Journal of Financial Stability 75 (2024) 101324

Contents lists available at ScienceDirect

Journal of Financial Stability

journal homepage: www.elsevier.com/locate/jfs

Independent directors' connectedness and bank risk-taking

Abu Amin [a], Sabur Mollah [b,*], Syed Kamal [c], Yang Zhao [d], Rasim Simsek [e]

[a] *Central Michigan University, Mount Pleasant, MI 48859, USA*
[b] *The University of Sheffield, Sheffield S10 2TN, United Kingdom*
[c] *University of Central Oklahoma, Edmond, OK 73034, USA*
[d] *University of Liverpool Management School, Liverpool L69 3BX, United Kingdom*
[e] *Bilecik Seyh Edebali University, Bilecik 11100, Turkiye*

ARTICLE INFO

Keywords:
Risk-taking
Network centrality
Independent directors' connectedness

ABSTRACT

This study examines the role of independent directors' network centrality in bank risk-taking. Following the shareholder-incentive hypothesis and social-network theory, we predict and find that independent directors' connectedness is positively associated with bank risk-taking. The results hold after a battery of robustness checks and endogeneity tests. Furthermore, consistent with the influence channel of networks, we show that connectedness empowers independent directors, whereas influential independent directors facilitate aggressive investment. We also find that the risk-taking effects are more pronounced for complex banks and banks with higher equity capital, higher income diversity, and lower cost-efficiency.

1. Introduction

The 2007–2009 financial crisis underscored the catastrophic effects of excessive risk-taking by financial institutions, revealing significant vulnerabilities in the banking sector (Brunnermeier, 2009; DeYoung et al., 2013). This crisis not only jeopardized the financial health of individual banks but also triggered a destabilizing spill-over effect on the global economy. A key lesson from this crisis was the high cost associated with the interconnectedness of financial institutions, often referred to as the "too-connected-to-fail" phenomenon (Allen and Babus, 2008; Kupiec et al., 2017). Consequently, recent regulatory reforms have emphasized the need to enhance banks' governance structures to better manage risk and address the interconnectedness of banks (Basel Committee, 2010, 2015; Federal Reserve, 2010; Dbouk et al., 2020).

Understanding banks' risk-taking behavior and the economic implications of interconnectedness remains critical. This paper focuses on the United States, where the regulatory environment and market dynamics present unique challenges and opportunities for risk management in banks. The U.S. banking sector, characterized by complexity and global integration, provides a fertile ground for a study of the intricate relationship between governance mechanisms and risk-taking behaviors. Furthermore, the role of independent directors in the United States is particularly significant due to the stringent regulatory expectations and the prominence of corporate governance practices aimed at protecting shareholders' interests.

Our study fills a notable gap in the literature by examining the impact of independent directors' network-centrality on bank risk-taking. While previous research has extensively explored the role of the board of directors in monitoring and controlling banks' risk exposure (Kirkpatrick, 2009) and the influence of financial networks on bank stability (Abbassi et al., 2017; Leitner, 2005), the specific link between board connectedness and risk-taking behavior remains under-investigated. By focusing on U.S. banks, this study provides a contextual understanding of how independent directors' professional network connections influence risk-taking incentives in a regulatory environment that highly values corporate governance.

Banks differ fundamentally from non-financial firms in several ways that influence their risk-taking behaviors (Bhattacharya and Thakor, 1993; Diamond and Dybvig, 1983; Merton, 1977). For instance, government guarantees such as deposit insurance and bailout support serve as put options, encouraging higher risk-taking (Merton, 1977). Additionally, the highly leveraged nature of banks amplifies these incentives, as the value of government guarantees increases with leverage (John et al., 2010). This creates a scenario in which bank shareholders are incentivized to pursue risky investments to maximize their returns – potentially at the expense of depositors, creditors, and government

* Corresponding author.
E-mail addresses: amin1a@cmich.edu (A. Amin), s.mollah@sheffield.ac.uk (S. Mollah), skamal3@uco.edu (S. Kamal), Yang.Zhao3@liverpool.ac.uk (Y. Zhao), rasim.simsek@bilecik.edu.tr (R. Simsek).

https://doi.org/10.1016/j.jfs.2024.101324

Available online 14 September 2024

guarantees (Bhattacharya and Thakor, 1993).

The board of directors is the apex body of an organization's internal governance system (Fama and Jensen, 1983). The board has ultimate responsibility for risk management in a bank. By advising and monitoring the bank executives, evaluating the consistency of a bank's risk exposures to its risk appetite, and designing the executive compensation structure, the board plays a pivotal role in influencing the risk-taking culture in a bank (Srivastav and Hagendorff, 2016). While the board is expected to serve the interests of shareholders, the optimal level of risk for shareholders may not align with the optimal level for society, leading to a potential conflict (Stulz, 2016).

Independent directors are vital for internal governance due to their perceived ability to monitor management effectively and protect shareholders' interests (e.g., De Andres and Vallelado, 2008; Erkens et al., 2012; Adams and Mehran, 2012). However, the literature includes mixed findings on the impact of board independence on bank risk-taking,[1] often focusing more on the quantity of independent directors than on their quality or attributes.[2] While previous studies have addressed heterogeneity in board independence,[3] to the best of our knowledge, this paper is the first to investigate the effect of independent directors' professional network connections – an indication of a director's quality – on banks' risk-taking incentives.

Social network theory suggests that independent directors' connections can impact economic outcomes through their influence (Adler and Kwon, 2002; Fogel et al., 2021; Kim et al., 2018; He, 2022) and information advantage (Hillman et al., 1999; Larcker et al., 2013; Akbas et al., 2016; Bjørnskov and Sønderskov, 2013; Cao et al., 2015; Ke et al., 2019; Omer et al., 2020; Chang and Wu, 2021; Fracassi, 2017). On the one hand, the influence hypothesis posits that well-networked directors possess skills, experience, knowledge, and reputation, making them valuable in the labor market. As banks and non-bank companies compete for the limited supply of qualified independent directors, those who are well-connected and in-demand can leverage their positions on boards, increasing their influence.[4] As their power and influence grow, these directors are more likely to serve shareholders' interests by endorsing risk-taking initiatives. Furthermore, the information-advantage hypothesis asserts that network connections enable independent directors to collect and disseminate valuable information to managers. Access to soft information from the network boosts directors' confidence in their risk assessments, thereby influencing the board's attitude toward risk-taking. Consequently, these directors better protect shareholders' interests by encouraging riskier investments. In summary, both the influence and information-advantage hypotheses of social networks predict a positive association between directors' connections and risk-taking.

We test our hypotheses using a sample of 424 U.S.-listed banks, with data spanning from 2000 to 2020. We assess each bank's connectedness based on the "centrality measures" in the networks of banks, firms, and other institutions. Specifically, two organizations are considered to be connected in a given year if they share one or more independent directors. Once the network is constructed, we calculate various centrality measures. The primary centrality measure, *Degree*, represents the number of organizations connected to a bank. More advanced measures, such as *Closeness*, *Eigenvector*, and *Betweenness*, consider not only the number of connections but also the distance, structural holes, relative importance of each connection, and redundancy within the network. Each centrality measure captures a specific aspect of the bank's network connectedness, but none of them alone reflects the overall level of connectedness. Therefore, following the extant literature on board and CEO networking in finance and accounting (Larcker et al., 2013; El-Khatib et al., 2015; Omer et al., 2020), we apply principal component analysis (PCA) to the four centrality measures. We then extract the first principal component (PC1) as our primary variable of interest. This measure is intuitively plausible and empirically validated (Padgett and Ansell, 1993; Banerjee et al., 2014). Our proxy for bank risk-taking is *Zscore,* which estimates the distance to capital exhaustion that occurs when a bank's equity falls short of covering losses (Bertay et al., 2013; Boyd and Runkle, 1993; Hakenes et al., 2015; Laeven and Levine, 2009; Schaeck et al., 2012; Vallascas et al., 2017). We find that directors' connectedness is negatively associated with the banks' distance to default (i.e., *Zscore*).

We thoroughly address the issue of endogeneity in the relationship between directors' network centrality and bank risk-taking. Endogeneity in corporate governance research can result in spurious and inconsistent findings due to omitted variable bias, reverse causality, and sample selection bias (Hermalin and Weisbach, 1988). To mitigate these concerns, we employ several empirical strategies. First, we conduct an instrumental variable (IV) analysis using a two-stage least squares (2SLS) regression. Following the methodologies of Faleye et al. (2014) and Intintoli et al. (2018), we use the average number of independent directors on a board who have previously worked in Fama–French 48 industries as an instrument. Our key findings remain robust even when the endogenous variable is replaced with this instrument. Second, we use the death of an independent director as an exogenous shock, following the approaches of Nguyen and Nielsen (2010) and Fracassi (2017), and perform a difference-in-differences (diff-in-diff) analysis. The results of this quasi-natural experiment show that, following the death of a well-connected independent director, banks tend to take fewer risks, while the main results remain consistent with the baseline model. Third, to address reverse causality, we follow Larcker et al. (2013) and Schabus (2022) by constructing a sample of banks with boards that are unchanged between consecutive years ("constant boards"). Thus, any changes in the boards' overall connections are due to changes in the directors' external connectivity. We expect the connectedness of independent directors in our constant board sample to be negatively associated with *Zscore*, and this expectation is confirmed in the results. Therefore, our findings are unlikely to be attributable to reverse causality. Fourth, we use the Oster (2019) procedure to address omitted variable bias, checking the stability of the coefficient by comparing the R-square values from regressions with and without controls. The results confirm that our findings are not sensitive to omitted variable bias. Fifth, we employ an entropy balancing (EB) approach (Hainmueller, 2012) to mitigate potential sample selection bias. Finally, we use alternative proxies for risk-taking and independent directors' connection centrality measures, finding that our primary results remain robust across these measures. Overall, these rigorous empirical strategies ensure the reliability and validity of our findings, effectively addressing various endogeneity concerns.

We examine board power and influence as a channel, drawing from existing literature (Adler and Kwon, 2002; Fogel et al., 2021; Kim et al., 2018; He, 2022). Since boards consist of directors and a CEO, it is plausible that bank CEOs wield significant influence in the

[1] Studies that find a positive relationship between board independence and risk-taking (e.g., Erkens et al., 2012; Vallascas et al., 2017; and Mollah et al., 2021) or a negative relationship between board independence and risk-taking (e.g., Pathan, 2009; Minton et al., 2014; Mollah et al., 2021) or no relationship (e.g., Mace, 1971; Hermalin and Weisbach, 1998; Zajac and Westphal, 1996; Shivdasani and Yermack, 1999).

[2] In a meta-analysis, John et al. (2016) emphasize the importance of the quality of independent directors, rather than the quantity.

[3] See Nguyen and Nielson (2010); Mehran et al. (2012); and Mollah et al. (2021).

[4] The extant literature and anecdotal evidence also support the notion that greater network-centrality makes directors more powerful. Huang et al. (2011) show that the directors who ranked higher on the standard network-centrality measures were also included in "powerful people" lists in the popular business press. Such lists include "Powerful Women in Business" in *Fortune* magazine, "Powerful People in Networking" in *Networking World* magazine, and "100 Most Influential People in Finance" by *Treasury and Risk Management* magazine. Based on this finding, Huang et al. (2011) suggest that relative network-connection strength contributes to a director's influence.

decision-making process. Therefore, it is essential to separate the effects of board influence from those of the CEO. To address this, we divide our sample into banks with high (low) board influence and compare them to those with low (high) CEO influence. Following Fogel et al. (2021), we estimate board power and influence using independent directors' network centrality and proxied CEO power using CEO duality and external connections. For each subsample, we re-estimate the baseline regression model. Our findings indicate a negative association between independent directors' connectedness and *Zscore* for banks with high board-power and low CEO-power. However, the coefficient is not significant for the subsample with low board-power and high CEO-power. Furthermore, the difference in coefficients between these two subgroups is statistically significant. Thus, consistent with the influence hypothesis, our results suggest that well-connected independent directors leverage their influence to serve shareholders' interests by encouraging managers to engage in more risk-taking activities.

Following the extant literature, we test the network-information-advantage theory to rule out alternative explanations (Hillman et al., 1999; Larcker et al., 2013; Akbas et al., 2016; Bjørnskov and Sønderskov, 2013; Cao et al., 2015; Ke et al., 2019; Omer et al., 2020; Chang and Wu, 2021; Fracassi, 2017). We employ several proxies to gauge the bank-information environment, including bid-ask spread, the Amihud illiquidity measure (Amihud, 2002; Amihud et al., 2015), and forecasting accuracy. We partition the sample into high and low information asymmetry groups and re-estimate the baseline regression for each. In both sub-samples, independent directors' connectedness is negatively associated with *Zscore*. However, there is no statistically significant difference between the coefficients of the two sub-samples. These results suggest that independent directors' connectedness encourages risk-taking regardless of the information environment. In other words, our tests find no support for the information-advantage hypothesis.

We further investigate the impact of board influence on banks' lending activities. Banks with well-connected independent directors tend to maintain higher loan-loss reserves and allocate more loan provisions against their current year's income. Additionally, these banks often deplete their Tier 1 capital to engage in lending activities. Consequently, well-connected banks exhibit higher delinquency ratios, indicated by a larger non-performing loan ratio. Our findings suggest that, in an attempt to maximize shareholder interests, powerful and well-connected independent directors encourage managers to pursue riskier lending policies, thereby increasing systemic risks in the banking system.

We also conduct several cross-sectional analyses and discover significant heterogeneity in the effects of directors' connectedness on risk-taking. For instance, managers of complex banks with well-connected independent directors are more likely to engage in higher levels of risk-taking. Similarly, banks with a higher book-value of equity relative to total assets tend to assume more risks when represented by a larger proportion of well-connected independent directors. Lastly, banks with greater income diversity and below-average cost efficiency are inclined to take more risks when their independent directors have strong connections.

This study makes several important contributions to the bank-governance literature. It is the first to explore the network connections of independent directors and their impact on bank risk-taking. Previous studies on the connectedness of independent directors have focused solely on non-financial institutions (e.g., Fracassi and Tate, 2012; Cao et al., 2015; Fogel et al., 2021), while this study examines these effects specifically within banks. Fracassi and Tate (2012) suggest that network ties between the board and the CEO weaken the intensity of board monitoring in non-financial firms. Cao et al. (2015) investigate whether independent directors can access private information through their connections to firm executives. They find that independent directors gain access to private bad news from senior executives, leading to significantly higher returns for these firms, especially those with greater information asymmetry and more powerful executives. Fogel et al. (2021) examine the network centrality of independent directors and conclude that influential independent directors are better at detecting and countering CEO missteps, thereby increasing firm value in non-financial firms. We extend this conversation to banks by adding influence and information dimensions. Our findings document that a more powerful board can significantly affect a bank's stability by increasing its risk-taking activities.

We also make a significant contribution to the literature on social network theory. Previous studies (e.g., Hillman, 2005; Coles et al., 2012; Larcker et al., 2013; Cao et al., 2015) conclude that independent directors have better access to information through their network connections. These studies highlight how the informational advantages of these connections impact corporate outcomes. In contrast, our research contributes to the relatively sparse literature on how network connections can also represent influence and power, thus balancing the power of CEOs (Adler and Kwon, 2002; Intintoli et al., 2018; Fogel et al., 2021).

The remainder of the paper is organized as follows: Section 2 discusses bank governance and risk-taking reforms in the United States; Section 3 presents the theoretical framework; Section 4 reviews the related literature and develops the hypotheses; Section 5 describes the data collection and methodology; Section 6 presents the empirical results, endogeneity and robustness tests, channel analysis, and cross-sectional analysis; and Section 7 concludes the paper.

2. Governance, independent directors, and bank risk-taking reforms in the United States

The primary objective of the board of directors of a bank is to establish good governance by mitigating conflicts among shareholders, stakeholders, and managers to strike a balance between risk-taking and financial performance. Independent directors play a crucial role in aligning executives with shareholders' interests in the bank's day-to-day operations. They bring diverse expertise and skills to the boardroom, enabling them to critically assess strategic decisions and risk management practices. Through active engagement and diligent oversight, independent directors help ensure that the bank's operations balance the pursuit of profit with the preservation of long-term value and the mitigation of unsystematic risk.

Regulatory bodies in the United States have long been striving to enhance governance and risk management to ensure the smooth functioning of financial institutions and safeguard the interests of both shareholders and stakeholders. One of the most significant reforms in strengthening governance and disciplining risk-taking in financial and non-financial institutions is the Sarbanes-Oxley Act of 2002 (SOX). SOX is considered crucial for sustaining and enhancing governance and risk management structures in the United States, particularly since corporate executives are generally not inherently motivated to prioritize the establishment and protection of robust governance or risk-management practices (Dak-Adzaklo and Wong, 2024). SOX emphasizes the importance of a well-functioning internal control system and the presence of independent directors on the board of directors. The act fortifies corporate governance by instilling transparency and accountability, particularly by empowering independent directors to oversee management decisions and align shareholder interests with stakeholder concerns. SOX introduces a more rigorous definition of "independent directors," stipulating that directors who have been employed by the company within the past three years or who have close relationships with company employees are not considered "independent." Furthermore, SOX mandates that the majority of the board of directors in a listed company must be comprised of independent members. SOX also requires public companies to establish three key committees—auditing, compensation, and nominating—composed solely of independent directors. These stringent criteria are intended to ensure that the board maintains a sufficient level of independence from management, allowing independent directors to conduct more effective monitoring and controlling activities on executives and other potential conflicts of interest. This, in turn, enhances the integrity and objectivity of corporate governance practices.

Additionally, SOX mitigates risk-taking by increasing executives' liability and implementing mandatory assessments and disclosures of internal controls, thereby fostering a culture of prudent decision-making and risk management (Cohen et al., 2013). To achieve this, SOX places significant emphasis on audit-related governance and mandates the existence of internal controls in listed companies. It requires companies to ensure the financial literacy of their board members, who should include at least one financial expert. Executives are responsible for regularly disclosing information about these controls to stakeholders. Their duties also include verifying and confirming the integrity, coherence, and truthfulness of financial reports on a quarterly, semi-annual, and annual basis. Failure to comply can result in significant personal penalties for executives who inadequately and inaccurately report financial statements. Along with intensive corporate governance practices and internal auditing systems, these measures are expected to mitigate excessive risk-taking by executives. Cohen et al. (2013) argue that these requirements are likely to discourage executive risk-taking incentives, particularly in investments in risky projects within financial institutions.

A large body of empirical literature examines the effects of the SOX guidelines on corporate governance practices and corporate outcomes. Guo and Masulis (2015), in a quasi-natural experiment before and after the implementation of SOX, find that greater board-independence and complete nomination-committee independence result in better monitoring of CEO activities and more effective disciplining of CEOs for poor performance. Cohen et al. (2008) examine the effect of SOX on earnings management in corporations and find that, following the passage of SOX, real earnings management practices replaced accrual-based earnings management practices. Bargeron et al. (2010) compare U.S. and non-U.S. firms after SOX and suggest that SOX had a negative effect on the risk-taking behaviors of officers. This finding confirms the results documented by Coles et al. (2008), who show an adverse relationship between SOX and executives' risk-taking behaviors. While executives may be discouraged from engaging in risk-taking behaviors to avoid potential personal liability and penalties under legal acts and laws, independent directors who prioritize shareholders' interests and seek to sustain their reputation among shareholders may push banks to take on more risks, aligning with shareholders' goals.

3. Theoretical framework

This study employs a theoretical framework that integrates social-network theory and the shareholder-incentive hypothesis to empirically examine independent directors' network connections and risk-taking in banks. Social-network theory suggests that independent directors' connections can affect economic outcomes through their influence (Adler and Kwon, 2002) and information advantage (Bjørnskov and Sønderskov, 2013; Hillman et al., 1999).

The literature indicates that well-connected independent directors are resourceful and influential for several reasons. First, they often have extensive experience, skills, and expertise from serving in many banks and non-bank organizations (Hillman and Dalziel, 2003). These directors have gained, through their connections, specialized knowledge in areas such as mergers and acquisitions (M&As; Renneboog and Zhao, 2014), CSR disclosure (Fernández-Gago et al., 2018; Amin et al., 2020), and corporate innovation (Wu and Dong, 2020). In a market with a limited number of qualified independent directors, those with specialized skills and experience are highly sought after by both banks and non-bank organizations.

Second, connected independent directors are often reputable individuals (Masulis and Mobbs, 2014; Sila et al., 2017). They may have links to political parties or governments (Wang, 2015), enabling them to facilitate beneficial business relationships with clients, suppliers, lenders, and borrowers (Mol, 2001; Nicholson et al., 2004). Guedj and Barnea (2009) provide an anecdotal example of network-driven influential directors. Mr. Vernon E. Jordan, Jr., who was at one time referred to as the "Washington Power Broker," was able to leverage his connections to influence outcomes. He became a senior managing director at Lazard Freres in 1999 and had direct network connections to 111 other board directors. Fogel et al. (2021) use "network centrality" to measure independent directors' influence and conclude that influential independent directors serve shareholders' interests and, consequently, network centrality enhances shareholder value.

Although some argue that independent directors do not influence strategic directions, it is clear that these directors do play a crucial role in discussions, providing valuable insights and perspectives (Westphal and Fredrickson, 2001; Gutiérrez and Sáez, 2013; Hermalin and Weisbach, 1998). Beltratti and Stulz (2012) suggest that shareholder-friendly boards promote risky investments, while Ellul and Yerramilli (2013) find that a higher proportion of independent directors with financial industry experience leads to weaker risk-management practices. This implies that in such cases, these experienced independent directors might be associated with higher risk-taking. Pathan (2009) finds a negative relationship between board independence and risk-taking in banks before SOX. In contrast, Mollah et al. (2021) find that independent directors increase both idiosyncratic and default risks in financial institutions in the post-SOX period. Erkens et al. (2012) suggest that, parallel to the shareholder-incentive hypothesis, lower stock returns during the period of the financial crisis can be explained by independent directors' influencing executives prior to the crisis to take more risks, exploiting the risk exposure of shareholders and stakeholders in financial institutions.

The shareholder-incentive hypothesis, prevalent in the corporate governance literature on banks and financial institutions, posits that independent directors on the board play a crucial role in shaping risk-taking behaviors. Shareholders often favor riskier strategic and investment decisions, with higher risk-preferences amplified by implicit and explicit government guarantees, such as deposit insurance and liquidity assistance. The asymmetry between shareholders and stakeholders in terms of their respective risk exposure is a core issue, with shareholders gaining from upside potential without fully bearing the downside risk, which is absorbed by stakeholders including depositors and taxpayers (Mollah et al., 2021). Independent directors are well-positioned to advocate for shareholder-oriented strategies, including establishing incentive schemes for bank executives and encouraging risk-taking, with the ultimate aim of maximizing shareholder returns (Iqbal and Vähämaa, 2019). This underscores the significance of independent directors in navigating the complex dynamics of risk and return within financial institutions. Their actions may favor activities, strategies, and decisions that pose a higher risk but could provide higher returns for shareholders while spreading risk between shareholders and stakeholders.

Network-information-advantage theory posits that well-connected boards can better align the interests of managers and shareholders by facilitating the transmission of knowledge, information, and ideas, thus enabling the prediction of trends, opportunities, and threats (Hillman, 2005; Larcker et al., 2013; Mizruchi, 1996; Moore, 2001). These connections also reduce information asymmetry among stakeholders, including competitors, customers, and suppliers (Schoorman et al., 1981; Coles et al., 2012). Consequently, directors with extensive networks benefit from superior information-access. Access to such soft information can be critical in the directors' risk-assessment process and thereby influence the board's attitude toward risk-taking. Fan et al. (2021) find that board-CEO social networks positively impact firm risk. CEOs socially connected to their independent directors are more inclined to pursue riskier investment, operating, and financing strategies due to the superior information-access facilitated by these networks. We hypothesize, consistent with network-information-advantage theory, a positive association between independent directors' connectedness and bank risk-taking. Given that both hypotheses predict a positive link between directors' connections and risk-taking, we test these channels separately in the empirical section.

Integrating social-network theory and the shareholder-incentive hypothesis clearly demonstrates that independent directors significantly contribute to risk-taking in financial institutions. Their extensive networks and expertise enable informed, strategic decisions that can enhance shareholder value. In addition, their advocacy for shareholder-oriented risk-taking strategies aligns with the inherent risk preferences of shareholders. Well-connected independent directors are expected to leverage their connections and networks to access valuable information and influence strategic decisions, such as risk-taking and financial outcomes, primarily to enhance shareholders' value. Moreover, independent directors aim to protect their image and reputation among shareholders by demonstrating their ability to deliver better financial outcomes. This reputational concern motivates them to utilize their connections effectively, ensuring that they bring not only expertise and valuable information but also influential relationships that can sway the board of directors toward shareholder-oriented decisions. This dual role is crucial, as it ensures that the directors are strategic in their risk-taking and mindful that maintaining the trust and confidence of shareholders can open doors to new opportunities and partnerships.

4. Related literature and hypotheses development

As fiduciary institutes, banks have a mandate to protect depositors' money and deliver returns to shareholders. Bank shareholders have incentives to take risks due to the moral-hazard problem, limited liability, and convex pay-off systems (Galai and Masulis, 1976; Jensen and Meckling, 1976; John et al., 1991). In general, bank shareholders have call options on a firm's value, with exercise prices equal to the total amount of debt outstanding. Galai and Masulis (1976) show that bank shareholders can exploit this underlying call option by increasing the asset risk if the interest rate is not accurately priced to reflect the risk. Thus, bank shareholders have strong incentives to make risky investments that maximize their own potential benefits at the cost of deposit insurance and/or bailout support. As a result, banks are intensely regulated to prevent negative externalities from systematic risks and to protect dispersed and unsophisticated bank depositors (Flannery, 1998; Pathan, 2009).

Stulz (2016) suggests that each bank has an optimal risk-level dependent on its investment opportunities and the nature of its business. In a well-governed bank, the board selects an appropriate risk level within regulatory constraints to maximize shareholders' wealth. However, shareholders may not consider the negative externalities of a bank's risk-taking. Consequently, the optimal risk-level for shareholders might not align with the optimal level for society. This means that a well-governed bank could enhance its value while becoming riskier. Within regulatory limits, a value-maximizing bank might still be undertaking what society considers excessive risk, overlooking societal impacts beyond those reflected in its value. Consistent with this, the existing literature does not show that better governance practices—such as those mandated by SOX—reduce risk-taking. For instance, Beltratti and Stulz (2012) and Erkens et al. (2012) find that banks with shareholder-friendly boards performed worse during the 2007–2008 financial crisis. Additionally, Minton, Taillard, and Williamson (2014) find no evidence that bank boards with financial expert directors performed any better than others. The implication is that better-governed banks took risks that would have been rewarding for shareholders had there not been the crisis, which was viewed as a very low-probability event ex-ante. However, the potential for personal penalties can deter executives from engaging in risk-taking behaviors that benefit shareholders. At this point, independent directors become crucial, as they can motivate and incentivize executives to undertake strategic risks.

A bank's board of directors is the apex body of internal governance (Fama and Jensen, 1983). It holds ultimate responsibility for overseeing management, including risk governance. The board establishes a bank's risk-taking culture by monitoring the impact of firm policies on bank risk, assessing whether current and planned risk exposures align with shareholder value, and setting executive compensation to promote optimal risk-taking (Srivastav and Hagendorff, 2016). However, the existing literature on a board's impact on risk-taking provides only ambiguous evidence. Several studies have failed to find a significant relationship between board independence and bank risk-taking (e.g., Mace, 1971; Hermalin and Weisbach, 1998; Zajac and Westphal, 1996; Shivdasani and Yermack, 1999; Fracassi and Tate, 2012; Francis et al., 2012). Conversely, other studies report a negative relationship (e.g., Pathan and Faff, 2013; Minton et al., 2014; Erkens et al., 2012; Mollah and Zaman, 2015; Pathan, 2009). In contrast, Pathan (2009) reports a positive association between board independence and bank risk-taking. Additionally, De Andres and Vallelado (2008) support an inverse U-shaped relationship, while Ramdani and van Witteloostuijn (2010) show that the effect of board independence on risk-taking varies across conditional quantiles. Since the advisory and monitoring functions of the board are not directly observable, these studies use board independence (i.e., percentage of independent directors) as a governance measure. A focus on quantity (measuring the percentage of independent directors) rather than quality (e.g., assessing the directors' attributes) may have contributed to the mixed evidence found in these studies.

Recent research has increasingly focused on the effects of various board attributes. Nguyen and Nielson (2010) assert that independent directors are valuable to shareholders not only for their objective decision-making but also for their abilities, expertise, and skills. Similarly, Mehran et al. (2012) argue that the effectiveness of a board of directors is influenced more by the quality of its members than by their quantity. In a recent study, Mollah et al. (2021) demonstrate that heterogeneity in independence directors' attributes mitigates risk-taking in banks, even though more-independent directors on a board tend to serve shareholder incentives via higher risk-taking. Examining the relationship between board demographics and bank risk-taking, Berger et al. (2014) discover that executive teams with younger members and more women tend to have higher bank-risk. Our study contributes to this literature by investigating the impact of independent directors' connections on bank risk-taking. Since the board of directors plays a vital role in monitoring and controlling bank risks and setting the risk culture, the directors' heterogeneous socioeconomic characteristics can impact the board's risk-assessment approach. This study focuses on the network characteristics of independent directors, a crucial aspect of the board's socioeconomic profile, to provide further insights into banks' risk-taking behaviors.

Intintoli et al. (2018) demonstrate that the connectedness of independent directors serves shareholders' interests by improving reporting quality, driven by the directors' need to protect their career prospects. They also find that shareholders and the market recognize the value of well-connected directors, reacting more negatively to the death of a well-connected director than to that of a less-connected one. Cai and Sevilir (2012) suggest that connected directors can facilitate M&A, leading to higher announcement returns for acquirers, lower takeover premiums, and greater value creation. However, Kuang and Lee (2017) uncover the "dark side" of independent directors' connections, demonstrating that external social connectedness is associated with reduced likelihood of fraud detection and more lenient consequences for fraud commission. Furthermore, Faccio et al. (2006) find that politically connected firms are significantly more likely to be bailed out during economic distress, highlighting the influence of connections on financial outcomes. Consequently, well-connected independent directors may perceive their connections as a safety net that mitigates the repercussions of risk-taking attributes. This perception may lead them to advocate for risk-taking behaviors, aligning with shareholders' interests and bolstering their image and reputation among shareholders. Should adverse outcomes arise, their connections may then serve as a resource to navigate the fallout.

Based on the above discussion, we hypothesize the following:

H1. *There is a positive association between the connectedness of independent directors and bank risk-taking behaviors. Specifically, banks with independent directors who possess extensive professional networks are more likely to engage in risk-taking activities*.

This hypothesis is based on the premise that well-connected independent directors use their network advantages to facilitate riskier strategic decisions that align with shareholder interests, given their access to superior information and influence.

5. Research design: data, variables, and summary statistics

5.1. Sample construction

For our empirical analysis, we construct a sample of 424 U.S. banks, drawing data from multiple databases spanning the period from 2000 to 2020. We begin with a primary sample of 726 listed U.S. banks, including 654 bank holding companies and 72 commercial banks, utilizing the BankFocus database, which provides comprehensive financial information on banks worldwide. We then source board-related information from the BoardEx database, successfully matching data for 431 of the listed banks. Seven of those banks are then excluded due to the unavailability of market data in the EIKON database. Consequently, our final sample consists of 424 banks, yielding a total of 3880 bank-year observations.

5.2. Constructing our dependent variable (Zscore) as the risk measure

Following previous studies, we construct our dependent variable, distance-to-default, as "*Zscore*," a proxy for bank risk-taking (Bertay et al., 2013; Boyd and Runkle, 1993; Hakenes et al., 2015; Laeven and Levine, 2009; Schaeck et al., 2012; Vallascas et al., 2017). The basic principle of the *Zscore* measure is to relate a bank's capital level to the variability in its returns, thereby identifying how much return variability can be absorbed by capital before the bank becomes insolvent. By definition, a lower Zscore indicates greater risk-exposure. This paper examines whether well-connected directors endorse policies that increase a bank's risk exposure; therefore, Zscore is a relevant measure for our study. Zscore accounts for both capital levels and return variation, making it a comprehensive measure of bank risk. It is widely used as a proxy for bank risk in empirical analyses. Previous literature has utilized Zscore to investigate various dimensions of financial stability. This includes examining the effects of capital regulations, deposit insurance, and other regulatory and bank policies on bank risk (e.g., Beltratti and Stulz, 2012; Houston et al., 2010; Laeven and Levine, 2009). Since the construction of Zscore relies on accounting data, we complement this accounting-based measure with a market-based measure to verify whether the results hold for an alternative measure of bank risk-taking. We construct *Total_risk* as the annualized standard deviation of daily stock returns for the banks in our sample.

Zscore estimates the probability of insolvency by measuring the standard deviations of a bank's distance to capital exhaustion, which occurs when a bank's equity is no longer sufficient to cover its losses. *Zscore* is calculated as a log of the sum of the bank's return on assets and the ratio of the equity to assets, divided by the standard deviation of return on assets (Roy, 1952), computed for a 1-year rolling period:

$$Zscore = \ln\left(\frac{ROA + \frac{E}{A}}{\sigma(ROA)} + 1\right) \tag{1}$$

where *ROA* is the return on assets, *E* stands for equity, *A* is assets, and *E/A* thus denotes the equity-to-asset ratio. The denominator is the standard deviation of return on assets. Following prior literature (e.g., Laeven and Levine, 2009; Vallascas et al., 2017), we use the logarithm of *Zscore* to minimize the effect of high skewness.

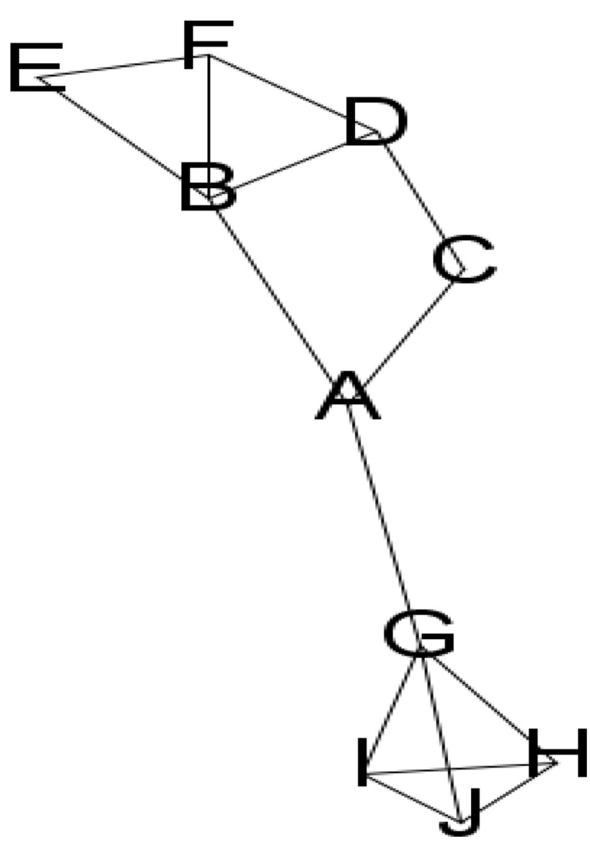

Fig. 1. Illustrative example of director network connections and centrality measures.

5.3. Board connectedness measures

We measure a bank's level of connectedness by examining its connections with other banks and non-bank corporations. It is important to note that, although we are focusing on the banking sector, network construction also involves organizations of other non-bank corporations. If we consider only banks and overlook connections to other firms, the resulting networks will be incomplete and biased. In the network construction, we consider two organizations to be connected if one or more independent directors are sitting on both boards in a given year: in other words, there is a connection between them. In the terminology of network analysis, each organization is a "vertex." The sharing of directors between organizations creates "connections" or "links."

For each year's director network, we use a variety of centrality measures to evaluate a bank's level of connectedness. We use the illustrative example below (Fig. 1 and Appendix Table A1) to explain the methodology of centrality measures. When the director of Bank A also sits on the board of B, Bank A and B are considered to be "connected." Likewise, Bank A is connected with B, C, and G. Bank A has three connections in total, thus its degree-centrality measure is three.[5] The higher the degree score of a bank, the more direct connections it has to other banks and firms. Such connections allow the focal bank to access information from connected firms via common directors. However, the information collected from connected firms can be trivial or redundant, especially when connected firms are small, local, and/or similar to the focal bank. Therefore, we introduce more sophisticated centrality measures to capture the dynamics in director networks based on the concept of the geodesic path (i.e., the shortest path between two firms in

[5] We further normalize all centrality measures by network size or theoretical maximum centrality score.

the network). For example, in Fig. 1 (Appendix Table A1), A and B are connected and B and D are connected. The geodesic path between A and D would be A–B–D, and the geodesic distance would be two (A–B and B–D). Note that the geodesic path may not be unique: there may be multiple geodesic paths with the same shortest distance (e.g., both A–B–D and A–C–D have the shortest geodesic distance of two). We calculate the geodesic distance (dG) between the focal vertex (v) and all other reachable banks and firms (t) in a given year's network. The inverse of the sum of all geodesic distances is *Closeness* centrality:

$$C_c(v) = \frac{1}{\sum d_G(v,t)} \tag{2}$$

Banks with higher closeness scores have shorter total geodesic distances. On average, they are closer to other organizations. Unlike the degree-centrality measure, closeness includes not only the number of connections to adjacent organizations but also the average distance to other organizations. In Fig. 1 (Appendix Table A1), B and G have the highest degree scores (four), but they are less connected than A, according to the closeness centrality measure. A is closer to other organizations and more central in the network. According to social-network theory (Freeman, 1978; Borgatti, 2005), vertices with such positioning advantages often have superior access to information. Therefore, closeness centrality is used in the finance literature to proxy a firm's information-collection ability (Renneboog and Zhao, 2014; Omer et al., 2014).

The next centrality measure, *Betweenness*, is also related to the geodesic path. Burt (1995) argues that two vertices that are distant from each other are more likely to have complementary—rather than redundant—sources of information. The gap between two distant vertices or two distant groups is a "structural hole." The vertices that act as a bridge between otherwise unconnected vertices or groups have superior access to multiple sources of information. Furthermore, they control the flow of information. The betweenness centrality measure of a vertex (v) reflects how likely it is to act as a bridge. This is the sum of the betweenness ratios, defined as the number of geodesic paths from vertex s to vertex t, passing through vertex v, divided by the total number of geodesic paths from s to t:

$$C_B(v) = \sum_{\substack{\&s \neq v \neq t \in V \\ \&s \neq t}} \frac{\sigma_{st}(v)}{\sigma_{st}} \tag{3}$$

A higher betweenness centrality measure indicates that the bank's board is more likely to act as a bridge to facilitate the continuous flow of information in the entire network. An example of this is Bank A in Fig. 1 (Appendix Table A1). Similarly, Organization G also plays a significant role in connecting the top and bottom groups in the network. In contrast, remote organizations E, H, I, and J receive low betweenness scores due to their absence on any geodesic paths. In earlier studies, researchers found that firms and banks with high betweenness centrality scores have superior information advantages (Wincent et al., 2010).

The final centrality measure, *Eigenvector*, is a proxy for the importance of each connected board and shows the number of boards connected. The eigenvector centrality of the focal firm v ($C_E[v]$) is defined as the sum of the eigenvector centrality scores ($C_E[j]$) of all adjacent boards (defined by the adjacent matrix $[A_{v,j}]$):

$$C_E(v) = \frac{1}{\lambda}\sum_{j=1}^{N} A_{v,j} C_E(j) \tag{4}$$

The calculation of eigenvector centrality is an iterative process in which the eigenvector score of each firm is carried over to the next iteration as the input. The factor λ allows the eigenvector scores to converge. The rationale for this generation of eigenvector centrality is that a vertex is important if it is connected to other important vertices in the network. Therefore, eigenvector centrality can be used to proxy for the influence and power of firms in the director network (Bonacich, 2007; Benson et al., 2018).

Finally, although the above centrality measures are designed to capture different aspects of network advantage, in practice, one advantage can quickly become the source of another strength. For example, Freeman (1978) and Burt (1992) note that positional advantage (proxied by a high betweenness score) allows a firm to decide whether to withhold or disseminate information. This then grants significant bargaining power over partner choices. Consequently, such a firm accumulates influence and power, which further enhances its eigenvector centrality. Unsurprisingly, centrality measures may be positively correlated (Iacobucci et al., 2017). Therefore, we conduct a PCA for the above four centrality measures to extract the most influential component as our aggregate measure of network strength.

5.4. Control variables

Following the literature on the risk attributes of banks (Beck et al., 2013; Houston et al., 2010; Stiroh, 2004; Vallascas et al., 2017), we include several firm-, board-, and CEO-level control variables in our empirical analysis. In line with the extant literature (e.g., Srivastav et al., 2017; Mollah et al., 2021), our board-level control variables include *Board independence*, calculated as the proportion of independent directors on a firm's board of directors, and *Board size,* calculated as the natural log of the total number of directors on the board. The literature (e.g., Jensen, 1993; Yermack, 1996; Lipton and Lorsch, 1992) suggests that smaller boards might be more effective than larger boards in monitoring management. Larger boards are easier for managers to control due to the coordination problems they face, as well as the limited time availability for each board member. Following prior literature (e.g., Erkens et al., 2012; Beltratti and Stulz, 2012), we include a proportion of independent directors because it is argued that independent boards improve the monitoring of managers and thus the effectiveness of the boards (Fama and Jensen, 1983; Bhagat and Black, 2002).

In addition, we create an index to measure *CEO power* that consists of two elements: *duality* and *internally recruited CEO* (Vallascas et al., 2017; Adams et al., 2005; Hermalin and Weisbach, 1998; May, 1995). Daily and Dalton (1994) provide empirical evidence that bankruptcy is more likely in companies where there is CEO duality. Fama and Jensen (1983) and Jensen (1993) explain that CEO duality allows CEOs to control the information flows to directors and thus limit the monitoring efficiency of the board of directors. An internally recruited CEO, it is argued, increases CEO power because a longer tenure increases the CEO's influence over the decision-making process (Adams et al., 2005; Pathan, 2009). Accordingly, if a CEO has a dual role as the chairperson of the board of directors and has been internally recruited, our index measure of CEO power takes a value of 1 for each element. The index ranges from 0 to 2, with a larger value indicating greater CEO power.

Finally, we control for various firm-specific factors in our tests. The literature suggests that the size of a company is a determinant of its risk attributes (Saunders et al., 1990; Boyd and Runkle, 1993). Therefore, we add the natural logarithm of the total assets (*ln(Asset)*) as a proxy of firm size. Mollah et al. (2021) find that profitability is negatively associated with the risk-taking attributes of banks. Thus, we include return on assets (*ROA*) in our model as a proxy for profitability. Additionally, we control the bank's funding choices, asset composition, and net interest margin. The bank's funding choices (*Deposit/TA*) are proxied by the ratio of customer deposits to total assets (Beltratti and Stulz, 2012). The bank's asset composition (*Loan/TA*) is defined as the ratio of loans to total assets, which is a liquidity ratio indicating the percentage of the bank's assets tied up in loans (Beltratti and Stulz, 2012). Finally, net interest margin (*NIM*) is a proxy comparing the investment returns and interest expenses of the bank (Uddin et al., 2020; Chaudron, 2018). The definitions of the variables are included in Appendix Table A2.

5.5. Summary statistics

Table 1 Panel A reports the descriptive statistics for the variables used in this study. The mean (median) value of our interest variable, *Zscore*, is 1.25 (1.31).

For the network variables, the mean (median) values are 1.92 (0.00), 3.16 (1.00), 0.005 (0.00), and 0.0004 (0.00) for degree (*Degree*), closeness (*Close)*, eigenvector (*Eigen*), and betweenness (*Between*), respectively. We conduct a PCA using the four network variables. The principal component factor, *PC1*, captures 63 % of the variations. *PC1* is the measure of overall connectedness and the main variable of interest in the study. The mean (median) values for *PC1* are 0.0041 (-0.75). The time series plots of the composite network measure, *PC1* (Fig. 2A), and the bank-risk measure, *ZScore* (Fig. 2B), reveal that the network measure (*PC1*) remained stable during the 2008 financial crisis. In contrast, *Zscore* experienced a significant downturn during this period, which is expected, as banks curtailed risk-taking initiatives amidst the economic turmoil.

The average board independence ratio in our sample is 73 %, and the average board size is 11.41. The average for CEO power (*CEO_power*) is 1.14, indicating that internal CEO and CEO duality are slightly more frequent than outsider CEO and separation of the roles. The mean (median) figures for bank-related variables are 15.12 (14.82), 0.92 (0.96), 0.76 (0.78), 0.66 (0.68), and 3.61 (3.57) for size (*ln(Asset)*), profitability (*ROA*), bank funding choices (*Deposit/TA*), bank asset composition (*Loan/TA*), and net interest margin (*NIM*), respectively. These results are in alignment with those recorded in the extant literature (Pathan et al., 2021; Adhikari and Agrawal, 2016; Gilani et al., 2021; Anginer et al., 2018). As explained before, *PC1* captures 63 % of the variations, and we consider *PC1* the main proxy for overall connectedness in the study (see Panel B). The first principal component is highly correlated with *Degree*, *Eigen,* and *Between* (see Panel C).

Table 2 presents the results of the Pearson's pairwise correlation analysis. In summary, *Zscore* and *PC1* have negative correlations, with a correlation coefficient of 4 %, which is significant at the 1 % level. The Pearson's pairwise correlation analysis reveals no strong correlation coefficient between regressors, indicating that multicollinearity is not a concern.

6. Empirical results

We begin our empirical analysis with a baseline estimation. The baseline regression results for independent directors' connectedness and bank risk-taking are detailed in Section 6.1. In Section 6.2, we address potential endogeneity issues in several ways. First, we conduct an instrumental variable (IV) regression using a two-stage least squares approach with an instrumental variable. Second, we employ a diff-in-diff analysis, leveraging an independent director's death as an exogenous shock in a quasi-natural experiment. Third, we impose the constant board assumption to check possible reverse causality. Fourth, we use the Oster (2019) estimation to address the possible omitted variable bias. Finally, we apply entropy balancing to address a possible sample-selection bias. In addition to these measures, we perform several robustness checks of the empirical results, which are reported in Section 6.3. We also conduct a channel analysis, and the findings are presented in Section 6.4. Furthermore, we examine the consequences of independent directors' connectedness on bank risk-taking, with results reported in Section 6.5. Lastly, Section 6.6 discusses the cross-sectional heterogeneity of the baseline results.

Table 1
Descriptive statistics.

Panel A:

Table Variable	Definitions	Observations	Mean	SD	p25	Median	p75	Max	Min
Dependent variable									
Zscore		3880	1.2523	0.6719	0.8649	1.3173	1.7150	2.5537	−6.0671
Independent variable									
PC1		3880	0.0041	1.3393	−0.7477	−0.7477	0.2074	6.7073	−0.7477
Network variables									
Degree		3880	1.9237	3.6130	0.0000	0.0000	2.0000	18.0000	0.0000
Close		3880	3.1614	2.5988	1.0000	1.0000	5.8487	8.4758	1.0000
Eigen		3880	0.0057	0.0204	0.0000	0.0000	0.0018	0.1433	0.0000
Between		3880	0.0004	0.0012	0.0000	0.0000	0.0001	0.0074	0.0000
Control Variables									
Board variables									
Board independence		3880	0.7332	0.1178	0.6667	0.7500	0.8182	0.9286	0.3333
ln(Board_size)		3880	2.3949	0.2852	2.1972	2.3979	2.5649	3.0910	1.6094
Board_size		3880	11.4152	3.2502	9.0000	11.0000	13.0000	22.0000	5.0000
CEO_power		3880	1.1369	0.7069	1.0000	1.0000	2.0000	2.0000	0.0000
Bank related variables									
ln(Asset)		3880	15.1215	1.6460	13.9246	14.8223	15.9325	20.8375	11.4707
Total Assets (th)		3880	44,200,000	236,000,000	1115,212	2736,730	8305,945	2620,000,000	95,866
ROA		3880	0.9243	0.7346	0.6823	0.9636	1.2275	8.9614	−3.3633
Deposit/TA		3880	0.7589	0.0995	0.7161	0.7804	0.8256	0.9002	0.0951
Loan/TA		3880	0.6572	0.1371	0.6008	0.6829	0.7464	0.8916	0.0007
NIM		3880	3.6144	0.8410	3.2000	3.5700	3.9900	9.1100	0.5400

Panel B: Principal Components (Unrotated = Principal)

	PC1	*PC2*	*PC3*	*PC4*
Eigenvalue	2.5249	0.9710	0.3947	0.1094
Proportion of Variance	0.6312	0.2428	0.0987	0.0274
Cumulative of Variance	0.6312	0.8740	0.9726	1.0000

Panel C: Principal Components (Eigenvectors)

VARIABLES	*PC1*	*PC2*	*PC3*	*PC4*
Degree	0.5803	0.1132	−0.4818	−0.6468
Eigen	0.5038	−0.3583	0.7650	−0.1806
Close	0.2588	0.9041	0.2936	0.1717
Between	0.5853	−0.2036	−0.3106	0.7208

This table reports summary statistics for our final sample, which comprises of 424 banks and 3880 bank-year over the period 2000–2020. Panel A shows summary statistics for the entire sample. Panel B and C show principal component analysis of the entire board network. Table A1 in the appendix defines the variables and reports the data sources.

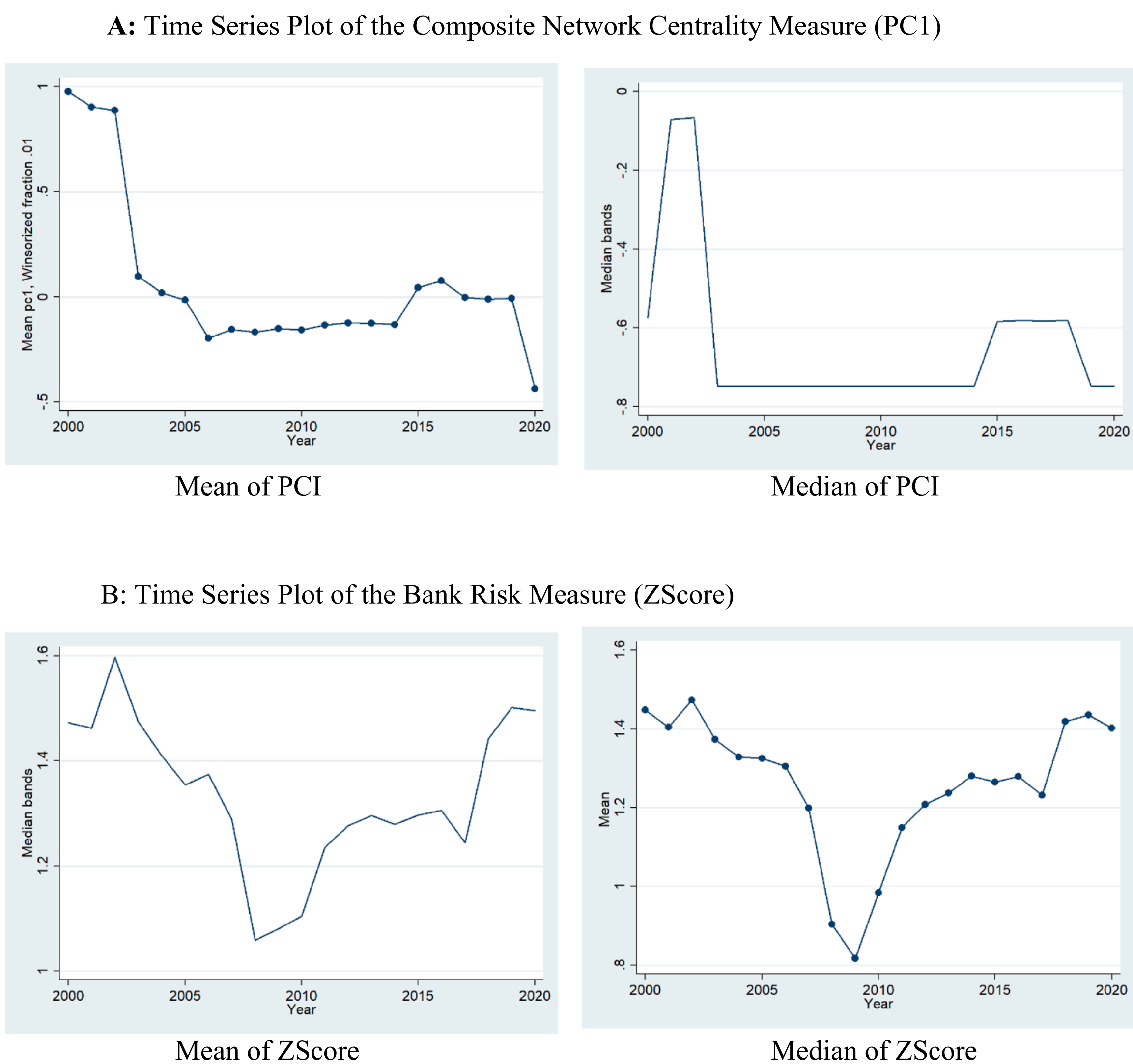

Fig. 2. A: Time series plot of the composite network centrality measure (PC1). B: Time series plot of the bank risk measure (ZScore).

6.1. Independent directors' connectedness and bank risk-taking

To explore the relationship between independent directors' connectedness and bank risk-taking, we use the following regression model:

$$\begin{aligned} Zscore_{i\ \ t} = \alpha + \ & \beta_1 PC1_{i\ \ t-1} + \ \beta_2 Board\ independence_{i\ \ t-1} \\ & + \beta_3 Board\_size_{i\ \ t-1} \ + \beta_4 \ \ CEO\_power_{i\ \ t-1} \\ & + \ \beta_5 \ \ \ln(Asset)_{i\ \ t-1} + \ \ \beta_6 ROA_{i\ \ t-1} \\ & + \ \ \beta_7 Deposit/TA_{i\ \ t-1} \ \ + \ \ \beta_8 \ \ Loan/TA_{i\ \ t-1} \\ & + \beta_9 NIM_{i\ \ t-1} + + \sum \gamma_j \ \ Year\_Dummy + \ \ \theta_{i,t} \end{aligned} \quad (5)$$

Here, *i* denotes banks and *t* denotes years. To partially mitigate the endogeneity concerns, all the explanatory variables are lagged by one year. The variables are described in Sections 5.2, 5.3, and 5.4. The main variable of interest in the baseline model is *PC1,* and the dependent variable is *Zscore*. Since, by definition, *Zscore* is a measure of distance-to-default, where a decrease (increase) in *Zscore* represents a higher (lower) risk exposure.

Table 3 presents the effects of different centrality measures on bank risk-taking. Columns 1–4 show the impact of individual centrality measures, while Column 5 reports the effect of an aggregate centrality measure (*PC1*). The degree-centrality measure indicates the number of independent directors connected to the boards of other firms, which is a proxy for a firm's direct connections to adjacent firms in the independent director network. The coefficient of *Degree* in Column 1 is negative and significant (coefficient −0.05, p<0.000), indicating that independent directors in banks with a larger number of external connections encourage increased risk-taking.

The second centrality measure is *Closeness* (Column 2, Table 3), which concerns the position of a firm in relation to all other reachable firms in the network. A higher closeness score implies a shorter average distance to other firms. The coefficient of *Closeness*, presented in Column 2, is negative and significant (coefficient 0.016, p<0.10). The third measure is the eigenvector, which concerns the influence among banks in the network. The negative and significant coefficient of *Eigen* in Column 3 implies that, all else being equal, banks with greater *Eigen* centrality are associated with lower *Zscores*. The fourth measure of centrality is *Betweenness*, which evaluates the importance of a bank as a bridge in the network. Banks with higher betweenness scores are more likely to be positioned on the information path between other firms. Our results in Column 4 show that, all else being equal, firms with higher values of *Betweenness* have lower *Zscores.* All individual centrality measures appear to have a similar effect on bank risk-taking.

Our composite network measure is *PC1*, which is the first principal component of all four centrality measures. PCAs are often employed to create a composite measure that serves as an underlying factor among correlated variables. Given that the four network centrality

Table 2
Correlation of baseline model.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Zscore	1.00													
2. Degree	−0.05***	1.00												
3. Close	−0.07***	0.97***	1.00											
4. Eigen	−0.03*	0.50***	0.43***	1.00										
5. Between	0.03	0.75***	0.64***	0.19***	1.00									
6. PC1	−0.04***	0.93***	0.90***	0.21***	0.71***	1.00								
7. ln(Board_size)	0.14***	0.33***	0.31***	0.24***	0.23***	0.28***	1.00							
8. Board ind.	0.05***	0.25***	0.28***	0.21***	0.09***	0.20***	0.20***	1.00						
9. CEO_power	0.08***	0.20***	0.20***	0.15***	0.13***	0.17***	0.09***	0.18***	1.00					
10. ln(Asset)	0.05***	0.70***	0.72***	0.37***	0.44***	0.62***	0.42***	0.30***	0.31***	1.00				
11. ROA	0.28***	0.11***	0.10***	0.05***	0.12***	0.08***	0.05***	0.01	0.06***	0.08***	1.00			
12. Deposit/TA	0.05***	−0.33***	−0.33***	−0.02	−0.28***	−0.34***	−0.05***	−0.04**	−0.14***	−0.43***	−0.17***	1.00		
13. Loan/TA	−0.07***	−0.24***	−0.27***	−0.01	−0.18***	−0.25***	−0.06***	−0.03*	−0.09***	−0.30***	−0.13***	0.43***	1.00	
14. NIM	0.05***	−0.14***	−0.16***	−0.02	−0.06***	−0.14***	−0.08***	−0.11***	−0.06***	−0.23***	0.11***	0.33***	0.40***	1.00

This table presents the correlations between variables. We winsorize continuous variables at the 1st and 99th percentiles. See appendix A1 for variable definitions.

measures—degree, closeness, betweenness, and eigenvector—are collinear, using the first component from the PCA of these measures as an aggregate indicator of overall connectedness aligns with previous research. Notable examples of studies that have utilized PCA to construct such composite measures include (a) Larcker et al. (2013), which investigates the relationship between board connectedness and firm performance; (b) Omer et al. (2014), which examines the impact of board connectedness on firm value, (c) El-Khatib et al. (2015), which explores the influence of CEO connectedness on merger performance, and (d) Omer et al. (2020), which studies the connection between audit-committee connectedness and financial-reporting quality. This aggregate measure of independent directors' connectedness (*PC1)* loads negatively (coefficient −0.098, p<0.000) with the bank's proclivity for risk-taking. Consistent with the view that independent directors serve shareholders' interests, our results suggest that well-connected independent directors encourage managers to take more risks to maximize shareholder returns. One implication of our findings is that the incentives for well-connected independent directors to take risks could increase the systemic risk in the banking system, resulting in more non-performing loans (see Table 12, Column 3). The coefficient is both statistically and economically significant: a one-unit increase in *PC1* leads to a 9.81 % decline in a bank's *Zscore*.

Of the board-level control variables, board size is positively related to *Zscore*, indicating that larger boards are associated with lower levels of risk-taking. Board independence also has a positive relationship with *Zscore*, although the coefficients are not statistically significant. These findings align with the existing literature (e.g., Vallascas et al., 2017). The CEO-power variable is positively associated with *Zscore*, suggesting that powerful CEOs tend to prioritize safety, which is also consistent with previous studies (e.g., Mollah et al., 2021). Regarding bank-level control variables, ROA is positively associated with *Zscore*, while the loan to total assets (*Loan/TA*) ratio is negatively associated. This implies that higher accounting profitability reduces risk-taking incentives, whereas increased bank lending heightens them. As indicated in later analyses (Table 12, Column 3), higher lending levels lead to an increase in non-performing loans.

6.2. *Endogeneity concerns*

The positive relationship between independent directors' connections and bank risk-taking may be influenced by endogeneity. Common sources of endogeneity concerns include omitted variable bias and reverse causality issues (Hermalin and Weisbach, 1988). Omitted unobservable variables may lead to inconsistent and biased estimations. Additionally, it is possible that banks with a greater risk appetite tend to recruit more connected directors, which would suggest reverse causality, contrary to our initial prediction. To address these concerns, as detailed in the following section, we conduct several tests, demonstrating that our results remain robust despite potential endogeneity issues.

6.2.1. *Instrumental variable approach*

Our initial approach involves estimating a two-stage least squares (2SLS) regression. A 2SLS analysis relies on an instrumental variable to address the endogeneity of the variable of interest, which in our case is *PC1* (the independent directors' connections). When selecting an instrument, it is crucial to ensure that both the relevance and exclusion conditions are met. The relevance condition requires that the instrument be positively correlated with the endogenous independent variable. The exclusion condition stipulates that the instrument must be uncorrelated with the dependent variable (*Zscore*), except through its effect on the treatment variable (*PC1*), after accounting for controls. An instrument that satisfies these conditions can effectively address omitted variable bias and reverse causality.

Drawing from existing literature on the impact of board connections on corporate policies (Faleye et al., 2014; Intintoli et al., 2018), we

Table 3
Independent directors' connectedness and banks' risk taking.

VARIABLES	(1) *Zscore*	(2) *Zscore*	(3) *Zscore*	(4) *Zscore*	(5) *Zscore*
Degree	−0.0479***				
	(−5.09)				
Close		−0.0156*			
		(−1.68)			
Eigen			−1.6845*		
			(−1.95)		
Between				−75.4757***	
				(−3.05)	
PC1					−0.0981***
					(−4.02)
ln(Board_size)	0.3053***	0.3227***	0.3100***	0.3107***	0.3165***
	(2.89)	(2.99)	(2.90)	(2.92)	(2.98)
Board independence	0.3143	0.1818	0.1756	0.2183	0.2733
	(1.29)	(0.73)	(0.71)	(0.90)	(1.12)
CEO_power	0.0773**	0.0872**	0.0835**	0.0802**	0.0806**
	(2.01)	(2.20)	(2.10)	(2.04)	(2.07)
ln(Asset)	0.0217	−0.0433**	−0.0443**	−0.0203	0.0005
	(0.90)	(−2.15)	(−2.10)	(−0.87)	(0.02)
ROA	0.2872***	0.2986***	0.2997***	0.2948***	0.2920***
	(6.83)	(6.66)	(6.73)	(6.78)	(6.78)
Deposit/TA	0.2276	0.3631	0.2890	0.2389	0.2496
	(0.83)	(1.30)	(1.02)	(0.86)	(0.91)
Loan/TA	−0.7600***	−0.6531***	−0.6720***	−0.7063***	−0.7133***
	(−3.62)	(−2.94)	(−3.06)	(−3.27)	(−3.35)
NIM	0.0080	0.0003	−0.0016	0.0011	0.0040
	(0.24)	(0.01)	(−0.05)	(0.03)	(0.12)
Constant	0.0611	0.8435**	1.0012**	0.6985*	0.3102
	(0.14)	(2.07)	(2.46)	(1.65)	(0.72)
Observations	3880	3880	3880	3880	3880
R-squared	0.2127	0.1877	0.1864	0.1944	0.2021
Year FE	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank

This table reports the results of independent directors' connectedness on bank's risk taking using an OLS regression. Our sample includes U.S. banks from 2000 to 2020. The dependent variable in all models is *Zscore*, which is estimated using BankFocus data. The main independent variable of interest is independent directors' connectedness *PC1*, which first principal component of component of the all the centrality measure. See Section 3.3 for a description of the individual and aggregate network centrality measures. Table A1 in the appendix defines all variables. All the independent variables are lagged by 1 year. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***$p < 0.01$; **$p < 0.05$; * $p < 0.1$.

select the average number of Fama–French 48 industries in which the independent directors have previously worked (*Sector_indep*) as our instrument. To construct this instrument for each firm year, we identify the number of Fama–French 48 industries an independent director has been involved with and then calculate the average industry-exposure of the independent directors on the board. This instrument satisfies both the relevance and exclusion conditions. The broad industry experience of an independent director is likely to increase the number of connections that they establish over the years (relevance condition). However, it is improbable that a director's diverse industry experience would directly influence a bank's risk-taking propensity (exclusion condition), other than through the impact of network connections.

Column 1 in Table 4 reports the first-stage regression estimates of the 2SLS regressions. In the first stage, we estimate the effect of our instrument (*Sector_indep*) on the network centrality measure (*PC1*). All the control variables included in the baseline regression are also included in this instrumental variable regression. We also include the year fixed-effects. As expected, we find that the instrument (*Sector_indep*) has a positive and significant effect on the directors' connections (*PC1*): specifically, a 1 % increase in the average independent director's prior sector experience (*Sector_indep*) results in an almost 2 % increase in their overall connectivity (*PC1*).

Following Stock and Yogo (2002), we report the Cragg-Donald Wald F-statistic as a test for weak instruments and of the validity of our relevance condition. The Cragg-Donald Wald F-statistic for the first-stage regression is 17.82, which exceeds the conventional threshold of 16.38 (10 % critical value), as reported by Stock and Yogo (2002). In another weak identification test, the Kleibergen-Paap Wald F-statistic is 95.80, far above the threshold level. Therefore, we reject the hypothesis that the instruments are weak and confirm that the instrument meets the relevance condition. For the under-identification value test, the Kleibergen-Paap rk LM statistic is 61.31, significant at the 1 % level. Accordingly, we confirm that there is no evidence of validity violations. These two tests show that the relevance and exclusion criteria are met.

The second-stage regression estimates are reported in Column 2 of Table 4. As in our baseline result, the effect of directors' connectedness (*PC1*) on bank risk-aversion (*Zscore*) is negative and statistically significant. Our finding shows that, even after accounting for endogeneity concerns using instrumental variables, independent directors' connectedness increases the banks' propensity for risk-taking.

6.2.2. *Difference-in-differences analysis using director's death*

The second approach to alleviating endogeneity concerns—following Nguyen and Nielsen (2010), Fracassi (2017), and Mollah et al. (2021)—is to use the death of an independent director as a quasi-natural experiment. A board's loss of its network connection due to the death of its independent director serves as an exogenous shock to the network and can thus be used as an identification mechanism for plausible causality.[6] Using the diff-in-diff approach and a propensity-matched sample, we shed light on the possible causal relationship between connectedness and risk-taking.

Following Nguyen and Nielsen (2010), Fracassi (2017), and Mollah

[6] Prior studies have also used director's death as exogenous shock to measure the impact on investment similarities (Fracassi, 2017); on CEO network diversity (Fang et al., 2018); on audit quality (Intintoli et al., 2018); on the cost of borrowing (Intintoli et al., 2021).

Table 4
Independent directors' connectedness and banks' risk taking: Instrumental variables approach.

VARIABLES	First Stage *PC1*	Second Stage *Zscore*
Sector_indep	1.9914***	
	(13.99)	
PC1		−0.2326***
		(−5.03)
ln(Board_size)	0.4763***	0.3249***
	(5.07)	(3.04)
Board independence	0.4050*	0.4354*
	(1.80)	(1.74)
CEO_power	−0.0204	0.0747*
	(−0.60)	(1.94)
ln(Asset)	0.1835***	0.0729**
	(4.08)	(2.35)
ROA	−0.0508*	0.2808***
	(−1.69)	(6.84)
Deposit/TA	−0.5906	0.1483
	(−1.40)	(0.52)
Loan/TA	−0.0038	−0.7757***
	(−0.02)	(−3.72)
NIM	0.0171	0.0123
	(0.33)	(0.34)
Constant	−2.7453***	−0.6883
	(−3.89)	(−1.34)
Observations	3880	3880
R-squared		0.1694
Year FE	Yes	Yes
Cluster	Bank	Bank
Underidentification Test	61.31	
Kleibergen-Paap rk LM statistic	(0.00)	
(p-value)		
Weak Identification Test	1782	
Cragg-Donald Wald F statistics	95.80	
Kleibergen-Paap Wald F statistic		

This table reports the results of two-stage least squares regressions using one instrument. Our sample includes U.S. banks from 2000 to 2020. Our first instrument is *Sector_indep* which is the average number of Fama-French (1997) industries in which independent directors worked in the past estimated for each bank-year. The dependent variable is *Zscore*, which is estimated from BankFocus data. Column 1 shows the first-stage regression and Column 2 shows the secondstage regression results. The main independent variable of interest is independent directors' connectedness *PC1*, which first principal component of component of the all the centrality measure. Table A1 in the appendix defines all variables. All the independent variables are lagged by 1 year. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. Tstatistics appear in parentheses. ***$p < 0.01$; **$p < 0.05$; * $p < 0.1$.

et al. (2021), we use BoardEx to collect information on the deaths of independent directors. We define a dummy variable (*Death_dum*) that takes 1 for a deceased independent-director in any year and 0 otherwise (Intintoli et al., 2018). In this way, banks that lost an independent director are assigned to the treatment group, while all others comprise the control group. Since there could be several control banks for each treatment bank, we use propensity score matching to identify a control that closely resembles the treatment bank. For propensity matching, we use *ln (asset)* and *Deposit/TA* as the primary matching criteria. To avoid the endogenous selection of variables, the control group and treatment group are matched using selection criteria measured in the year prior to the shock. Furthermore, we require non-missing values for matching and outcome variables. A probit model is used to estimate propensity scores that include all the explanatory variables used in the main baseline model to predict *Death_dum*. The propensity score is estimated using the nearest neighbor matching with a caliper of 0.05. The matched pairs are then used for the diff-in-diff regression.

To check the parallel-trend properties of our matched sample, we report the balancing properties of the propensity matching (Panel A of Table 5). The parallel-trend assumption ensures that the treatment and control groups are essentially the same prior to the exogenous shock; therefore, any change in the outcome variable is assumed to be a consequence of the death of an independent director and not an artifact due to converging or diverging trends (e.g., Roberts and Whited, 2013). The treatment banks in our sample are comprised of 186 death cases, from which our matching criteria yielded 186 control banks. The covariates in the balancing table for the treatment and control banks are not significantly different, except for ***ln (board size)*** and ***CEO_power***, which are significant at 10 %. Overall, the results indicate that the treated and control banks are comparable with respect to the matching variables prior to the treatment.

The diff-in-diff results for the matched sample are presented in Panel B of Table 5. In Column 1, we report the difference between the treated and control firms in terms of bank risk-taking incentives between 1-year post-shock and one-1 pre-shock (***1-year post, 1-year pre***) while controlling for firm-specific determinants of *Zscore* lagged by 1 year. The coefficient of *Death_dum* is positive and significant ($p<0.000$), which suggests that the treated banks saw a greater improvement than the control group in their *Zscore* in the short run (i.e., they tend to take fewer risks). Although well-connected independent directors generally induce risk-taking, a subsequent death then reduces the bank's propensity to take risks. Importantly, the overall effect of a bank's connectedness remains negative and significant ($p<0.000$), implying that—even after the death of an independent director—the risk-taking incentives of a well-connected bank do not disappear altogether. As shown in Column 2, we also examine the effect of the deaths on the boards by comparing all pre-death and post-death periods for the treatment and control groups. We also control for firm-specific determinants of *Zscore,* lagged by a year. The diff-in-diff estimate (*Death_dum*) is positive and significant at 1 %.[7] The overall effect of *PC1* remains negative and significant, consistent with the baseline result. Thus, following the death of an independent director, the pre-period *Zscore* improves in the post-period, as the treated banks tend to take fewer risks than the control group in the long run. An improvement in a bank's *Zscore* following an exogenous shock (i.e., the death of an independent director) suggests the direction of causality and underscores the importance of the director's connections as an important catalyst for bank risk-taking. We conclude that the results from our quasi-natural experiment alleviate the endogeneity concerns.

6.2.3. Additional testing for reverse causality

Our third approach investigates concerns related to reverse causality. Following Larcker et al. (2013) and Schabus (2022), we construct a sample of banks whose boards remained unchanged between two consecutive years (i.e., constant boards). Any change in the boards' overall connectedness can thus be attributed to changes in their independent directors' external connectivity or to changes in the boards of other companies to which the banks are connected. For this sample, the focal bank's network centrality becomes exogenous in nature. We re-estimate our baseline for banks with constant boards, and the results are reported in Column 1 of Table 6. The main effect of *PC1* remains negative and significant at 1 % when all variables are lagged by one period. It is important to note here that the sample size is reduced significantly by the strict sampling criteria.

In Columns 2 and 3, we include two additional model specifications. We regress the banks' *Zscores* for the measures of overall connectedness (*PC1*), lagged by three periods, while the other board- and firm-level controls in the model are lagged by one period. Faleye et al. (2014) show that lagging a main independent variable by more than a year will further eliminate any reverse causality concerns. In line with this

[7] Our main inference on the long-run effect of the diff-in-diff estimator remains unchanged under several alternative matching criteria. In addition, the balancing properties between the treatment and control samples under each of the alternative matching criteria are qualitatively similar. The unreported results are available upon request.

Table 5
Independent directors' connectedness and bank's risk taking: Difference-in-difference analysis.

Panel A: Balancing table for propensity score matching

Variable	N	Treatment group Mean (Standard errors)	N	Control group Mean (Standard errors)	*t*-test Treatment - Control
ln(Board_size)	186	2.450	186	2.421	0.029
		[0.020]		[0.019]	
Board independence	186	0.716	186	0.713	0.003
		[0.008]		[0.009]	
CEO_power	186	1.151	186	1.022	0.129*
		[0.049]		[0.054]	
ln(Asset)	186	15.072	186	14.947	0.125
		[0.118]		[0.119]	
ROA	186	1.162	186	0.997	0.165
		[0.080]		[0.068]	
Deposit/TA	186	0.740	186	0.735	0.005
		[0.009]		[0.010]	
Loan/TA	186	0.650	186	0.640	0.010
		[0.011]		[0.012]	
NIM	186	3.698	186	3.561	0.137
		[0.069]		[0.062]	

Panel B: Difference-in-difference on propensity-score-matched sample

	(1)	(2)
	Treatment-Control & Post-Pre	*Treatment-Control & All Post-All Pre*
VARIABLES	*Zscore*	*Zscore*
Death_dum	0.1620**	0.1568**
	(2.11)	(2.52)
PC1	−0.1437***	−0.0935***
	(−2.87)	(−3.71)
ln(Board_size)	0.1526	0.2869**
	(1.02)	(2.35)
Board independence	0.2854	0.1007
	(0.74)	(0.36)
CEO_power	0.1022*	0.0797*
	(1.82)	(1.67)
ln(Asset)	0.0340	−0.0001
	(0.88)	(−0.00)
ROA	0.2815*	0.2991***
	(1.89)	(3.21)
Deposit/TA	0.2124	0.2337
	(0.44)	(0.66)
Loan/TA	−0.4444	−0.8114***
	(−1.44)	(−3.39)
NIM	0.0692	0.0268
	(0.99)	(0.60)
Constant	−0.2065	0.4668
	(−0.33)	(0.94)
Observations	331	2557
R-squared	0.2444	0.2067
Year FE	Yes	Yes
Cluster	Bank	Bank

This table reports change in *Zscore* following the death of independent director as a quasi-natural experiment. Our sample includes U.S. banks from 2000 to 2020. Panel A shows the balancing properties of 191 treatment firms that experience death of independent director(s) as an exogenous shock. For matching purposes, the control group consists of firms with no shock but that have characteristics similar to the treatment firm a year before the treatment firms' shock. The propensity score matching (PSM) method matches the treatment and control groups. Panel B shows the regression results for a propensity-matched sample where the main dependent variable is *Zscore*. The main variable of interest is Death_dum, which equals 1 if an independent director dies in any firm-year and 0 otherwise. Table A1 in the appendix defines all variables. All the independent variables are lagged by 1 year. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***$p < 0.01$; **$p < 0.05$; * $p < 0.1$

argument, as employment-related connections are determined long before any bank risk-taking practices are established, if the distant lagged independent variables are significant, a reverse causality issue will become less intuitive (e.g., Faleye, 2007; Cheng, 2008). In Column 2, we report the regression results for the sample of banks with constant boards, indicating a negative and significant *PC1*. In Column 3, we present the findings of the same analysis for a full sample of banks, and the results are consistent. Overall, this suggests that our findings are unlikely to be attributable to reverse causality.

6.2.4. *Oster (2019) indicative test for omitted variable bias*

In our fourth robustness check, we follow Oster (2019) and Altonji et al. (2005) in checking whether our inferences are sensitive to omitted variable bias. The test for omitted variables relies on the stability of coefficients, whereby R-squares from regressions with and without controls are used to construct an identifiable set. If the identifiable set does not include zero, the null that a potential omitted variable is driving the results can be rejected.

The identified set is defined as $[\widetilde{\beta}, \quad \beta^{*'}]$, where $\beta^{*'}$ is derived using the following formula:

$$\beta^{*'} = \quad \widetilde{\beta} - \delta\left[\dot{\beta} - \widetilde{\beta}\right] \frac{R_{\max} - \widetilde{R}}{\widetilde{R} - \dot{R}} \tag{6}$$

where $\widetilde{\beta}$ and $\widetilde{R}$ are the estimated coefficient of main variable interest (*PC1*) and the R-square value from the baseline model with all controls

Table 6
Independent directors' connectedness and bank's risk taking: reverse causality.

Variables	*Zscore* Constant Board with one lag (1)	*Zscore* Constant Board with three lags (2)	*Zscore* Full Sample with three lags (3)
PC1	−0.1596*** (−3.62)		
PC1		−0.1618*** (−3.26)	−0.0953*** (−3.79)
Other controls	Yes	Yes	Yes
Observations	962	754	3295
R-squared	0.2089	0.2136	0.2211
Year FE	Yes	Yes	Yes
Cluster	Bank	Bank	Bank

This table reports additional robustness checking on reverse causality. Our sample includes U.S. banks from 2000 to 2020. Column 1 report baseline regression on a subsample restricted to include constant boards defined as boards with no change in composition over 2 consecutive years following Faleye et al. (2014). Column 2 re-produces the baseline regression results by lagging the *PC1* three periods for the constant board subsample. Finally, in Column 3, we re-estimated baseline model by lagging the *PC1* three periods for the entire sample. The dependent variable in all models is *Zscore*. Table A1 in the appendix defines all variables. All the independent variables are lagged by 1 year (unless otherwise mentioned). Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***$p < 0.01$; **$p < 0.05$; * $p < 0.1$.

Table 7
Robustness checking for omitted variable bias.

Oster Condition	**Variable of interest**	**Identified Set**	**Includes Zero?**
Assume δ=1; RMAX=min (1.25$\tilde{R}$,1)	$PC1_{t-1}$	[−0.1151, −0.0980]	No
Assume δ=1; RMAX=min (1.5$\tilde{R}$,1)	$PC1_{t-1}$	[−0.1321, −0.0980]	No
Assume δ=1; RMAX=min (2$\tilde{R}$,1)	$PC1_{t-1}$	[−0.1663, −0.0980]	No
Assume δ=1; RMAX=min (2.2$\tilde{R}$,1)	$PC1_{t-1}$	[−0.1799, −0.0980]	No
Assume δ=1; RMAX=1	$PC1_{t-1}$	[−0.3676, −0.0980]	No

This table presents the Oster (2019) bounds for our variable of interest as depicted in our baseline regressions in Table 3. Our dependent variable is *Zscore* and our variables of interest is the independent directors' connectedness *PC1*. We present results based on the Mian and Sufi (2014) assumptions of Oster bounds using δ=1 and RMAX=min(2.2$\tilde{R}$,1) as well as some other multiplying factors and the extreme cash of RMAX=1.

(see Table 7), and $\dot{\beta}$ and $\dot{R}$ are their counterparts from the regression, with no control variables or fixed effects. We rely on the Oster (2019) argument that the appropriate upper bound for δ is 1, which means that the omitted variables need to be as influential as those included to make the value of the coefficient equal to zero.

For the upper Oster bound in the identified sets, we follow the more conservative value from Mian and Sufi (2014) of $R_{\max} = \min(2.2\widetilde{R}, 1)$ (see Row 4, Table 7) and the extreme one from Oster of $R_{MAX} = 1$ (see Row 5, Table 7). According to Oster (2019), the majority of the bounds would not survive under the conditions $R_{MAX} = 1$ (and $\delta = 1$). We use several combinations of upper and lower bounds, as reported in Table 7, and ultimately find that zero is not included in the identified sets.[8] Therefore, following Oster's omitted variable test, we reject the null hypothesis that our results are sensitive to omitted variable bias.

6.2.5. Entropy-balancing approach

The fifth approach addresses concerns related to sample-selection biases. In any causal inference, it is important that the treatment and control groups are assigned randomly. In most observational studies, this condition is less likely to hold, which can lead to biased causal inference, as treatment exposure may correlate with some of the covariates related to the outcome, resulting in a covariate imbalance. To adjust for covariate imbalance, entropy balancing (EB) is popularly used to reweight and incorporate covariate balance into the weight function (see Hainmueller [2012] for details). One advantage of the EB approach is that it assigns continuous weights to the control sample while keeping the weights as equal as possible, thereby ensuring that higher order moments of covariate distributions are similar across treated and control samples, resulting in near-perfect covariate balance (see Canil et al., 2019).

We split our sample into two subsamples on the basis of each bank's median independent-director connectedness, where *High_connected_board* (*Low_connected_board*) is defined by the bank-year observations where a bank's aggregate connections are greater (lower) in number than the median of the other banks in the sample. We then assign *High_connected_board* (*Low_connected_board*) to the treatment (control) groups. To achieve covariate balancing under the EB method, we ensure convergence by using the first moments of the covariates (i.e., the mean for the treatment and control group covariates are the same). In Panel A (Panel B) of Table 8, we present the moment conditions of the before (after) covariate balance, using the EB method. In Panel B, a simple comparison of means shows that the treatment and control groups are identical. Once the covariate balancing is ensured, we run the baseline regression in the matched sample, and the results are reported in Panel C of Table 8. We find a negative significant relationship between independent directors' connectedness and risk-taking in banks. The estimated regression coefficient is comparable to the baseline model. Therefore, our main inference is not likely to be driven by any sample-selection bias.

6.3. Additional robustness tests

We conduct additional robustness checks to ensure that the results are not sensitive to our definitions of risk-taking or independent directors' connections. The results are discussed in this section.

Our dependent variable is defined as *Zscore*, which is an accounting-based measure. To check whether the results hold for an alternative measure of bank risk-taking, we construct *Total_risk*, defined as the annualized standard deviation of daily stock returns for the banks in our sample. Thus, the alternative measure is a market-based proxy for bank risk-taking. If well-connected boards encourage banks to take more risks, we expect a positive significant coefficient for independent directors' connectedness (*PC1*). The results presented in Panel A of Table 9 show a positive significant coefficient for four of five network centrality measures (Columns 1–5) used in the baseline model (see Table 3). The coefficient for *Eigen* does not load significantly for the alternative measure, *Total_risk*. Nonetheless, the main variable of interest (*PC1*) remains highly significant in the alternative market-based proxy for risk-taking. Therefore, we conclude that the relationship between bank risk-taking and independent directors' connectedness is not sensitive to the manner in which risk proxies are defined.

However, our results could be sensitive to the manner in which the aggregate network centrality measures are defined. To address this concern, we follow Larcker et al. (2013) and construct an alternative proxy for independent directors' connectedness. For this measure, we sort each of the four centrality measures (*Degree, Close, Eigen,* and *Between*) into five quintiles. We estimate the *N-score*, which is the average of each quintile ranking of all centrality measures for each bank-year. We then sort *N-score* into five quintiles, making *Quintile (N-score)* our

[8] For completeness, we also present results with $\widetilde{R}$ multipliers of 1.25 (Row 1), 1.5 (Row 2), and 2 (Row 3), as Oster (2019) uses those multipliers in her Table 4 (see p. 201).

Table 8
Entropy balancing for sample selection bias.

Panel A: Before Weighting

	Treatment			Control		
VARIABLES	Mean	Variance	Skewness	Mean	Variance	Skewness
ln(Board_size)	*2.473*	*0.067*	*−0.248*	*2.316*	*0.077*	*−0.071*
Board independence	*0.768*	*0.011*	*−0.918*	*0.712*	*0.013*	*−0.550*
CEO_power	*1.195*	*0.523*	*−0.313*	*1.039*	*0.493*	*−0.054*
ln(Asset)	*15.960*	*3.228*	*0.795*	*14.460*	*1.070*	*0.570*
ROA	*1.015*	*0.446*	*3.359*	*0.930*	*0.288*	*0.739*
Deposit/TA	*0.756*	*0.011*	*−2.129*	*0.769*	*0.008*	*−1.521*
Loan/TA	*0.652*	*0.023*	*−1.709*	*0.669*	*0.014*	*−0.975*
NIM	*3.547*	*0.883*	*1.126*	*3.636*	*0.488*	*0.981*

Panel B: After Weighting

	Treatment			Control		
VARIABLES	Mean	Variance	Skewness	Mean	Variance	Skewness
ln(Board_size)	2.473	0.067	−0.248	2.473	0.050	0.085
Board independence	0.768	0.011	−0.918	0.768	0.010	−0.434
CEO_power	1.195	0.523	−0.313	1.195	0.574	−0.340
ln(Asset)	15.960	3.228	0.794	15.960	1.148	−0.349
ROA	1.015	0.446	3.359	1.014	0.197	−1.198
Deposit/TA	0.756	0.011	−2.129	0.756	0.009	−1.450
Loan/TA	0.652	0.023	−1.709	0.652	0.013	−0.787
NIM	3.547	0.883	1.126	3.547	0.412	0.877

Panel C: Regression analysis using Entropy balanced sample

	(1)
VARIABLES	*Zscore*
PC1	−0.1037***
	(−4.70)
ln(Board_size)	0.3508***
	(3.25)
Board independence	0.0675
	(0.24)
CEO_power	0.1254***
	(2.78)
ln(Asset)	0.0116
	(0.51)
ROA	0.2920***
	(6.71)
Deposit/TA	0.4088
	(1.48)
Loan/TA	−0.9439***
	(−3.61)
NIM	0.0086
	(0.26)
Constant	0.1384
	(0.27)
Observations	3850
R-squared	0.2612
Year FE	Yes
Cluster	Bank

This table reports our results using the Entropy Balanced samples for causal effects proposed by Hainmueller (2012). Panel A (Panel B) reports means, variances and skewnesses for the covariates for the treatment and control groups before (after) balancing. We reach convergence as there is no mean difference between the treatment and control groups after the balancing. Panel C presents the estimates of OLS regressions based on the baseline models. Table A1 in the appendix defines all variables. All the independent variables are lagged by 1 year (unless otherwise mentioned). Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***$p < 0.01$; **$p < 0.05$; * $p < 0.1$.

alternative proxy for independent directors' overall connectedness. As reported in Panel B of Table 9, all alternative measures of network centrality are negative and significant: thus, as banks become more connected, their proclivity for risk also increases, resulting in lower *Zscores*. In summary, our main results remain robust and are thus unlikely to be sensitive to how network measures are constructed.

Furthermore, we check whether our results are sensitive to the financial crisis of 2008. To do so, we re-estimate the baseline model, excluding the years 2008 and 2009 from our sample, and our main results remain robust.

In summary, we conduct various robustness tests to rule out issues related to identification, reverse causality, omitted variable bias, measurement issues, and the sample study period. Based on the findings of these analyses, we conclude that our main findings are consistent and robust.

6.4. Channel analysis

Social-network theory suggests that independent directors' connections can influence economic outcomes in two ways: influence and information (Kim and Lu, 2018). Prior research provides support for the notion of influence (Adler and Kwon, 2002; Fogel et al., 2021; Kim et al., 2018; He, 2022) and the information advantages of a network (Hillman et al., 1999; Larcker et al., 2013; Akbas et al., 2016; Bjørnskov and Sønderskov, 2013; Cao et al., 2015; Ke et al., 2019; Omer et al., 2020; Chang and Wu, 2021; Fracassi, 2017). Fogel et al. (2021) conclude that powerful and well-connected independent directors can influence corporate outcomes (influence channel). Furthermore, Amin et al. (2020) show that the network connections of boards and independent directors facilitate the transformation of information because information advantage stands out as a predominant channel of network

Table 9
Additional robustness checking.

Panel A: Baseline regression with alternative proxies for risk taking

VARIABLES	*Total_risk* (1)	*Total_risk* (2)	*Total_risk* (3)	*Total_risk* (4)	*Total_risk* (5)
Degree	0.0004***				
	(3.68)				
Close		0.0001*			
		(1.79)			
Eigen			0.0061		
			(0.63)		
Between				0.6301***	
				(2.95)	
PC1					0.0008***
					(3.11)
ln(Board_size)	−0.0017**	−0.0019**	−0.0018**	−0.0018**	−0.0018**
	(−2.18)	(−2.30)	(−2.20)	(−2.21)	(−2.26)
Board independence	−0.0031	−0.0021	−0.0019	−0.0024	−0.0028
	(−1.33)	(−0.92)	(−0.84)	(−1.04)	(−1.22)
CEO_power	−0.0004	−0.0005*	−0.0005*	−0.0005*	−0.0005*
	(−1.62)	(−1.86)	(−1.77)	(−1.67)	(−1.69)
ln(Asset)	−0.0007**	−0.0002	−0.0002	−0.0004	−0.0005*
	(−2.10)	(−0.91)	(−0.66)	(−1.46)	(−1.76)
ROA	−0.0035***	−0.0036***	−0.0036***	−0.0035***	−0.0035***
	(−5.33)	(−5.25)	(−5.25)	(−5.29)	(−5.32)
Deposit/TA	0.0019	0.0008	0.0013	0.0019	0.0017
	(0.72)	(0.28)	(0.46)	(0.70)	(0.66)
Loan/TA	−0.0004	−0.0012	−0.0011	−0.0008	−0.0007
	(−0.26)	(−0.76)	(−0.67)	(−0.49)	(−0.48)
NIM	0.0009***	0.0009***	0.0009***	0.0009***	0.0009***
	(3.47)	(3.59)	(3.65)	(3.60)	(3.55)
Constant	0.0367***	0.0312***	0.0296***	0.0323***	0.0351***
	(5.11)	(5.00)	(4.95)	(5.00)	(4.96)
Observations	3877	3877	3877	3877	3877
R-squared	0.5982	0.5940	0.5933	0.5954	0.5967
Year FE	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank

Panel B: Baseline regression with alternative network measure

VARIABLES	*Zscore* (1)	*Zscore* (2)	*Zscore* (3)	*Zscore* (4)	*Zscore* (5)
Quartile (Degree)	−0.0681***				
	(−3.98)				
Quartile (Close)		−0.0281**			
		(−2.00)			
Quartile (Eigen)			−0.0528***		
			(−3.53)		
Quartile (Between)				−0.0588***	
				(−3.79)	
Quartile (N-score)					−0.0591***
					(−3.59)
ln(Board_size)	0.3312***	0.3317***	0.3243***	0.3234***	0.3330***
	(3.09)	(3.09)	(3.00)	(3.03)	(3.10)
Board independence	0.2646	0.2444	0.1908	0.2409	0.2485
	(1.05)	(0.97)	(0.77)	(0.96)	(0.99)
CEO_power	0.0846**	0.0846**	0.0876**	0.0806**	0.0851**
	(2.15)	(2.14)	(2.21)	(2.04)	(2.16)
ln(Asset)	−0.0136	−0.0233	−0.0399**	−0.0173	−0.0200
	(−0.66)	(−1.14)	(−1.98)	(−0.82)	(−0.98)
ROA	0.2954***	0.2975***	0.2979***	0.2959***	0.2967***
	(6.81)	(6.84)	(6.66)	(6.73)	(6.79)
Deposit/TA	0.3908	0.3882	0.3676	0.3388	0.3899
	(1.43)	(1.41)	(1.32)	(1.23)	(1.42)
Loan/TA	−0.6544***	−0.6509***	−0.6533***	−0.7037***	−0.6531***
	(−3.03)	(−2.98)	(−2.94)	(−3.25)	(−3.00)
NIM	0.0041	0.0009	0.0007	0.0047	0.0024
	(0.13)	(0.03)	(0.02)	(0.14)	(0.07)
Constant	0.4283	0.5786	0.8004**	0.5393	0.5091
	(1.09)	(1.46)	(1.97)	(1.37)	(1.28)
Observations	3880	3880	3880	3880	3880
R-squared	0.2006	0.1966	0.1889	0.1977	0.1977
Year FE	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank

This table reports results on additional robustness test. Our sample includes U.S. banks from 2000 to 2020. Panel A employs *Total_risk* an alternative market-based measure of risk taking. In Panel B, presents an alternative measure of independent directors' connectedness. All the independent variables are lagged by 1 year. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***$p < 0.01$; **$p < 0.05$; * $p < 0.1$.

connections. Therefore, whether the positive association between connectedness and risk-taking is driven by information or influence remains an empirical question.

6.4.1. Influence effect of board connections

As previously discussed, connections can be viewed as valuable human capital (Hillman and Dalziel, 2003), and firm executives often use network connections as social power (Kim and Lu, 2018; He, 2022). The experience, expertise, and skills that well-networked directors bring to a board are valuable, improving their monitoring abilities (Wang et al., 2015). Furthermore, well-connected directors may have specialized training and expertise in financial, technological, social, or environmental areas. Directors with specialist skills can better serve their boards when specific needs arise, making them influential in the decision-making process (Guner et al., 2008; Gopalan et al., 2021). In addition, connected independent directors can assist banks in negotiating deals for M&As (Cai and Sevilir, 2012) and in loan-syndication dealings (Egrican, 2021). Finally, well-connected directors are often more reputable in wider society (Masulis and Mobbs, 2014; Sila et al., 2017). Reputable well-connected directors tend to come from a social elite, which enhances their legitimacy and makes them more sought after (Chikh and Filbien, 2011). As their connections grow, they become more reputed and more influential on the board. Previous studies have found that these influential and powerful directors create value for their companies (Fogel et al., 2021; He, 2022). When such connections are viewed as scarce, in-demand, and critical "resources," independent directors with more connections become more influential in bank decision-making processes. Thus, we conjecture that independent directors' connectedness increases bank risk-taking through the influence channel.

There is an empirical challenge when testing this channel, as the board is comprised of independent directors and insiders. The CEOs of banks are also likely to play an influential role in investment decisions. The power balance between the board and the CEO is examined by Pathan (2009), Minton et al. (2014), Mollah and Liljeblom (2016), and Fogel et al. (2021), all of whom find that CEO power negatively affects risk-taking. A strong board consisting of many independent directors with financial expertise better reflects shareholder interests and thus increases risk-taking. Therefore, it is critical to disentangle the effect of CEO influence from board influence when investigating the influence channel in relation to independent directors' networks. To disentangle the effects of board influence from those of the CEO, our empirical approach is to partition our sample into banks with high and low board-power and banks with high and low CEO-power. We can then conduct our baseline regression analysis with two sub-samples: (a) banks with high board-power and low CEO-power, and (b) banks with low board-power and high CEO-power. The rationale behind this approach is that, in banks with high board-power and low CEO-power, the board is the dominant force, while in banks with low board-power and high CEO-power, the CEO is the dominant force. By isolating these dominant forces, we can more accurately attribute the influence on risk-taking incentives to the appropriate party. If the positive association between risk-taking incentives and connections is due to board influence, we can expect to see a stronger effect in banks where well-connected boards dominate the CEO. Conversely, if the CEO is the dominant force, the effect will be weaker. We exclude banks with both high board-power and high CEO-power, as well as those with both low board-power and low CEO-power, because these scenarios do not indicate a single dominant party influencing the decision-making process.

To test our conjecture, we partition our sample into high and low groups, based on board attributes. We define board influence (*Board_power*) as a dummy variable, taking a value of 1 if the degree and eigenvalues of the independent director's network connection are top quintiles, *Degree* and *Between* is the top quintile, or *Between* and *Eigen* is the top quintile, and 0 otherwise. Furthermore, we define CEO influence using two proxies: *CEO_power* and *High_network_CEO* (see Appendix for details).

In Column 1 of Table 10, we report the effects of independent directors' connections on bank risk-taking for a sub-sample of banks with high board-power and low CEO-power. We find that the effects are stronger when the board is more influential relative to the CEO. In Column 2, we present the findings for the group of banks with CEOs more powerful than their well-connected independent directors. Consistent with our expectations, we find that the aggregate network measure is not significant for this sub-group of banks, meaning that a powerful CEO plays an inconsequential role in the bank's risk-taking activities. As detailed in Columns 3 and 4, we repeat the analysis, this time using the CEO's external professional connections as an alternative proxy to measure CEO-power, and the results are similar. We conduct a Chi-square test for the coefficients of *PC1* between Models 1 and 2 and Models 3 and 4, and the test statistics for these sub-samples are significant, providing support for the power hypothesis.

The results from our sample of banks indicate that well-connected independent directors significantly influence management, promoting riskier lending policies. This finding adds to the ongoing discussion on the impact of independent directors on bank risk-taking. Erkens et al. (2012) find no significant relationship between independent directors and bank risk-taking, whereas Pathan (2009) identifies a positive relationship, and Altunbas et al. (2020) report a negative relationship. Our study suggests that, beyond the number of independent directors, the diversity of their connections is crucial. Even a small group of well-connected directors can effectively steer board decisions to favor shareholder interests. Additionally, our findings imply that well-connected independent directors can curb excessive CEO power, leading to more optimal risk-taking practices.

6.4.2. Alternative explanation – the information advantage of networks

We previously discussed how connections can bring information advantages (see Cao et al., 2015; Ke et al., 2019; Omer et al., 2020; Chang and Wu, 2021; Fracassi, 2017). Networking allows independent directors to gather valuable information on issues such as peer strategy, the impact of macroeconomic trends and regulations, the impact of disruptive technologies, geo-political risks, new and sustainable opportunities for investment, and so on (e.g., Mizruchi, 1996; Mol, 2001; Cao et al., 2015; Ke et al., 2019; Omer et al., 2020; Chang and Wu, 2021; Fracassi, 2017). The dissemination of information reduces the information gap and improves the alignment between the expectations of a bank's shareholders and those of its management (Schoorman et al., 1981). Therefore, as its connections grow, a well-networked board can improve its monitoring and advisory role by sharing information, which then contributes to increasing its risk-taking incentives. Consistent with this view, Fan et al. (2021) stress that the CEOs who are socially connected to their independent directors are motivated to adopt riskier strategies for investment, operating, and financing, due to their superior access to information. Cao et al. (2015) demonstrate that the social connections between independent directors and the senior and powerful executives of firms help these directors to access private information and to mitigate information asymmetry in stock prices. Furthermore, Mace (1971) shows that well-connected directors access information through a diverse network, which helps with decision-making. Based on these arguments and findings, we conjecture that the positive impact of independent directors' connectedness on bank risk-taking may be driven by the information channel of the network.

For our empirical testing, we partition the sample according to the banks' information environments. If independent directors' connections affect bank risk-taking via information advantage, this effect should be more pronounced for the sub-sample of banks with the poorer (higher) informational environment (asymmetry). As the effect can be channeled through either influence or information, a lack of significant difference between banks with better and poorer information environments would imply that the network's effect on risk-taking is not due to the prevailing information environment. We define the information environments

Table 10
Influence Role of Network.

VARIABLES	(1) Zscore High Board Power & Low CEO Power (CEO duality=0)	(2) Zscore Low Board Power & High CEO Power (CEO duality=1)	(3) Zscore High Board Power & Low CEO Power (High network_CEO = 0)	(4) Zscore Low Board Power & High CEO Power (High network_CEO = 1)
PC1	−0.0780*	−0.0064	−0.2567***	−0.0289
	(−1.93)	(−0.19)	(−3.33)	(−0.47)
ln(Board_size)	0.7287***	0.2034	0.5188	0.4902***
	(3.21)	(1.10)	(0.97)	(3.06)
Board independence	−0.1628	0.4881	2.0551***	0.5708
	(−0.27)	(1.28)	(2.89)	(1.64)
ln(Asset)	−0.0338	0.0536	−0.0258	0.0469
	(−1.02)	(1.22)	(−0.51)	(1.09)
ROA	0.1510***	0.4385***	0.1786***	0.2626***
	(3.57)	(5.84)	(3.49)	(3.09)
Deposit/TA	0.2705	0.7315	−0.3496	−0.5491
	(0.54)	(1.46)	(−0.74)	(−0.89)
Loan/TA	−0.8082**	−0.8346**	−0.5758	−0.7610**
	(−2.53)	(−2.02)	(−1.20)	(−2.13)
NIM	0.0585	−0.0575	0.0961**	−0.0254
	(1.30)	(−0.88)	(2.03)	(−0.35)
Constant	0.4298	−0.3825	−0.9370	−0.0984
	(0.54)	(−0.44)	(−0.75)	(−0.10)
Observations	335	919	143	1305
R-squared	0.4054	0.2570	0.5396	0.2032
Year FE	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank
Chi Square	3.25	5.51		
Prob > p-values	0.0715	0.0189		

This table reports the effect of influence effect of independent directors' connectedness. Our sample includes U.S. banks from 2000 to 2020. We measure network's influence effect using two proxies: Powerful board and CEO power (using two proxies). Following Fogel et al. (2021), we define *Board_power* as an indicator variable which takes a value of 1 if the degree and eigen values of independent director's network connection is top quintile or degree and between is top quintile or between and eigen is in top quintile, and 0. Therefore, *High Board_power* takes a value of 1 if the Board_power of a bank is above median our first proxy for CEO power is *CEO_duality* which takes a value of 1 if CEO has dual role (i.e., Chairman and CEO of the bank) and CEO is internally promoted, zero otherwise. The second proxy used to measure CEO power is based on the degree centrality. It measures the number of direct connections by the CEO of the bank. We define *High_network_CEO* as indicator variable that takes a value of 1 if the degree centrality of the CEO is above the median degree centrality of CEOs of other banks. All the independent variables are lagged by 1 year. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***p < 0.01; **p < 0.05; * p < 0.1.

using several proxies. The first is *Bid-ask spread*, which is defined as the difference between the daily bid-spread and ask-spread averaged over the year. The second proxy is Amihud's *Illiquidity* measure, which is the daily price-response associated with one dollar of trading volume (Amihud, 2002; Amihud et al., 2015), and the final proxy is *Accuracy* in relation to analyst forecasts (see Appendix A for a definition). We partition the sample into high and low information-asymmetry groups, indicating above- or below-average values for these proxies compared to the respective industry averages. Table 11 presents our findings.

Columns 1 and 2 of Table 11 report the effect of independent directors' connectedness on bank risk-taking for banks with higher and lower *Spread*, respectively. For both sub-groups, the coefficient of *PC1* loads negatively, with a significance of 1 %. We then conduct Chi-square testing to check the difference between the coefficients of the two subsamples, and we find no statistically significant difference. This implies that connectedness continues to affect risk-taking, regardless of the prevailing information environment. In other words, the positive association is unlikely to be driven by the information advantage of the network. In Columns 3–6, we report the results for the other proxies of information asymmetry, with all yielding the same inference. Overall, we find no support for the information-advantage hypothesis of network connections.

6.5. Consequence of the influence of independent directors' connectedness on risk-taking

In this section, we further explore the consequences of risk-taking by banks with well-connected independent directors. An increase in lending activities is likely to be followed by higher credit risk and higher loan-loss provisions (Bhat et al., 2019). At the same time, the effects of higher-lending activities on non-performing loans (NPLs) can go in both directions (Radivojević et al., 2019). In banks with prudent loan-screening, higher-lending activities can lead to lower rates of NPLs, while indiscriminate lending activities can be associated with higher rates of NPLs. Similarly, the depletion (addition) of Tier 1 capital follows when banks use more (less) statutory capital to support their lending activities (Li, 2021). To test these conjectures, we construct several loan-quality-related matrixes and estimate the baseline model, replacing *Zscore* with *Lending_risk, Loan_provision, NPL,* and *Tier 1* (see Appendix A for definition).

The consequences of risk-taking in well-connected banks are presented in Table 12. Consistent with the literature, we find that loan-loss reserve (proxied by *Lending_risk* in Column 1), loan-loss provisions (proxied by *Loan_provision* in Column 2), and NPLs (proxied by *NPL* in Column 3) increase alongside growth in a bank's aggregate network connections. These banks also tend to use more shareholder capital to support their lending activities (proxied by *Tier 1* in Column 4).

The results presented in this section collectively indicate that well-connected independent directors can influence their bank's lending activities, encouraging risk-taking and thereby compromising overall banking stability. This increased risk-taking heightens the systemic risk within the banking system. These findings align with recent studies on banking directors' financial expertise. For instance, Minton et al. (2014) show that directors with financial expertise actively seek risky opportunities, a practice that becomes detrimental during financial crises. In our case, well-connected independent directors, in the interest of

Table 11
Information advantage of network.

VARIABLES	(1) *Zscore* *High_spread* (High Information Asymmetry)	(2) *Zscore* *Low_spread* (Low Information Asymmetry)	(3) *Zscore* High_illiquidity (High Information Asymmetry)	(4) *Zscore* Low_illiquidity (Low Information Asymmetry)	(5) *Zscore* Low_ accuracy (High Information Asymmetry)	(6) *Zscore* High _accuracy (Low Information Asymmetry)
PC1	−0.4325***	−0.4073***	−0.4417**	−0.4786***	−0.3322***	−0.1869***
	(0.1114)	(0.0575)	(0.1956)	(0.0711)	(0.0663)	(0.0608)
ln(Board_size)	0.8810***	1.0544***	0.8599***	1.7974***	1.4157***	0.5820**
	(0.2320)	(0.2300)	(0.3081)	(0.2878)	(0.2307)	(0.2610)
Board independence	−0.2211	−0.3591	−0.1468	−0.0919	0.8418	−0.0632
	(0.5621)	(0.5441)	(0.7515)	(0.6270)	(0.5381)	(0.6131)
CEO_power	0.1336	0.7388***	0.0815	0.6521***	0.3942***	0.6536***
	(0.0897)	(0.0786)	(0.1168)	(0.0966)	(0.0856)	(0.0923)
ln(Asset)	0.0554	−0.1889***	0.1284	−0.1885***	−0.1070*	−0.2524***
	(0.0826)	(0.0597)	(0.1191)	(0.0723)	(0.0626)	(0.0675)
ROA	0.8812***	0.9097***	0.8220***	0.8634***	0.9303***	1.0092***
	(0.0701)	(0.1030)	(0.0958)	(0.1176)	(0.0786)	(0.1284)
Deposit/TA	0.5847	0.1906	1.0093	−1.0303	0.4021	−0.3666
	(0.8073)	(0.5869)	(1.1584)	(0.6868)	(0.6970)	(0.8471)
Loan/TA	−3.2273***	−3.1150***	−2.4482***	−2.8297***	−2.9210***	−2.7285***
	(0.5699)	(0.4270)	(0.7563)	(0.5382)	(0.5265)	(0.5203)
NIM	0.1188	−0.0324	0.0139	0.0169	0.0992	−0.0174
	(0.0896)	(0.0725)	(0.1126)	(0.0904)	(0.0832)	(0.0967)
Constant	1.2048	3.9766***	−0.1989	2.6785*	0.6881	6.5449***
	(1.5078)	(1.3075)	(2.0128)	(1.5046)	(1.2931)	(1.7533)
Observations	1682	1768	1184	1197	1421	1447
R-squared	0.2128	0.1929	0.1295	0.2118	0.2482	0.1309
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank	Bank
Chi Square	0.01		0.01		2.24	
Prob > p-values	0.9062		0.9261		0.1341	

This table reports the effect of information advantage of network. Our sample includes U.S. banks from 2000 to 2020. Several measures of information asymmetry proxies (Spread, Illiquidity, Accuracy) used for the analysis. We define *High_spread* as an indicator variable that take a value of 1 if *Spread* of a bank is above the average spread of other banks in the industry and 0 otherwise. We define *High_illiquidity* as an indicator variable that take a value of 1 if *Illiquidity* of a bank is above the average illiquidity of other banks in the industry and 0 otherwise. Finally, We define *Low_accuracy* as an indicator variable that take a value of 1 if *Accuracy* of a bank is below the average accuracy of other banks in the industry and 0 otherwise. Table A1 in the appendix defines all variables. All the independent variables are lagged by 1. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***p < 0.01; **p < 0.05; * p < 0.1.

maximizing shareholder value, pursue risky policies that may enhance performance outside of financial crises. However, the associated systemic risk to the banking system should not be overlooked.

6.6. Cross-sectional heterogeneity

Previous research suggests that banks with high complexity (opaque banks) hold high bank-capital and achieve higher income-diversity and less cost-efficiency (Sarma and Pais, 2011; Lee and Hsieh, 2013). Thus, banks with these characteristics tend to engage in riskier investments to serve their shareholders.

Complex organizational structures can lead to increased risk in banking operations. This complexity may appear as additional legal entities, a wider variety of business activities, or a broader geographic presence of bank holding company (BHC) affiliates (Correa and Goldberg, 2022). These organizations are more difficult to manage due to agency problems and moral hazard (Penas and Unal, 2004; Duchin and Sosyura, 2014). Elevated monitoring and information costs can heighten a bank's idiosyncratic risk. Managers pursuing an unchecked "empire-building" strategy might create overly complex structures, resulting in risk-management failures. A weak corporate governance environment, possibly influenced by implicit government subsidies (Freixas et al., 2007), can worsen this situation. Consistent with this, Berger et al. (2017) find that internationalization in U.S. commercial banks is linked to higher idiosyncratic risk.

Banks with higher capital are associated with higher levels of risk. A higher level of capital can provide a safety buffer for banks to take higher risks. This relationship is consistent with the regulatory hypothesis (Pettway, 1976; Shrieves and Dahl, 1992), which posits a positive relationship between bank capital and risk, resulting from regulators encouraging banks to increase their capital commensurate with their level of risk exposure. Studies also find that banks that increase their capital levels over time also increase their risk appetite (Shrieves and Dahl, 1992; Rime, 2001).

A higher level of income diversity (i.e., increased dependence on non-interest income) can increase risk exposure. The diversification gains from income diversity are offset by increased exposure to more volatile non-interest income activities in these diversified banks (DeYoung and Roland, 2001; Stiroh, 2004; Stiroh and Rumble, 2006). The push for shifts toward non-interest revenues in the form of fees, commission income, and trading income may generate higher returns at the expense of higher volatility.

Lower cost-efficiency can increase bank risk (Fiordelisi et al., 2011). Banks with low cost-efficiency might attempt to enhance returns by reducing their operating standards—engaging in less-rigorous credit monitoring, for example. Additionally, a less-efficient bank with low capital might be inclined to assume higher risks to make up for diminished returns. Consistent with this, Berger and De Young (1997) demonstrate that both efficiency and capital are significant determinants of bank risk.

Does the influence of well-connected independent directors on risky lending behavior vary across banks? We address this question by splitting our sample into cross-sections based on four characteristics: namely, high complexity vs. low complexity, high bank-capital vs. low bank-capital, high income-diversity vs. low income-diversity, and high cost-efficiency vs. low cost-efficiency. We then interact high complexity,

Table 12
Consequences of influence channel.

VARIABLES	(1) *Lending_risk*	(2) *Loan_provision*	(3) *NPL*	(4) *Tier1*
PC1	0.0007***	0.1513**	0.1161***	−0.2281*
	(2.83)	(2.29)	(2.98)	(−1.76)
ln(Board_size)	−0.0021***	−0.2916**	−0.5984***	−2.3878***
	(−2.94)	(−2.04)	(−4.24)	(−4.59)
Board independence	−0.0018	−1.1194***	−0.7712***	0.9672
	(−0.87)	(−3.28)	(−2.77)	(0.83)
CEO_power	0.0001	−0.0662	−0.0051	0.2084
	(0.34)	(−1.17)	(−0.11)	(1.43)
ln(Asset)	0.0003	1.1395***	0.0418	−0.7018***
	(1.06)	(21.25)	(1.11)	(−5.22)
ROA	−0.0022***	−0.2977***	−0.5066***	0.3553**
	(−5.77)	(−3.68)	(−6.96)	(2.33)
Deposit/TA	−0.0062*	0.4392	−1.2500**	−11.1080***
	(−1.88)	(0.53)	(−2.35)	(−4.93)
Loan/TA	−0.0061**	3.4170***	0.0388	−10.0228***
	(−2.52)	(4.84)	(0.11)	(−8.59)
NIM	0.0033***	0.3989***	0.2458***	0.2729*
	(5.60)	(6.26)	(4.34)	(1.90)
Constant	0.0144***	−10.5914***	2.6685***	40.0768***
	(2.89)	(−10.97)	(3.14)	(11.04)
Observations	3694	3649	3968	3048
R-squared	0.3801	0.6455	0.4445	0.3479
Year FE	Yes	Yes	Yes	Yes
Cluster	Yes	Yes	Yes	Yes

This table presents the results of independent directors' network connections on bank lending activities. Our sample includes U.S. banks from 2000 to 2020. Several proxies are used to gauge bank's lending activities. In Column (1) we present the effect of independent directors' connections on *Lending_risk*, defined as the ratio of loan loss reserves to total loans; Column (2) report the effect on *Loan_provisions,* defined as the natural logarithm of total loan loss provisions*;* Column (3) show the effect on *NPL*, defined as the ratio of non-performing loan to total asset.; and Column (4) document the effect on *Tier 1,* defined as the ratio of shareholder funds plus perpetual noncumulative preference shares as a percentage of risk weighted assets and off-balance sheet risks measures under Basel rules. All the independent variables are lagged by 1 year. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***p < 0.01; **p < 0.05; * p < 0.1.

high bank-capital, high income-diversity, and low cost-efficiency with *PC1*. The results are reported in Table 13.

In Model 1, we interact *PC1* with the high-complexity dummy. We find that the effect of independent directors' connectedness on bank risk-taking is highly significant (negative) for complex banks (see Column 1). This indicates that highly connected independent directors in complex banks enhance bank risk-taking. Similarly, we interact *PC1* with a high bank-capital dummy in Model 2. As expected, we find a highly negative significant relationship between the interaction term and risk-taking (see Column 2). Again, this indicates that highly connected independent directors in highly capitalized banks tend to enhance bank risk-taking. Likewise, we interact *PC1* with a high income-diversity dummy in Model 3. We find a negative significant relationship (10 % level) between the interaction term and bank risk-taking (see Column 3). This indicates that highly connected independent directors in banks with high income-diversity tend to increase risk-taking. Finally, we interact *PC1* with a low cost-efficiency dummy in Model 4. Again, as expected, we find a highly negative significant relationship between the interaction term and risk-taking (see Column 4). These results indicate that banks with low cost-efficiency tend to increase their risk-taking.

However, as we can see, both the sign and significance of *PC1* remain the same as those of the baseline estimation, indicating that well-connected independent directors encourage managers to take more risks to maximize returns for shareholders. Thus, the interpretation of our main result remains unchanged. Overall, we find cross-sectional differences across different sub-samples and conclude that well-connected independent directors encourage riskier lending policies for complex banks, highly capitalized banks, and banks with high income-diversity or low cost-efficiency.

7. Summary and conclusion

Recent academic literature questions the role of independent directors, indicating that a higher percentage of such directors alone does not guarantee good governance. These studies emphasize, instead, the importance of the "quality" of independent directors. Researchers argue that the expertise and skills of independent directors are crucial for effective board monitoring, and due to the variability in these skills, simply counting the number of independent directors results in an inadequate measure. An important indicator of the quality of independent directors is their network connections. However, there is limited research in banking on the network connections of independent directors.

This study has delved into the intricate dynamics between independent directors' network centrality and bank risk-taking. Leveraging a comprehensive dataset of 424 U.S.-listed banks spanning from 2000 to 2020, our study finds that independent directors' connectedness is positively associated with increased risk-taking. The results hold after various robustness checks and endogeneity tests. In the channel analysis, our empirical results predominantly support the influence channel, demonstrating that well-connected directors leverage their power to promote risk-taking initiatives. Our empirical findings do not provide support for the alternative channel—namely, the "information advantage." Our study also highlights the significant impact of well-connected independent directors on banks' lending activities. These directors drive banks to maintain higher loan-loss reserves and provisions, deplete Tier-1 capital, and engage in riskier lending, leading to higher delinquency and non-performing loan ratios. Furthermore, the study's cross-sectional analyses reveal significant heterogeneity in the effects of directors' connectedness on risk-taking across different bank characteristics. Complex banks—namely, those with higher equity capital, greater income diversity, and lower cost-efficiency—are particularly susceptible to increased risk-taking driven by influential independent directors.

This research makes significant contributions to both corporate governance and social-network theory. By integrating the shareholder-incentive hypothesis with social-network theory, we highlight the importance of the quality of independent directors, focusing on their network centrality rather than their number. Our findings demonstrate that well-connected independent directors are pivotal in shaping risk-taking behaviors in banks, providing new insights into the governance mechanisms at play in financial institutions. Our study also contributes to the literature by highlighting the dual channels by which directors' connections influence risk-taking: influence and information advantage. Our empirical analysis confirms the influence channel, indicating that well-connected directors use their power to encourage risk-taking initiatives, but it does not support the alternative "information advantage" channel.

The findings have several important implications. This association between directors' network connections and bank risk-taking underscores the critical role of directors' networks in shaping strategic decisions in financial institutions. For policymakers, this study suggests that regulations designed to enhance bank stability should account for the network characteristics of board members, in addition to their independence. The connectedness of board members can significantly influence bank-risk profiles, and greater understanding of this dynamic could shape future regulatory frameworks aimed at bolstering financial stability. For bank management, understanding the influence of directors' network connections could help to design governance structures that appropriately balance risk and reward. This insight could aid in the selection of board members who possess both the necessary expertise and the right network connections to optimize risk-taking for shareholder-value maximization. For shareholders, the results underline the importance of carefully selecting board members with the right mix

Table 13
Cross-sectional heterogeneity.

VARIABLES	(1) *Zscore*	(2) *Zscore*	(3) *Zscore*	(4) *Zscore*
Complex PC1*	−0.0607***			
	(−2.87)			
High_complexity	0.1009**			
	(2.10)			
*Capital * PC1*		−0.0661***		
		(−2.99)		
High_capital		−0.0188		
		(−0.42)		
*Income_Diversity * PC1*			−0.0579*	
			(−1.84)	
High_income_diversity			0.0218	
			(0.47)	
Cost_efficiency PC1*				−0.0858***
				(−3.31)
Low_costefficiency				0.1252***
				(2.72)
PC1	−0.0657***	−0.0726***	−0.0853***	−0.0605**
	(−2.88)	(−2.89)	(−3.31)	(−2.47)
ln(Board_size)	0.2873***	0.3208***	0.3274***	0.3177***
	(2.71)	(3.02)	(3.08)	(2.99)
Board independence	0.2608	0.2800	0.2721	0.2615
	(1.09)	(1.14)	(1.11)	(1.07)
CEO_power	0.0759*	0.0796**	0.0820**	0.0854**
	(1.96)	(2.04)	(2.11)	(2.20)
ln(Asset)	−0.0024	0.0031	0.0018	−0.0020
	(−0.10)	(0.13)	(0.08)	(−0.09)
ROA	0.2904***	0.2929***	0.2939***	0.2746***
	(6.88)	(6.83)	(6.82)	(6.77)
Deposit/TA	0.3642	0.2716	0.2826	0.3357
	(1.36)	(0.97)	(1.02)	(1.25)
Loan/TA	−0.7641***	−0.7111***	−0.7266***	−0.7928***
	(−3.55)	(−3.34)	(−3.33)	(−3.75)
NIM	0.0076	0.0094	0.0093	0.0324
	(0.23)	(0.30)	(0.28)	(0.95)
Constant	0.3463	0.2061	0.2154	0.1485
	(0.78)	(0.48)	(0.48)	(0.35)
Observations	3880	3880	3880	3880
R-squared	0.2096	0.2062	0.2043	0.2158
Year FE	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank

This table reports cross-sectional variations in the effect of independent directors' connections on banks risk taking. Our sample includes U.S. banks from 2000 to 2020. We measure cross-sectional heterogeneity along four dimensions: Complexity, Capital source, Income diversity and Cost efficiency. Table A1 in the appendix defines all variables. All the independent variables are lagged by 1 year and the sample period is from 2002 to 2013. Standard errors are clustered at the bank level. All variables are winsorized at both the 1 % and 99 % levels. T-statistics appear in parentheses. ***$p < 0.01$; **$p < 0.05$; * $p < 0.1$.

of expertise and network connections to optimize risk-taking policy.

While our study offers robust insights, several limitations should be acknowledged. First, our analysis is confined to U.S.-listed banks, which may limit the generalizability of our findings to other regulatory environments. Second, despite our efforts to address endogeneity, there may still be unobserved factors affecting both directors' connectedness and bank risk-taking. Third, our focus on board-level network connections does not delve into the individual contributions of each director, which could offer more granular insights.

Future research could build on our findings in several ways. First, examining the role of independent directors' network connections in different regulatory contexts could yield more comprehensive insights. Longitudinal studies could explore how changes in network centrality over time influence risk-taking behaviors. Additionally, qualitative research of directors' decision-making processes could further elucidate the mechanisms by which network connections impact risk-taking.

In conclusion, this study highlights the critical role of independent directors' network connections in influencing bank risk-taking behaviors. By bridging social-network theory and the shareholder-incentive hypothesis, we provide a deeper understanding of how board governance can affect financial stability and performance.

CRediT authorship contribution statement

Sabur Mollah: Writing – original draft, Supervision, Methodology, Data curation, Conceptualization. **Yang Zhao:** Writing – review & editing, Methodology. **Syed Kamal:** Visualization, Resources, Investigation, Data curation. **Rasim Simsek:** Formal analysis, Data curation. **Abu Amin:** Validation, Software, Formal analysis.

Data availability

Data will be made available on request.

Acknowledgments

We thank Abhishek Bhardwaj, Matteo Binfare, Stephen Black, Darren Duxbury, Marwa Elnahas, Simon Hussain, Randal Ice, Alper Kara, Zulfiqar Shah, Vu Trinh, and Hanxiong Zhang, as well as seminar participants at the Newcastle University Business School, Huddersfield Business School, Department of Finance at the University of Central Oklahoma, the 2nd Annual Conference of ASFAAG (2022), and the 2022 Financial Management Association (FMA) Meeting for their constructive feedback.

Appendix

Table A1
Level of connectedness of a bank with other banks and non-bank corporations

The highest centrality score of each measure is indicated by underlining.

Vertex	Degree	Normalised Degree	Normalised Closeness	Normalised Betweenness	Normalised Eigenvector
A	3	0.333	<u>0.600</u>	<u>0.579</u>	0.713
B	<u>4</u>	<u>0.444</u>	0.529	0.380	0.786
C	2	0.222	0.450	0.069	0.430
D	3	0.333	0.409	0.060	0.604
E	2	0.222	0.375	0	0.462
F	3	0.333	0.409	0.023	0.612
G	<u>4</u>	<u>0.444</u>	0.529	0.500	<u>1</u>
H	3	0.333	0.391	0	0.826
I	3	0.333	0.391	0	0.826
J	3	0.333	0.391	0	0.826

Table A2
Variable definitions.

Variables	**Definition**
<u>Dependent variable</u>	
Zscore	The measure of bank's risk aversion. It is computed as natural log of the sum of bank's return on asset and equity to asset ratio divided by the 1 year rolling standard deviation of return on asset plus 1. Source: Authors calculation based on BankFocus data.
<u>Independent variable</u>	
PC1	PC1 is the first principal component of the all the centrality measure (degree, betweenness, eigenvector). Source: Authors calculation based on BoardEx data.
<u>Network variables</u>	
Degree	The degree centrality measures the number of direct connections to adjacent boards. Source: Authors calculation based on BoardEx data.
Close	The closeness centrality measure. Source: Authors calculation based on BoardEx data.
Eigen	The eigenvector centrality measures the importance of each connected board. Source: Authors calculation based on BoardEx data.
Between	The betweenness centrality measures the positioning advantage of a board in the entire network. It is a centrality measure based on the geodesic path. Source: Authors calculation based on BoardEx data.
Sector_indep	The average number of Fama-French (1997) industries in which independent directors worked in the past estimated for each firm-year based on the Fama-French 48-industries classification. Source: Authors calculation based on BoardEx data.
Death_dum	Dummy variable takes a value of 1 if there is a death in the board, 0 otherwise. Source: Authors calculation based on BoardEx data.
Quartile (Degree)	The quartile ranking of the degree centrality measure by year. Source: Authors calculation based on BoardEx data.
Quartile (Close)	The quartile ranking of the closeness centrality measure by year. Source: Authors calculation based on BoardEx data.
Quartile (Eigen)	The quartile ranking of the eigenvector centrality measure by year. Source: Authors calculation based on BoardEx data.
Quartile (Between)	The quartile ranking of the between centrality measure by year. Source: Authors calculation based on BoardEx data.
Quartile (N-score)	N-Score is the average of quartile rank of all four board centrality measures by year. The quartile of *N-score* measure. Source: Authors calculation based on BoardEx data.
<u>Board variables</u>	
Board independence	The proportion of independent directors on a firm's board of directors. Source: BoardEx
ln(Board_size)	The natural log of total number of directors in the board. Source: BoardEX
<u>Bank related variables</u>	
ln(Asset)	The natural logarithm of total assets. Source: Authors calculation based on BankFocus data.
ROA	Net income divided by average total assets. Source: Authors calculation based on BankFocus data.
Deposit/TA	The ratio of total deposit to total asset. Source: Authors calculation based on BankFocus. data.
Loan/TA	The ratio of total loan to total asset. Source: Authors calculation based on BankFocus data
NIM	Annualized net interest income in the banking book as a percentage of assets. Source: Authors calculation based on BankFocus data.
Total_Risk	The standard deviation of daily stock returns. Source: Authors calculation based on CRSP data.
NPL	The ratio of non-performing loan to total asset. Source: Authors calculation based on BankFocus data.
CEO_power	It takes a value of 1 if CEO has dual role (i.e., Chairman and CEO of the bank) and CEO is internally promoted, zero otherwise. Source: Authors calculation based on BoardEx data.
High_complexity	A principal component factor of firm size, firm age, leverage, tier1, and the number of business segments. We calculate the factor score for each of the above proxies using the first principal component. For each firm-year observation, the complexity factor score is a linear combination of the standard normal values of the five proxy variables of complexity. High complexity takes a value of 1 if the complexity of a bank is above the median complexity of other banks. Source: Authors calculation based on BankFocus and CRSP data.
High_income_diversity	Income diversity is the absolute value of the difference between net interest income and other operating income scaled by total operating income. High income diversity takes 1 if income diversity is above median income diversity of other banks. Source: Authors calculation based on BankFocus data.
High_capital	Bank capital is the ratio of book value of equity to book value of assets. High capital takes a value of 1 if bank capital is above median bank capital of other banks. Source: Authors calculation based on BankFocus data.
Low_costefficiency	Cost efficiency is the ratio of overheads to total assets. Low cost efficiency takes value of 1 if bank's cost efficiency is below or equal to median cost efficiency of other banks. Source: Authors calculation based on BankFocus data.
Lending_risk	The ratio of loan loss reserves to total loans. Source: Authors calculation based on BankFocus data.
Loan_provision	The natural logarithm of total loan loss provisions. Source: Authors calculation based on BankFocus data.
Tier1	The ratio of shareholder funds plus perpetual noncumulative preference shares as a percentage of risk weighted assets and off-balance sheet risks measures under Basel rules. Source: Authors calculation based on BankFocus data.
Board_power	Takes a value of 1 if the degree and eigen values of independent director's network connection is top quintile or degree and between is top quintile or between and eigen is in top quintile, and 0 otherwise. Source: Authors calculation based on BoardEx data.
Duality	Takes a value of 1 if CEO is Chairman and CEO of the bank and zero otherwise. Source: Authors calculation based on BoardEx data.

(*continued on next page*)

Table A2 (*continued*)

Variables	Definition
High_netwrok_CEO	The degree centrality measures the number of direct connections by the CEO of the bank. High network takes a value of 1 if the degree centrality of the CEO is above the median degree centrality of CEOs of other banks. Source: Authors calculation based on BoardEx data.
Spread	Annual average of the ratio of the daily closing bid-ask spread to the closing price for firm *i* in the fiscal year *t*.
Illiquidity	Amihud's (2002) Price Impact Measure, defined as "daily price response associated with one dollar of trading volume".
Accuracy	The absolute earnings forecast error is calculated as the absolute difference of actual earnings per share and median forecast earnings per share scaled by fiscal year end price and then multiplied by a hundred.

References

Abbassi, P., Brownlees, C., Hans, C., Podlich, N., 2017. Credit risk interconnectedness: what does the market really know? J. Financ. Stab. 29, 1–12. https://doi.org/10.1016/j.jfs.2017.01.002.

Adams, R.B., Almeida, H., Ferreira, D., 2005. Powerful CEOs and their impact on corporate performance. Rev. Financ. Stud. 18 (4), 1403–1432. https://doi.org/10.1093/rfs/hhi030.

Adams, R., Mehran, H., 2012. Bank board structure and performance: evidence for large bank holding companies. J. Financ. Inter. 21 (2), 243–267. https://doi.org/10.1016/j.jfi.2011.09.002.

Adhikari, B.K., Agrawal, A., 2016. Does local religiosity matter for bank risk-taking? J. Corp. Financ. 38, 272–293. https://doi.org/10.1016/j.jcorpfin.2016.01.009.

Adler, P.S., Kwon, S.W., 2002. Social capital: prospects for a new concept. Acad. Manag. Rev. 27 (1), 17–40. https://doi.org/10.5465/amr.2002.5922314.

Akbas, F., Meschke, F., Wintoki, M.B., 2016. Corporate directors and informedtraders. J. Account. Econ. 62 (1), 1–23. https://doi.org/10.1016/j.jacceco.2016.03.003.

Allen, Franklin, Babus, Ana, (2008). Networks in finance. Wharton Financial Institutions Center Working Paper No. 08-07, doi: 10.2139/ssrn.1094883.

Altonji, J.G., Elder, T.E., Taber, C.R., 2005. Selection on observed and unobserved variables: assessing the effectiveness of catholic schools. J. Political Econ. 113 (1), 151–184.

Altunbas, Y., Thornton, J., Uymaz, Y., 2020. The effect of CEO power on bank risk: do boards and institutional investors matter? Financ. Res. Lett. vol. 33 (issue C), 2020. https://doi.org/10.1016/j.frl.2019.05.020.

Amihud, Y., 2002. Illiquidity and stock returns: cross-setion and time-series effects. J. Financ. Mark. 5, 31–56. https://doi.org/10.1016/S1386-4181(01)00024-6.

Amihud, Y., Hameed, A., Kang, W., Zhang, H., 2015. The illiquidity premium: international evidence. J. Financ. Econ. 117 (2), 350–368. https://doi.org/10.1016/j.jfineco.2015.04.005.

Amin, A., Chourou, L., Kamal, S., Malik, Mahfuja, Zhao, Y., 2020. It's who you know counts: board connectedness and CSR performance. J. Corp. Financ. 64. https://doi.org/10.1016/j.jcorpfin.2020.101662.

Anginer, D., Demirguc-Kunt, A., Huizinga, H., Ma, K., 2018. Corporate governance of banks and financial stability. J. Financ. Econ. 130 (2), 327–346. https://doi.org/10.1016/j.jfineco.2018.06.011.

Banerjee, A., Chandrasekhar, A.G., Duflo, E., Jackson, M.O., 2014. Gossip: Identifying central individuals in a social network. NBER Working Paper, 20422. https://doi.org/10.3386/w20422.

Bargeron, L.L., Lehn, K.M., Zutter, C.J., 2010. Sarbanes-Oxley and corporate risk-taking. J. Account. Econ. 49 (1-2), 34–52. https://doi.org/10.1016/j.jacceco.2009.05.001.

Basel Committee, 2010. Principles for enhancing corporate governance. Basel Committee on Banking Supervision, Switzerland.

Basel Committee, 2015. Principles for enhancing corporate governance. Basel Committee on Banking Supervision, Switzerland.

Beck, T., De Jonghe, O., Schepens, G., 2013. Bank competition and stability: cross-country heterogeneity. J. Financ. Inter. 22 (2), 218–244. https://doi.org/10.1016/j.jfi.2012.07.001.

Beltratti, A., Stulz, R.M., 2012. The credit crisis around the globe: why did some banks perform better? J. Financ. Econ. 105 (1), 1–17. https://doi.org/10.1016/j.jfineco.2011.12.005.

Benson, B.W., Iyer, S.R., Kemper, K.J., Zhao, J., 2018. Director networks and credit ratings. Financ. Rev. 53 (2), 301–336. https://doi.org/10.1111/fire.12157.

Berger, A., De Young, R., 1997. Problem loans and cost efficiency in commercial banking. J. Bank. Financ. 21, 849–870. https://doi.org/10.1016/S0378-4266(97)00003-4.

Berger, A., Ghoul, S., Guedhami, O., Roman, R., 2017. Internationalization and bank risk. Manag. Sci. 63 (7), 2283–2301. https://doi.org/10.1287/mnsc.2016.2422.

Berger, A.N., Kick, T., Schaeck, K., 2014. Executive board composition and bank risk taking. J. Corp. Financ. 28, 48–65. https://doi.org/10.1016/j.jcorpfin.2013.11.006.

Bertay, A.C., Demirgüç-Kunt, A., Huizinga, H., 2013. Do we need big banks? Evidence on performance, strategy and market discipline. J. Financ. Inter. 22 (4), 532–558. https://doi.org/10.1016/j.jfi.2013.02.002.

Bhagat, S., Black, B.S., 2002. The non–correlation between board independence and long-term firm performance. J. Corp. Law 27 (2), 231–273.

Bhat, G., Ryan, S.J., Vyas, D., 2019. The Implications of credit risk modeling for banks' loan loss provisions and loan-origination procyclicality. Manag. Sci. 65, 2116–2141. https://doi.org/10.1287/mnsc.2018.3041.

Bhattacharya, S., Thakor, A.V., 1993. Contemporary banking theory. J. Financ. Inter. 3 (1), 2–50.

Bjørnskov, C., Sønderskov, K.M., 2013. Is social capital a good concept? Soc. Indic. Res. 114, 1225–1242. https://doi.org/10.1007/s11205-012-0199-1.

Bonacich, P., 2007. Some unique properties of eigenvector centrality. Soc. Netw. 29 (4), 555–564. https://doi.org/10.1016/j.socnet.2007.04.002.

Borgatti, S.P., 2005. Centrality and network flow. Soc. Netw. 27 (1), 55–71. https://doi.org/10.1016/j.socnet.2004.11.008.

Boyd, J.H., Runkle, D.E., 1993. Size and performance of banking firms: testing the predictions of theory. J. Monet. Econ. 31 (1), 47–67. https://doi.org/10.1016/0304-3932(93)90016-9.

Brunnermeier, M.K., 2009. Deciphering the liquidity and credit crunch 2007-2008. J Econ. Perspect. 23 (1), 77–100. https://doi.org/10.1257/jep.23.1.77.

Burt, R.S., 1992. Structural holes: The social structure of competition. Harvard University Press. ISBN: 9780674843714.

Burt, R.S., 1995. Structural Holes: The social structure of competition. Harvard University Press, Cambridge. ISBN 978-0-674-84372-1.

Cai, Y., Sevilir, M., 2012. Board connections and M&A transactions. J. Financ. Econ. 103 (2), 327–349. https://doi.org/10.1016/j.jfineco.2011.05.017.

Canil, J., Karpavičius, S., Yu, C.F., 2019. Are shareholders gender neutral? Evidence form say on pay. J. Corp. Financ. 58, 169–186. https://doi.org/10.1016/j.jcorpfin.2019.05.004.

Cao, Y., Dhaliwal, D., Li, Z., Yang, Y.G., 2015. Are all independent directors equally informed? Evidence based on their trading returns and social networks. Manag. Sci. 61 (4), 795–813. https://doi.org/10.1287/mnsc.2013.1892.

Chang, C.H., Wu, Q., 2021. Board networks and corporate innovation. Manag. Sci. 67 (6), 3618–3654. https://doi.org/10.1287/mnsc.2020.3587.

Chaudron, R.F., 2018. Bank's interest rate risk and profitability in a prolonged environment of low interest rates. J. Bank. Financ. 89, 94–104. https://doi.org/10.1016/j.jbankfin.2018.01.007.

Cheng, S., 2008. Board size and the variability of corporate performance. J. Financ. Econ. 87 (1), 157–176. https://doi.org/10.1016/J.JFINECO.2006.10.006.

Chikh, S., Filbien, J.Y., 2011. Acquisitions and CEO power: evidence from French networks. J. Corp. Financ. 17, 1221–1236. https://doi.org/10.1016/j.jcorpfin.2011.06.007.

Cohen, D.A., Dey, A., Kys, T.Z., 2008. Real and accrual-based earnings management in the pre- and post-Sarbanes-Oxley periods. Account. Rev. 83 (3), 757–787. https://doi.org/10.2308/accr.2008.83.3.757.

Cohen, D.A., Dey, A., Kys, T.Z., 2013. Corporate governance reform and executive incentives: implications for investments and risk taking. Contemp. Account Res. 30 (4), 1296–1332. https://doi.org/10.1111/1911-3846.12015.

Coles, F.L., Daniel, N.D., Naveen, L., 2008. Boards: does one size fit all? J. Financ. Econ. 87 (2), 329–356. https://doi.org/10.1016/j.jfineco.2006.08.008.

Coles, J.L., Daniel, N.D., and Naveen, L. (2012) Board advising. ⟨www.ssrn.com⟩.

Correa, R., Goldberg, L., 2022. Bank complexity, governance and risk. J. Bank. Financ. 134. https://doi.org/10.1016/j.jbankfin.2020.106013.

Daily, C.M., Dalton, D.R., 1994. Bankruptcy and corporate governance: the impact of board composition and structure. Acad. Manag. J. 37 (6), 1603–1617. https://doi.org/10.5465/256801.

Dak-Adzaklo, Cephas Simon Peter, Wong, Raymond M.K., 2024. Corporate governance reforms, societal trust, and corporate financial policies. J. Corp. Financ. 84, 102507. https://doi.org/10.1016/j.jcorpfin.2023.102507.

Dbouk, W., Fang, Y., Liu, L., Wang, H., 2020. Do social networks encourage risk-taking? Evidence from bank CEOs. J. Financ. Stab. Volume 46, 100708. https://doi.org/10.1016/j.jfs.2019.100708.

De Andres, P., Vallelado, E., 2008. Corporate governance in banking: the role of the board of directors. J. Bank. Financ. 32 (12), 2570–2580. https://doi.org/10.1016/j.jbankfin.2008.05.008.

DeYoung, R., Peng, E.Y., Yan, M., 2013. Executive compensation and business policy choices at US commercial banks. J. Financ. Quant. Anal. 48 (1), 165–196.

DeYoung, R., Roland, K.P., 2001. Product mix and earnings volatility at commercial banks: evidence from a degree of total leverage model. J. Financ. Inter. 10, 54–84. https://doi.org/10.1006/jfin.2000.0305.

Diamond, D.W., Dybvig, P.H., 1983. Bank runs, deposit insurance, and liquidity. J. Political Econ. 91 (3), 401–419.

Duchin, R., Sosyura, D., 2014. Safer ratios, riskier portfolios: banks' response to government aid. J. Financ. Econ. 113 (1), 1–28. https://doi.org/10.1016/j.jfineco.2014.03.005.

Egrican, A., 2021. Overlapping board connections with banker directors and corporate loan terms: evidence from syndicated loans. Glob. Financ. J. 50. https://doi.org/10.1016/j.gfj.2021.100672.

El-Khatib, R., Fogel, K., Jandik, T., 2015. CEO network centrality and merger performance. J. Financ. Econ. 116, 349–382. https://doi.org/10.1016/j.jfineco.2015.01.001.

Ellul, A., Yerramilli, V., 2013. Stronger risk controls, lower risk: evidence from U.S. bank holding companies. J. Financ. 68 (5), 1757–1803. https://doi.org/10.1111/jofi.12057.
Erkens, D., Hung, M., Matos, P., 2012. Corporate governance in the 2007–2008 financial crisis: evidence from financial institutions worldwide. J. Corp. Financ. 18 (2), 389–411. https://doi.org/10.1016/j.jcorpfin.2012.01.005.
Faccio, M., Masulis, R.W., McConnell, J.J., 2006. Political connections and corporate bailouts. J. Financ. 61 (6), 2597–2635. https://doi.org/10.1111/j.1540-6261.2006.01000.x.
Faleye, O., 2007. Classified boards, firm value, and managerial entrenchment. J. Financ. Econ. 83 (2), 501–529. https://doi.org/10.1016/J.JFINECO.2006.01.005.
Faleye, O., Kovacs, T., Venkateswaran, A., 2014. Do better-connected CEOs innovate more? J. Financ. Quant. Anal. 49 (5–6), 1201–1225. https://doi.org/10.1017/S0022109014000714.
Fama, E.F., Jensen, M.C., 1983. Separation of ownership and control. J. Law Econ. 26 (2), 301–325. ⟨https://www.jstor.org/stable/725104⟩.
Fan, Y., Boateng, A., Ly, K.C., Jiang, Y., 2021. Are bonds blind? Bond-CEO social networks and firm risk. J. Corp. Financ. 68, 101922.
Fang, Y., Francis, B., Hasan, I., 2018. Differences make a difference: diversity in social learning and value creation. J. Corp. Financ. 48, 474–491. https://doi.org/10.1016/j.jcorpfin.2017.11.015.
Federal Reserve, Office of the Comptroller of the Currency, Office of Thrift Supervision, Federal Deposit Insurance Corporation. 2010. Guidance on sound incentive compensation policies, June 2010.
Fernández-Gago, R., Cabeza-García, L., Nieto, M., 2018. Independent directors' background and CSR disclosure. Corp. Soc. Responsib. Environ. Manag. 25 (5), 991–1001. https://doi.org/10.1002/csr.151.
Fiordelisi, F., Marques-Ibanez, D., Molyneux, P., 2011. Efficiency and risk in European banking. J. Bank. Financ. 35 (2011), 1315–1326. https://doi.org/10.1016/j.jbankfin.2010.10.005.
Flannery, M.J., 1998. Using market information in prudential bank supervision: a review of the US empirical evidence. J. Money Credit Bank. 30 (3), 273–305. https://doi.org/10.2307/2601102.
Fogel, K., Ma, L., Morck, R., 2021. Powerful independent directors. Financ. Manag. 50 (4), 935–983. https://doi.org/10.1111/fima.12365.
Fracassi, C., 2017. Corporate Finance Policies and Social Networks. Manag. Sci. 63 (8), 2420–2438. https://doi.org/10.1287/mnsc.2016.2433.
Fracassi, C., Tate, G., 2012. External networking and internal firm governance. J. Financ. 67 (1), 153–194. https://doi.org/10.1111/j.1540-6261.2011.01706.x.
Francis, B., Hasan, I., and Wu, Q. (2012) Do corporate boards affect firm performance? New evidence from the financial crisis. Bank of Finland Research Discussion Papers, No:11/2012. ⟨http://nbn-resolving.de/urn:NBN:fi:bof-20140807228⟩.
Freeman, L.C., 1978. Centrality in social networks conceptual clarification. Soc. Netw. 1 (3), 215–239. https://doi.org/10.1016/0378-8733(78)90021-7.
Freixas, X., Loranth, G., Morrison, A., 2007. Regulating financial conglomerates. J. Financ. Inter. 16 (4), 479–514. https://doi.org/10.1016/j.jfi.2007.03.004.
Galai, D., Masulis, R.W., 1976. The option pricing model and the risk factor of stock. J. Financ. Econ. 3 (1-2), 53–81. https://doi.org/10.1016/0304-405X(76)90020-9.
Gilani, U., Keasey, K., Vallascas, F., 2021. Board financial expertise and the capital decisions of US banks. J. Corp. Financ. 71, 102091. https://doi.org/10.1016/j.jcorpfin.2021.102091.
Gopalan, R., Gormley, T., Kalda, A., 2021. It's not so bad: director bankruptcy experience and corporate risk-taking. J. Financ. Econ. 142 (1), 261–292. https://doi.org/10.1016/j.jfineco.2021.04.037.
Guedj, Ilan and Barnea, Amir, Director Networks (January 1, 2009). EFA 2007 Ljubljana Meetings Paper, Available at SSRN: http://dx.doi.org/10.2139/ssrn.966555.
Guner, A., Malmendier, U., Tate, G., 2008. Financial expertise of directors. J. Financ. Econ. 88 (2), 323–354. https://doi.org/10.1016/j.jfineco.2007.05.009.
Guo, L., Masulis, R.W., 2015. Board structure and monitoring: new evidence from CEO turnovers. Rev. Financ. Stud. 28 (10), 2770–2811. https://doi.org/10.1093/rfs/hhv038.
Gutiérrez, M., Sáez, M., 2013. Deconstructing independent directors. J. Corp. Law Stud. 13 (1), 63–94. https://doi.org/10.5235/14735970.13.1.63.
Hainmueller, J., 2012. Entropy balancing for causal effects: a multivariate reweighting method to produce balanced samples in observational studies. Political Anal. 20 (1), 25–46. https://doi.org/10.1093/pan/mpr025.
Hakenes, H., Hasan, I., Molyneux, P., Xie, R., 2015. Small banks and local economic development. Rev. Financ. 19 (2), 653–683. https://doi.org/10.1093/rof/rfu003.
He, J., 2022. Executive network centrality and corporate reporting. Manag. Sci. 68 (2), 1512–1536. https://doi.org/10.1287/mnsc.2020.3924.
Hermalin, B.E., Weisbach, M.S., 1988. The determinants of board composition. RAND J. Econ. 19 (4), 589–606. https://doi.org/10.2307/2555459.
Hermalin, B.E., Weisbach, M.S., 1998. Endogenously chosen boards of directors and their monitoring of the CEO. Am. Econ. Rev. 88 (1), 96–118. ⟨https://www.jstor.org/stable/116820⟩.
Hillman, A.J., 2005. Politicians on the board of directors: do connections affect the bottom line? J. Manag. 31 (3), 464–581. https://doi.org/10.1177/0149206304272187.
Hillman, A., Dalziel, T., 2003. Boards of directors and firm performance: Integrating agency and resource-dependence perspectives. Acad. Manag. Rev. 28, 383–396. https://doi.org/10.5465/amr.2003.10196729.
Hillman, A., Zardkoohi, A., Bierman, L., 1999. Corporate political strategies and firm performance: An indication of firm-specific benefits from personal service in the U.S. government. Strateg. Manag. J. 20, 67–82. https://doi.org/10.1002/(SICI)1097-0266(199901)20:13.0.CO;2-T.
Houston, J.F., Lin, C., Lin, P., Ma, Y., 2010. Creditor rights, information sharing, and bank risk taking. J. Financ. Econ. 96 (3), 485–512. https://doi.org/10.1016/j.jfineco.2010.02.008.
Huang, X., Vodenska, I., Wang, F., Havlin, S., Stanley, H., 2011. Identifying influential directors in the United States corporate governance network. Phys. Rev. E 84, 046101. https://doi.org/10.1103/PhysRevE.84.046101.
Iacobucci, D., McBride, R., Popovich, D., Rouziou, M., 2017. In social network analysis, which centrality index should I use? Theoretical differences and empirical similarities among top centralities. J. Methods Meas. Soc. Sci. 8 (2), 72–99. https://doi.org/10.2458/v8i2.22991.
Intintoli, V.J., Kahle, K.M., Zhao, W., 2018. Director connectedness: Monitoring efficacy and career prospects. J. Financ. Quant. Anal. 53 (1), 65–108. https://doi.org/10.1017/S0022109018000017.
Intintoli, V., Kahle, K.M., Zhao, W., 2021. The impact of director connectedness on financing and investment. SSRN Electron. J. https://doi.org/10.2139/SSRN.3270299.
Iqbal, J., Vähämaa, S., 2019. Managerial risk-taking incentives and the systemic risk of financial institutions. Rev. Quant. Financ. Account. 53, 1229–1258. https://doi.org/10.1007/s11156-018-0780-z.
Jensen, M.C., 1993. The modern industrial revolution, exit and the failure of internal control systems. J. Financ. 48 (3), 831–880. https://doi.org/10.1111/j.1540-6261.1993.tb04022.x.
Jensen, M.C., Meckling, W.H., 1976. Theory of firm: managerial behavior, agency costs and ownership structure. J. Financ. Econ. 3 (4), 305–460. https://doi.org/10.1016/0304-405X(76)90026-X.
John, K., John, T.A., Senbet, L.W., 1991. Risk-shifting incentives of depository institutions: a new perspective on federal deposit insurance reform. J. Bank. Financ. 15 (4-5), 895–915. https://doi.org/10.1016/0378-4266(91)90105-U.
John, K., Masi, S.D., Paci, A., 2016. Corporate governance in banks. Corp. Gov.: Int. Rev. 24 (3), 303–321. https://doi.org/10.1111/corg.12161.
John, K., Mehran, H., Qian, Y., 2010. Outside monitoring and CEO compensation in the banking industry. J. Corp. Financ. 16 (4), 383–399.
Ke, R., Li, M., Ling, Z., Zhang, Y., 2019. Social connections within executive teams and management forecasts. Manag. Sci. 65 (1), 439–457. https://doi.org/10.1287/mnsc.2017.2925.
Kim, E.H., Lu, Y., 2018. Executive suite independence: is it related to board independence? Manag. Sci. 64 (3), 1015–1033. https://doi.org/10.1287/mnsc.2016.2603.
Kirkpatrick, G., 2009. The corporate governance lessons from the financial crisis. OECD J.: Financ. Mark. Trends 2009 (1), 61–87.
Kuang, Y.L., Lee, G., 2017. Corporate fraud and external social connectedness of independent directors. J. Corp. Financ. 45, 401–427. https://doi.org/10.1016/j.jcorpfin.2017.05.014.
Kupiec, P., Lee, Y., Rosenfeld, C., 2017. Does bank supervision impact bank loangrowth? J. Financ. Stab. 28, 29–48.
Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. J. Financ. Econ. 93 (2), 259–275. https://doi.org/10.1016/j.jfineco.2008.09.003.
Larcker, D.F., So, E.C., Wang, C.C.Y., 2013. Boardroom centrality and firm performance. J. Account. Econ. 55 (2–3), 225–250. https://doi.org/10.1016/j.jacceco.2013.01.006.
Lee, C.F., Hsieh, M.F., 2013. The impact of bank capital on profitability and risk in Asian banking. J. Int. Money Financ. 32, 251–281. https://doi.org/10.1016/j.jimonfin.2012.04.013.
Leitner, Y., 2005. Financial networks: contagion, commitment, and private sectorbailouts. J. Financ. 60 (6), 2925–2953. https://doi.org/10.1111/j.1540-6261.2005.00821.x.
Li, S., 2021. Quality of bank capital, competition, and risk-taking: some international evidence. Emerg. Mark. Financ. Trade 57, 3455–3488. https://doi.org/10.1080/1540496X.2019.1696189.
Lipton, L., Lorsch, J., 1992. A modest proposal for improved corporate governance. Bus. Lawyer 48 (1), 59–77. ⟨https://www.jstor.org/stable/40687360⟩.
Mace, M.L., 1971. Directors: Myth and Reality. Harvard Business School Press, Boston. ISBN-13:0875840949-978.
Masulis, R.W., Mobbs, S., 2014. Independent director incentives: Where do talented directors spend their limited time and energy? J. Financ. Econ. 111 (2), 406–429. https://doi.org/10.1016/j.jfineco.2013.10.011.
May, D.O., 1995. Do managerial motives influence firm risk reduction strategies? J. Financ. 50 (4), 1291–1308. https://doi.org/10.1111/j.1540-6261.1995.tb04059.x.
Mehran, H., Morrison, A., Shapiro, J., 2012. Corporate Governance and Banks: What Have We Learned from the Financial Crisis? In: Dewatripont, M., Freixas, X. (Eds.), The crisis aftermath: New regulatory paradigms. Centre for Economic Policy Research, London.
Merton, R.C., 1977. An analytic derivation of the cost of deposit insurance and loan guarantees An application of modern option pricing theory. J. Bank. Financ. 1 (1), 3–11.
Mian, A., Sufi, A., 2014. What explains the 2007–2009 drop in employment? Econometrica 82 (6), 2197–2223. https://doi.org/10.3982/ECTA10451.
Minton, B., Taillard, J.P.A., Williamson, R., 2014. Financial expertise of the board, risk taking, and performance: evidence from bank holding companies. J. Financ. Quant. Anal. 49 (2), 351–380. https://doi.org/10.1017/S0022109014000283.
Mizruchi, M.S., 1996. What do interlocks do? An analysis, critique, and assessment of research on interlocking directorates. Annu. Rev. Sociol. 22, 271–298.
Mol, M., 2001. Creating wealth through working with others: interorganizational relationships. Acad. Manag. Perspect. 15, 150–152. https://doi.org/10.5465/ame.2001.4251565.

Mollah, S., Liljeblom, E., 2016. Governance and bank characteristics in the credit and sovereign debt crises – the impact of CEO power. J. Financ. Stab. 27, 59–73. https://doi.org/10.1016/j.jfs.2016.09.003.

Mollah, S., Liljeblom, E., Mobarek, A., 2021. Heterogeneity in independent non-executive directors' attributes and risk-taking in large banks. J. Corp. Financ. 70, 102074. https://doi.org/10.1016/j.jcorpfin.2021.102074.

Mollah, S., Zaman, M., 2015. Shari'ah supervision, corporate governance and performance: conventional vs. Islamic banks. J. Bank. Financ. 58, 418–435. https://doi.org/10.1016/j.jbankfin.2015.04.030.

Moore, G., 2001. Corporate social and financial performance: An investigation in the U. K. supermarket industry. J. Bus. Ethics 34, 299–315. https://doi.org/10.1023/A:1012537016969.

Nguyen, B.D., Nielsen, K.M., 2010. The value of independent directors: evidence from sudden deaths. J. Financ. Econ. 98 (3), 550–567. https://doi.org/10.1016/j.jfineco.2010.07.004.

Nicholson, G., Alexander, M., Kiel, G., 2004. Defining the social capital of the board of directors: an exploratory study. J. Manag. Organ. 10, 54–72. https://doi.org/10.5172/jmo.2004.10.1.54.

Omer, T.C., Shelley, M.K., Tice, F.M., 2014. Do well-connected directors affect firm value? J. Appl. Financ. 24 (2), 17–32. https://doi.org/10.2139/SSRN.2167354.

Omer, T.C., Shelley, M.K., Tice, F.M., 2020. Do director networks matter for financial reporting quality? Evidence from audit committee connectedness and restatements. Manag. Sci. 66 (8), 3361–3388. https://doi.org/10.1287/mnsc.2019.3331.

Oster, E., 2019. Unobservable selection and coefficient stability: Theory and evidence. J. Bus. Econ. Stat. 37 (2), 187–204. https://doi.org/10.1080/07350015.2016.1227711.

Padgett, J.F., Ansell, C.K., 1993. Robust action and the rise of the Medici, 1400-1434. Am. J. Sociol. 98 (6), 1259–1319.

Pathan, S., 2009. Strong boards, CEO power and bank risk-taking. J. Bank. Financ. 33 (7), 1340–1350. https://doi.org/10.1016/j.jbankfin.2009.02.001.

Pathan, S., Faff, R., 2013. Does board structure in banks really affect their performance? J. Bank. Financ. 37 (5), 1573–1589. https://doi.org/10.1016/j.jbankfin.2012.12.016.

Pathan, S., Haq, M., Faff, R., Seymour, T., 2021. Institutional investor horizon and bank-risk taking. J. Corp. Financ. 66, 101794. https://doi.org/10.1016/j.jcorpfin.2020.101794.

Penas, M., Unal, H., 2004. Gains in bank mergers: evidence from the bond markets. J. Financ. Econ. 74 (1), 149–179. https://doi.org/10.1016/j.jfineco.2003.05.004.

Pettway, R., 1976. Market tests of capital adequacy of large commercial banks. J. Financ. 31 (3), 865–875. https://doi.org/10.2307/2326431.

8 Radivojević, N., Cvijanović, D., Sekulic, D., Pavlovic, D., Jovic, S., Maksimović, G., 2019. Econometric model of non-performing loans determinants. Phys. A: Stat. Mech. its Appl. 520, 481–488. https://doi.org/10.1016/j.physa.2019.01.015.

Ramdani, D., van Witteloostuijn, A., 2010. The impact of board independence and ceo duality on firm performance: a quantile regression analysis for Indonesia, Malaysia, South Korea and Thailand. Br. J. Manag. 21 (3), 607–626. https://doi.org/10.1111/j.1467-8551.2010.00708.x.

Renneboog, L., Zhao, Y., 2014. Director networks and takeovers. J. Corp. Financ. 28, 218–234. https://doi.org/10.1016/j.jcorpfin.2013.11.012.

Rime, B., 2001. Capital requirements and bank behavior: empirical evidence for Switzerland. J. Bank. Financ. 25 (4), 789–805. https://doi.org/10.1016/S0378-4266(00)00105-9.

Roberts, M.R., Whited, T.M., 2013. Endogeneity in empirical corporate finance. Handb. Econ. Financ. 2 (A), 493–572. https://doi.org/10.1016/B978-0-44-453594-8.00007-0.

Roy, A.D., 1952. Safety first and the holding of assets. Econometrica 20 (3), 431–449. https://doi.org/10.2307/1907413.

9 Sarma, M., Pais, J., 2011. Financial inclusion and development. J. Int. Dev. 23, 613–628. https://doi.org/10.1002/jid.1698.

Saunders, A., Strock, E., Travlos, N.G., 1990. Ownership structure, deregulation, and bank risk-taking. J. Financ. 45 (2), 643–654. https://doi.org/10.1111/j.1540-6261.1990.tb03709.x.

Schabus, M., 2022. Do director networks help managers forecast better? Account. Rev. 97 (2), 397–426. https://doi.org/10.2308/TAR-2018-0074.

Schaeck, K., Cihak, M., Maechler, A., Stolz, S., 2012. Who disciplines bank managers? Rev. Financ. 16 (1), 197–243. https://doi.org/10.1093/rof/rfr010.

Schoorman, F.D., Bazerman, M.H., Atkin, R.S., 1981. Interlocking directorates: A strategy for reducing environmental uncertainty. Acad. Manag. Rev. 6 (2), 243–251. https://doi.org/10.2307/257880.

Shivdasani, A., Yermack, D., 1999. CEO involvement in the selection of new board members: an empirical analysis. J. Financ. 54 (5), 1829–1853. https://doi.org/10.1111/0022-1082.00168.

Shrieves, R., Dahl, D., 1992. The relationship between risk and capital in commercial banks. J. Bank. Financ. 16 (2), 439–457. https://doi.org/10.1016/0378-4266(92)90024-T.

Sila, V., Gonzalez, A., Hagendorff, J., 2017. Independent director reputation incentives and stock price informativeness. J. Corp. Financ. 47, 219–235. https://doi.org/10.1016/j.jcorpfin.2017.09.018.

Srivastav, A., Hagendorff, J., 2016. Corporate Governance and Bank Risk-taking. ISSN 0964-8410 Corp. Gov.: Int. Rev. 24 (3), 334–345. https://doi.org/10.1111/corg.12133.

Srivastav, A., Keasey, K., Mollah, S., Vallascas, F., 2017. CEO turnover in large banks: does tail risk matter? J. Account. Econ. 64 (1), 37–55. https://doi.org/10.1016/j.jacceco.2017.05.001.

Stiroh, K.J., 2004. Diversification in banking: is noninterest income the answer? J. Money, Credit Bank. 36 (5), 853–882. ⟨https://www.jstor.org/stable/3839138⟩.

Stiroh, K.J., Rumble, A., 2006. The darkside of diversification: the case of US financial holding companies. J. Bank. Financ. 30, 2131–2161. https://doi.org/10.1016/j.jbankfin.2005.04.030.

Stock, J.H., Yogo, M., 2002. Testing for weak instruments in linear IV regression. In: Andrews, D.W.K. (Ed.), Identification and Inference for Econometric Models. Cambridge University Press, New York, pp. 80–108. https://doi.org/10.3386/T0284.

Stulz, R.M., 2016. Risk management, governance, culture, and risk taking in banks. economic policy review. Fed. Reserve Bank N. Y. 22 (1), 43–59, 2016.

Uddin, M.H., Mollah, S., Ali, M.H., 2020. Does cyber tech spending matter for bank stability? Int. Rev. Financ. Anal. 72, 101587. https://doi.org/10.1016/j.irfa.2020.101587.

Vallascas, F., Mollah, S., Keasey, K., 2017. Does the impact of board independence on large bank risks change after the global financial crisis? J. Corp. Financ. 44, 149–166. https://doi.org/10.1016/j.jcorpfin.2017.03.011.

Wang, C., Xie, F., Zhu, M., 2015. Industry expertise of independent directors and board monitoring. J. Financ. Quant. Anal. 50 (5), 929–962. https://doi.org/10.1017/S0022109015000459.

Westphal, J.D., Fredrickson, J.W., 2001. Who directs strategic change? Directors experience, the selection of new CEOs, and change in corporate strategy. Strateg. Manag. J. 22, 1113–1137. https://doi.org/10.1002/smj.205.

Wincent, J., Anokhin, S., Örtqvist, D., Autio, E., 2010. Quality meets structure: generalized reciprocity and firm-level advantage in strategic networks. J. Manag. Stud. 47 (4), 597–624. https://doi.org/10.1111/j.1467-6486.2009.00882.x.

Wu, Y., Dong, B., 2020. Independent director network and corporate innovation: evidence from a natural experiment in China. Appl. Econ. Lett. 28 (7), 559–564. https://doi.org/10.1080/13504851.2020.1764475.

Yermack, D., 1996. Higher market valuation of companies with a small board of directors. J. Financ. Econ. 40 (2), 185–211. https://doi.org/10.1016/0304-405X(95)00844-5.

Zajac, E.J., Westphal, J.D., 1996. Director reputation, CEO-board power, and the dynamics of board interlocks. Adm. Sci. Q. 41 (3), 507–529. https://doi.org/10.2307/2393940.