010), Mahadeo et al. (2012) and Wellalage and Locke (2013) document negative effects of educationally heterogeneous board members on firm performance. They base their findings on the social integration theory and argue that the negative relationship is a result of conflicts and communication problems amongst board members with differing thoughts, perspectives and skills due to their educational discrepancies.

Adnan, Sabli, Abd Rashid, Bin Hashim, Paino and Abdullah (2016) fail to find a significant relationship between board educational diversity and firm return on assets and return on equity. As such, they conclude that educational homogeneity amongst board members is better for enhancing firm performance.

Kaplan, Klebanov and Sorensen (2008) also found no significant relationship between firm performance and average executive's SAT and college selective scores, used as a proxy for education level.

Graham and Harvey (2001) conclude that executives with higher educational qualifications such as MBAs and PhDs rely on more advanced valuation techniques such as the Capital Asset Pricing Model. As such, the implementation of these techniques is expected to reduce firm risk (Berger et al., 2014). Conversely, Bertrand and Schoar (2003) document higher aggressiveness levels and a tendency to run more levered firms amongst executives with MBAs suggesting that they employ policies that increase firm risk.

Berger et al. (2014) conclude that bank portfolio risk decreases as the representation of executives with PhD degrees on boards of directors increases suggesting that they dedicate more time and effort for risk management activities.

However, Setiyono and Tarazi (2014) find that, amongst Indonesian banks, educational diversity on boards of directors' leads to better bank performance and higher income volatility and leverage risk.

This paper argues that directors tend to display greater risk aversion levels as their educational attainments increase. This is expected to be motivated by their willingness to ascertain higher levels of job and income security, and the reputational factors associated with their professional career lives. On the other hand, directors with lower education levels are known to be more risk averse as they place higher emphasis on job security and their current career attainments. Hence boards with varying educational attainments are believed to have convergent risk preferences, and as such, educational diversity is expected to reduce firm risk.

2.5.4 The Combined Effects of Diversity on Firms

There is a lack of evidence on the overall effects of board diversity on firms since a limited number of papers in Finance study the overall effects of board of directors' diversity on firm performance and risk using composite diversity measures.

Randøy et al. (2006) study the effects of board diversity in Nordic firms encompassing gender, nationality and age attributes, on firm performance and stock market value. They construct an overall board diversity index as the sum of the percentages of females on the board, board mean age and foreign executives, and their results reveal that board diversity does not significantly affect firm performance and stock market valuation.

Hafsi and Turgut (2013) focus on the relationship between board heterogeneity and US firm social corporate performance using a composite diversity index consisting of gender, age, ethnicity, experience and tenure characteristics. Gender and ethnic diversity were estimated as the percentage of female and non-Caucasian directors respectively, while a coefficient of variation was used to estimate each of age and tenure diversity. Finally, the average of board director committee experience amongst members was used as a proxy for experience diversity.

In order to create their diversity index, the sample was divided into three terciles representing below average, average and above average levels of diversity. The three terciles were then given scores of zero, one and two respectively and the sum of the scores across all of the five diversity components was used as a diversity index. Their findings reveal a positive relationship between board diversity and firm performance.

Giannetti and Zhao (2016) provide compelling evidence on the affiliation between board diversity and US firm performance volatility as a measure of firm risk. The aspects incorporated in their board diversity measure are member ethnicity, age, education and experience, and they rely on the first principal component of the age coefficient of variation and Herfindahl-based indices of ethnicity, education and experience to construct their board diversity index. They concluded that firms exhibit higher volatility levels as board diversity increases, thus making them riskier.

Conversely, Bernile, Bhagwat and Yonker (2018) document a negative relationship between board diversity and firm risk, measured as the annualized volatility of daily stock returns. Their diversity index, taking into account member gender, age, board experiences, ethnicity, education, and financial experiences, was estimated as the standardized sum of the percentage of female members on the board, standard deviation of member age and Herfindal-based indices for ethnicity, number of directors that achieved their Bachelor's degrees and financial experiences.

As such, Bernile et al. (2018) argue that board diversity is used as a governance mechanism which moderates decisions and reduces the magnitude of groupthink problems thus reducing firm risk.

2.6 Hypotheses

In light of the arguments presented in the aforementioned theories and literature, this study argues that under normal market conditions, as boards of directors become more diverse, as a result of compositional fluctuations caused by changes in the representation of female executives, the generational distribution and the educational attainments of different members on the board, there is an increase in the probability of having more conflicts and communication problems between board members. This diminishes the cohesiveness of business decisions and prolongs decision making processes, making it harder for board members to agree on risk decisions thus emphasizing the need for compromises. This decreases the level of risk taken on by firms and reduces their overall volatility.

However, under highly volatile market conditions, such as those observed during financial crises, increased conflicts and communication problems amongst diverse board members prolong their decision making processes thus serving as obstacles for effective business processes during

periods which require faster reaction times and more purposeful decision making. As such, an increase in board diversity under these circumstances is expected to reduce firm risk at a lower rate than that observed under normal market conditions as they fail to accommodate to fluctuating market conditions.

Therefore, this paper investigates the following hypotheses:

Hypothesis (1): An increase in board of directors' diversity reduces firm risk.

Hypothesis (2): During financial crises, an increase in board of directors' diversity reduces firm risk at a lower rate than under normal market conditions.

Figure 1 summarizes the expected directions of the effects of the various diversity measures on firm risk.

3. Data

3.1 Data Sources

Data on the board composition and individual directors' profiles are required in order to estimate the overall board diversity in terms of gender, age and education.

The BoardEx database is used to retrieve the analytical organizational summary and director profile data including firm name, country, ticker, CIK code, the number of directors and percentage of males on each board and each director's name, year of birth, educational achievements and tenure with the firm. Any missing data on the directors' years of birth and highest educational achievements are hand collected from a combination of firm annual reports as well as proxy statements provided on the US Securities and Exchange Commission's (SEC) EDGAR, Bloomberg and directors' personal LinkedIn profiles where available.

The retrieved tickers, CIK codes and firm names are used to collect and match each firm with its industry four-digit SIC code, CUSIP, financial data and daily stock price data obtained from Standard and Poor's Compusat and The University of Chicago's Center for Research in Security Prices (CRSP) respectively in order to estimate the control and dependent variables discussed in the following sections.

Firms with SIC codes between 6000 and 6999, and 4900 and 4999, representing financial and utility firms respectively, are excluded as they are highly regulated industries, and following the SEC's definition of penny stocks, stocks with prices below $5 are eliminated from the sample as they exhibit high price fluctuations thus inflating the dependent variable. Firms with less than 90 daily stock returns per year and inadequate financial data to estimate the dependent and control variables are also dropped. Finally, corporations with less than three years of data are removed as they do not contribute significantly to the data generating process, as well as those that end up in insolvency since they would bias the firm risk measures.

This procedure produced a final sample consisting of 33,536 firm-year observations originating from 3,513 different US firms for the years between 2000 and 2017.

3.2 Dependent Variable – Firm Risk

This study is concerned with the effects that diversity amongst board members has on firm risk. As such, the dependent variable is a measure that accurately reflects the level of firm risk. In the literature, scholars employ various financial and performance measures which are argued to adequately proxy for firm risk.

Chen et al. (2017) rely on modified firm financial distress scores by reducing the weight assigned to profitability measures thus creating risk measures which encompass both corporation long-term and short-term liquidity risk and insolvency risk. Giannetti and Zhao (2016), Sila et al. (2016) and Bernile et al. (2018) incorporate idiosyncratic risk estimates as measures of firm risk, calculated as the annualized standard deviation of the return residuals obtained using the market model.

Other researchers proxy for total firm financial risk with the annualized volatility of daily firm stock returns (Lenard et al., 2014; Sila et al., 2016; Jizi & Nehme, 2017; Bernile et al., 2018), or monthly firm stock returns (Lenard et al., 2014; Giannetti & Zhao, 2016; Bernile et al., 2018) over the business year preceding the end of their fiscal year.

On the other hand, Giannetti and Zhao (2016) verify the validity of their findings by adopting the volatility of firm earnings per share over the eight quarters preceding the end of their fiscal year as a measure of firm performance risk. However, such measure is subject to bias due to the lack of an adequate reporting frequency to estimate volatility. Alternatively, Sila et al. (2016) focus on estimates of firm systematic risk (beta), defined as the coefficients obtained by

regressing firm monthly stock returns on the returns of the CRSP Equally Weighted Index in a market model based methodology

Following Sila et al.'s (2016) methodology, the results of this study depend on firm systematic risk (beta) as a quantification of firm risk. This is estimated by the coefficient produced from regressing firm daily stock returns in the year prior to their fiscal year end on the daily returns of the CRSP Value Weighted Index on matching dates in a market model regression. Beta values greater than, equal to or less than one indicate that the firm's stock exhibits higher, equal or lower volatility levels than the market index respectively thus in turn signalling higher, equal and lower risk levels, while negative values indicate that a firm's stock is inversely correlated to the market.

In an attempt to ascertain the validity of this study findings, additional analysis is performed on the approximations of total firm financial risk, calculated as the square root of 252 multiplied by the standard deviation of a minimum of 90 daily stock returns realized by the firm in the year prior to its fiscal year end in accordance with Lenard et al. (2014), Sila et al. (2016), Jizi & Nehme (2017), and Bernile et al. (2018).

3.3 Independent Variable – Board Diversity

This research is interested in the overall consequences of board diversity in terms of board member gender, age and education. As such, a composite diversity index which encompasses all three factors is developed, which serves as the independent variable of interest.

The majority of the existing empirical papers on the effects of gender diversity mentioned in the literature review (e.g. Lenard et al., 2014; Setityono & Tarazi, 2014; Sila et al., 2016; Chen et al., 2017; Jizi & Nehme, 2017) base their gender diversity approximations on the ratio of the total number of female directors elected to the board to the total number of board members, or categorical variables that indicate the presence of female executives (e.g. Lenard et al., 2014; Jizi&Nehme, 2017; Chen et al., 2017).

Interestingly, Wellalage and Locke (2013) adapt Blau's (1977) and Shannon's (1948) heterogeneity indices to reflect levels of board gender heterogeneity. These measures are widely implemented in economics and finance diversity studies as they are argued to provide better reflections of a firm's relative heterogeneity (Campbell & Mínguez-Vera, 2008).

Equation (1) outlines the calculation of Blau's (1977) diversity index where P_i measures the proportion of individuals that belong to category i.

$$Blau\_Diversity = 1 - \sum_{i=1}^{n} P_i^2 \quad (1)$$

Similarly, equation (2) outlines the calculation of Shannon's (1948) diversity index where P_i has the same definition as that in the Blau index.
Higher values of both diversity indices indicate higher heterogeneity levels amongst the sample.

$$Shannon\_Diversity = -\sum_{i=1}^{n} P_i \ln(P_i) \quad (2)$$

The literature on the effects of age diversity also follows various ways to estimate the level of age heterogeneity amongst board members. Kim and Lim (2010) allocate scores to the directors in their sample based on the age category they belong to, and estimate the average firm age score as a measure of diversity. However, Darmadi (2011), Wellalage and Locke (2013) and Ferrero-Ferrero, Fernández-Izquierdo and Muñoz-Torres (2015) distribute board members into different generational cohorts and calculate Blau indices on the basis of the proportion of directors that are a part of each cohort. Conversely, Talavera et al. (2018) rely on the age coefficient of variation amongst board members to proxy for board age diversity.

Additionally, scholars adopt varying methods to measure the level of educational heterogeneity amongst board members. While Bathula (2008) and Adnan et al. (2016) employ the percentage of members holding PhD and master degrees or beyond respectively as educational diversity measures, Wellalage and Locke (2013) and Setiyono and Tarazi (2014) compute Blau indices focusing on executives' highest educational achievements.

This study computes both Blau and Shannon diversity indices to estimate the degree of firm level board heterogeneity with respect to each of the three aspects: gender, age and education.

Similar to Wellalage and Locke (2013), this study employs the percentages of male and female directors to calculate the gender indices. Additionally, following Ferrero-Ferro et al.'s (2015) methodology, this research estimates the proportions of board members belonging to one of five generational cohorts based on their year of birth outlined in Table 1 in order to generate

the age diversity indices. Finally, consistent with Wellalage and Locke (2013), the percentage of executives with maximum educational achievements classified into one of the five categories listed in Table 2, are computed to quantify board educational heterogeneity.

In the interest of creating a relative composite diversity measure, the individual gender, age and education indices are distributed into quantiles and allocated scores which reflect their fractional quantile positions. The gender measures are divided on the basis of the median and given scores of one-half and one respectively, while each of the age and education measures are split into terciles and assigned scores of one-third, two-third and one respectively. The firm's overall diversity index is then computed as six times the sum of its gender, age and education scores thus giving equal weights to the individual aspects and creating a relative composite diversity index with values that range between seven and 18. Appendix B outlines the number of quantiles per diversity aspect, the scores assigned to each quantile and five hypothetical examples of estimating the composite firm diversity index.

The analysis and conclusions of this study rely on the Blau based composite diversity index. However, a Shannon based composite diversity measure is implemented to test the robustness of the results to different diversity measures. Moreover, additional robustness tests are performed using two other composite diversity indices computed as the simple sum of each firm's gender, age and education Blau and Shannon indices respectively.

3.4 Control Variables

Several researchers argue that various firm and board specific factors influence firm performance and risk. As such, a set of firm and board specific factors, including firm size, leverage, market-to-book ratio, return on assets, board size and average board member tenure, are added to the regression analysis to control for their effects.

Richard (2000), Smith, Smith and Verner (2006) and Labelle, Francoeur and Lakhal (2015) assume that size increases the probability that a firm would achieve economies of scale and market power. Also, larger firms are known to have better access to external financial resources which could enhance their profits and market returns (Carter et al., 2010; Labelle et al., 2015). On the other hand, Baek, Kang and Suh (2004) believe that large firms benefit from the luxury of their ability to diversify their investments which leads to less volatile stock prices as confirmed by Giannetti and Zhao's (2015) and Jizi and Nehme's (2017) results.

However, Campbell and Mínguez-Vera (2008) document a negative relationship between firm size and performance which they attribute to increased agency problems and divergence of interests in large firms, while Sila et al. (2016) find a positive relationship between firm size and systematic risk.

These arguments, in turn, suggest the existence of variation amongst the market returns of large and small firms which affects their risk. Thus, this study uses the natural logarithm of a firm's total book value of assets as obtained from Compustat to control for the effects of firm size and expects that large firms have the resources and abilities to tolerate higher levels of risk thus indicating a positive relationship between firm size and risk.

On the other hand, compared to unlevered firms, highly levered firms are commonly known to have higher operations risk due to their tendency to encounter significantly larger costs in bankruptcy cases (Campbell &Mínguez-Vera, 2008; Labelle et al., 2015).

Researchers also believe that leverage could also be used as a method to reduce the magnitude of the agency problem and improve stock performance as directors of levered firms are motivated to collaborate and work harder in order to reduce firm debt and avoid bankruptcy (Jizi & Nehme, 2017). As such, this suggests that highly levered firms tend to take riskier business decisions with higher payoff rates which is consistent with Lenard et al.'s (2014), Giannetti and Zhao's (2015) and Bernile et al.'s (2018) findings. Conversely, the fact that highly levered firms face higher chances of financial distress may reduce the extent to which directors make risky decisions which is evidenced in Sila et al.'s (2016) results. Therefore, the ratio of a firm's total book value of debt to its total book value of assets obtained from Compustat is incorporated in the analysis of this study in order to control for firm leverage, and a positive relationship between a firm's leverage level and its risk is anticipated.

The level of growth opportunities available to firms is also expected to alter the variability of their prospective financial performance which ultimately affects their riskiness (Jizi & Dixon, 2017). Chen et al. (2017) use firm market-to-book ratios to proxy for firm growth expectations. Jizi and Nehme (2017) explain that high market-to-book ratios signal a firm's ability to adequately put its cash flows to use by investing in new business opportunities which could increase future returns thus increasing firm risk (Guay, 1999). Furthermore, Sila et al. (2016), Jizi and Nehme (2017) and Bernile et al. (2018) confirm the existence of a positive relationship between market-to-book ratios and return volatility. Accordingly, firm market-to-book ratio,

measured as the ratio of a firm's market value of equity to its book value of equity obtained from a combination of Compustat and CRSP sources is incorporated in this study to proxy for the effects of firm growth, and is expected to be positively associated with firm risk.

Various scholars point to the existence of a relationship between firm profitability and risk, especially amongst diverse boards. Hutchinson, Mack, Plastow and Montroe (2015) provide compelling evidence on an increased correlation between firm risk and return on assets, as a proxy for profitability, amongst Australian gender diverse boards. Baek et al. (2004) posit that profitable firms have a higher resistance to economic downturns and financial situations as profitability acts as a reward for the higher risks investors bear. In the literature, Lenard et al. (2014), Sila et al. (2016), Jizi and Nehme (2017) and Bernile et al. (2018) document negative relationships between return on assets and different measures of firm risk in diverse boards. Therefore, firm return on asset, estimated as the ratio of net income to total book value of assets obtained from Compustat is included in this study to accommodate for the effects of profitability on firm risk.

Moreover, academicians argue that the number of directors on boards, as a measure of board size, affects firm performance and risk. Carter et al. (2003) and Labelle et al. (2015) expect that larger boards possess better information processing skills and decision making processes which enhance firm performance due to an increase in the amount of member external relations. However, their results demonstrate the existence of a negative relationship between board size and firm performance due to an increase in agency problems and inter-director conflicts in larger boards.

Cheng (2008) documents a reduction in stock return variability as board size increases, which he associates with less extreme decisions and longer discussions amongst members (Sah and Stiglitz, 1991). This was further confirmed by Lenard et al.'s (2014) and Sila et al.'s (2016) findings while focusing exclusively on gender diverse boards. Conversely, Wang (2012) concludes that smaller boards force CEOs to take on riskier business decisions. Interestingly, Giannetti and Zhao (2015) and Jizi and Nehme (2017) fail to find a significant relationship between board size and firm risk amongst US and UK firms respectively. As such, this study controls for the effects of board size using the natural logarithm of the number of directors on the board in a given year obtained from BoardEx, and predicts a negative relationship to firm risk due to increased director conflicts amongst large boards.

Director tenure is a measure of the amount of time that the director has been as part of the organization or its board of directors. Setiyono and Tarazi (2014) explain that a director that has been with a firm for a longer period of time is expected to have a better understanding of the nature of the firm's business and policies and would therefore lead to better performance. In fact, Hambrick, Cho and Chen (1996) show that tenure heterogeneous top management teams make more business decisions which have positive effects on firm market share and profitability. Similarly, Tihayni, Ellstrand, Daily and Dalton (2000) conclude that firms with higher tenured boards engage in higher international diversification levels which could enhance their risk exposure.

Contrarily, Carson et al. (2015) point out that employees that have been as part of an organization for longer periods tend to be highly committed to the status quo, and as such, they would take fewer business possibilities into account, resulting in less risky business outcomes (Bantel & Jackson, 1989; Michel & Hambrick, 1992; Hambrick, Geletkanycz & Fredrickson, 1993). Consequently, in this study, the average time in the company in years amongst all directors is used to account for the effects of tenure variation and is expected to be negatively related to firm risk.

The correlation between board diversity and firm risk is expected to vary across different industries. Carter et al. (2003) claim that financial firms elect the highest number of female directors. Similarly, Kang et al. (2007) find that the age diversity amongst Australian board members differs depending on the industry that the firm belongs to. As a result, this study relies on firm two digits SIC codes to control for industry effects.

Finally, this research includes year fixed effects to account for differences in economic situations and business cycles and time variation not attributable to other explanatory variables which lead to changes in firm risk.

4. Methodology

4.1 Models

Panel fixed effect regression analysis is applied on the sample to determine the impact of board diversity on firm risk. Equation (3) outlines the model used to test hypothesis (1) where $risk_{i,t}$ is a measure of firm systematic risk (firm beta) and total risk (firm annualized volatility) in turn. $Diversity\_Index_{i,t}$ takes on the values of the composite Blau and Shannon diversity indices

explained in the previous sections. φ_k and π_t represent industry and year fixed effects respectively, while the remaining variables are as explained above. Appendix A contains the definitions of the full variable set used in the study. All variables are winsorized at the fifth and 95th percentiles of their cross-sectional distributions for the purpose of the analysis, and standard errors are clustered at the firm-level to correct for autocorrelation and heteroscedasticity.

$$risk_{i,t} = \alpha + \beta_1 Board\_Diversity\_Index_{i,t-1} + \beta_2 Firm\_Size_{i,t-1} + \beta_3 Board\_Size_{i,t-1} + \beta_4 Leverage_{i,t-1} + \beta_5 M/B_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 Tenure_{i,t-1} + \varphi_k + \pi_t + \varepsilon_{i,t} \quad (3)$$

Equation (4) outlines the model used to test Hypothesis (2) where the variables have the same definitions as those in Equation (3). However, to capture the effects of periods of high financial volatility, a financial crisis dummy variable is introduced to the model which take on the value of 1 for the years 2007, 2008, 2009 and 2010, and 0 otherwise. Due to the nature of this analysis, year fixed effects are eliminated from the model. Additionally, an interaction of the dummy and the diversity index is introduced to determine the relationship between board diversity and firm risk during financial crises. As such, β_3 is the coefficient of interest for Hypothesis (2) and a significantly positive value would support the argumentation.

$$risk_{i,t} = \alpha + \beta_1 Board\_Diversity\_Index_{i,t-1} + \beta_2 CRISIS\_DUMMY + \beta_3 CRISIS\_DUMMY \times Board\_Diversity\_Index + \beta_4 Firm\_Size_{i,t-1} + \beta_5 Board\_Size_{i,t-1} + \beta_6 Leverage_{i,t-1} + \beta_7 M/B_{i,t-1} + \beta_8 ROA_{i,t-1} + \beta_9 Tenure_{i,t-1} + \varphi_k + \varepsilon_{i,t} \quad (4)$$

4.2 Endogeneity Concerns

Establishing a causal relationship between board diversity and firm risk is inhibited by the endogeneity of the board's diversity. As such, following Schweizer, Walker and Zhang's (2017) methodology, this study incorporates two additional tests in order to accommodate for this problem by determining whether changes in board diversity are affecting firm risk.

For the purpose of the first test, two sets of dummy variables are created to account for large positive and negative changes in the firm's diversity index over a one year period thus

reflecting unexpected shocks, captured by the index jump and the index drop dummy variables respectively. As such, the dummy variables are equal to 1 if the change in the firm's diversity index lies in the highest or lowest fifth percentile of the cross-sectional change distributions respectively and 0 otherwise. Equation (5) outlines the model used for this purpose where β_2 is the coefficient of interest. A significantly negative (positive) coefficient following an increase (decrease) in the diversity index would provide further support for Hypothesis (1) by indicating an instantaneous decline (increase) in firm risk.

$$risk_{i,t} = \alpha + \beta_1 Board\_Diversity\_Index_{\,i,t-1} + \beta_2 INDEX\_JUMP(DROP)\_DUMMY + \beta_3 Firm\_Size_{i,t-1} + \beta_4 Board\_Size_{i,t-1} + \beta_5 Leverage_{i,t-1} + \beta_6 M/B_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 Tenure_{i,t-1} + \varphi_k + \pi_t + \varepsilon_{i,t} \quad (5)$$

As for the second test, a super index dummy variable is created which takes on the value 1 when the composite diversity index is in the upper 20th percentile of its cross-sectional distribution and 0 otherwise. This is used to test whether firms with higher board diversity levels indeed exhibit lower risk as argued in Hypothesis (1). Equation (6) outlines the model used for this purpose where β_2 is the coefficient of interest, and a significantly negative coefficient is expected.

$$risk_{i,t} = \alpha + \beta_1 Board\_Diversity\_Index_{i,t-1} + \beta_2 SUPER\_INDEX\_DUMMY + \beta_3 Firm\_Size_{i,t-1} + \beta_4 Board\_Size_{i,t-1} + \beta_5 Leverage_{i,t-1} + \beta_6 M/B_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 Tenure_{i,t-1} + \varphi_k + \pi_t + \varepsilon_{i,t} \quad (6)$$

5. Empirical Results

5.1 Descriptive Statistics

The descriptive statistics for the differing firm risk measures, diversity estimates, composite diversity indices and firm specific characteristics used throughout this study's empirical analysis processes are provided in Table 3.

Low risk levels are demonstrated, on average, for the sampled firms with a mean firm systematic risk (beta) of 1.18 and an average annualized volatility of 0.486. However, large

ranges and standard deviations for both measures are noticeable due to the use of a multi-year sample including periods classified by high financial volatility levels, justifying the need to control for year effects.

The Blau board gender diversity measures range between 0 and 0.444, indicating the presence of gender homogeneous boards within the sample. However, a low median (0.180) supports the notion that US boards are lagging in terms of their gender compositions caused by the low representation of female directors. On the other hand, boards exhibit high levels of age and educational diversity. Interestingly, the minimum educational heterogeneity measure (0.320) indicates that all firms contain directors with differing educational accomplishments. Additionally, the composite diversity indices demonstrate that boards are compositionally heterogeneous due to varying combinations of the incorporated diversity aspects, shown by high means and standard deviations respectively.

The number of directors on firm boards range between 5 and 14, with a mean and median of 8 members. They also possess high levels of variation in their tenure levels reflected in the variable's high mean (9.02 years) and standard deviation (4.64) emphasizing the necessity to account for tenure variations.

Finally, large variations in firm size and market-to-book ratios, associated with the use of a multi-industry sample, demonstrated by the variables' large ranges and standard deviations respectively, justify the need to control for industry effects.

Panel A of Table 4 reports the pairwise correlation between the various Blau based heterogeneity measures of the components of board diversity and the composite diversity index. The high correlation values between the individual components and the composite index emphasize the fact that the index accurately incorporates the effects of all aspects. On the other hand, the weak correlations between the differing individual components demonstrate that each measure captures a distinct heterogeneity dimension.

Panel B displays the pairwise correlation between the independent, dependent and control variables. All values are less than 0.5 with the exception of the correlation between firm size and board size (0.587) suggesting that multicollinearity does not affect the analysis's validity. However, variance inflation factors are also calculated as supplementary tests for multicollinearity issues in the multivariate regressions. As such, this study ensures that it does not appear to cause any problems in a multivariate context.

– Please insert Tables 3 and 4 about here –

5.2 Board Diversity and Firm Risk

Tables 5 and 6 report the results pertaining to the effects of board diversity on firm beta and annualized volatility respectively. Panels A and B of each table rely on Blau and Shannon measures in turn. Column (1) estimates the overall effects of board diversity on firm risk. The results demonstrate that higher board diversity is associated with lower firm risk, with 5% and 10% significance levels for firm beta and annualized volatility respectively. These findings are consistent for both Blau and Shannon diversity measures. Specifically, a 1% increase in a firm's Blau board diversity index is associated with a 4.3% and 6.0% decrease in firm beta and annualized volatility respectively. This is in line with Bernile et al.'s (2018) findings and provides evidence to support this study's first hypothesis that more diverse boards would face higher conflicts and disagreement, making it harder on them to agree on risk decisions thus reducing the level of risk taken on by firms.

On the other hand, consistent with Carter et al. (2010), Labelle et al. (2015) and Sila et al.'s (2016) findings, large firms have significantly higher risk levels due to increased economies of scale, market power and better access to financial resources which would enable them to tolerate higher risk levels.

In agreement with Cheng (2008), Lenard et al.'s (2014) and Sila et al.'s (2016) larger boards contribute to reducing firm risk. This could be interpreted as an indication of the directors of larger boards being unable to voice their opinions due to increased disagreements and communication problems thus prolonging decision making processes. Moreover, contrary to this study's expectations, an increase in firm leverage decreases firm risk. This indicates that levered firms reduce the extent to which they engage in risky decisions, as argued by Sila et al. (2016), due to increased chances of facing financial distress. It also suggests that directors' actions appear to be driven by job security motives thus taking actions that are perceived to be better for their own self-interests.

Market-to-book ratio, as a proxy for firm growth, is positively associated with firm risk. This suggests that firms are investing in new business opportunities, increasing the variability of their future returns and altering firm risk which is in accordance with the arguments and findings of prior researchers. Furthermore, as firms become more profitable, estimated by their return on

assets, they tend to engage in less risky decisions. This is an indication that firms focus on maintaining their profitability levels by taking on less risk which is in line with Lenard et al. (2014), Sila et al. (2016), Jizi and Nehme (2017) and Bernile et al. (2018).

Additionally, the longer directors that have been part of a business, the more comfortable they get with the status quo and the less resistant they become to change. The findings confirm this notion by showing that an increase in the average time that directors have been part of an organization significantly decreases firm risk.

Columns (2), (3) and (4) of Tables 5 and 6 break down the combined diversity effect into its individual gender, age and education components in turn. In line with this research expectations, and Lenard et al. (2014), Loukil and Yousfi (2016) and Jizi and Nehme's (2017) findings, the analysis in column (2) reveals that gender diversity reduces firm risk with the effect being statistically significant at the 5% level. However, the effect is marginally small in magnitude as a 1% increase in board gender diversity leads to a 0.9% and 1.3% decrease in firm beta and annualized volatility respectively. This is an indication that gender diverse boards are better at governing firms and monitoring management's actions. Additionally, it shows that female directors are not marginalized, but rather they tend to voice out their concerns in an attempt to modify firm risk decisions. Therefore, this proves that it is beneficial for firms to increase the representation of females on boards for reasons other than reducing discrimination and improving the firm's image.

On the other hand, Column (3), in line with Randøy (2006) and Darmadi (2011), provides compelling evidence that board age diversity does not significantly influence firm risk. This finding could be driven by a lack of an adequate variation in the age cohorts represented on US boards. In spite of these conclusions, however, firms should still engage in increasing board age diversity in an attempt to promote equality and fairness in workplaces.

Finally, consistent with this research's argumentation, column (4) reveals that director educational diversity has a significant risk reducing effect on firms. Specifically, a 1% increase in director educational diversity reduces firm beta and annualized volatility by 4.8% and 5.0% respectively. This indicates that board educational composition has the strongest effect on firm risk. Additionally, from a social identity theory standpoint, the result suggests that educationally diverse directors ignore their differences and are motivated by job security reasons to act together in a risk averse manner reducing firm risk.

– Please insert Tables 5 and 6 about here –

To address the potential endogeneity issue associated with the board's diversity affecting firm risk, inspired by the work of Schweizer et al. (2017), this study tests for the consequences of large unexpected increases and decreases in board diversity over a one year period. It is expected that large spontaneous increases in a firm's diversity score be accompanied by greater reductions in firm risk, while large unprompted decreases in director heterogeneity be followed by increases in firm risk.

Panels A and B of Table 7 provide the coefficients of the effects of increases in director diversity that are within the upper fifth percentile of their cross sectional distributions on firm beta and annualized volatility respectively using an index jump categorical variable. The negative and statistically significant coefficient associated with this variable confirms that boards demonstrating a spontaneous increase in their board member diversity indeed observe decreases in their risk levels.[1]

Panels A and B of Table 8 report the estimates pertaining to the reactions of firm beta and annualized volatility, in turn, to decreases in director heterogeneity that are within the lowest fifth percentile of their cross sectional distributions by relying on an index drop categorical variable. The positive and statistically significant coefficient indicates that firm risk significantly increases following an instantaneous decline in director diversity.[1]

– Please insert Tables 7 and 8 about here –

To confirm whether firms with high diversity levels observe significantly larger reductions in their risk levels, as expected under Hypothesis (1), an additional test is performed. Panels A and B of Table 9 display the estimates of the effects of firms with board diversity levels belonging to the upper 20^{th} percentile of the annual diversity indices distribution on firm beta and annualized volatility respectively by employing a super index categorical variable. The negative and statistically significant coefficient affirms that firms with higher heterogeneity levels notice significantly larger declines in their risk levels. As such, these tests provide strong evidence supporting this study's first hypothesis, and succeed at establishing a causal relationship between board diversity and firm risk.[1]

[1] These findings could also be affected by prior changes in firm risk which are not accounted for in the tests.

– Please insert Table 9 about here –

To summarize, the conclusions presented in this section reveal that even though board age diversity does not affect firm risk, the combined effect of the various diversity aspects negatively affects decision making processes, and as such, reduces the volatility of firm outcomes as expected under Hypothesis (1).

5.3 Board Diversity and Firm Risk During Financial Crises

The estimates of the effects of board member heterogeneity on firm beta and annualized volatility during periods characterized as having high levels of market volatility, as a proxy for large business environment changes, are displayed in Table 10 Panels A and B respectively.

The positive and significant coefficient on the financial crisis indicator variable indicates the existence of a change in firm risk in the sample during these periods. Additionally, confirming Hypothesis (2), the positive coefficient on the crisis dummy interaction term indicates that an increase in board diversity during periods of high financial uncertainty lowers the rate at which firm risk is reduced, suggesting that board diversity has a significantly lower net effect on firm risk during more volatile market conditions. This evidence suggests that increased conflicts and communication problems between directors prolong their decision making processes, and thus serve as obstacles for effective business processes especially during periods which require faster reaction times and more purposeful decision making. This finding also confirms that director heterogeneity s is not equally effective at reducing risk under varying market circumstances.

– Please insert Table 10 about here –

5.4 Robustness Checks

To ascertain the validity of the effects of board diversity on firm risk, this study incorporates both Blau and Shannon diversity measures in its tables, and analyzes their effects on two firm risk measures as dependent variables: beta and annualized volatility. The results reported in the previous sections remain unchanged independent of the diversity and risk measure employed.

As a second robustness check, this study repeats the analysis performed in section 5.2 using two alternative composite board diversity measures constructed as the simple sum of each firm's Blau and Shannon diversity measures. The estimated coefficients are reported in columns (1) and (2) of Table 11 respectively.

Panel A of Table 11 reports the coefficients where firm beta is the dependent variable while Panel B relies on annualized volatility as the dependent variable. The results further support Hypothesis (1) by demonstrating that an increase in board member heterogeneity reduces both measures of firm risk, while the signs and significance of all variables remain unchanged. This confirms that the findings are robust to various index formulations and are not as a result of spurious correlation with the composite index.

– Please insert Table 11 about here –

6. Conclusion

The effects of the diversity of a firm's board of directors on its performance, value and risk is a highly controversial topic in Finance. In fact, recent trends in corporate governance research reflect an increase in the amount of studies investigating the role and composition of boards of directors. However, a lack of evidence on the outcomes of the demographic composition of boards still exists.

The widening of the candidate pool available to businesses caused by the world's varying demographic composition, legislative changes and cultural developments, ultimately leading to an increase in workplace diversity, justifies the need for a better understanding of this phenomenon from a business perspective.

Theories point to the existence of a strong association between board diversity and firm performance and risk. On the one hand, Ross (1973) and Mitnick's (1975) Agency Theory expects diverse boards of directors to be better monitors and regulators of management's decisions. On the other hand, Barney's (1991) Resource-Based Theory and Becker's (1964) Human Capital Theory predict that heterogeneity amongst board members increases the resources at firms' disposal and enhances their problem solving and leadership styles. This, in turn, is expected to result in higher firm innovation and creativity levels and improve the quality of their business decisions. Contrarily, social psychology's Social Identity Theory explains that

as boards become more diverse, there tends to be a higher probability of encountering a larger amount of conflicts and communication breakdowns between directors from differing backgrounds. This would hinder group dynamics and decision making processes and adversely affect firm corporate performance (Carter et al., 2003; Giannetti & Zhao, 2016). Theories therefore forecast inconsistencies in the nature and direction of the relationship between board diversity and firm risk. Consistently, the results of numerous empirical studies conclude positive effects while others document negative or insignificant consequences.

This research aims to determine the overall effects of board diversity in terms of director gender, age and educational level on firm risk. Composite diversity indices, constructed from a combination of Blau (1977) and Shannon (1948) heterogeneity measures respectively, reflecting the board's composition with respect to the three characteristics, are developed using a sample of 3,513 US non-financial and non-utility firms for the period between 2000 and 2017.

Relying on the Social Identity Theory, this study argues that higher board diversity levels would increase the chances of conflicts and communication problems between members. As such, this is expected to reduce the cohesiveness of business decisions and act as an obstacle for board members to agree on risk decisions thus decreasing the level of risk taken on by firms and their overall risk.

The results reveal that while board member age diversity does not affect firm risk, gender and educational heterogeneity are negatively related to firm systematic and total risk, measured as a firm's beta and annualized stock return volatility respectively. Moreover, an increase in boards' overall diversity, as estimated by the composite diversity indices, is found to reduce firm risk. This is in line with the study's first hypothesis and could be interpreted as an indication of an increase in inter-director conflicts and disagreements, making it more difficult for boards to decide on business decisions thus reducing the risk taken on by firms under normal market conditions. The findings are unaffected by different risk measures, diversity measures and index compositions. They are also robust to endogeneity concerns as firms that are characterized as having high diversity levels amongst their board members exhibit significantly lower risk levels, while those that demonstrate increases (decreases) in the board's overall diversity levels observe significant decreases (increases) in their respective risk levels indicating that the risk alterations are as a result of the diversity variations.

On the other hand, during high market volatility periods, higher heterogeneity levels amongst directors lower the rate at which firm risk is reduced, suggesting that the net effect of diversity on firm risk is significantly lower during more volatile market conditions. As such, boards fail to accommodate their business decisions to fluctuating market conditions. This result is consistent with the second hypothesis and provides further evidence of an increase in board member conflicts and disagreements, increasing the consequences of financial crises.

In general, the empirical analysis supports the notion that board diversity is beneficial to firms under normal market conditions. This conclusion is consistent with Bernile et al.'s (2018) findings. However, board diversity strengthens the effects of market wide volatility on firm risk during periods which require faster reaction times and clearer decision making, leading to an increase in firm risk. Therefore, this suggests that diversity is not equally effective under differing market circumstances.

These conclusions have several implications for shareholders as the rates of return on their investments are highly dependent on management's risky decisions under the premise of the risk-return relationship. Consequently, firms with higher levels of board heterogeneity have lower risk levels and thus provide shareholders with lower returns on their investments. Shareholders should therefore use their voting rights to elect board directors in a manner which reflects their risk tolerance levels. Additionally, financial investors would equally benefit from utilizing these results in order to make future investment decisions which are suitable for their risk preferences. Furthermore, current and future employees face several advantages from the interpretation of the study's conclusions as their livelihood and future earnings are dependent on firm risk. On the other hand, policy makers could rely on the findings by implementing board diversity quotas as tools to control firm risk.

While this analysis contributes to the diversity literature, it has some limitations that could be addressed by further researchers. The use of a sample consisting of only US firms limits the translatability of the results to other countries. Further research could benefit from the use of a multi-country sample thus facilitating a comparison of the differences between the effects of member heterogeneity in developed, developing and underdeveloped countries. On the other hand, the elimination of financial and utility firms confines the ability to investigate potential discrepancies in the effects within these industries. As such, additional research could focus on

the combined effects of diversity on financial firms thus enabling a better understanding of the relationship.

Additionally, the lack of accessible data on additional board characteristics such as director nationality, the ratio of outside directors and director previous board experiences restricts the extent to which the study is able to incorporate other diversity aspects into the diversity indices and control for other variables known to affect firm performance and risk. Future researchers should thus consider incorporating such aspects where available from other sources. Finally, investigating the potential consequences of the implementation of the gender quota in California, compared to the effects of letting companies freely decide on the composition of their boards of directors could yield interesting results.

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Figures and Tables

Figure 1: Expected Directions of the Various Diversity Measures on Firm Risk

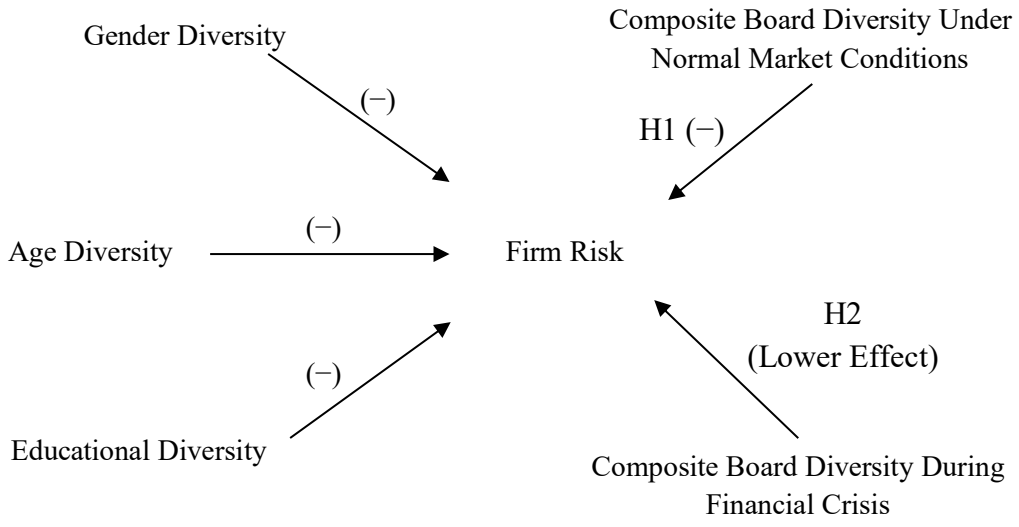

Table 1: Age Index Groups

This table provides the generational cohorts to which directors could belong based on their years of birth used to estimate firm-year age diversity measures.

	Generation	Years of Birth
1.	Lost Generation	1900 - 1921
2.	Greatest Generation	1922 - 1945
3.	Baby Boomers	1946 - 1964
4.	Generation X	1965 - 1983
5.	Generation Y	1984 - 2002

Table 2: Education Index Groups

This table provides the educational categories to which directors highest educational qualifications could belong used to estimate firm-year educational diversity measures.

	Educational Qualification
1.	Less than a bachelor's degree
2.	Bachelor's degree or equivalent
3.	Vocational training programs and professional certifications
4.	Master's degree
5.	PhD and beyond

Table 3: Descriptive Statistics

The sample is composed of all public non-financial and non-utility firms with adequate data on the BoardEx database used to estimate the gender, age and nationality indices in order to develop the composite board diversity index for the years 2000 to 2017. The final sample consists of 33,536 firm-year observations. The table below reports the descriptive statistics for the various characteristics used throughout this study. The variables are defined in Appendix A. All variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions.

Variable	Mean	Std. Dev.	Median	Min	Max
Firm Risk:					
Firm Beta	1.180	0.552	1.140	-0.405	2.827
Firm Annualized Volatility	0.486	0.901	0.431	0.164	6.511
Diversity:					
Blau Gender Diversity	0.155	0.145	0.180	0.000	0.444
Blau Age Diversity	0.422	0.131	0.460	0.000	0.625
Blau Education Diversity	0.597	0.102	0.615	0.320	0.738
Shannon Gender Diversity	0.251	0.226	0.325	0.000	0.636
Shannon Age Diversity	0.649	0.206	0.662	0.000	1.036
Shannon Education Diversity	1.034	0.229	1.055	0.500	1.374
Blau Board Diversity Index	12.274	2.747	12.000	7.000	18.000
Shannon Board Diversity Index	12.274	2.806	12.000	7.000	18.000
Firm Specific Characteristics:					
Size	6.767	1.622	6.676	3.586	10.332
Board Size	2.099	0.246	2.079	1.609	2.639
Leverage	0.482	0.220	0.481	0.111	0.989
Market-to-Book	3.158	2.589	2.328	-0.513	14.509
Return on Assets	0.025	0.107	0.046	-0.412	0.201
Tenure	9.019	4.636	8.533	0.900	19.267

Table 4: Correlation Matrices

Panel A reports the Pairwise correlation between the Blau based indices of the components of board diversity and the composite board diversity index used in this study. Panel B reports the Pairwise correlation between all the variables implemented in this study. Values in bold indicate significance at the 5% level. The definitions of the various variables are in Appendix A. All variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions.

Panel A

		1	2	3	4
Blau Board Diversity Index	**1**	1.000			
Blau Gender Diversity	**2**	**0.470**	1.000		
Blau Age Diversity	**3**	**0.464**	**-0.089**	1.000	
Blau Education Diversity	**4**	**0.562**	**0.042**	**0.054**	1.000

Panel B

		1	2	3	4	5	6	7	8
Firm Beta	**1**	1.000							
Blau Board Diversity Index	**2**	**-0.067**	1.000						
Size	**3**	**0.005**	**0.193**	1.000					
Board Size	**4**	**-0.051**	**0.320**	**0.587**	1.000				
Leverage	**5**	**-0.040**	**0.110**	**0.437**	**0.301**	1.000			
M/B	**6**	**0.016**	**-0.010**	**-0.011**	**0.018**	**0.116**	1.000		
ROA	**7**	**-0.159**	**0.069**	**0.209**	**0.089**	**-0.058**	**0.047**	1.000	
Tenure	**8**	**-0.065**	**0.055**	**0.029**	**0.032**	**-0.081**	**-0.121**	**0.236**	1.000

Table 5: Board Diversity and Firm Beta

Panel A columns (1), (2), (3) and (4) report the panel regression estimates where board diversity is measured as the composite Blau board diversity index, and the individual Blau gender, age and education indices respectively, while Panel B Columns (1), (2), (3) and (4) report the panel regression estimates where board diversity is measured as the composite Shannon board diversity index, and the individual Shannon gender, age and education indices respectively. Firm beta is the dependent variable. All models include year and industry fixed effects. The definitions of all variables are in Appendix A. All continuous variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions. T-statistics are reported in parentheses and are based on standard errors that are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Panel A: Blau Board Diversity and Firm Beta

	Dependent Variable: Firm Risk (Beta)			
	(1)	(2)	(3)	(4)
Blau Board Diversity Index	-0.00413**			
	(-2.54)			
Blau Gender Diversity		-0.0716**		
		(-2.03)		
Blau Age Diversity			0.00526	
			(0.16)	
Blau Education Diversity				-0.0943**
				(-2.09)
Firm Size	0.0348***	0.0360***	0.0347***	0.0345***
	(7.86)	(8.00)	(7.83)	(7.80)
Board Size	-0.108***	-0.112***	-0.122***	-0.115***
	(-4.49)	(-4.69)	(-5.13)	(-4.81)
Leverage	-0.161***	-0.161***	-0.162***	-0.161***
	(-6.34)	(-6.36)	(-6.36)	(-6.34)
Market-to-Book	0.0104***	0.0106***	0.0105***	0.0103***
	(6.07)	(6.21)	(6.11)	(6.02)
Return on Assets	-0.879***	-0.880***	-0.882***	-0.879***
	(-19.84)	(-19.88)	(-19.88)	(-19.83)
Tenure	-0.00331***	-0.00347***	-0.00339***	-0.00321***
	(-3.09)	(-3.24)	(-3.16)	(-2.99)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	33,536	33,536	33,536	33,536
Max VIF	1.84	1.88	1.86	1.84
Mean VIF	1.31	1.33	1.29	1.30

Table 5: Board Diversity and Firm Beta – *Continued*

Panel B: Shannon Board Diversity and Firm Beta				
	Dependent Variable: Firm Risk (Beta)			
	(1)	(2)	(3)	(4)
Shannon Board Diversity Index	-0.00444***			
	(-2.78)			
Shannon Gender Diversity		-0.0382*		
		(-1.66)		
Shannon Age Diversity			0.00129	
			(0.06)	
Shannon Education Diversity				-0.0430**
				(-2.10)
Firm Size	0.0348***	0.0358***	0.0347***	0.0345***
	(7.85)	(7.94)	(7.82)	(7.79)
Board Size	-0.106***	-0.113***	-0.122***	-0.112***
	(-4.37)	(-4.70)	(-5.11)	(-4.67)
Leverage	-0.161***	-0.161***	-0.162***	-0.161***
	(-6.33)	(-6.36)	(-6.36)	(-6.33)
Market-to-Book	0.0104***	0.0106***	0.0105***	0.0103***
	(6.08)	(6.19)	(6.11)	(6.02)
Return on Assets	-0.878***	-0.881***	-0.882***	-0.878***
	(-19.81)	(-19.88)	(-19.88)	(-19.81)
Tenure	-0.00335***	-0.00345***	-0.00338***	-0.00321***
	(-3.14)	(-3.22)	(-3.17)	(-3.00)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	33,536	33,536	33,536	33,536
Max VIF	1.84	1.88	1.87	1.84
Mean VIF	1.32	1.33	1.29	1.3

Table 6: Board Diversity and Firm Stock Return Volatility

Panel A columns (1), (2), (3) and (4) report the panel regression estimates where board diversity is measured as the composite Blau board diversity index, and the individual Blau gender, age and education indices respectively, while Panel B Columns (1), (2), (3) and (4) report the panel regression estimates where board diversity is measured as the composite Shannon board diversity index, and the individual Shannon gender, age and education indices respectively. Firm Annualized volatility is the dependent variable. All models include year and industry fixed effects. The definitions of all variables are in Appendix A. All continuous variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions. T-statistics are reported in parentheses and are based on standard errors that are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Panel A: Blau Board Diversity and Firm Annualized Volatility

	Dependent Variable: Firm Annualized Volatility			
	(1)	(2)	(3)	(4)
Blau Board Diversity Index	-0.00239*			
	(-1.83)			
Blau Gender Diversity		-0.0418*		
		(-1.54)		
Blau Age Diversity			0.0326	
			(1.60)	
Blau Education Diversity				-0.0407*
				(-1.67)
Firm Size	0.0218***	0.0220***	0.0219***	0.0219***
	(6.70)	(6.77)	(6.75)	(6.72)
Board Size	-0.0617**	-0.0618**	-0.0619**	-0.0619**
	(-2.30)	(-2.26)	(-2.18)	(-2.20)
Leverage	-0.101***	-0.101***	-0.102***	-0.101***
	(-4.52)	(-4.13)	(-4.15)	(-4.13)
Market-to-Book	0.00858***	0.00850***	0.00852***	0.00852***
	(3.58)	(3.56)	(3.57)	(3.57)
Return on Assets	-0.507**	-0.508**	-0.508**	-0.509**
	(-2.12)	(2.14)	(2.14)	(2.11)
Tenure	-0.00254***	-0.00244***	-0.00234***	-0.00254***
	(-7.64)	(-7.61)	(-7.63)	(-7.63)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	33,536	33,536	33,536	33,536
Max VIF	1.84	1.88	1.86	1.84
Mean VIF	1.31	1.33	1.29	1.30

Table 6: Board Diversity and Firm Stock Return Volatility – *Continued*

Panel B: Shannon Board Diversity and Firm Annualized Volatility				
	Dependent Variable: Firm Annualized Volatility			
	(1)	(2)	(3)	(4)
Shannon Board Diversity Index	-0.00269*			
	(-1.98)			
Shannon Gender Index		-0.0634*		
		(-1.56)		
Shannon Age Index			0.0494	
			(1.05)	
Shannon Education Index				-0.0245*
				(-1.82)
Firm Size	0.0219***	0.0220***	0.0219***	0.0219***
	(6.71)	(6.77)	(6.75)	(6.71)
Board Size	-0.0620**	-0.0613**	-0.0612**	-0.0610**
	(-2.18)	(-2.13)	(-2.18)	(-2.12)
Leverage	-0.100***	-0.101***	-0.102***	-0.100***
	(-4.12)	(-4.13)	(-4.15)	(-4.12)
Market-to-Book	0.00856***	0.00848***	0.00852***	0.00850***
	(3.58)	(3.55)	(3.57)	(3.56)
Return on Assets	-0.536**	-0.537**	-0.538**	-0.536**
	(2.10)	(2.13)	(2.14)	(2.11)
Tenure	-0.00254***	-0.00254***	-0.00244***	-0.00234***
	(-7.64)	(-7.61)	(-7.63)	(-7.65)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	33,536	33,536	33,536	33,536
Max VIF	1.84	1.88	1.87	1.84
Mean VIF	1.31	1.33	1.29	1.30

Table 7: The Effects of Large Spontaneous Jumps in Board Diversity on Firm Risk

This table reports the regression estimates of the effects of large increases in board diversity on firm risk. Firm beta and annualized volatility are the dependant variables in Panel A and B respectively. Columns (1) and (2) report the panel regression estimates where board diversity is measured using Blau and Shannon based composite indices respectively. All models include year and industry fixed effects. The definitions of all variables are in Appendix A. All continuous variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions. T-statistics are reported in parentheses and are based on standard errors that are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Panel A: Large Spontaneous Jumps in Board Diversity and Firm Beta

	Dependent Variable: Firm Risk (Beta)	
	(1)	(2)
Blau Board Diversity Index	-0.00431**	
	(-2.52)	
Shannon Board Diversity Index		-0.00448***
		(-2.66)
Index Jump Dummy	-0.00923**	-0.00769**
	(-1.72)	(-1.79)
Firm Size	0.0224***	0.0224***
	(4.95)	(4.93)
Board Size	-0.0902***	-0.0884***
	(-3.67)	(-3.58)
Leverage	-0.117***	-0.117***
	(-4.42)	(-4.41)
Market-to-Book	0.00643***	0.00646***
	(3.68)	(3.69)
Return on Assets	-0.882***	-0.881***
	(-19.32)	(-19.30)
Tenure	-0.00473***	-0.00478***
	(-4.25)	(-4.30)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations [1]	29,034	29,034
Max VIF	1.85	1.85
Mean VIF	1.29	1.29

Table 7: The Effects of Large Spontaneous Jumps in Board Diversity on Firm Risk – *Continued*

Panel B: Large Spontaneous Jumps in Board Diversity and Firm Annualized Volatility		
	Dependent Variable: Firm Annualized Volatility	
	(1)	(2)
Blau Board Diversity Index	-0.00224**	
	(-2.18)	
Shannon Board Diversity Index		-0.00169*
		(-1.83)
Index Jump Dummy	-0.00749**	-0.00512*
	(-1.82)	(-1.65)
Firm Size	0.0204***	0.0204***
	(24.17)	(24.19)
Board Size	-0.0691**	-0.0607**
	(-1.95)	(-2.06)
Leverage	-0.111***	-0.111***
	(-7.99)	(-7.98)
Market-to-Book	0.00764***	0.00762***
	(7.71)	(7.69)
Return on Assets	-0.575***	-0.574***
	(12.57)	(12.56)
Tenure	-0.00284***	-0.00282***
	(-4.09)	(-4.06)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations [2]	29,034	29,034
Max VIF	1.85	1.85
Mean VIF	1.29	1.29

[2] The observations are based on a one year change in the composite board diversity index. Observations with a difference greater than one year are dropped.

Table 8: The Effects of Large Spontaneous Declines in Board Diversity on Firm Risk

This table reports the regression estimates of the effects of large decreases in board diversity on firm risk. Firm beta and annualized volatility are the dependant variables in Panel A and B respectively. Columns (1) and (2) report the panel regression estimates where board diversity is measured using Blau and Shannon based composite indices respectively. All models include year and industry fixed effects. The definitions of all variables are in Appendix A. All continuous variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions. T-statistics are reported in parentheses and are based on standard errors that are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Panel A: Large Spontaneous Declines in Board Diversity and Firm Beta		
	Dependent Variable: Firm Risk (Beta)	
	(1)	(2)
Blau Board Diversity Index	-0.00456**	
	(-2.64)	
Shannon Board Diversity Index		-0.00467**
		(-2.76)
Index Drop Dummy	0.0179**	0.0159**
	(1.98)	(2.01)
Firm Size	0.0225***	0.0224***
	(4.96)	(4.94)
Board Size	-0.0886***	-0.0870***
	(-3.60)	(-3.52)
Leverage	-0.117***	-0.117***
	(-4.41)	(-4.41)
Market-to-Book	0.00641***	0.00644***
	(3.67)	(3.68)
Return on Assets	-0.882***	-0.881***
	(-19.32)	(-19.30)
Tenure	-0.00481***	-0.00485***
	(-4.32)	(-4.36)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations [2]	29,034	29,034
Max VIF	1.85	1.85
Mean VIF	1.29	1.29

Table 8: The Effects of Large Spontaneous Declines in Board Diversity on Firm Risk – *Continued*

Panel B: Large Spontaneous Declines in Board Diversity and Firm Annualized Volatility		
	Dependent Variable: Firm Annualized Volatility	
	(1)	(2)
Blau Board Diversity Index	-0.00477*	
	(-1.73)	
Shannon Board Diversity Index		-0.00415*
		(-1.69)
Index Drop Dummy	0.0245*	0.0228*
	(1.69)	(1.67)
Firm Size	0.0233***	0.0232***
	(4.89)	(4.87)
Board Size	-0.0666**	-0.0667**
	(-2.23)	(-2.21)
Leverage	-0.158	-0.158
	(-3.05)	(-3.05)
Market-to-Book	0.00698***	0.00693***
	(2.77)	(2.75)
Return on Assets	-0.527***	-0.526***
	(-4.09)	(4.08)
Tenure	-0.00201**	-0.00200**
	(-2.22)	(-2.28)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations [3]	29,034	29,034
Max VIF	1.85	1.85
Mean VIF	1.29	1.29

[2] The observations are based on a one year change in the composite board diversity index. Observations with a difference greater than one year are dropped.

Table 9: The Effects of Firms with High Board Diversity Levels

This table reports the regression estimates of the relationship between firms with high board diversity levels by belonging to the upper 20th percentile of the cross-sectional diversity indices distribution and firm risk. Firm beta and annualized volatility are the dependant variables in Panel A and B respectively. Columns (1) and (2) report the panel regression estimates where board diversity is measured using Blau and Shannon based composite indices respectively. All models include year and industry fixed effects. The definitions of all variables are in Appendix A. All continuous variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions. T-statistics are reported in parentheses and are based on standard errors that are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Panel A: The Effects of Firms with High Board Diversity Level on Firm Beta		
	Dependent Variable: Firm Risk (Beta)	
	(1)	(2)
Blau Board Diversity Index	-0.00672***	
	(-3.28)	
Shannon Board Diversity Index		-0.00552***
		(-2.72)
Super Index Dummy	-0.0290**	-0.0119**
	(-2.28)	(-2.46)
Firm Size	0.0347***	0.0347***
	(7.85)	(7.84)
Board Size	-0.108***	-0.106***
	(-4.48)	(-4.36)
Leverage	-0.160***	-0.161***
	(-6.31)	(-6.31)
Market-to-Book	0.0104***	0.0104***
	(6.08)	(6.09)
Return on Assets	-0.879***	-0.878***
	(-19.84)	(-19.81)
Tenure	-0.00330***	-0.00335***
	(-3.08)	(-3.13)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	33,536	33,536
Max VIF	1.90	1.98
Mean VIF	1.47	1.49

Table 9: The Effects of Firms with High Board Diversity Levels – *Continued*

Panel B: The Effects of Firms with High Board Diversity Level on Firm Annualized Volatility		
	Dependent Variable: Firm Annualized Volatility	
	(1)	(2)
Blau Board Diversity Index	-0.00242*	
	(-1.93)	
Shannon Board Diversity Index		-0.00216*
		(-1.82)
Super Index Dummy	-0.00105*	-0.00375*
	(-1.73)	(-1.92)
Firm Size	0.0271***	0.0272***
	(26.55)	(26.57)
Board Size	-0.0663**	-0.0674**
	(-2.43)	(-2.49)
Leverage	-0.106***	-0.106***
	(-7.43)	(-7.43)
Market-to-Book	0.00675***	0.00673***
	(6.73)	(6.71)
Return on Assets	-0.563***	-0.562***
	(-11.94)	(-11.94)
Tenure	-0.00255***	-0.00253***
	(-3.65)	(-3.61)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	33,536	33,536
Max VIF	1.90	1.98
Mean VIF	1.47	1.49

Table 10: The Effects of Board Diversity During Financial Crises

This table reports the regression estimates of the effects of board diversity during financial crises periods. Firm beta and annualized volatility are the dependant variables in Panel A and B respectively. Columns (1) and (2) report the panel regression estimates where board diversity is measured using Blau and Shannon based composite indices respectively. All models include industry fixed effects. The definitions of all variables are in Appendix A. All continuous variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions. T-statistics are reported in parentheses and are based on standard errors that are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Panel A: The Effects of Board Diversity during Financial Crises Periods on Firm Beta		
	Dependent Variable: Firm Risk (Beta)	
	(1)	(2)
Blau Board Diversity Index	-0.00658***	
	(-3.59)	
Shannon Board Diversity Index		-0.00630***
		(-3.58)
Crisis Dummy	0.198***	0.190***
	(6.23)	(6.04)
Crisis Diversity Interaction	0.00980***	0.00913***
	(3.96)	(3.70)
Firm Size	0.0339***	0.0338***
	(7.83)	(7.82)
Board Size	-0.120***	-0.118***
	(-4.97)	(-4.89)
Leverage	-0.156***	-0.156***
	(-6.14)	(-6.12)
Market-to-Book	0.00947***	0.00950***
	(5.67)	(5.68)
Return on Assets	-0.822***	-0.821***
	(-18.97)	(-18.93)
Tenure	-0.00329***	-0.00332***
	(-3.05)	(-3.08)
Year Fixed Effects	No	No
Industry Fixed Effects	Yes	Yes
Observations	33,536	33,536
Max VIF	1.84	1.84
Mean VIF	1.28	1.28

Table 10: The Effects of Board Diversity During Financial Crises – *Continued*

Panel B: The Effects of Board Diversity during Financial Crises Periods on Firm Annualized Volatility		
	Dependent Variable: Firm Annualized Volatility	
	(1)	(2)
Blau Board Diversity Index	-0.00293**	
	(-2.46)	
Shannon Board Diversity Index		-0.00271**
		(-2.41)
Crisis Dummy	0.0397**	0.0237**
	(2.36)	(2.28)
Crisis Diversity Interaction	0.00581***	0.00452***
	(4.43)	(3.60)
Firm Size	0.0237***	0.0237***
	(27.03)	(27.02)
Board Size	-0.0607**	-0.0606**
	(-2.01)	(-2.12)
Leverage	-0.102***	-0.103***
	(-6.92)	(-6.92)
Market-to-Book	0.00848***	0.00847***
	(9.23)	(9.22)
Return on Assets	-0.533***	-0.533***
	(-10.29)	(-10.27)
Tenure	-0.00242***	-0.00241***
	(-3.46)	(-3.45)
Year Fixed Effects	No	No
Industry Fixed Effects	Yes	Yes
Observations	33,536	33,536
Max VIF	1.84	1.84
Mean VIF	1.28	1.28

Table 11: Alternative Measures of Composite Board Diversity and Firm Risk

This table reports the regression estimates of the effects of board diversity using alternative diversity indices to ascertain the validity of the findings. Firm beta and annualized volatility are the dependant variables in Panel A and B respectively. Columns (1) and (2) report the panel regression estimates where board diversity is measured using Blau and Shannon based composite indices respectively. All models include industry fixed effects. The definitions of all variables are in Appendix A. All continuous variables are winsorized at the 5th and 95th percentiles of their cross-sectional distributions. T-statistics are reported in parentheses and are based on standard errors that are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Panel A: Alternative measures of composite Board Diversity and Firm Beta

	Dependent Variable: Firm Risk (Beta)	
	(1)	(2)
Blau Board Diversity Index 2	-0.0525**	
	(-2.25)	
Shannon Board Diversity Index 2		-0.0310**
		(-2.32)
Firm Size	0.0351***	0.0348***
	(7.90)	(7.87)
Board Size	-0.108***	-0.105***
	(-4.44)	(-4.25)
Leverage	-0.161***	-0.161***
	(-6.36)	(-6.34)
Market-to-Book	0.0105***	0.0104***
	(6.11)	(6.09)
Return on Assets	-0.880***	-0.879***
	(-19.85)	(-19.83)
Tenure	-0.00331***	-0.00332***
	(-3.10)	(-3.11)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	33,536	33,536
Max VIF	1.84	1.84
Mean VIF	1.32	1.33

Table 11: Alternative Measures of Composite Board Diversity and Firm Risk – *Continued*

Panel B: Alternative measures of composite Board Diversity and Firm Annualized Volatility		
	Dependent Variable: Firm Annualized Volatility	
	(1)	(2)
Blau Board Diversity Index 2	-0.00326*	
	(-1.74)	
Shannon Board Diversity Index 2		-0.00218*
		(-1.71)
Firm Size	0.0271***	0.0272***
	(26.57)	(26.59)
Board Size	-0.0608**	-0.0613**
	(-1.80)	(-1.72)
Leverage	-0.106***	-0.106***
	(-7.41)	(-7.41)
Market-to-Book	0.00771***	0.00772***
	(6.69)	(6.70)
Return on Assets	-0.564***	-0.564***
	(-12.00)	(-12.00)
Tenure	-0.00253***	-0.00252***
	(-3.61)	(-3.60)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	33,536	33,536
Max VIF	1.84	1.84
Mean VIF	1.32	1.33

Appendix A. Variable Definitions

Variable	Definition	Formula
Firm Beta	An estimate of a firm's annual systematic risk (CAPM Beta) obtained using regression analysis.	
Firm Annualized Volatility	Square root of 252 multiplied by the standard deviation of each firm's daily stock returns from CRSP, used to estimate firm total risk in a given year.	
Gender Diversity	A Blau or Shannon diversity index estimated using the proportion of male and female executives on each firm's board in a given year as indicated on BoardEx.	$1 - \sum_{i=1}^{2} P_i^2$
Age Diversity	A Blau or Shannon diversity index estimated using the proportion of executives on each firm's board in a given year that belong to five generations based on their respective years of birth as indicated on BoardEx. These generations are: The Lost generation, The Greatest Generation, Baby Boomers, Generation X and Generation Y outlined in Table 1.	$1 - \sum_{i=1}^{5} \mathrm{P}_i^2$
Education Diversity	A Blau or Shannon diversity index estimated using the proportion of executives on each firm's board in a given year with highest academic achievements that belong to one of five categories. These categories are: less than a Bachelor's degree, Bachelor's degree or equivalent, vocational qualifications and professional certifications, Master's degree or equivalent, and PhD or beyond outlined in Table 2.	$1 - \sum_{i=1}^{5} P_i^2$
Board Diversity Index	A composite board diversity index constructed as six times the sum of the fractional quantiles of the Blau or Shannon gender, age and education diversity measures for each firm in a given year.	
Board Diversity Index 2	A composite board diversity index constructed as the sum of each firm's Blau or Shannon gender, age and education diversity measures in a given year.	
Board Size	The natural logarithm of the number of directors on a firm's board in a given year as indicated on BoardEx.	$\ln(\mathrm{NumberDirectors})$
Firm Size	The natural logarithm of total firm book value of assets (AT) obtained from Compustat.	$\ln(\mathrm{AT})$
Leverage	The ratio of a firm's total book liabilities (LT) to its total book assets (AT) in a given year obtained from Compustat.	$\frac{\mathrm{LT}}{\mathrm{AT}}$

Market-to-Book	The ratio of a firm's market value of equity (MKVALT) to its book value of equity (PRC × SHROUT) in a given year obtained from Compustat and CRSP respectively.	$\frac{\text{MKVALT}}{\text{PRC} \times SHROUT}$
Return on Assets	The ratio of a firm's net income (NI) to its total book assets (AT) in a given year obtained from Compustat.	$\frac{\text{NI}}{\text{AT}}$
Tenure	A measure of the average number of years that all board members have been with the firm in a given year obtained from BoardEx.	$\frac{\sum \text{TimeinCo}}{\text{NumberDirectors}}$
Crisis Dummy	A dummy variable equal to 1 when a fiscal year is affected by the financial crisis thus exhibiting higher volatility and 0 otherwise. Financial crisis years are: 2008, 2009 and 2010.	
Crisis Diversity Interaction	The product of a firm's board diversity index and the crisis dummy in each respective year.	
Index Jump Dummy	A dummy variable equal to 1 when the change in a firm's board diversity index lies in the highest 5% of its cross-sectional distribution and 0 otherwise.	
Index Drop Dummy	A dummy variable equal to 1 when the change in a firm's board diversity index lies in the lowest 5% of its cross-sectional distribution and 0 otherwise.	
Super Index Dummy	A dummy variable equal to 1 when a firm's board diversity index lies in the highest 20% of its cross-sectional distribution and 0 otherwise.	

Appendix B. Composite Diversity Index Formulation

	Number of Quantiles	Scores		
		Quantile 1	Quantile 2	Quantile 3
Gender Diversity	2	$\frac{1}{2}$	1	-
Age Diversity	3	$\frac{1}{3}$	$\frac{2}{3}$	1
Education Diversity	3	$\frac{1}{3}$	$\frac{2}{3}$	1

Diversity Index Computation Examples:

	Gender Quantile	Age Quantile	Education Quantile	Diversity Index Calculation	Diversity Index Value
Firm A	1	1	1	$6 \times \left(\frac{1}{2} + \frac{1}{3} + \frac{1}{3}\right)$	7
Firm B	1	2	3	$6 \times \left(\frac{1}{2} + \frac{2}{3} + 1\right)$	13
Firm C	2	3	1	$6 \times \left(1 + 1 + \frac{1}{3}\right)$	14
Firm D	2	2	3	$6 \times \left(1 + \frac{2}{3} + 1\right)$	16
Firm E	2	3	3	$6 \times (1 + 1 + 1)$	18