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Working Paper

Does Board Diversity Mitigate Risk? The Effect of Homophily and Social Ties on Risk-Taking in Financial Institutions

RUNNING TITLE: Examining the effect of several aspects of board diversity and social networks on risk in US financial institutions using structural equations models for the 2010-2022 period.

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ABSTRACT

This study examines the effect of board diversity and social networks on risk in US financial institutions for the period from 2010 to 2018. The econometric strategy involved structural equations models, where risk as dependent variable was measured by two latent variables and a total of five measures of risk. Several aspects of board diversity were utilised including gender, social, experience and educational backgrounds. Results suggest that age and gender diversity had a minor effect to mitigate risk of financial institutions. National diversity had a significant and positive effect while appearing strongest when compared with other variables. Two education measures had mixed results while suggesting that financial education is associated with greater risk. Also, social networks have a significant effect on risk-taking especially on market risk. These results imply that financial institutions need to have a sensible level of board diversity in all aspects.

Keywords: Board diversity, financial institutions, risk taking, social networks, structural equation model.

1. INTRODUCTION

There is some evidence to suggest that corporate governance arrangements for financial institutions differ from those of non-financial firms. Indeed, board of directors in financial institutions tend to differ from non-financial firms because the former are characterized by bigger sizes and more independence, while they are subject to more scrutiny (de Andres, Romero-Merino, Santamaria, & Vallelado, 2012; García-Meca, García-Sánchez, & Martínez-Ferrero, 2015). Hence, the Basel Committee on Banking Supervision has emphasized the importance of corporate governance for financial institutions (Basel Committee on Banking Supervision, 2006, 2015) while calling for improvements in the overall corporate governance of financial institutions and a better understanding of its links with drives of risk-taking (Berger, Kick, & Schaeck, 2014; Laeven & Levine, 2009). But despite many corporate governance codes of conduct across the world assigning the responsibility of monitoring and ensuring the effectiveness of risk management to the board of directors in financial institutions (Basel Committee on Banking Supervision, 2015; Financial Reporting Council, 2018; OECD, 2015), most systematic empirical studies of corporate governance examine performance within the non-financial sector (Bernile, Bhagwat, & Yonker, 2018; Harjoto, Laksmana, & Yang, 2018; Poletti-Hughes & Briano-Turrent, 2019), while only a handful of systematic studies address the impact of board diversity on risk-taking in financial institutions (Akbar et al., 2017; Minton et al., 2014; Wang & Hsu, 2013).

Research on governance issues resulting from the diversity of boards of directors' dates to the seminal contributions of Carter, Simkins, and Simpson (2003) and Fields and Keys (2003). It also marked a departure from the dominant research perspective using agency theory to explore shareholder value (e.g. Daily, Dalton, and Cannella (2003) and Hillman and Thomas (2003)). Heterogeneity of boards can arise from many aspects, including directors' age, gender, ethnicity, experience, and education (Anderson, Reeb, Upadhyay, & Zhao, 2011). However, most studies that attempt to explore how the diversity of corporate leaders affects corporate actions and outcomes mostly examine the impact of gender diversity, but often find that gender diversity might not be the most important dimension of board diversity and risk-taking (Bernile et al., 2018; Harjoto et al., 2018). A review conducted by Kent Baker, Pandey, Kumar, and Haldar (2020) show that studies on board diversity focus mainly on gender diversity, while less attention is given to age, nationality, ethnicity, professional background, and cognition. This highlights the importance of broadening the studying board diversity and its impact on risk-taking. Indeed, Bernile et al. (2018) is the only study to investigate the effect of several aspect of board diversity including age, gender, ethnicity, education and experience on risk-taking. Still, this research was conducted for a sample of non-financial firms.

This paper contributes to the extant literature on corporate governance by examining the impact of board diversity on risk-taking attitudes within the financial sector. Following Roba and Aly (2019), we also study the effect of board diversity and social ties on risk-taking. Case studies in the aluminum industry (Perchard & MacKenzie, 2020) suggested that homophily or the social homogeneity within boards of directors is detrimental to the long-term performance of firms. Social capital theory suggests that directors with similar educational backgrounds, past experiences, gender and ethnicity are more likely to form ties and appoint individuals with similar background and social profile to their board. Researchers have noted that social ties influence individual behavior and the flow and quality of information. Thus, social ties are

believed to have an effect on economic outcomes (Cohen, Frazzini, & Malloy, 2010; Granovetter, 2005; Hwang & Kim, 2009; Westphal, Boivie, & Chng, 2006). In this regard, Berger, Kick, Koetter, and Schaeck (2013) study the impact of board diversity and social networks on executive appointments in banks, but to the best of our knowledge and with the exception of Roba and Aly (2019), there has been no attempt to explore the impact of board diversity and social ties on risk-taking by financial institutions.

In short, research in this paper contributes to ongoing debates in corporate governance by documenting how many aspects of board diversity and social ties impact alternative measures of risk attitudes of financial institutions. The remainder of the paper is organized as follows. The following section situates the research question within its larger setting. The third section details data and variables used in the empirical analysis. The fourth section presents the econometric strategy, while the fifth and last section offers tentative conclusions.

2. LITERATURE REVIEW

2.1 Social diversity and Homophily

Walt and Ingley (2003) state that the concept of diversity in corporate governance relates to board composition and the varied combination of attributes, characteristics and expertise contributed by individual board members in relation to board process and decision making. Theories behind board diversity include the social categorization framework developed by Turner (1987), which describes the circumstances under which people will classify themselves and others as a group using salient characteristics such as age and gender. This approach also states that people form a social identity by identifying themselves as members of a group (Tajfel & Turner, 1986). The theory predicts that categorizing people into groups could create biases, where people are likely to favor members of the group and perceive non-members as less trustworthy, dishonest, and less cooperative than group members (Tajfel, 1974). In

addition, the similarity/attraction theory and the homophily principle (i.e. affinity for similar others) suggest that people are attracted to others who hold similar attributes to themselves such as attitudes and values (Berger et al., 2013; Byrne, Clore, & Worchel, 1966). These theories put forward the idea that diversity affects groups processes and performances by altering communications among members and by creating negative attitudes toward dissimilar individuals (Riordan & Shore, 1997). The homophily principles further suggest that homogeneity among directors has powerful implications for the information they receive, the attitudes they form, and the interactions they experience (Miller, Lynn, & James, 2001).

Homophily is also believed to be the basis of constructing network ties, where social capital theory suggest that people form social ties based on homophily and similarity of attributes such as age, gender or educational background (Berger et al., 2013; Miller et al., 2001). Consequently, social networks along with other aspects of diversity has the potential to have an impact on economic outcomes, individual behaviors and decision making because they affect the flow and quality of information (Cohen et al., 2010; Granovetter, 2005; Hwang & Kim, 2009; Westphal et al., 2006).

Group diversity in boards of directors has advantages and disadvantages (Berger et al., 2013; Erhardt, Werbel, & Shrader, 2003; Wang & Hsu, 2013; Webber & Donahue, 2001). Diversity is believed to enhance group performance because diverse groups with members from different perspectives have greater pool of knowledge, skills, experiences and abilities (Anderson et al., 2011; Berger et al., 2013; Webber & Donahue, 2001), have more ability to solve complex issues and are able to come up with creative solutions of tasks (Harjoto et al., 2018). These advantages of diversity affect board performance by contributing to a more through decision-making process (Berger et al., 2013) and providing greater access to information which results in better oversight and monitoring (Anderson et al., 2011; Erhardt et al., 2003). In addition, board diversity leads to social heterogeneity among directors which is

helpful in bringing diverse social viewpoints and developing new strategies (Anderson et al., 2011).

On the other hand, group diversity might have an adverse impact on board functioning resulting from less cohesion that hinders the decision making process (Harjoto et al., 2018; Wang & Hsu, 2013), complicated communications, coordination difficulties and increased internal conflict due to different backgrounds of directors (Anderson et al., 2011; Berger *et al.,* 2013; Wang & Hsu, 2013). This suggests that too much diversity on a board of directors might lead to inability to reach consensus on risk policies and unbalanced decision-taking process which affects corporate outcomes such as risk-taking (Berger et al., 2013; Bernile et al., 2018).

But as mentioned above, board diversity can be reflected in a number of dimensions. Empirical studies that have examined board diversity include Harjoto et al. (2018) who found that diverse boards are more effective in monitoring corporate investment activities than homogeneous boards. In addition, Anderson et al. (2011) and Erhardt et al. (2003) show that board diversity is positively associated with firm performance, while García-Meca et al. (2015) show that board diversity has less influence on bank performance in contexts of weaker regulatory and lower investor protection. García-Meca et al. (2015) also find that the type of diversity is important in banks. Berger et al. (2013), Bernile et al. (2018) and Abdelbadie and Salama (2019) are the only studies that combines board diversity and board networks to examine their effect on outsider appointment. They found that similarity of age and gender increase the chances of the outsider appointments and that greater social networks also increase the probability of an outside appointment. They also found that diverse boards adopt more persistent and less risky financial policies and have more efficient innovation processes.

These studies include several aspects of board diversity including age, gender, ethnicity, education and experience which are studied in the context of a single index. However, the

validity of using a single index to capture a complex concept such as corporate governance has been questioned by researchers (Black, de Carvalho, Khanna, Kim, & Yurtoglu, 2017; Sheikh, 2019). Also, their measurements of the education and experience diversity only account for some aspects of these variables. For education diversity, they measure the diversity of institutions that granted the bachelor's degrees to directors, but ignore the level and number of qualifications and the financial education aspect. For experience diversity, they include two measurements which are the financial experience and the mean number of other boards on which current directors serve. The later variable only measures current experience while does not take into account the past experiences of directors, it also does not take into account the other professional experiences including legal, executive and consultation.

Table 1 further shows that diversity in the composition of the board of directors has been measured in a number of ways. Table 1 also suggest mixed results from fieldwork. Each of these dimensions is discuss in greater detail below where it will be evident that some of them have received little attention.

[Table 1 near here]

2.2 Age and Gender

As noted in table 1, age as a component of board diversity has received widespread attention. Berger et al. (2014) found that greater board age decreases risk-taking. In addition, Wang and Hsu (2013) show that age heterogeneity result in good operational risk management but has an adverse impact on the monitoring function of the boards. However, Harjoto et al. (2018) found no association between several aspects of board diversity including age and board performance.

Gender diversity of boards is another aspect that has been widely researched. Altunbas, Gambacorta, Reghezza, and Velliscig (2022) show that gender diversity has mitigating effects

on climate change. They believe that the negative effect is due to the pro-environmental traits of female personalities, such as social sensitivity and risk-aversion, which help female managers better contain the environmental impact of their decisions about how to implement the board's strategy.

In addition, García-Meca et al. (2015) provide empirical evidence that gender diversity increases performance in banks and qualified women have unique characteristics that create additional value. Their results also suggest that women on boards of banks enhance governance. Also, Jizi and Nehme (2017) found that the presence of women boards favourably impact the risk of firms by reducing stock return volatility. However, Berger et al. (2014) justify the negative impact of female presence on portfolio risk by the lower experience of female directors in comparison to their male counterparts. On the other hand, Farag and Mallin (2017) found that female directors are not risk averse in European banks.

2.3 Education

Table 1 also suggest there has been an interest in exploring the effects of formal education background on risk and performance. The Basel Committee recommends banks to have adequate collective knowledge of each of the types of material financial activities the bank intends to pursue. They also recommend the board to have sufficient knowledge and expertise to enable effective governance and oversight (Basel Committee on Banking Supervision, 2006). In addition, the Organisation for Economic Co-operation and Development (OECD) provide a report of the financial crisis. They state that one of the causes on the crisis was the board's limited knowledge and poor understanding of risk managements (Kirkpatrick, 2009).

Education diversity has been measured differently in different studies. Berger et al. (2014) measured education diversity by the presence of executives with doctoral degrees and found that it is associated with a decrease in portfolio risk. They believe that this result implies

that educated directors apply better risk management techniques. In addition, Anderson et al. (2011) measure education diversity based on the educational levels and types of degrees the directors have achieved. For education levels, they use education categories; no college degree, a bachelor degree only, or a master degree or beyond. For the types of degrees, they calculate the percentage of directors with an MBA degree, a technical degree, a law degree, or a liberal arts degree. They found that board diversity including education diversity has a positive relationship with firm performance. Dionne et al. (2019) study the effect of financial knowledge on risk management. In their study, financial knowledge is measured by financial experience, financial education, or accounting background. Their findings show that directors' financial knowledge increases firm value and that financially educated directors are more effective in hedging activities. They believe that their findings have regulatory implications suggesting that experience and education dimensions should be added to corporate governance regulation for better governance.

2.4 Financial Experience

The diversity of board experience is a very important board characteristic that has been found to have significant effect on various aspects of the firm. Harjoto et al. (2018) found that task-oriented diversity including expertise diversity has a negative impact on suboptimal investment, which suggest that boards with diverse experiences are more effective in overseeing corporate investment activities. They categories board experience as financial, consulting, legal, management, and other expertise. Similarly, Anderson et al. (2011) used four measures of experience which are the percentage of directors that are CEOs of other firms, the functional background of directors, the heterogeneity of director career development, and the number of senior positions that each director has held during their career. They found that board diversity including experience have a positive effect on firm performance. In addition, Cao et al. (2019) found that foreign experience of directors reduces stock prices crash risk and this

effect is more pronounced for firms with more agency problems and weaker corporate governance.

For financial institutions, financial experience is more important than the other sectors. The OECD report on the causes of the financial sector argue that the lack of financial expertise of directors played a major role in the crisis. The report also explain that financial expertise among directors is low in financial institutions in the US (Kirkpatrick, 2009). Minton et al. (2014) found that the presence of financial experts is positively related risk-taking using several measures of risk. They explain that this result is due to the fact that financially experienced directors have a better understanding of complex investments and encourage bank management to increase risk-taking. In their study, a director is considered a financial expert if the director has held an executive position at a banking institution, holds an executive position at a nonbank financial institution, holds a finance-related position, accountant, treasurer of a nonfinancial firm, holds an academic position in a related field, or works as a hedge fund or private equity fund manager.

2.5 Nationality and Ethnicity

Most studies that investigate board diversity do not include the race, ethnicity or nationality of directors, the empirical studies on the impact of ethnicity and nationality on risk-taking are even more limited. Bernile et al. (2018) is one of the limited studies that incorporates a diversity index to study board diversity's effect on risk-taking in non-financial firms. Their diversity index includes the ethnicity of directors and found that greater board diversity leads to lower risk-taking. In addition, Harjoto et al. (2018) investigate the effect of relation-oriented diversity including race on board performance in corporate investment oversight. Their findings show no association between relation-oriented diversity and board performance. They include five categories of race which are Asian, Black, Caucasian, Hispanic, and Native Americans.

Studies that investigate the effect of board race and nationality on firm performance include Anderson et al. (2011) who measure board diversity along several dimensions including board race, they found that board diversity has a positive effect on firm performance. They explain that these results are due to the fact that directors from different cultural backgrounds provide new perspectives and problem-solving skills to board discussions. Similarly, Erhardt et al. (2003) found that ethnic diversity has a positive effect on firm financial performance. On the other hand, García-Meca et al. (2015) show that national diversity decreases bank performance and explain that this due to the fact that demographic differences lower cohesion between groups which leads to slowing the decision process and eventually reduces bank performance.

Based on the above discussed aspects of board diversity, we distil our main working hypothesis, namely:

H1: Greater board diversity reduces risk taking in financial institutions.

2.6 Social Ties

Board networks have been shown to influence strategic decisions and corporate policies. The effect of social networks have been studied on several aspects including merger and acquisition (El-Khatib, Fogel, & Jandik, 2015), bond yield spreads (Qiu, Su, & Xiao, 2019), preferential source of financing (Engelberg, Reed, & Ringgenberg, 2012), both stock option pay and board reform (Yoshikawa, Shim, Kim, & Tuschke, 2020), executive appointments (Berger et al., 2013), credit ratings (Khatami, Marchica, & Mura, 2016) and firm performance (Fan, Boateng, King, & MacRae, 2019; Kim, 2005; Larcker, So, & Wang, 2013; Zona, Gomez-Mejia, & Withers, 2015). However, little studies have examined the effect of board social networks on risk-taking of financial institutions. These studies include Abdelbadie and Salama

(2019) who found that well connected directors mitigate their credit and insolvency risk. However, this study focuses on banks only.

Figures 1 and 2 had a preliminary look at the behavior of social ties within the selected sample (details of the sample are provided in the third section below). Figure 1 shows at least eleven clusters of directors' networks that collect 3327 individual interlocks, which suggests high connectedness and possibly indirect ties. While figure 2 visualizes the connections among financial institutions for the period from 2010 to 2018 and suggest that there are at least six clusters of financial institutions' ties.

[Figure 1 near here]

[Figure 2 near here]

Social networks are believed to provide firms with strategic resources that help in creating competitive advantages (Yoshikawa et al., 2020). However, existing studies have different results on the benefits of social networks. In studying the effect of social networks on firm performance, Larcker et al. (2013) found that firms with well-connected boards earn higher returns. However, Kim (2005) found that while moderate level of board network enhances firm performance, a too cohesive board network destroys it. Similarly, Fan et al. (2019) found that social ties tend to destroy firm value whereas professional ties do not.

Qiu et al. (2019) investigate the effect of social networks on the cost of debt capital. They found that networks of top management team have a negative correlation with bond yield spreads. They also found that top management team network increases a firm's access to media coverage, political ties, and financial ties, which in turn can help lower bondholder's risk premiums. They believe that these results imply that networks of firm's top management can help obtain more resources due to improved reputation and image. Similarly, Khatami et al. (2016) found that the social connections between firms and the rating agencies has a positive

effect on the credit ratings assigned to the company's issues. Finally, Yoshikawa et al. (2020) show that social networks carry information to directors that effects the director's interests and hierarchical power, which in turn effects the actions of adopting new practices.

H2: Diffused directors' social networks reduce risk taking in financial institutions.

3. EMPIRICAL SUPPORT

3.1 Sample Data

The data covers the period from 2010 to 2018. It includes publicly listed financial institutions in US markets. The financial data was collected from Bloomberg, while the data related to the board diversity variables and board networks was obtained from BoardEx. The selection of financial institutions is based on the Global Industry Classification System (GICS), which includes banks, insurance, and diversified financial companies.

3.2 Dependent Variable: Risk-taking

We select the risk-taking measurements based on prior literature. We include the prior studies that investigated the effect of corporate governance on risk-taking because there are limited studies that focused on board characteristics or diversity. Ho et al. (2013) found that board composition affects different risk measures differently. Thus, they recommend to use different risk measures. Therefore, we include two types of risk-taking measurements namely market risk and specific risk. Incorporating two types of risk will provide a view of the risk in a firm's level and the firm's sensitivity to market.

For marker risk, we use two risk measurements namely Stock Return Volatility (Bernile et al., 2018; Cain & McKeon, 2016; Cassell, Huang, Manuel Sanchez, & Stuart, 2012; Christy, Matolcsy, Wright, & Wyatt, 2013; Deyoung, Peng, & Yan, 2013; Erkens, Hung, & Matos, 2012; Ferris, Javakhadze, & Rajkovic, 2017; Guay, 1999; Hutchinson, Seamer, & Chapple, 2015; Jizi & Nehme, 2017; Minton et al., 2014; Nakano & Nguyen, 2012; Pathan, 2009;

Saunders, Strock, & Travlos, 1990; Sheikh, 2019) and Idiosyncratic Risk (Akbar et al., 2017; Cassell et al., 2012; Deyoung et al., 2013; Ferreira & Laux, 2007; Pathan, 2009; Sheikh, 2019; Wu, 2016). In our study Stock Return Volatility is calculated as the annualized standard deviation of the daily stock returns, and the Idiosyncratic Risk measured as the standard deviation of the residuals derived from regressing daily stock return on market return in each year.

For the Specific Risk, we use three risk measurements namely Z-score(Akbar et al., 2017; Berger, Imbierowicz, & Rauch, 2016; Hutchinson et al., 2015; Pathan, 2009), Leverage (Anginer, Demirguc-Kunt, Huizinga, & Ma, 2018; Bernile et al., 2018; Cassell et al., 2012; Ferris et al., 2017; Ho et al., 2013; Minton et al., 2014), and Return on Assets Volatility (Ferris et al., 2017; Ho et al., 2013; John, Litov, & Yeung, 2008; Laeven & Levine, 2009; Mishra, 2011; Nakano & Nguyen, 2012; Pathan, 2009; Poletti-Hughes & Briano-Turrent, 2019). The Z-score is calculated as the return on assets plus equity to assets ratio divided by the standard deviation of return on assets, and high score of Z-score indicate lower risk. Return on Assets Volatility and Leverage are calculated as the standard deviation of return on assets and the ratio of total debt total assets respectively.

3.3 Independent variables: Board Diversity

To cover all aspects of board diversity, we include seven measurements to account for five types of board diversity. The first aspect of diversity is gender diversity calculated as the percentage of female directors to the total number of directors. Second, age diversity is measured as the standard deviation of the ages of all directors in the board following Anderson et al. (2011), Bernile et al. (2018) and Wang and Hsu (2013). Third, nationality diversity is measured as the proportion of directors from different countries.

Forth, we use two measurements of educational diversity; the diversity of qualifications and financial knowledge. For qualification diversity, we calculate the standard deviation of the number of all qualifications held by directors, including professional qualifications. The financial knowledge diversity is calculated as the percentage of directors on board that hold a financial or accounting degree or certificate.

For experience diversity, we calculate financial experience and professional experience. Financial experience is calculated as the percentage of directors with previous financial experience. To measure professional experience, we use the Herfindahl index based on percentage of directors' expertise within five categories: financial, consulting, legal, management (executives), and other expertise (i.e. research, technology, medical, etc.) following Harjoto et al. (2018).

Figures 1 and 2 present a preliminary analysis of institutions and directors social ties within the sample. Figure 1 shows 3327 social ties between directors, with at least 11 main clusters. Most clusters in this map are connected to each other, which suggests the presence of indirect networking between directors. Figure 2 shows social networks of 1,912 firms in the sample. There are at least six main clusters with a range between two to six sub-clusters. Unlike the directors networking map, the institutions networking map shows that there are isolated clusters that are not connected to other groups. The analysis suggest that social ties is an important aspect and that we can regard our sample as highly connected.

To proxy for board network, we use two measurements. The first is inside network size measured as the log of total network size of directors that share professional and/or educational background with another director within the board, following Fan et al. (2019) in studying Board and CEO ties. The second network measurement is the log of the total outside network

size of director measured as the number of overlaps through employment and education as provided by BoardEx.

3.4 Control variables

For the linear regression, we use control variables drawn from the literature on board diversity and board social networks. The most common control variables are the Firm Size (Akbar et al., 2017; Altunbaş, Thornton, & Uymaz, 2018; Berger et al., 2013, 2014; Bernile et al., 2018; Cao et al., 2019; Dionne et al., 2019; Erhardt et al., 2003; García-Meca et al., 2015; Harjoto et al., 2018; Ho et al., 2013; Jizi & Nehme, 2017; Khatami et al., 2016; Kim, 2005; Larcker et al., 2013; Minton et al., 2014; Poletti-Hughes & Briano-Turrent, 2019; Wang & Hsu, 2013; Wu, 2016; Yoshikawa et al., 2020) and the Board Size (Anderson et al., 2011; Berger et al., 2013, 2014; Bernile et al., 2018; Erhardt et al., 2003; Fan et al., 2019; García-Meca et al., 2015; Jizi & Nehme, 2017; Kim, 2005; Minton et al., 2014; Poletti-Hughes & Briano-Turrent, 2019; Yoshikawa et al., 2020). Other control variables used in board diversity studies include Market to Book ratio (Akbar et al., 2017; Bernile et al., 2018; Cao et al., 2019; Dionne et al., 2019; Jizi & Nehme, 2017; Larcker et al., 2013; Wu, 2016), Board Independence (Anderson et al., 2011; Fan et al., 2019; García-Meca et al., 2015; Harjoto et al., 2018; Jizi & Nehme, 2017; Larcker et al., 2013; Minton et al., 2014; Poletti-Hughes & Briano-Turrent, 2019), and CEO Duality (Bernile et al., 2018; Fan et al., 2019; García-Meca et al., 2015; Jizi & Nehme, 2017).

4. ECONOMETRIC STRATEGY

4.1 Structural Equation Model

We include two Structural Equation Modelling (SEM) to examine the effect of board diversity and social ties on risk-taking. Researchers have supported the use of SEM as means of theory testing (Bhaduri & Selarka, 2016; Cliff, 1983; Dolan, Bechger, & Molenaar, 1999;

Freedman, 1987). The SEM includes two latent variables which are Stand Alone Risk (that loads three measurements of risk), and Market Risk (which loads two measurements of risk). The five observable variables in the measurement model that load the latent variables are the Z-score, ROAV, Leverage, Idiosyncratic Risk, Stock Return Volatility. The measurement models are specified as follows:

$$ROA\,V_{i,t} = \alpha_2 + \beta_2 LV\ StandAlone\ Risk_{i,t} + \varepsilon 1_{i,t} \quad (1)$$

$$Z - score_{i,t} = \alpha_1 + \beta_1 LV\ StandAlone\ Risk_{i,t} + \varepsilon 2_{i,t} \quad (2)$$

$$Leverage_{i,t} = \alpha_3 + \beta_3 LV\ StandAlone\ Risk_{i,t} + \varepsilon 3_{i,t} \quad (3)$$

$$Stock\ Return\ Volatility_{i,t} = \alpha_4 + \beta_4 LV\ Market\ Risk_{i,t} + \varepsilon 4_{i,t} \quad (4)$$

$$Idiosyncratic\ Risk_{i,t} = \alpha_5 + \beta_5 LV\ Market\ Risk_{i,t} + \varepsilon 5_{i,t} \quad (5)$$

Where $LV\ StandAlone\ Risk_{i,t}$ and $LV\ Market\ Risk_{i,t}$ are the latent variables that represent the stand-alone risk and market risk for the institution i in the year t. Z-score, ROAV, Leverage, Idiosyncratic Risk, and Stock Return Volatility are the observed variables. β_1, β_2 β_3, β_4 and β_5 are the factor loadings that show how the observed indicators determine scores of latent variables. ε represent the residual. This measurement model is the same for both SEMs (board diversity and social ties)

The structural model for the first SEM includes the board diversity variables as the exogenous variables and the predictors of the latent variables defined in the measurement model. The structural model is specified as the following system of equations:

$$LV\ StandAlone\ Risk_{i,t} = \alpha_6 + \lambda_1 Age\ Diversity_{i,t-1} + \lambda_2 Gender\ Diversity_{i,t-1} + \lambda_3 Nationality\ Diversity_{i,t-1} + \lambda_4 Financial\ Education\ Diversity_{i,t-1} +$$

$\lambda_5 Qualification\ Diversity_{i,t-1} + \lambda_6 Financial\ Experience_{i,t-1} +$

$\lambda_7 Professional\ Experience_{i,t-1} + \varepsilon 6_{i,t}$ (6)

$LV\ Market\ Risk_{i,t} = \alpha_7 + \lambda_8 Age\ Diversity_{i,t-1} + \lambda_9 Gender\ Diversity_{i,t-1} +$

$\lambda_{10} Nationality\ Diversity_{i,t-1} + \lambda_{11} Financial\ Education\ Diversity_{i,t-1} +$

$\lambda_{12} Qualification\ Diversity_{i,t-1} + \lambda_{13} Financial\ Experience_{i,t-1} +$

$\lambda_{14} Professional\ Experience_{i,t-1} + \varepsilon 7_{i,t}$ (7)

Where $Age\ Diversity_{i,t-1}$, $Gender\ Diversity_{i,t-1}$, $Nationality\ Diversity_{i,t-1}$, $Financial\ Education\ Diversity_{i,t-1}$, $Qualification\ Diversity_{i,t-1}$, $Financial\ Experience_{i,t-1}$ and $Professional\ Experience_{i,t-1}$ are the board diversity and social network variables for the firm i in the year $t-1$. LV StandAlone Risk and LV Market Risk are the latent variables defined in the measurement model. λ_1 to λ_{14} are the regression coefficients.

The structural model for the second SEM includes the social ties variables as the exogenous variables and the predictors of the latent variables defined in the measurement model. The structural model is specified as the following system of equations:

$LV\ StandAlone\ Risk_{i,t} = \alpha_6 + \lambda_1 OutsideNetwork_{i,t-1} +$

$\lambda_2 InsideNetwork_{i,t-1} + \varepsilon 6_{i,t}$ (8)

$LV\ Market\ Risk_{i,t} = \alpha_7 + \lambda_3 OutsideNetwork_{i,t-1} + \lambda_4 InsideNetwork_{i,t-1} +$

$\varepsilon 7_{i,t}$ (9)

Where $OutsideNetwork_{i,t-1}$ and $InsideNetwork_{i,t-1}$ are the board diversity and social network variables for the firm i in the year $t-1$. LV StandAlone Risk and LV Market Risk are the latent variables defined in the measurement model. λ_1 to λ_4 are the regression coefficients.

The variables and their definitions are listed in the vairables' list. The exogenous variables were lagged by one year (t-1). We have ran the model with current variables and lagged it by one to three years. The results show that there is not much difference between laggings interms of significance had and model fit. Therefore, we lag the exogenous variables by one year to account for the lagged effect of board diversity and social networking on risk-taking.

4.2 Linear Regression

To test the robustness of the effect of board diversity and social ties on risk-taking with the control variables, we estimate the following model:

$$Risk_{i,t} = \beta_0 + \beta_1 Age\ Diversity_{i,t-1} + \beta_2 Gender\ Diversity_{i,t-1} + \beta_3 Nationality\ Diversity_{i,t-1} + \beta_4 Financial\ Education\ Diversity_{i,t-1} + \beta_5 Qualification\ Diversity_{i,t-1} + \beta_6 Financial\ Experience_{i,t-1} + \beta_7 Professional\ Experience_{i,t-1} + \beta_8 Control_{i,t-1} + \varepsilon_{i,t} \quad (10)$$

$$Risk_{i,t} = \beta_0 + \beta_1 InsideNetwork_{i,t-1} + \beta_2 OutsideNetwork_{i,t-1} + \beta_3 Control_{i,t-1} + \varepsilon_{i,t} \quad (11)$$

Where $Risk_{i,t}$ is one risk measurement for the company i in the year t out of the five different measurements of risk. In all risk measurements, a higher value indicates a higher risk, except for the Z-score where higher values indicate lower risk. $Age\ Diversity_{i,t-1}$, $Gender\ Diversity_{i,t-1}$, $Nationality\ Diversity_{i,t-1}$, $Financial\ Education\ Diversity_{i,t-1}$, $Qualification\ Diversity_{i,t-1}$, $Financial\ Experience_{i,t-1}$, $Professional\ Experience_{i,t-1}$, $InsideNetwork_{i,t-1}$, $OutsideNetwork_{i,t-1}$ are the board diversity and social network variables for the firm i in the year $t-1$. $Control_{i,t-1}$ is a set of five variables that control for

firm level. Is $\varepsilon_{i,t}$ is the residual. We run a hausman test which reveals that the null hypothesis is rejected, thus, all models include industry and year fixed effects.

The independent and control variables were lagged by one year (t-1) to account for lagged effects.. The descriptions and definitions of all variables are detailed in the variables' list.

5. EMPIRICAL RESULTS

Table 4 and figure 3 show the results of the SEM for the board diversity variables. Panel A reports the measurement model that shows the factor loadings of the rik measurements in the factor analysis. The variables ROA volatility and Levreage are positively loaded on the latent variable Stand-Alone Risk, while Z-score is negatively loaded. This means that the higher value of this latent variable indicate higher risk-taking, because the higher value of Z-score indicte lower risk-taking. In addition, Idiosyncratic Risk and Stock Return Volatility are positively loaded on the latent variable Market Risk, which means that the higher value of Market Risk indicate a more risk-taking.

[Table 4 near here]

[Figure 3 near here]

Panel B of table 4 shows the results of the structural model. Age Diversity has a significant and positive effect on both the stand-alone and market risk. However, the effect is minor with a coefficient of only 0.116 for stand-alone risk, and 0.198 for market risk. These results are in line with Harjoto et al. (2018) who found no association between age diversity and board performance. In addition, Gender Diversity has a significant effect on risk-taking, but the effect is negative on stand-alone risk and positive on market risk. Also, similar to the age diversity, gender diversity's effect is low. The negative effect of female presence on stand-alone risk can by justified with the conclusion made by Berger et al. (2014) that female directors have lower experience in comparison to their male counterparts. Since greater age

and gender diversity does not seem correlated with lower risk taking in financial institutions, these results thus reject the main hypothesis (H1).

The results show that nationality diversity has a sinigificant and positive effect on risk. The effect also appears to be the strongst compared to the other variables. This result is supported by the increasing importance of nationality diversity in Europe. Borges (2011) report that the average non-national directors on European boards is 24%. This reflects the demand and importance for international competencies benefited from divrsity of nationality. However, Borges (2011) also reports that nationality diversity brings issues such as language difficulties and logistic problems. When comparing this result to other studies, they contradict the findings by García-Meca et al. (2015) who conclude that the demographic differences resulting from diversity of nationality lower cohesion between groups which leads to slowing the decision process. Also, the positive effect shown in the our results is not in line with Bernile et al. (2018) who found that the diversity index (including ethnicity) leads to lower risk-taking. However, our results are not comparable to theirs, because the effect of ethnicity diversity might have been off-set by the other five variables in the same index. Finally, since greater nationality diversity does not seem correlated with lower risk taking in financial institutions, this result thus rejects the main hypothesis (H1).

We include two aspects of the education diversity, a general qualification aspect and another one that is focused on financial education. Including more than one measurement will help us get a detailed view of the effect of the diversity of education on risk-taking and enable us to compare between the importance of the type of qualification. The results show both general qualification and financial education diversity have more significant effect on stand-alone risk than the market risk. However, the general qualification diversity has a negative effect, while the financial education diversity has a postiive effect. This indicates that financially educated board members influence the boards to take more risk.

For diversity of experience, we also include two measurements which are financial and professsional. The professional diversity is measured using the Herfindahl-Hirschman index (HHI) which means that the higher value of this variable represent lower diversity. The results show that financial experience does not have a signifcant effect on risk-taking, while the diversity of professional experience has a significant and positive effect on market risk. This result is supported by the finding of Anderson et al. (2011) who found that board diversity including experience have a positive effect on firm performance. This can be explain by Harjoto et al. (2018) conclusion that boards with diverse experiences are more effective in overseeing corporate investment activities.

Including several measurements of the same variable enable us to compare and contrast it with other variables from different angles. We have previously compared financial and non-financial aspects of the same variable. When comparing only the finacial aspect of education and experience diversity, the results show that financial education has more significant effect on risk than the financial experience. This finding is in line with the corporate governance principles of Basel Committee on Banking Supervision (2015) and the corporate governance guide of NYSE Governance Services, (2016); they both include board qualification as a main principle for selecting a board member.

Table 5 and figure 4 show the results of the SEM to study the effect on board ties on risk-taking. The loadings of the latent variables in the measurement model are similar to the previous SEM suggesting that higher values of the latent variables indicate more risk-taking. Panel B reports the structural model of regressing Outside Network and Inside Network on the latent variables. The results show that both inside and outside ties of board memebers have more significant effect on the market risk than on stand-alone risk. However, outside network has a positive effect (in line with H2) while inside network has a negative effect (rejecting H2). This significant effect shows the important role of social ties in the decision process related to

risk-taking. This important rule is perhaps the results of the strategic resources provided by the board's social works which helps in creating competitive advantages (Yoshikawa et al., 2020). The positive effect of outside network and the negative effect of the inside network is in line with Fan et al. (2019) who found that social ties tend to destroy firm value whereas professional ties do not. Also, it is worth mentioning that Kim (2005) found that while moderate level of board network enhances firm performance, a too cohesive board network destroys it. Overall, the results on the effects of social networks are significant but the direction of the effect is inconclusive.

[Table 5 near here]

[Figure 4 near here]

Table 6 provides the resutls for estimating equation (10) to study the effect of board diversity on five risk measurements. Most of the linear regression results are consistant with the SEM's results except for few differences. The SEM results show that nationality diversity is very significant while it was not significant in the linear regression. Table 7 provides the results for estimating equation (11) to study the effect of board ties on five risk measerments. The results show consistanacy of the inside network effect on risk with the SEM's results reported in table 5. However, the results of the outside network of boards are different, significant by linear regression and not significant by SEM.

[Table 6 near here]

[Table 7 near here]

For further analysis, we have divided the sample to two sub-samples; banks and non-banks. The results of the sub-samples were relatively similar to the full sample of financial institutions.

6. CONCLUSION

This paper was aimed to provide an improved understanding of the effect of several diversity aspects on risk-taking by examining US financial institutions. The diversity aspects that are covered are age, gender, nationality, education and experience. We also included several dimensions of the same variable; level of qualification and financial aspect for diversity of education, and professional and financial aspects for diversity of experience.

Our findings highlight the regulatory requirements of board diversity, where corporate governance codes of conduct should include recommendations to increase or decrease different aspects of diversity in the boards of financial institutions. Our results not only show that the diversity of board has a significant effect on risk-taking (H1), but it also shows that the type of diversity is a very important matter.

Amongst the several studied aspects of diversity in this paper, the results show that the qualification of boards are the most important in affecting risk-taking. Age and gender also have a significant but minor effect on risk, while experience diversity is the least important especially when compared to education. Regarding the nationality diversity, our results are varied, it is very significant by SEM but not significant by linear regression.

The results also show that social networks of directors (H2) have a significant effect on risk-taking especially on market risk. However, the inconclusiveness of the results calls for further investigation. Because, for instance, the importance of social ties raises the questions of how it can be regulated as a characteristic of directors. The UK's corporate governance code of conduct recommend that both the appointment and succession plans should be based on many aspects of diversity including social backgrounds (Financial Reporting Council, 2018). A very crucial implication of this finding is that it is important to include the size and characteristics of the social network as a part of the definition of the independence of directors,

where it is important to include requirements related to the inside and outside networking size of directors to be classified as independent.

Another important implication of our results is that boards need to have a sensible level of diversity in all aspects, especially in nationality, social backgrounds and most importantly education. Also, financial institutions need to consider the level of diversity in their boards when appointing new directors. These implications rise from the conclusion that a too diverse board might suffer from the lack of cohesion and communication which might affect the decision-making process, while a very low diverse board will not be able to benefit from the diverse backgrounds and expertise.

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TABLE 1 Selected Research into Board Diversity and Risk-Taking in Financial Institutions

Aspect of Board Diversity	**Positive Impact (Decrease risk or superior performance)**	**Negative Impact on (Increased risk or poor performance)**	**No Impact on Risk (Undetermined)**
Age	Berger *et al*. (2014)	Wang & Hsu (2013)	Wang & Hsu (2013)
Gender	García-Meca *et al*. (2015); Jizi & Nehme (2017)	Berger *et al*. (2014)	
Education	Berger *et al*. (2014); Anderson *et al*. (2011); Dionne *et al*. (2019)	Kirkpatrick (2009)	N/A
Nationality and Ethnicity	Bernile *et al*. (2018); Anderson *et al*. (2011)	García-Meca *et al*. (2015)	Harjoto *et al*. (2018)
Social Ties	Yoshikawa *et al*., (2020); Larcker *et al*. (2013); Khatami *et al*. (2016)	Kim (2005); *Fan et al*. (2019); Qiu *et al*. (2019)	N/A

Notes: Source: authors own estimates.

TABLE 2 List of Variables

Variable	Definition	Database
Risk Measurement		
Z-score	Return on assets plus equity to asset ratio divided by the standard deviation of the return on assets over the period 2010-2018 (High value=low risk)	Bloomberg
ROAV	The standard deviation of the returns on Asset constructed over the period 2010-2018	Bloomberg
Leverage	The ratio of total debt to total assets	Bloomberg
Stock Return Volatility	Annualized standard Deviation of Daily stock returns	Bloomberg
Idiosyncratic Risk	The Standard deviation of the residuals derived from regressing daily stock return on market return in each year	Bloomberg
LV Stand-Alone Risk	A latent variable that represents the stand-alone risk generated from the measurement model based on three risk measurements; *ROAV, Leverage* and *Z-score.*	Structed Equational Model
LV Market Risk	A latent variable that represents market risk generated from the measurement model based on wo risk measurements; *Stock Return Volatility* and *Idiosyncratic Risk.*	Structed Equational Model
Board Diversity and Network		
Age Diversity	The standard deviation of the ages of all directors in the board	BoardEx
Gender Diversity	Percentage of female directors to the total number of directors	BoardEx
Nationality Diversity	Proportion of Directors from different countries	BoardEx
Financial Education Diversity	The percentage of directors on board that hold a financial or accounting degree or certificate	BoardEx
Qualification Diversity	The measure of dispersion of the number of qualifications held by Directors from the mean. This is a count of all qualifications of degree level including all professional qualifications.	BoardEx
Financial Experience Diversity	The percentage of directors with financial experience that are Former bank executives, Executives of nonbank financials, Finance executives of nonfinancial firms, academic position in a related field, or Professional investors	BoardEx

Professional Experience Diversity	The Herfindahl index based on the number of directors' expertise within five categories: consulting, legal, management (executives), and other expertise (i.e. research, technology, medical, etc.). For example, 2directors with legal experience and 3 directors with consulting experience would be defined as (2/5)^2 + (3/5)^2.	BoardEx
Inside Network	The log of the total network size of directors that share professional and/or educational background with another director within the board	BoardEx
Outside Network	The log of the total outside network which is the numbers of overlaps through employment and education as provided by BoardEx.	BoardEx
Firm Control Variables		
Firm size	the log of total assets in billion US dollars	Bloomberg
Market to Book	Market capitalisation to the book value of equity	Bloomberg
Board Size	Number of Directors on the company's board	Bloomberg
Board Independence	Independent directors as a percentage of total board membership.	Bloomberg
CEO Duality	Indicates whether the company's Chief Executive Officer is currently also chairperson of the Board. Takes the value of 0 when the CEO and chairperson positions are separated and 1 otherwise	Bloomberg

TABLE 3 Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
IdiosyncraticRisk	3842	0.07	46.97	2.53	4.58
Zscore	3842	-1.82	36.72	5.21	5.47
ROAVolatility	3842	0.02	30.35	1.52	3.72
Leverage	3842	0.00	94.33	13.09	16.06
StockReturnVolatility	3842	0.13	49.44	3.00	5.27
AgeDiversity	3842	2.90	14.80	7.72	2.37
GenderDiversity	3842	0.00	41.67	12.80	9.56
NationalityDiversity	3842	0.00	0.60	0.04	0.12
QualificationDiversity	3842	0.30	2.20	1.08	0.36
FinancialEducationDiversity	3842	0.00	0.50	0.11	0.11
FinancialExperienceDiversity	3842	0.00	0.29	0.03	0.06
ProfessionalExperienceDiversity	3842	0.22	1.00	0.45	0.14
OutsideNetwork	3842	298	77211	12015.91	12439.47
InsideNetwork	373	10	117	32.45	25.02
BoardIndependence	3842	37.50	94.12	78.87	12.07
BoardSize	3842	5	20	10.56	2.92
CEODuality	3842	0	1	0.42	0.49
FirmSize	3842	7.86	12.29	9.58	0.83
MarkettoBook	3842	0.13	17.49	1.56	1.63

TABLE 4 SEM: Board Diversity

Panel A: Measurement Model		
	LV StandAlone Risk	**LV Market Risk**
ROAV ←	1 (Constrained)	
Z-score ←	-1.429*** (0.124)	
Leverage ←	2.837*** (0.268)	
Idiosyncratic Risk ←		1 (Constrained)
Stock Return Volatility ←		0.854*** (0.026)
Panel B: Structural Model		
	LV StandAlone Risk ←	**LV Market Risk ←**
Age Diversity	0.116*** (0.021)	0.198*** (0.039)
Gender Diversity	-0.017*** (0.005)	0.051*** (0.010)
Nationality Diversity	2.244*** (0.414)	4.690*** (0.773)
Qualification Diversity	-1.558*** (0.149)	-0.548 (0.254)
Financial Education Diversity	1.278** (0.452)	-2.065* (0.860)
Financial Experience Diversity	-1.124 (0.821)	-1.217 (1.570)
Professional Experience Diversity	0.272 (0.340)	3.477*** (0.653)
R Squared	0.139	0.039
Observations	3299	3299
Panel C: Model Fit		
Chi-squared	NFI	CFI
1152.971	1.000	1.000

Notes: This table represents the results of the SEM to study the impact of board diversity on stand-alone and market risk. Definitions and sources of all variables are detailed in table 1. Standard errors are provided in parentheses. Variables with arrows pointing towards them are the endogenous variables *, **, and *** denote significance at 10%, 5%, and 1% respectively.

TABLE 5 SEM: Board Social Ties

Panel A: Measurement Model		
	LV StandAlone Risk	**LV Market Risk**
ROAV ←	1 (Constrained)	
Z-score ←	-3.267** (1.095)	
Leverage ←	8.656** (2.728)	
Idiosyncratic Risk ←		1 (Constrained)
Stock Return Volatility ←		0.980*** (0.040)
Panel B: Structural Model		
	LV StandAlone Risk ←	**LV Market Risk ←**
Outside Network	-0.038 (0.101)	4.722*** (1.122)
Inside Network	-0.270* (0.151)	-5.354*** (1.547)
R Squared	0.022	0.082
Observations	328	328
Panel C: Model Fit		
Chi-squared	NFI	CFI
77.292	1.000	1.000

Notes: This table represents the results of the SEM to study the impact of social network on stand-alone and market risk. Definitions and sources of all variables are detailed in table 1. Standard errors are provided in parentheses. Variables with arrows pointing towards them are the endogenous variables *, **, and *** denote significance at 10%, 5%, and 1% respectively.

TABLE 6 Linear Regression: Board Diversity

	Dependent Variable: Five measures of risk				
	ROAV	**Z-score**	**Leverage**	**Stock Return Volatility**	**Idiosyncratic Risk**
Age Diversity	-0.036 (0.026)	0.032 (0.038)	0.717*** (0.113)	0.174*** (0.599)	0.158*** (0.056)
Gender Diversity	0.019** (0.010)	0.046*** (0.010)	-0.047 (0.030)	-0.001 (0.010)	0.005 (0.009)
Nationality Diversity	-0.556 (0.500)	-0.860 (0.585)	-2.592 (2.908)	0.351 (0.961)	-0.133 (0.819)
Qualification Diversity	-0.505*** (0.116)	0.462* (0.262)	-1.224* (0.694)	0.452** (0.195)	0.432* (0.174)
Financial Education Diversity	-0.899* (0.537)	-0.851 (0.812)	- 12.441*** (2.319)	-3.931*** (0.916)	-3.186*** (0.797)
Financial Experience Diversity	-3.102*** (0.898)	-1.251 (1.416)	5.054 (4.054)	-1.735 (1.489)	-1.230 (1.286)
Professional Experience Diversity	-0.896*** (0.332)	0.362 (0.582)	-4.865** (1.904)	3.902*** (1.311)	3.590*** (1.227)
Board Independence	-0.010** (0.005)	0.006 (0.008)	0.040* (0.025)	-0.041*** (0.008)	-0.033*** (0.007)
Board Size	-0.064*** (0.015)	0.255*** (0.043)	-0.767*** (0.109)	0.001 (0.038)	-0.016 (0.033)
CEO Duality	0.231* (0.123)	0.260 (0.168)	0.051 (0.548)	0.589*** (0.193)	0.569*** (0.169)
Firm Size	-1.186*** (0.125)	-0.138 (0.148)	3.507*** (0.430)	1.929*** (0.195)	1.575*** (0.182)
Market to Book	0.546*** (0.086)	0.319*** (0.064)	-1.089*** (0.284)	0.444*** (0.078)	0.380*** (0.065)
Observations	3299	3299	3299	3299	3299
R Squared	0.376	0.149	0.325	0.171	0.158

Notes: This table represents the results of regressing five risk measurements (*ROAV, Leverage, Z-score, Stock Return Volatility* and *Idiosyncratic Risk*) on board diversity variables. Definitions and sources of all variables are detailed in table 1. Model are estimated using industry and year fixed effects. t-statistics based on robust standard errors are provided in parentheses. *, **, and *** denote significance at 10%, 5%, and 1% respectively.

TABLE 7 Linear Regression: Board Social Ties

	Dependent Variable: Five measures of risk				
	ROAV	**Z-score**	**Leverage**	**Stock Return Volatility**	**Idiosyncratic Risk**
Outside Network	0.089	-1.462***	2.940*	-3.639***	-2.919***
	(0.117)	(0.406)	(2.118)	(1.275)	(1.030)
Inside Network	0.203	1.936**	-1.685	-4.475**	-4.623**
	(0.185)	(0.798)	(1.874)	(2.044)	(1.898)
Board Independence	-0.021***	0.021	-0.336***	-0.293***	-0.260***
	(0.006)	(0.019)	(0.082)	(0.065)	(0.061)
Board Size	-0.033**	0.189***	-0.313	0.213*	0.174*
	(0.017)	(0.068)	(0.254)	(0.127)	(0.111)
CEO Duality	-0.008	1.178***	-0.951	-0.849	-0.881
	(0.098)	(0.466)	(1.377)	(0.834)	(0.754)
Firm Size	-0.269***	-0.085	1.981*	4.995***	4.622***
	(0.089)	(0.252)	(1.152)	(1.356)	(1.319)
Market to Book	0.234***	0.785***	-4.521***	-0.206	-0.137
	(0.105)	(0.296)	(1.304)	(0.291)	(0.258)
Observations	328	328	328	328	328
R Squared	0.551	0.175	0.535	0.403	0.402

Notes: This table represents the results of regressing five risk measurements (*ROAV, Leverage, Z-score, Stock Return Volatility* and *Idiosyncratic Risk*) on social network variables. Definitions and sources of all variables are detailed in table 1. Model are estimated using industry and year fixed effects. t-statistics based on robust standard errors are provided in parentheses. *, **, and *** denote significance at 10%, 5%, and 1% respectively.

FIGURE 1 Director network

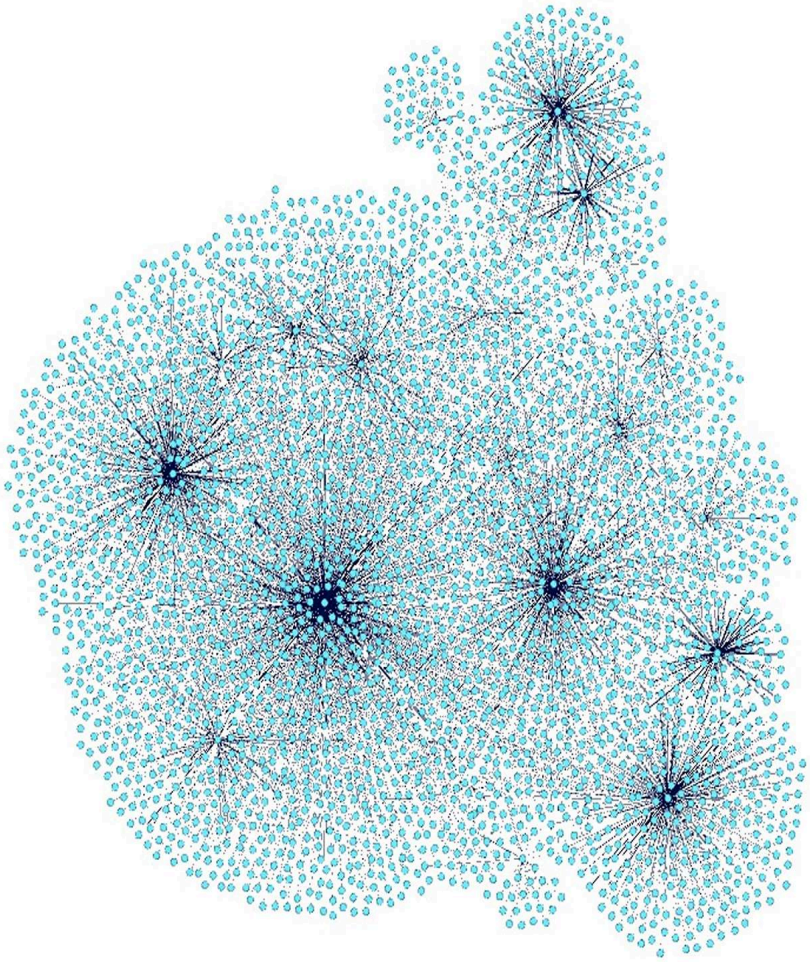


FIGURE 2 Financial institutions network

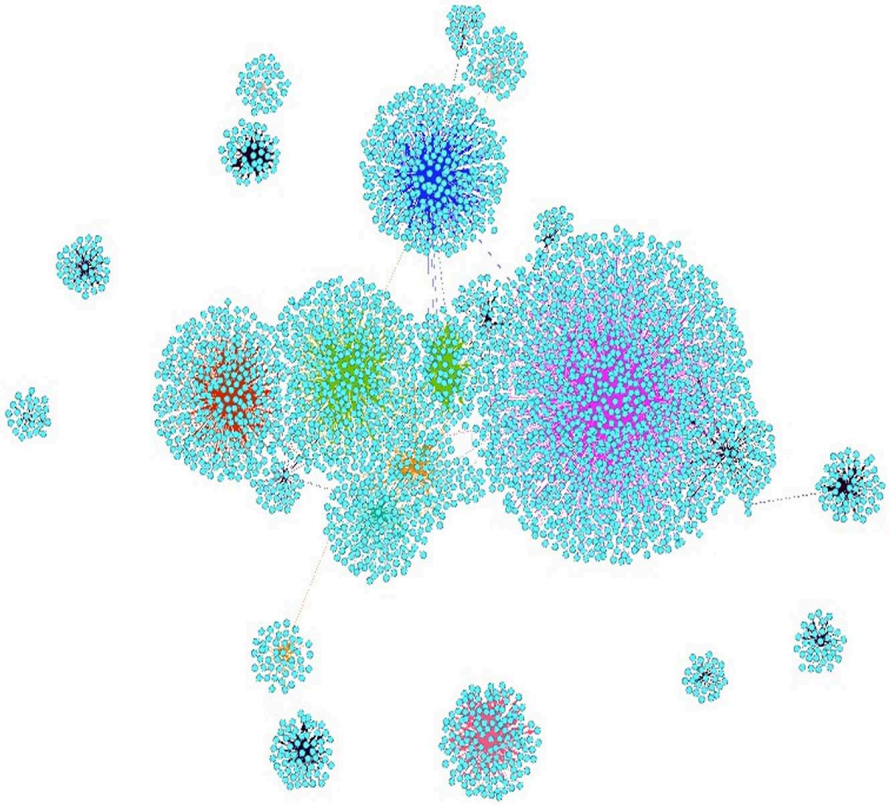


FIGURE 3 SEM: Board Diversity

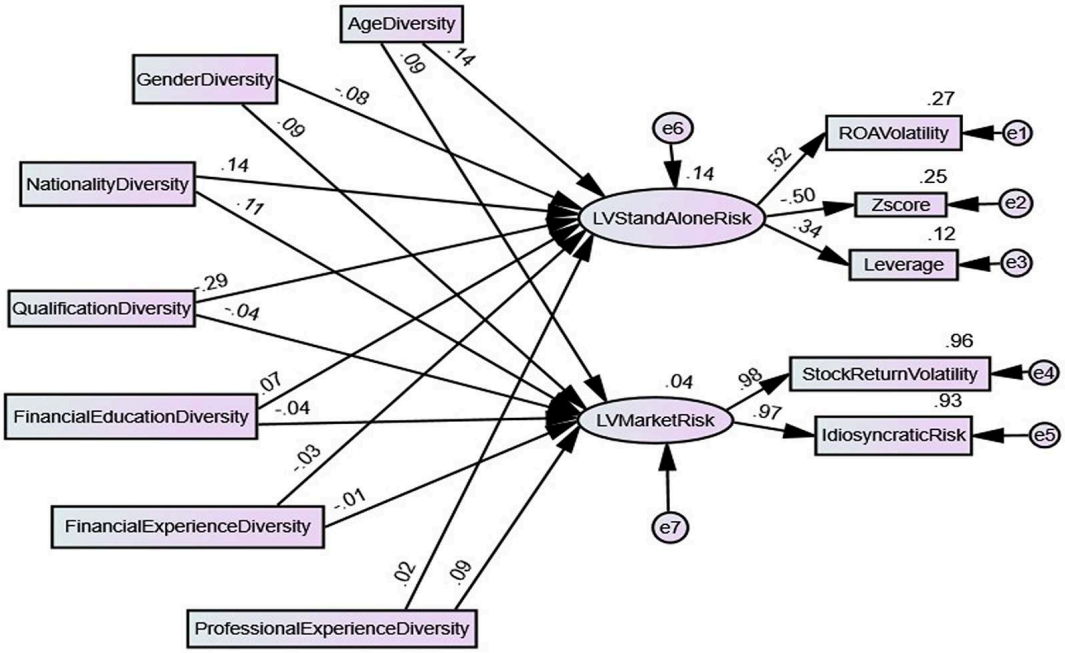
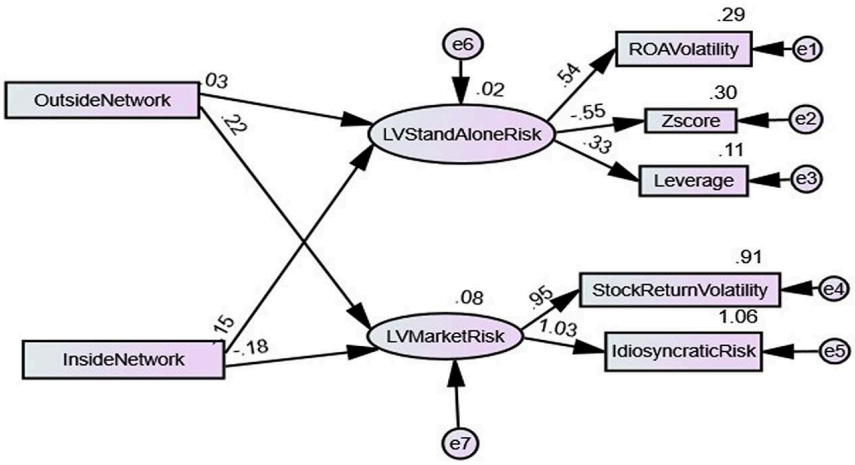


FIGURE 4 SEM Board Social Ties



APPENDIX A Pearson Correlation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Idiosyncratic Risk	1	.003	.062**	.027	.944**	.065**	.070**	.097**	-.035*	-.048**	-.044**	.082**	.164**	-.073	-.083**	.025	.130**	.228**	.116**
Zscore	.003	1	-.284**	-.157**	-.001	-.044**	.088**	-.081**	.106**	-.061**	-.008	-.008	-.081**	.097	.121**	.217**	-.048**	.019	.003
ROA Volatility	.062**	-.284**	1	.137**	.038*	.085**	-.039*	.019	-.167**	.027	-.049**	.050**	-.016	-.032	-.221**	-.295**	.082**	-.288**	.389**
Leverage	.027	-.157**	.137**	1	.019	.088**	.002	.114**	-.150**	-.042**	.012	-.040*	.155**	-.015	-.094**	-.169**	.111**	.084**	.028
Stock Return Volatility	.944**	-.001	.038*	.019	1	.062**	.069**	.111**	-.035*	-.057**	-.050**	.074**	.186**	-.075	-.082**	.044**	.124**	.251**	.114**
Age Diversity	.065**	-.044**	.085**	.088**	.062**	1	-.176**	-.031	.028	-.033*	-.075**	.128**	-.139**	-.328**	-.270**	-.089**	.000	-.204**	.011
Gender Diversity	.070**	.088**	-.039*	.002	.069**	-.176**	1	.099**	-.034*	.007	.086**	-.163**	.307**	.194**	.272**	.188**	.028	.341**	.078**
Nationality Diversity	.097**	-.081**	.019	.114**	.111**	-.031	.099**	1	-.048**	-.029	.024	-.112**	.354**	.401**	.075**	.095**	.041*	.277**	.049**
Qualification Diversity	-.035*	.106**	-.167**	-.150**	-.035*	.028	-.034*	-.048**	1	.007	-.009	.036*	-.166**	-.039	.102**	.122**	-.150**	-.074**	-.118**

Financial Education Diversity	-.048**	-.061**	.027	-.042**	-.057**	-.033*	.007	-.029	.007	1	.130**	-.037*	.012	.132*	-.047**	-.117**	.044**	-.002	.049**
Financial Experience Diversity	-.044**	-.008	-.049**	.012	-.050**	-.075**	.086**	.024	-.009	.130**	1	-.412**	.041*	.006	.030	-.012	.055**	.064**	.036*
Professional ExperienceDiversity	.082**	-.008	.050**	-.040*	.074**	.128**	-.163**	-.112**	.036*	-.037*	-.412**	1	-.220**	-.241**	-.208**	-.151**	-.003	-.209**	-.007
Outside Network	.164**	-.081**	-.016	.155**	.186**	-.139**	.307**	.354**	-.166**	.012	.041*	-.220**	1	.293**	.173**	.340**	.140**	.691**	.060**
Inside Network	-.073	.097	-.032	-.015	-.075	-.328**	.194**	.401**	-.039	.132*	.006	-.241**	.293**	1	.274**	.309**	-.167**	.284**	-.027
Board Independence	-.083**	.121**	-.221**	-.094**	-.082**	-.270**	.272**	.075**	.102**	-.047**	.030	-.208**	.173**	.274**	1	.241**	-.148**	.265**	-.067**
Board Size	.025	.217**	-.295**	-.169**	.044**	-.089**	.188**	.095**	.122**	-.117**	-.012	-.151**	.340**	.309**	.241**	1	-.123**	.427**	-.091**
CEO Duality	.130**	-.048**	.082**	.111**	.124**	.000	.028	.041*	-.150**	.044**	.055**	-.003	.140**	-.167**	-.148**	-.123**	1	.145**	.030
Firm Size	.228**	.019	-.288**	.084**	.251**	-.204**	.341**	.277**	-.074**	-.002	.064**	-.209**	.691**	.284**	.265**	.427**	.145**	1	-.128**
Market To Book	.11	.003	.38	.028	.11	.011	.07	.04	-.11	.04	.036*	-.0	.06	-.0	-.06	-.09	.030	-.12	1

	6**		9**		4**		8**	9**	8**	9**		07	0**	27	7**	1**		8**

Note: ** Correlation is significant at the 0.01 level, * Correlation is significant at the 0.05 level.

APPENDIX B Board diversity and social network review

Paper	Board variables	Variables Definition	Risk measurements	Effect of board on risk	sector	country	sample size	Period
(Berger *et al*., 2014)	age, gender, education of Board executives	Average Board Age increase of 5 years. Increase in female presence. Presence of executives with PhD	Risk-weighted assets to total assets (RWA/TA), and a Herfindahl Hirschman index for loan portfolio concentration (HHI, log))	Board age negatively related to risk. Increase in female presence leads to increase in portfolio risk. The presence of executives with PhD leads to decrease in portfolio risk	Banks	Germany	3525 banks, 19,750 observations	1994-2010
(Wu, 2016)	Gender Diversity	-	firm as being bankrupt if it makes a Chapter 11 filing. variable is set to 1 if the firm files for bankruptcy within one year, and 0 otherwise	Board size and gender diversity are negatively related to bankruptcy risk.	Non-financial	US	217 bankrupts. 9,100 non-bankrupts	1996-2006

(Ho *et al*., 2013)	Board size, CEO duality, Board independence	-	Total risk is measured by the standard deviation of return on assets, Underwriting risk is measured by the standard deviation of the company's loss ratio, Investment risk is measured by the standard deviation of return on investment, Leverage risk is defined as 1 minus the surplus-to assets ratio	More board independence and CEO duality lead to higher risk, impact of board size on different risk-taking measures varies.	Property Causality Insurance Industry	US	252 firms	1996-2007
(Akbar *et al*., 2017)	Board size, independence and CEO duality	Size is the log of number of directors, percentage of nonexecutive	idiosyncratic risk is the standard deviation of the residuals from the two-index market	Board independence and CEO duality have a negative impact on risk, board	Financial Sector	UK	276 firms, 2760 firm year observation	2003-2012

		directors, CEO duality is a dummy variable	model, Z-score is the average ROA and Average CAR to the standard deviation of ROS	size has no impact on size				
(Wang & Hsu, 2013)	Board size, independence, age, tenure	Size is number of directors, independence is percentage of independent directors, the standard deviation of age divided by average age, the standard deviation of tenure divided by average tenure	events by the variable OP, which equals one if a firm has an operational risk event in a certain year in our sample period, 0 otherwise	Board size is negatively associated with operational risk, board independence is associated with less fraud, board age and tenure a proxy for diversity show important role in managing operational risk	Financial institutions	US	103 firms	1996-2010
(Harjoto *et al*., 2018)	Board gender, race (Asian, Black, Caucasian, Hispanic, and Native	relation oriented index (Board gender, race, age) task-oriented index	firm-specific deviation from the expected level of investment. They measure corporate	task-oriented board diversity attributes, such as tenure and expertis	non-financial firms	US	15,125 firm year observations form 1898 firms	1998-2014

	Americans), age, tenure, experience (financial, consulting, legal, management (executives), and other expertise)	(tenure, experience)	investment using capital expenditures (CAPEX), R&D expenses (RDEX), and acquisition spending (ACQEX)	e, are negatively associated with suboptimal investment. No association between board relation-oriented diversity measured by gender, race, and age, and board performance				
(García-Meca *et al*., 2015)	Women, Foreigners	the percentage of female and foreign directors on boards	Tobin's Q: the book value of total assets minus the book value of common equity plus the market value of common equity divided by the book value of total assets. ROA is calculated as the	gender diversity increases bank performance, while national diversity inhibits it	Banks	9 countries (Canada, France, Germany, Italy, the Netherlands, Spain, Sweden, the United Kingdom, and the United States)	159 banks, 877 observations	2004-2010

			income before extraordinary items, interest expense, and taxes divided by the average of the two most recent years of total assets					
(Bernile *et al*., 2018)	Diversity index (gender, age, ethnicity, education, experience)	fraction of women on board, standard deviation of board age, Herfindahl concentration indexes for director ethnicity, institutions where directors received bachelor degree, director financial experience	Volatility of stock return, net book leverage, net market leverage, dividend-to-equity ratio, CAPEX-to-asset ratio, and R&D-to-asset ratio, log number of patents, firm profitability	greater board diversity leads to lower volatility and better performance.	nonfinancial, non-utility firms	US	21,572 firm year observations	1996-2014

(Minton *et al*., 2014)	Financial expertise in the board	Directors is the percentage of independent directors who are financial exp (Former bank executive, Executive of nonbank financials, Finance executive of nonfinancial, academic position in a related field, Professional investor)	The standard deviation of daily stock return, section: real-estate-related activity and bank leverage, nominal cumulative stock return	fraction of independent financial experts is positively related to several measures of	commercial banks, S&Ls and investment banks	US	1,106 firm year observations	2003-208
(Cao *et al*., 2019)	Board directors with foreign experience	equals 1 if a firm has at least one director with foreign experience and 0 otherwise	negative conditional skewness, down-to-up volatility	Board Directors with Foreign Experience help reduce crash risk	non-financial firms	Chinese	23,758 observations, 2,610 firms	1999-2017
(Erhardt *et al*., 2003)	Ethnic and gender diversity	percentage of women and minorities	Return on assets and investments	board diversity is positively associat	Public firms	US	127 firms	1993-1998

		(African, Hispanic, Asian and Native Americans) to white Anglo-Saxons for executive directors		ed with return on assets and investments				
(Anderson *et al*., 2011)	age, gender, ethnic, education, experience, tenure	Age: the coefficient of variation of director age, Gender: percentage of women on board, Ethnicity: percentage of Asian, African American, Hispanic, and Native American director. Education: Herfindahl index based on percentage of education level	Industry adjusted Topin's Q.	both types of director heterogeneity gave a positive relationship to firm performance	Russell 1000 nonfinancial, industrial firms	US	615 firms	2003-2005

		and major. Experience: CEO in other firms, Professional experience (law, accounting, consulting), standard deviation of firm's directors worked in, number of senior managerial positions during the career. Board tenure						
(Jizi & Nehme, 2017)	Gender Diversity	Percentage of women on board, dummy variables to indicate the existence of women on the board	Stock return volatility	Women on board reduce firm's risk	FTSE 350 non-financial firms	UK	1,138 observations	2008-2013

(Dionne *et al*., 2019)	Board independence and knowledge	A director has a financial knowledge if he or she is (a) financially active or has financial experience, (b) is financially educated, or (c) possesses an accounting background	Delta percentage, ROE, ROA, Tobin's Q	directors' financial knowledge increases firm value through the risk management	Gold mining industry	Canada and US	36 firms	1992-1999
(Poletti-Hughes & Briano-Turrent, 2019)	Gender Diversity	Percentage of female directors on the board	Volatility of ROA, Volatility of Tobin's Q, sales growth	women on board increase venture risk and performance hazard risk in family-owned firms	non-financial firms	Argentina, Brazil, Chile and Mexico	125 firms and 1,263 observations	2004-2014
(Altunbaş *et al*., 2018)	CEO tenure, CEO age, CEO gender, CEO experience, CEO education, Board size, Board	CEO number of years	dummy variable indicating the presence of corporate misconduct	banks are more likely to commit misconduct when the CEO tenure is long. Large and independence	banks	US	960 banks	1998-2015

	independence			boards mitigate but do not prevent misconduct				
(Qiu *et al*., 2019)	Top management team network	interlocking members are defined as the ones who work in two or more firms in a fiscal year. three centrality measures: Degree, Betweenness, and Eigenvector.	The cost of debt. by subtracting the matched Chinese treasury bond yield from the corporate bond yield	results provide strong evidence that bondholders require lower bond yield spreads for firms with higher TMT network centrality	non-financial firms	China	688 firms, 857 bond year observations	2007-2016
(Yoshikawa *et al*., 2020)	Sent ties and Received ties	Sent ties are the number of the focal firm's executive directors who serve on the	dummy variable that takes the value of 1 if firm i adopts the practice in year t, and 0	sent ties established by executives increase the probability of adopting stock option	non-financial firms	Japan	3,565 firms	1997-2002

		board of another firm that has already adopted stock option pay and/or EOS. received ties are the count of the focal firm's directors who also serve as directors on the board of firms that are prior adopters.	otherwise.	pay whereas received ties are strongly related to the adoption of both stock option pay and board reform				
(Fan *et al.*, 2019)	CEO-Board ties	classify a director as friendship-tied to the CEO if she has shared educational background or memberships of social organizations. Friendship Tie Breadth is	Tobin's Q and Total Q	board-CEO friendship ties have a negative and economically meaningful impact on firm value	non-financial firms	US	1696 firms, 2786 unique CEOs and 20,487 directors	2000-2014

		defined as the number of directors with friendship-ties to the CEO divided by the total number of board directors. Friendship Tie Depth is computed as the total number of friendships ties the CEO has with board directors divided by the total number of board directors						
(Berger *et al*., 2013)	Board Age, Board education, Gender diversity, social ties	Age: absolute difference between the age of the individual in question and the average age of the	Outside appointments or inside appointments	Homophily based on age and gender increase the chances of the outsider appointments. Similar educatio	Banks	Germany	between 1821 to 3364 per year	1993-2008

members of the executive board. Education: dummy variable that takes on the value one if both the appointee and any member of the executive board of the appointing bank have an academic degree. Gender diversity: dummy equal to one if both the appointee as well as at least one executive board member is female. Social ties: the intensity of an individual's connectedness is measure	nal backgrounds, in contrast, reduce the chance that the appointee is an outsider. Greater social ties also increase the probability of an outside appointment

		d by the number of common contacts the agent has with any other individual in the staff database prior to appointment.						
(Kim, 2005)	Board network density, board external social capital	Board network density is defined as the extensiveness or the cohesiveness of contact among the members of board of directors, and board external social capital refers to the degree to which board members have outside contacts in the external	ROA	moderate level of board network density enhances firm value, while too cohesive a board network destroys	Large Public firms	Korea	199 firms	1990-1999

		environment.						
(Larcker *et al*., 2013)	Director's formal or professional ties	Well connectedness by degree, closeness, betweenness, centrality, eigenvector	firm-specific one-year-ahead characteristic-adjusted returns	Firms with the best-connected boards earn higher future excess returns	Public firms	US	115,411 directors	2000-2007
(Khatami *et al*., 2016)	connections between board members and senior executives of Moody's and those of public debt issuers.	Connection Dummy: takes the value of 1 if there are past connections, current connections, Professional connections, educational connection, Army connections	non-convertible debt issues	the existence of personal connections between directors of the rating agency and those of the issuing company has a significant positive impact on the credit ratings assigned to the company's issues	industrial companies	US	1719 non-convertible public debt issues by 327 companies	1994-2011