



Corporate governance and financial stability in US banks: Do indirect interlocks matter?[☆]

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ABSTRACT

In the context of the Depository Institution Management Interlocks Act of 1978 (Interlocks Act), we investigate the structure and implications of the professional connections among bank directors. Based on a hand-collected unique dataset for a sample of 168 US commercial banks listed continuously from 2009 to 2015, we find that the barriers set out in the Interlocks Act have been circumvented by the establishment of indirect interlocks that allow for mass professional connections among bank directors. Our evidence suggests that bank well-connectedness through indirect interlocks has a significant impact on financial stability. In particular, we find, in support of the extended resource-based view (RBV), that well-connected banks mitigate their credit and insolvency risks but, contrary to our expectation, lower bank capitalisation. Our evidence suggests that the Interlocks Act and bank governance reforms need to consider the role of professional communications among bank directors to fully achieve their intended goals.

1. Introduction

Many researchers attempt to explore the role of corporate leader interlocks in shaping corporate actions and outcomes (Davis, Yoo, & Baker, 2003; Fich & Shivdasani, 2006; Haunschild, 1993; Homroy & Slechten, 2017; Horton, Millo, & Serafeim, 2012; Hwang & Kim, 2009; Ingram & Roberts, 2000; Joh & Jung, 2018; Kaczmarek, Kimino, & Pye, 2014; Larcker, So, & Wang, 2013; Mizruchi, 1996). A key weakness of this extensive research base is a failure to describe how social, as well as professional, communication between board members influences the ability of boards to execute their responsibilities, with existing studies focussing on the direct association between directorship interlocks and company economic and strategic outcomes. Indeed, only Carpenter and Westphal (2001) surveyed non-executive directors and chief executive officers (CEOs) of the Forbes 1000 index of US industrial and services companies, concluding that boards with directors who have external network ties to strategically related organisations could provide better

advice and counsel, thereby contributing to the strategic decision-making process.

In the context of US antitrust laws, Lang and Lockhart (1990) highlighted the mass exploitation of indirect interlocks among directors of eight truck companies operating in the airline industry as a legal means to establish intra-industry board connections. According to US antitrust laws, in particular, the 1914 Clayton Act (Fear & Kobrak, 2010; Platt & Platt, 2012; Zajac, 1988) and 1978 Depository Institution Management Interlocks Act (Interlocks Act) (Baccini & Marroni, 2016; FDIC, 2016; Roche, 2009), holding a seat on the board of two competing companies leads to direct interlocks between those companies, suggesting possible anticompetitive effects with adverse impacts on market health. In this context, indirect interlocks are simply another type of professional connection that occur when directors from two companies are affiliated with and/or sit on the board of a third organisation. To date, there has been scarce empirical testing of the economic consequences of

Abbreviations: BFS, bank financial stability; CG, corporate governance; FDIC, Federal Deposit Insurance Corporation; IDIs, indirect interlocks; PCA, Prompt Corrective Action; SIC, Standard Industrial Classification

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professional connections among US competitors through indirect interlocks.

This study suggests the US banking sector to address this literature gap by (i) investigating the very existence of indirect interlocks as a special type of legal connection among bank directors that circumvents barriers set by US antitrust laws and (ii) examining the extent to which bank credit, insolvency and capital risks are affected by the interbank networks. Practitioners and researchers agree on the essence of the detailed investigation that links board governance and risk-taking practices in the banking sector. The reasons are two-fold. First, bank stability is the backbone of the stability of other sectors (Berger, Klapper, & Turk-Ariss, 2009). Therefore, controlling bank risk-taking, which is a key driver of bank financial stability, is perceived as a fiduciary duty owed to the whole economy. Second, compared with non-financial sectors, the governance of bank boards has unique challenges and uncertainties due to the agency problems that arise when protecting diverse stakeholder interests, especially after the 2008 financial crisis and its adverse consequences for financial institutions.

The role of directorship interlocks in the banking sector has recently received considerable research attention (Elyasiani & Zhang, 2015; Muller-Kahle & Lewellyn, 2011; Nguyen, Hagendorff, & Eshraghi, 2015). However, the narrow emphasis on board busyness leads to inconclusive evidence. Indeed, John, De Masi, and Paci (2016) call for future research to consider the influence of board/director networks in the banking sector. By constructing unique social network matrices that address the interbank networks, we intend to fill this gap in the banking literature and offer an improved understanding of the role of director interlocks in the banking sector. Drawing on the insights of extended resource-based view (extended RBV), this study posits that bank financial stability depends on board social capital created by strong professional connections among bank directors. Specifically, we argue that a well-connected bank boardroom signals a unique board quality (i.e., board social capital) in the form of facilitating effective circulation of rare, confidential information, an exceptional accumulation of boardroom competences in the form of relevant knowledge, skills and expertise, and a superior ability to mitigate the competitive uncertainties, ultimately contributing to bank financial stability.

Using a sample of 168 US commercial banks that were listed consistently in the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and Nasdaq in the period 2009 to 2015, we found that indirect interlocks are used commonly for professional connections among bank directors. We also found that well-connectedness among banks is significantly associated with a low credit risk and a low insolvency risk, but with a high capital risk. Our results are consistent with the extended RBV perspective, indicating that directors of well-connected bank boards are highly qualified and competent to protect various stakeholder interests by mitigating both bank credit risk and bank insolvency risk. Moreover, but contrary to our expectation, well-connected boards signal a new model of shareholder-friendly boards that, through minimising the adverse effects of holding very high capital ratios, favours the interests of bank shareholders, while at the same time, avoiding high-risk decisions and strategies. Our additional analysis demonstrates the persistent effect of bank well-connectedness on the following year's bank risk exposures.

This study offers several contributions. Based on the extended RBV, we broaden the focus of board quality research to link interbank networks, in a setting that prevents direct interlocks among competing companies, with bank financial stability. Our evidence contributes to both the banking and corporate governance literature by proposing board social capital created by professional connections among bank directors as an antecedent of bank financial stability. Attention, then, will be directed to the professional connections among competitors as a new informal governance mechanism in the US banking sector that affects board ability to perform its tasks. In this context, this study challenges the universality of admonitions for communications among US competitors.

2. Theoretical background and conceptual framework

The role of the board of directors has been examined widely in corporate governance literature. In general, board ability to foster effective task performance is contingent on competent oversight of management behaviour (agency theory), with the board acting as a mentor to the management by providing sound professional advice (stewardship theory) and supplying the organisation with required resources through connections with the external environment (resource dependence theory) (Adams, Hermalin, & Weisbach, 2010; John et al., 2016; McNulty, Florackis, & Ormrod, 2013; Minichilli, Zattoni, & Zona, 2009; Muller-Kahle & Lewellyn, 2011; Srivastav & Hagendorff, 2016; Zona & Zattoni, 2007). Therefore, poor company performance and high risk, both of which contribute to financial instability, are downstream consequences of board inability to perform tasks effectively.

Board social capital is widely regarded as a critical aspect of board behaviour and performance. According to Walter, Lechner, and Kellermanns (2007, p. 700), “social capital has been broadly defined as the benefits that actors derive from their social relationships”. Interlocking directorates are formal social connections that, through evolving trust and cooperation among various organisation board members, can develop board social capital (Buchnea, 2017). A growing body of research, drawing on agency theory and resource dependence theory, argues that interlocks can affect board ability through enhancing director knowledge and expertise, which are used effectively in their supervisory role (agency theory) and for information provision and networking, so that they act as efficient suppliers of resources (resource dependence theory) (Burt, 1997; Carpenter & Westphal, 2001; Hillman & Dalziel, 2003; Mizruchi, 1996; Wiseman, Cuevas-Rodríguez, & Gomez-Mejia, 2012). However, relying heavily on agency theory and resource dependence theory to explain the positive implications of external directorships on improving (limiting) company performance (risks) demonstrates that board members are merely controllers and suppliers rather than strategists (Huse, 2005). This leads to the contemporary view where board members are “a highly valued organisational asset which has the potential to contribute to sustainable competitive advantage” (Minichilli, Gabrielsson, & Huse, 2007, p. 610).

2.1. Towards the extended resource-based view (RBV)

Some effort has been made to integrate RBV principles with social network theory perspectives to recognise social capital developed through buyer-supplier relationships (Whipple, Wiedmer, & K Boyer, 2015), strategic alliances (Ireland, Hitt, & Vaidyanath, 2002; Kang & Zaheer, 2018; Lavie, 2006), and business group affiliation (Popli, Ladkani, & Gaur, 2017) as a resource that affects company performance. In particular, prior studies suggest that strategic connections between companies create a resource bundle that leverages and complements their internal resources with scarce resources and capabilities (Ireland et al., 2002; Rauch, Rosenbusch, Unger, & Frese, 2016; Whipple et al., 2015). According to Barney (1991, p. 101), resources are “all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness”. In broad terms, traditional RBV states that internally generated resources (tangible or intangible) of a company are regarded only as assets that create and add a sustainable competitive advantage when they are (i) controlled by the company, (ii) valuable, (iii) rare, (iv) inimitable, and (v) non-substitutable (Barney, 1991; Lavie, 2006; Toms, 2002).

Applying the above five criteria in a networked environment requires strict clarification of how the value created by social capital, formed through external connections, can generate a sustainable internal resource. Lavie (2006) developed an extended RBV in a first attempt to incorporate social network theories into traditional RBV. The extended RBV suggests that having a complete right to use a resource is

not useful when the resource does not provide any potential service or benefit (Lavie, 2006; Popli et al., 2017). Furthermore, the extended RBV reveals that, in a network environment, the nature of the connection between actors determines and signifies, to a great extent, the value, inimitability and rarity of such connections (Ireland et al., 2002; Ortiz-de-Mandojana & Aragon-Correa, 2015; Rauch et al., 2016), suggesting that not all connections and networks have similar impact (Brown & Drake, 2013; Carpenter & Westphal, 2001).

Carpenter and Westphal (2001) postulate that the value of board interlocks as a tool to enhance board ability to effectively supervise and advise management is context-dependent and contingent on the type of companies to which the focal company board of directors is interlocked. The impact of the extent of industry diversity of the companies in which directors are affiliated is a matter of current controversy (Chen & Lin, 2016a; Lavie, 2006). From one perspective, it is assumed that information obtained, as well as knowledge and skills gained from director affiliations with similar companies, might be somehow redundant because the similarity between the companies might be coincidental (Basuil & Datta, 2017; Ortiz-de-Mandojana & Aragon-Correa, 2015). By contrast, it has been suggested that holding seats on boards of companies that operate similarly would add value to board quality by ensuring that circulated information is relevant and by accumulating the value of shared knowledge and expertise; this, in turn, enhances the effectiveness of board task performance (Carpenter & Westphal, 2001; Mazzola, Perrone, & Kamuriwo, 2016).

Carpenter and Westphal (2001) used primary data collected from a survey distributed to non-executive directors of 600 large and medium-sized US industrial and service companies to investigate the extent to which board contribution in making strategic decisions is affected by the external networks of directors. The authors provide evidence that, in a stable environment, a board of directors that appoints directors holding board seats of, or tied to, companies operating similarly (strategically related companies) is more able to accomplish its tasks effectively, both in supervisory and advisory roles, and more able to be involved promptly in strategic decision making.¹ In accordance with Lavie's (2006) development of the extended RBV and findings reported by Carpenter and Westphal (2001), social connections among competitors through board networks form a new board social capital that can create a resource within the boardroom and, thus, enhance overall board quality.

Communication among the leaders of competitors is an important form of external social connection, and this communication has received growing research attention in recent years. On the one hand, Baker and Faulkner (1993), Dobbin and Dowd (1997), and Podolny and Scott Morton (1999) showed how illegal social relationships among competitors facilitate price-fixing conspiracies. Additionally, concerns have been raised regarding the moral hazard associated with knowledge and skills leakage among competitors (Pahnke, McDonald, Wang, & Hallen, 2015). On the other hand, Ingram and Roberts (2000) investigated informal connections among managers, who were friends, of competing hotels in Sydney; they found that these connections had a positive impact on hotel performance, suggesting that such friendships ease professional collaboration, mitigate competition and enhance information sharing. Additionally, Okazaki and Sawada (2011) examined the impact of the direct interlocks among Japanese banks on their survivability before the Second World War; they reported a positive association between interbank networks and bank ability to avoid potential financial distress and bankruptcy, revealing that professional connections among banks contribute to the financial system stability.

Interestingly, direct interlocking directorates among competitors (i.e., when a director of one company is also a director of a competitor) are rare, mainly because the US antitrust laws prohibit an individual

from holding a position as a director or management official in two non-affiliated corporations operating similarly in the market (Federal Trade Commission, 2012). The purpose of the US antitrust laws is to prevent collusion and monopolistic behaviour and to ensure healthy competition in the economy. The phenomenon of indirect interlocks, which occur when directors from two competitors are affiliated with and/or sit on the board of a third party, host non-competing company, governmental organisation and other nonprofit organisation, is the sole means of facilitating professional communications and legitimatising connections among competitors (Baccini & Marroni, 2016; Burt, 1980; Lang & Lockhart, 1990). Fig. 1 illustrates direct interlocks among competitors, which are prohibited under the US antitrust laws, and how indirect interlocks can be formed between competitors. Lang and Lockhart (1990) found that, under the enforcement of Section 8 of the 1914 Clayton Antitrust Act, which prohibits direct interlocks among competitors, there was an enormous increase in the number of indirect interlocks among eight US truck companies in the 1970s following the deregulation of the US domestic airline industry. Lang and Lockhart (1990), drawing on resource dependence theory, postulated that the reconciliation with high levels of competitive uncertainties that followed industry deregulation was a key driver in the excessive use of indirect interlocks to alleviate competitive uncertainty.

Notably, there is limited but emerging empirical evidence that indirect interlocks are a form of board social capital that has an apparent impact on corporate outcomes. For example, Palmer, Jennings, and Zhou (1993) showed that, during the 1960s, the adoption of a multi-divisional structure is contingent on the extent to which the company has indirect interlocks with adopters of the multi-divisional structure. Ahuja (2000) also reported that indirect interlocks among companies in the international chemicals industry operating in Western Europe, Japan and the US play a significant positive role in developing patents. The positive implications of indirect interlocks on company performance suggest that valuable information circulates among companies through indirect interlocks, connecting companies to rare information sources (Ahuja, 2000; Lang & Lockhart, 1990; Palmer et al., 1993). Notwithstanding, one should consider that indirect interlocks have been regarded as weak ties (Granovetter, 1973) that are only influential when the boardroom depends on them as ultimate connection tools and when the boardroom is well-connected and central in the network through multiple indirect interlocks (Ahuja, 2000).

A well-connected boardroom, developed through multiple interlocking directorates, demonstrates that its organisation has a prominent position in the network that reduces social and physical distance, removes organisational boundaries and connects the organisation to its external environment (Filatotchev & Nakajima, 2010; Wilson, Buchnea, & Tilba, 2018). Research on board governance provides empirical support for the importance of companies taking a prominent network position when seeking to increase the number of acquisitions (Haunschild & Beckman, 1998), company performance (Larcker et al., 2013), reporting quality (Felix, 2016), new product development (Mazzola et al., 2016), and post-acquisition (long-term) performance (Popli et al., 2017). Thus, a well-connected board has greater access to a wide range of information, and its members have superior knowledge, expertise and skills, all of which are vital to simplify and improve the accomplishment of its responsibilities (Burt, 1980; Singh & Delios, 2017). Accordingly, being professionally well-connected with competitors through indirect interlocks, in a legal system that prohibits any direct interlocks among competitors, signals unique connections that form a new board social capital; this social capital can create valuable, rare and inimitable intangible resources that endow the boardroom with credible, highly diversified and relevant additional information, knowledge, skills and expertise. Understanding the role of indirect interlocks among US competitors, with a focus on highly regulated sectors, such as banking, remains challenging in the context of “black box” corporate boardrooms.

¹ A stable environment is characterised by small unpredictable changes or low levels of volatility (Carpenter & Westphal, 2001).

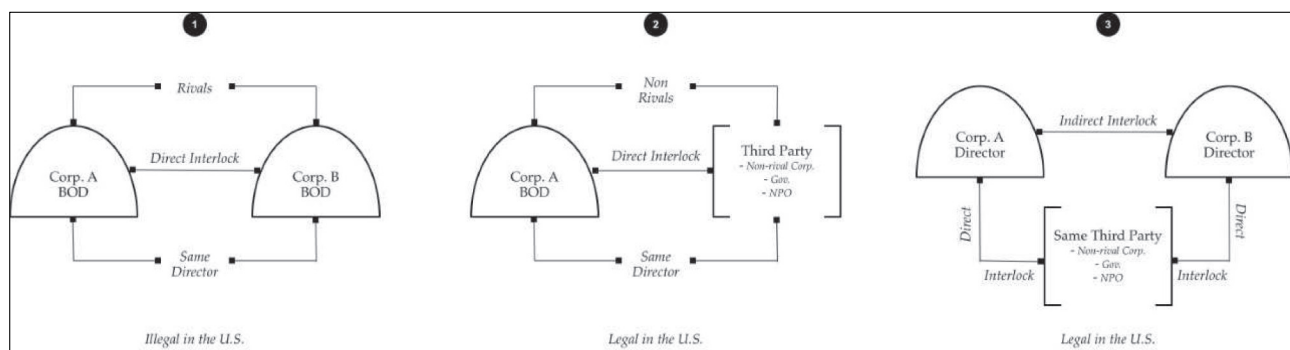


Fig. 1. Possible connections among competitors under the US antitrust laws.

Notes: The figure illustrates direct interlocks among competitors that are prohibited under the US antitrust laws, and how indirect interlocks can be formed between competitors. BOD represents board of directors. Gov. represents governmental organisations. NPO represents nonprofit organisations.

2.2. The banking sector

“Trust is the expectation that another person (or institution) will perform actions that are beneficial, or at least not detrimental, to [stakeholders] regardless of [their] capacity to monitor those actions” (Sapienza & Zingales, 2012, p. 124). Since the mortgage crisis, financial institutions, particularly banks, have been continuously subject to a lack of trust as well as excessive pressures to regularly signify and present remarkable performance to shareholders, sustainable stability to depositors and borrowers, good corporate image to customers and the public, and legitimacy to regulators and legislators (Jizi, Salama, Dixon, & Stratling, 2014; Peni & Vähämaa, 2012). Factors such as a substantial level of leverage and the significant mismatch between bank assets and liabilities reflect the key attributes that make banks more complex and opaque than non-financial companies (Elyasiani & Zhang, 2015; Srivastav & Hagendorff, 2016). Moreover, unlike non-financial companies, the board of directors in the banking sector has a fiduciary responsibility to ensure overall financial stability that serves not only the interests of shareholders but also those of other stakeholders, including depositors, borrowers, and regulators (Aebi, Sabato, & Schmid, 2012; Elyasiani & Zhang, 2015; John et al., 2016; Pathan & Skully, 2010).

Bank board governance has been the subject of intense regulatory attention and public scrutiny, with much criticism of the significant board contribution to the 2007 subprime mortgage crisis and subsequent 2008 credit crunch (Berger, Imbierowicz, & Rauch, 2016; Pathan & Faff, 2013; Peni & Vähämaa, 2012; Srivastav & Hagendorff, 2016). A growing body of research emphasises the importance of board structure such as high levels of board independence (Akbar, Kharabsheh, Poletti-Hughes, & Shah, 2017; Liang, Xu, & Jiraporn, 2013; Pathan, 2009), proper CEO/Chair separation (Talavera, Yin, & Zhang, 2018), high levels of board membership by women (Farag & Mallin, 2017), the existence of senior role models for women (Palvia, Vähämaa, & Vähämaa, 2015), and board quality such as high number of educated bank directors to the PhD level (Berger, Kick, & Schaeck, 2014) and the presence of financial experts (García-Sánchez, García-Meca, & Cuadrado-Ballesteros, 2017) to sustain low levels of bank risk-taking, enhance bank stability, and restore the trust of various stakeholders.

Empirical research on the role of directorship interlocks in banks has shown that board busyness, as measured by the average number of board positions held by non-executive directors, was associated with higher levels of risky subprime lending in the period 1997 to 2005 (Muller-Kahle & Lewellyn, 2011). Nguyen et al. (2015) also reported that board busyness, proxied by the number of current directorships held by bank non-executive directors, negatively affects the market performance of US banks. The negative impact of board busyness on bank performance and risk suggests that busy directors in the banking

sector hinder board ability to effectively meet its fiduciary obligations. However, Elyasiani and Zhang (2015) provide evidence that director busyness—i.e., holding many direct interlocks with other companies—has a significant impact on enhancing (reducing) US bank holding company performance (risk). That is, holding multiple directorships enables directors to bring knowledge, expertise and connections that strengthen board performance. We address inconclusive results from previous studies by linking bank well-connectedness² with other banks to bank financial stability; this is, to our knowledge, the first attempt to make this link. Sustaining bank financial stability requires the board of directors to manage and lessen risk-taking activities effectively. To do so, bank board members are responsible for setting and overseeing the implementation of policies and procedures related to risk-taking decisions, such as credit, insolvency and capital risks. To model the theoretical relationship between bank well-connectedness and bank financial stability, we extend the contemporary RBV perspective to the banking sector, conjecturing that bank well-connectedness with other banks through indirect interlocks signals board social capital that enhances board ability to perform its tasks effectively (supplying, advising and monitoring) towards controlling risk-taking activities, thus promoting bank financial stability (see Fig. 2).

2.3. Hypotheses development

Several studies have reported, drawing on resource dependence theory, that directorship interlocks between companies facilitate the contagion of strategies and policies through sharing critical and strategic information (Cai, Dhaliwal, Kim, & Pan, 2014; Chiu, Teoh, & Tian, 2012). In the extended RBV paradigm, indirectly interlocked banks have privileged access to valuable and confidential information from other banks regarding critical risk mitigation strategies and ways to improve overall bank financial stability. However, it is not possible to access or obtain accurate and diversified information in a highly regulated environment without having a strong network (Larcker et al., 2013; Mazzola et al., 2016; Renneboog & Zhao, 2014; Singh & Delios, 2017). Accordingly, one can argue that banks with many indirect connections to other banks or that act as bridges between unconnected banks would have access to more accurate and reliable information, usually with almost no additional cost. Board social capital, developed through board well-connectedness, therefore, increases the value of the circulated information, even if that information is readily available in the market (Haunschild & Beckman, 1998; Lavie, 2006; Ortiz-de-Mandojana & Aragon-Correa, 2015). Ingram and Roberts (2000) showed, through conducting interviews with leaders of hotels in Sydney, that friendship among leaders serves as an effective and

² We used the terms well-connectedness and centrality interchangeably throughout the study.

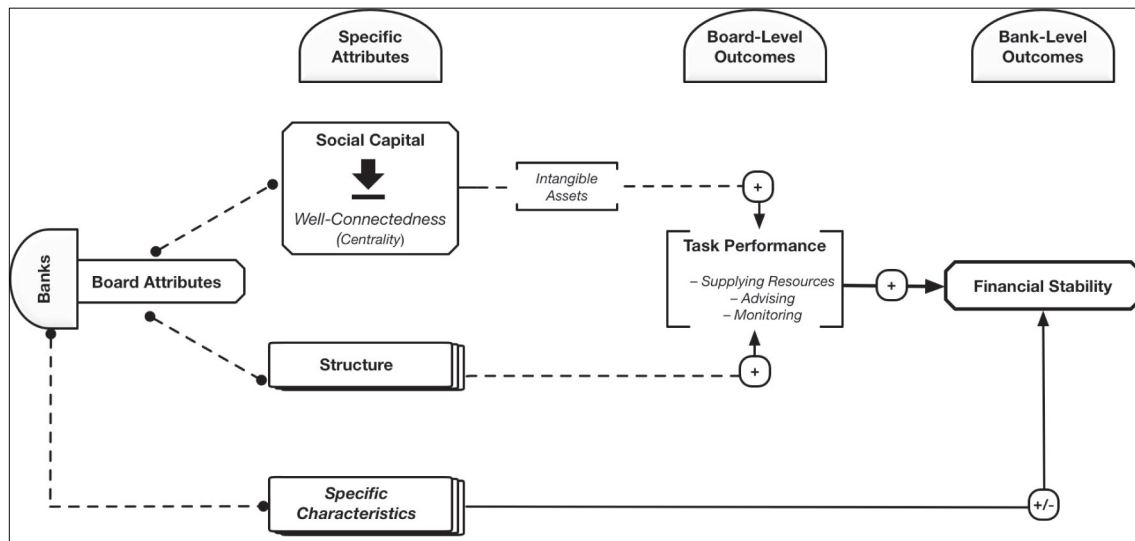


Fig. 2. Conceptual model.

reliable tool to obtain significant information about the hotel market. Applying this perspective to the financial sector, a bank that holds a central position in the banking network signals a well-endowed boardroom that has greater access to important strategic information than an isolated bank.

In addition to the benefits of exchanging essential information, it is evident that knowledge transfer is another important outcome of the interlocks (Walter et al., 2007). Prior studies have shown the importance of knowledge leakage among strategically related companies in accumulating director/board human capital, thus enhancing the board's ability to provide prompt and relevant advice (see Carpenter & Westphal, 2001; Ireland et al., 2002). Since director knowledge and expertise are essential qualities for undertaking a board advisory role in complex sectors such as banking (Berger et al., 2014; De Andrés & Vallelado, 2008; Elyasiani & Zhang, 2015), the additional human capital linked to indirect connections among bank directors is likely to aggregate boardroom capabilities with highly relevant knowledge and expertise required to fulfil its advisory role. However, ensuring the level of resource diversification requires a high number of connections between directors and a prominent position in the corporate network (Basuil & Datta, 2017; Popli et al., 2017). Accordingly, having well-connected bank directors signals stronger opportunities to aggregate boardroom knowledge with diversifiable, relevant and updated knowledge and skills. Well-connectedness then enhances the board's ability to consult effectively, professionally and promptly to develop strategies and policies that minimise bank risk and pursue bank financial stability.

While board competencies depend on having members with relevant banking skills and experience, having strong connections with other banks affects how directors and managers are incentivised when making risky decisions. The social theory of agency considers the social capital created by corporate networks as a new governance mechanism that reduces agency costs by eliminating information asymmetry and opportunistic behaviour (Wiseman et al., 2012). Strong connections with companies that operate similarly reduce uncertainty by breaking down boundaries between connected competitors (Ingram & Roberts, 2000; Lang & Lockhart, 1990; Okazaki & Sawada, 2011). Therefore, having a central position in an industry-specific network increases board ability to reduce performance pressures and mitigate competitive uncertainties, thus reducing the tendency of company managers to make risky or irrational decisions (Antoniades, 2016; Drechsler, Drechsel, Marques-Ibanez, & Schnabl, 2016; Leblebici & Salancik,

1981), as well as allowing extensive monitoring of the company's external environment (Larcker et al., 2013; Mazzola et al., 2016). Thus, the well-connectedness of a bank signals that its board can monitor the managerial behaviour efficiently by linking company management to both peers and the external environment. Opening methods of communication among bank managers and executives eliminate pressure and regulate manager incentives to make irrational or risky decisions that would affect overall bank financial stability. In line with these arguments, the theoretical relationship between board social capital and bank financial stability, illustrated in Fig. 2, leads directly to the following hypotheses:

H₁. Banks with well-connected boardrooms sustain financial stability through lowering credit risk.

H₂. Banks with well-connected boardrooms sustain financial stability through lowering insolvency risk.

H₃. Banks with well-connected boardrooms sustain financial stability through enhancing capital adequacy.

3. Research design and methodology

3.1. Sample

Our initial sample comprised all national and state US commercial banks listed as of December 31, 2015 in the New York Stock Exchange (NYSE), American Stock Exchange (Amex), and Nasdaq. The inclusion criteria for our study sample were: (i) having a Standard Industrial Classification (SIC) code of either 6021 (assigned to national banks) or 6022 (assigned to state banks) and (ii) being continuously listed with completed accounting, financial, and corporate governance (CG) data during the seven-year period of 2009–2015. This focused dataset captures the existence, magnitude and implication of well-connectedness among continuously listed banks that operate similarly and that are uniformly regulated. Having applied these criteria, we obtained a balanced study sample of 504 bank-years observations for 168 banks (76 national banks and 92 state banks) for 2010, 2012, and 2014. Because several previous studies have found that board tenure does not change significantly over time (Baselga-Pascual, Trujillo-Ponce, Vähämaa, & Vähämaa, 2018; Reeb & Zhao, 2013), we left a two-year gap to allow for changes in the composition of bank boards.

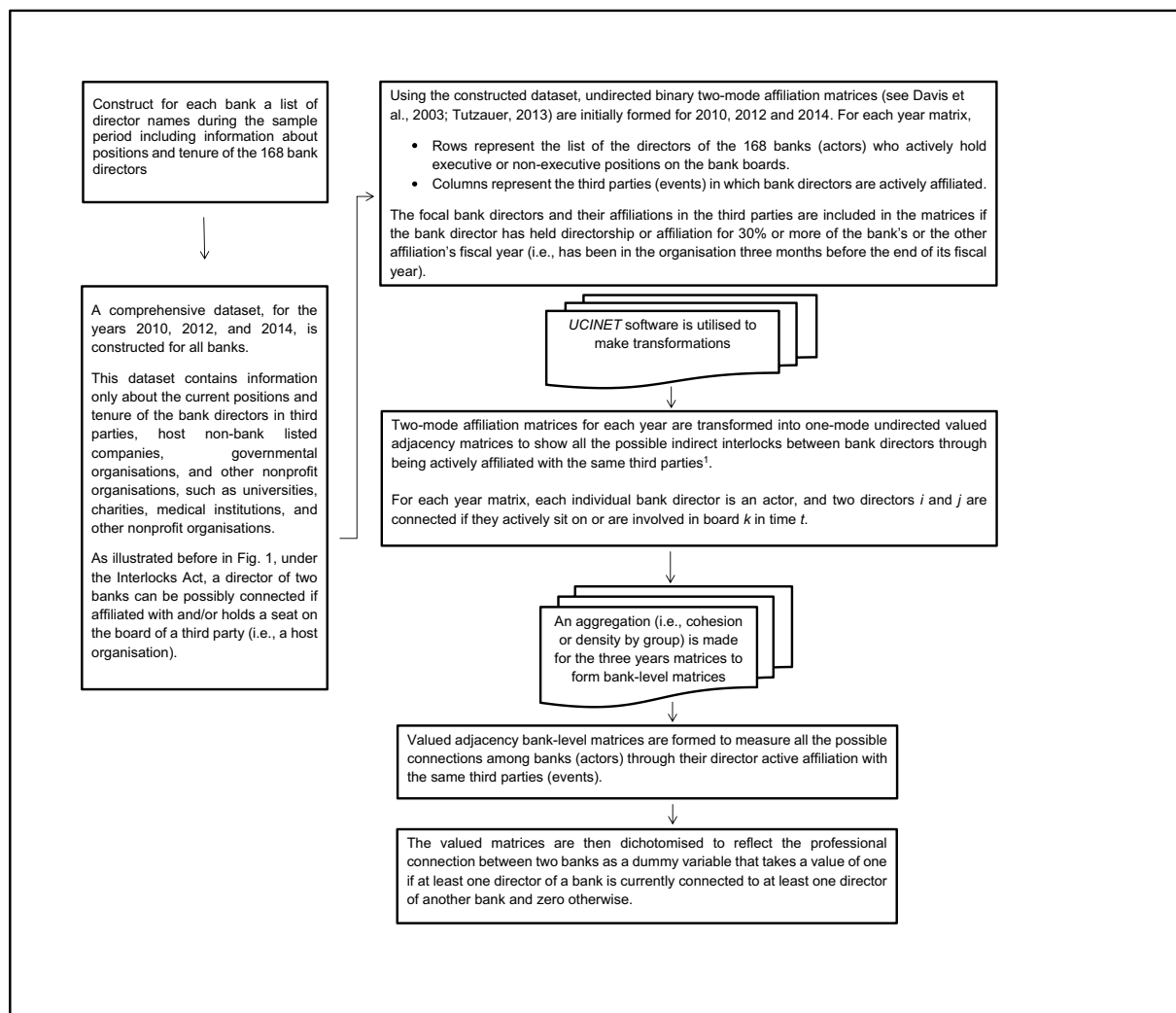


Fig. 3. Sequences of steps used in constructing centrality measures.

An adjacency matrix is a squared matrix that has an equal number of rows and columns reflecting the unit of analysis (i.e., bank directors or banks). The one-mode adjacency matrix can be either binary or valued. The cell of the binary adjacency matrix takes a value of one if there is at least a common relationship between two directors or banks and zero otherwise. However, the cell in the valued adjacency matrix reflects the number of all possible common connections between two directors (Tutzauer, 2013).

3.2. Variables

3.2.1. Dependent variables

A bank's ability to manage different types of risks indicates, to a great extent, bank financial stability (BFS) (Berger et al., 2009). We employed three different bank risk indicators to proxy for BFS. We first used credit risk, calculated by the ratio of non-performing assets to total loans (*NPA*), as the first measure of BFS. Non-performing assets reflect loans that are at least 90 days in default or are in arrears on scheduled payments of principal or interest (Grove, Patelli, Victoravich, & Xu, 2011; Thiagarajan, Ayyappan, & Ramachandran, 2011). Hence, *NPA* indicates a bank credit quality.

Second, we used insolvency risk. We measured this indicator by the *Z-SCORE*, which is a well-established measure for the probability that negative bank returns would force it to default or bankrupt (Akbar et al., 2017; Bhagat, Bolton, & Lu, 2015; Elyasiani & Zhang, 2015). *Z-SCORE* is calculated as $(ROA + CAR)/\sigma(ROA)$, where *ROA* represents earnings divided by assets, *CAR* represents the capital-asset ratio, and $\sigma(ROA)$ represents the standard deviation of *ROA*. Accordingly, a *Z-SCORE* with a high value indicates that the bank has sufficient profit to cover its debt liability and, hence, has a lower probability to default or bankrupt (Bai & Elyasiani, 2013). The average *Z-SCORE* of the 168

banks over the period of study was highly skewed. Therefore, we used the natural logarithm of the *Z-SCORE* to adjust for high skewness (see Elyasiani & Zhang, 2015; Laeven & Levine, 2009).

Finally, we used the Basel Tier 1 capital ratio (*TIER-1*), which indicates bank adherence to the bank's regulatory capital ratio or, in other words, the bank's prudence in maintaining adequate capital, as the third proxy for BFS. Capital levels are associated with bank willingness to undertake riskier activities (Berger et al., 2009) and could have significant impacts on attracting current and potential investors (Chen & Lin, 2016b). The *BANK COMPUSTAT* and *Bloomberg* databases are the sources used for the accounting and financial data.

3.2.2. Independent variables

We employed a bank's well-connectedness (i.e., centrality) in the boardroom network as a proxy of board social capital. Due to the multidimensional nature of the centrality concept, we used the UCINET software package (Borgatti, Everett, & Freeman, 2002) to calculate three basic types of commonly applied network centrality measures: degree, reachability, and betweenness (Ben Barka & Dardour, 2015; Larcker et al., 2013). Degree centrality (*DEGREE*) is the first-degree bank connections. Hence, a high *DEGREE* indicates that a bank is central in the network in terms of having directors who have unique direct

communications with many other bank directors in third parties. Regarding the second board social capital proxy, this article used reachability centrality (*REACH*) to count the number of banks that can be reached in the network through its first-degree connections (Borgatti, Everett, & Johnson, 2018). Therefore, a bank is considered to be well-connected if it is connected to banks that are also well-connected. Finally, we used betweenness centrality (*BETWEEN*) to capture the intermediary role of a bank in the network. Thus, *BETWEEN* indicates the ability of a bank to integrate other unconnected banks into its network and, hence, that bank's well-connectedness and importance in the network (Fracassi, 2016). Thus, a bank boardroom with high betweenness centrality is expected to be in a dominant position. Namely, such a bank boardroom can access massive flows of relevant and accurate information, aggregate the knowledge and skills of its own members and those of different neighbours, and control the flow of information and resources among the unconnected banks.

To accurately calculate the three centrality measures, we first collected biographical information about the bank directors mainly from the *BoardEx* database. To complete any missing biographical information, we then supplemented with hand-collected data from *SEC filings*, such as proxy statements (*DEF 14A*) and annual reports (*10K*), and from *Thomson One Banker*, *Bloomberg*, and *LexisNexis*. Next, following prior research on social network analysis (Bruynseels & Cardinaels, 2013; Fracassi, 2016; Haunschild, 1993; Hwang & Kim, 2009; Kim, 2005, 2007), we performed the steps shown in Fig. 3.

3.2.3. Control variables

In line with prior studies (Bai & Elyasiani, 2013; Bhagat et al., 2015; Elyasiani & Zhang, 2015; Haynes & Hillman, 2010; Kanas, 2013; Laeven, Ratnovski, & Tong, 2016; Louati, Louhichi, & Boujelbene, 2016; Palvia et al., 2015; Vallascas & Hagendorff, 2013), we accounted for the potential effect of a set of bank-specific variables as well as various board structural and compositional characteristics on BFS variables. We controlled for bank size (*LOGSIZE*), profitability (*PROFIT*), bank risk (*VOLATILITY*), CEO pay-performance sensitivity (*DELTA*), leverage (*LEVERAGE*), bank liquidity (*LOANS*), bank funding policy (*DEPOSITS*), bank cost efficiency (*EFFICIENCY*), and dividend payout (*DIVIDEND*). We used *BANK COMPUSTAT* and *Bloomberg* to collect the accounting and financial data required to calculate bank-specific control variables. The percentage of independent directors (*INDEPEND*), average board age (*AGE*), and percentage of women on the board (*WOMEN*) are also included to control for the potential impact of board incentives, overall experience, and diversity, respectively, on BFS. Additionally, we aimed to use director educational background and financial experience (*EDU_EXPERT*), measured by the ratio of the number of directors who hold accounting, finance, and/or banking certificates to board size, as a control variable to mitigate the possible omitted variable bias (i.e., unobservable heterogeneity problem). Furthermore, because equity-based compensation is suggested to have a significant impact on allaying the incentives of board members with shareholders' interests (Bai & Elyasiani, 2013; Bouslah, Liñares-Zegarra, M'Zali, & Scholtens, 2018; Mehran & Rosenberg, 2008), we controlled for the potential effect of CEO stock awards (*CEO_AWARD*) on bank risk variables. We collected CG and board characteristics data from *BoardEx*, *Bloomberg*, and *SEC filings*.

3.3. Descriptive statistics

Table 1 presents the summary statistics for all variables used in the analysis. Detailed definitions, along with the data sources of the study's variables, are provided in Appendix A. First, the mean values of *NPA* and *Z-SCORE* were -3.888 and 3.894 , respectively. Compared with Elyasiani and Zhang (2015), the average *Z-SCORE* was unchanged over time despite the severe consequences of the crisis. The mean value of *TIER-1* was 13.638% , revealing that, on average, banks have a comfortable buffer as their Tier 1 capital ratio exceeds the Basel minimum

requirements.³ Regarding the first centrality measure, the average number of banks that a bank was connected with through their director direct communications with the same third parties (*DEGREE*) was five. Regarding the second centrality measure, on average, 31 banks could be reached in two steps (*REACH*). Finally, the average number of times that a bank could be an actor on the shortest path connecting two other banks (*BETWEEN*) was approximately 92. In the presence of the Interlocks Act, the mean centrality measures of our sample confirmed Lang and Lockhart's (1990) findings and Baccini and Marroni's (2016) argument and highlight the importance of third parties in facilitating direct communications among bank directors.

The average size of the commercial banks (*SIZE*) was \$53.693 billion. The market-to-book ratio (*PROFIT*) was, on average, 10.4% , while the average stock volatility (*VOLATILITY*) was 3.458% . The table also shows that the mean leverage (*LEVERAGE*) was 89.5% , and the mean deposit to liabilities ratio (*DEPOSITS*) was 88.2% , indicating that banks, unlike non-financial companies, are highly leveraged and depend heavily on deposits as the principal source of funding. Moreover, the mean bank loan (*LOANS*) was 64.2% relative to total assets, with an average cost efficiency (*EFFICIENCY*) of 66.5% .

Regarding board characteristics, the commercial banks had, on average, 11 directors on their boards (*BOARD SIZE*). Thus, the average board size of the commercial banks was smaller than that (i.e., 14 directors approximately) reported by Elyasiani and Zhang (2015) for US bank holding companies over the period of 2001–2010. This difference in size suggests that US commercial banks have recently tended to reduce their board size. Board independence (*INDEPEND*) was, on average, approximately 82% . Women's representation on boards (*WOMEN*) was, on average, 12% . The mean board age (*AGE*) was approximately 63 years, and 12% of board members, on average, held an accounting, finance, and/or banking certificate (*EDU_EXPERT*).

Table 2 presents the properties of the indirect interlock network among the US commercial banks over the period of the study. The number of network sub-groups with a minimum of two connected banks decreased from two in 2010 to one in 2012 but then increased to four in 2014. The size of the largest network sub-group increased consistently from 124 banks in 2010 to 137 banks in 2014. This latter increase explained the notable increase in the number of ties from 758 in 2010 to 1066 in 2014. Additionally, the actual number of ties relative to the total number of possible ties in the network gradually increased from 0.027 in 2010 to 0.038 in 2014, implying that the banking network density had increased over the years. The finding may also explain the reduction in the average distance between banks from 3.085 in 2010 to 2.817 in 2014. Table 2 also presents a fragmentation measure, reflecting the proportion of banks that cannot reach other. The table shows a significant decrease in the fragmentation from 45.6% in 2010 to 36.6% in 2014, indicating that banks tend to reduce the social and physical distance between them by establishing more connections. The lowest value of fragmentation, which emerged in 2012, can be explained by the highest value of *BETWEEN*, which was 102.906 in 2012; in comparison, in 2010 and 2014, the values of *BETWEEN* were 82.266 and 89.733, respectively. Not surprisingly, the number of isolated banks significantly decreased from 42 in 2010 to 25 in 2014. The very existence of indirect interlocks among US banks over years contradicts Hernandez, Sanders, and Tuschke's (2015) findings that German companies tend to terminate their direct interlocks with companies that facilitate connections with competitors to prevent leakage of strategic knowledge, revealing that US banks are keen to extensively benefit from the direct interlocks with third parties to establish interbank networks.

³ The Basel II capital framework establishes a minimum requirement for a Tier 1 capital of 4% of risk-weighted assets, while the Basel III capital framework increases the minimum requirement for a Tier 1 capital of 6% of risk-weighted assets.

Table 1

Descriptive statistics of all variables for all (504) bank-years.

	Mean	Median	SD	Min	Max	Skewness	Kurtosis
NPA	−3.888	−3.895	0.951	−7.310	0.000	−0.082	4.166
Z-SCORE	3.894	4.054	1.365	−0.176	7.892	−0.413	3.237
TIER-1	13.638	13.360	2.639	6.810	21.280	0.664	3.700
DEGREE	5.149	3.000	5.337	0.000	19.000	1.218	3.626
REACH	31.464	27.500	28.175	0.000	116.000	0.696	2.598
BETWEEN	91.635	12.206	146.100	0.000	499.325	1.754	4.925
INDEPEND	0.821	0.846	0.096	0.500	1.000	−0.956	3.290
AGE	62.507	62.333	3.604	47.620	77.860	0.427	4.784
WOMEN	0.116	0.100	0.091	0.000	0.400	0.544	2.849
EDU_EXPERT	0.123	0.111	0.096	0.000	0.333	0.497	2.459
SIZE (US\$ in billion)	53.694	3.397	273.665	0.402	257.313	7.317	57.788
LOGSIZE	8.391	8.131	1.476	6.450	11.986	0.902	3.162
PROFIT	0.104	0.126	0.345	−0.747	0.706	−0.396	2.845
VOLATILITY	3.458	3.347	0.394	2.956	4.543	0.941	3.274
DELTA	0.040	0.032	0.098	−0.168	0.230	0.046	2.787
LEVERAGE	0.895	0.896	0.019	0.859	0.930	−0.090	2.230
CEO_AWARD	0.083	0.116	0.063	0.000	0.167	−0.476	1.401
LOANS	0.642	0.650	0.104	0.400	0.799	−0.671	2.923
DEPOSITS	0.882	0.893	0.062	0.744	0.972	−0.583	2.473
EFFICIENCY	0.665	0.657	0.116	0.469	0.958	0.556	3.199
DIVIDEND	0.021	0.019	0.019	0.000	0.062	0.641	2.394
BOARD_SIZE	2.412	2.398	0.237	1.946	2.833	−0.199	2.389
BOARD SIZE	11.488	11.000	2.819	5.000	21.000	0.391	3.015
N_BANK	20.617	14.000	16.049	1.000	57.000	0.818	2.491

Notes: The table presents the descriptive statistics for the 168 US publicly listed national and state commercial banks for 2010, 2012, and 2014. *NPA* represents credit risk. *Z-SCORE* represents insolvency risk. *TIER-1* represents capital risk. *DEGREE* represents the focal bank first-degree connections. *REACH* represents the number of banks in the sample that the focal bank can reach in two steps. *BETWEEN* represents the number of the shortest paths linking any two banks in the network that pass through the focal bank. *INDEPEND* represents board independence. *AGE* represents board average age. *WOMEN* represents percentage of women directors on the board. *EDU_EXPERT* represents the percentage of directors with relevant educational background and financial experience. *SIZE* represents bank total assets. *LOGSIZE* represents the natural logarithm of bank total assets. *PROFIT* represents market to book ratio. *VOLATILITY* represents bank risk. *DELTA* represents CEO pay-performance sensitivity. *CEO_AWARD* represents CEO stock award. *LOANS* represents bank liquidity. *DEPOSITS* represents bank funding. *EFFICIENCY* represents bank cost efficiency. *DIVIDEND* represents dividend payout. *BOARD_SIZE* represents the natural logarithm of the number of directors on the board. *BOARD SIZE* represents the number of directors on the board. *N_BANK* represents the number of banks headquartered in the state where the focal bank is headquartered. All variables are defined with their data sources in [Appendix A](#).

Table 2

Structure of the indirect interlock network among the US commercial banks by year.

	2010	2012	2014
Number of banks	168	168	168
DEGREE	4.399	4.964	6.083
REACH	25.786	29.595	39.012
BETWEEN	82.266	102.906	89.733
Isolated banks	42.000	30.000	25.000
Sub-groups (minimum 2 linked banks)	2.000	1.000	4.000
Number of banks in the largest sub-group	124.000	138.000	137.000
Number of cores (sub-components)	6.000	8.000	9.000
Number of ties	758.000	866.000	1066.000
Density	0.027	0.031	0.038
Avg. distance	3.085	3.182	2.817
Fragmentation	0.456	0.326	0.336

Notes: The table presents the properties of the indirect interlock network among US commercial banks in 2010, 2012, and 2014. *DEGREE* represents the number of banks that the focal bank is connected with through their director indirect interlocks in the same third parties. *REACH* represents the number of banks in the sample that the focal bank can reach in two steps. *BETWEEN* represents the number of the shortest paths linking any two banks in the network that pass through the focal bank. *Isolated banks* is the number of banks that are not connected. *Sub-groups* represents the number of groups in which at least two banks are connected. *Number of cores* represents subcomponents within which all individuals have the highest possible numbers of internal ties. *Density* represents the total number of actual ties over the total number of possible ties. *Avg. distance* represents the average length of the shortest path between two nodes or banks. *Fragmentation* represents the proportion of banks that cannot reach other.

[Table 3](#) shows the average well-connectedness of the ten largest banks in the sample. All the centrality measures of these ten banks are larger than the average centrality measures of the whole sample. Bank of New York Mellon Corporation (Bank of New York Mellon) and Bank of America Corporation (Bank of America) exhibit the highest average *DEGREE*, *REACH*, and *BETWEEN* over the period of the study. JPMorgan Chase & Co. (JPMorgan), the largest bank in the sample, interestingly has the lowest average *DEGREE* and *REACH* among the ten largest banks. However, because JPMorgan is a well-established bank, its well-connectedness with other banks may still plays an important role in its board governance, complementing its other governance strategies. [Table 3](#) also shows that State Street Corporation has the lowest average *BETWEEN* among the ten largest banks. The results reported in [Table 3](#) broadly signify the essence of the well-connectedness, formed through multiple indirect interlocks (IDIs), among bank boardrooms.

Using NetDraw software for network visualisation ([Borgatti, 2002](#)), [Figs. 4, 5, and 6](#) show visualisations for the connections among banks in 2010, 2012, and 2014, respectively. The shapes (circles, squares, triangles, upside-down triangles, and boxes) in each figure represent the network sub-groups. Consistent with the results reported in [Table 2](#), [Fig. 5](#) shows that 2012 has only two shapes (i.e., circles for the connected banks and squares for the isolated banks), while 2010 and 2014 have three and five shapes, respectively. In other words, while 2012 has one network sub-group, 2010 and 2014 have two and four network sub-groups, respectively. The high average betweenness centrality in 2012, which was the highest average of all three years, can explain the singular sub-group in 2012's network. Namely, high betweenness centrality increases the connectedness among banks, reduces the distance among unconnected banks, and contributes to eliminating the

Table 3
Average well-connectedness of the ten largest banks.

	Total assets (US\$ in billion)	Degree	Reach	Between
JPMorgan Chase & Co.	2349.957	10.667	67.000	320.171
Bank of America Corporation	2193.139	23.667	101.000	810.629
Wells Fargo & Company (recently WFC Holdings Corporation)	1456.084	22.000	91.333	630.527
US Bancorp	354.723	17.667	79.333	597.458
Bank of New York Mellon Corporation	330.517	29.000	102.667	1370.321
PNC Financial Services Group, Inc.	304.821	22.000	95.667	629.286
State Street Corporation	219.069	17.333	86.667	283.724
Suntrust Banks Inc.	178.881	20.000	89.667	465.685
BB&T Corporation	175.922	18.333	88.333	802.858
Fifth Third Bancorp	123.869	15.333	77.667	462.930

Notes: The table presents the average well-connectedness of the ten largest banks in the sample for 2010, 2012, and 2014. *DEGREE* represents the number of banks that the focal bank is connected with through their director indirect interlocks in the same third parties. *REACH* represents the number of banks in the sample that the focal bank can reach in two steps. *BETWEEN* represents the number of the shortest paths linking any two banks in the network that pass through the focal bank.

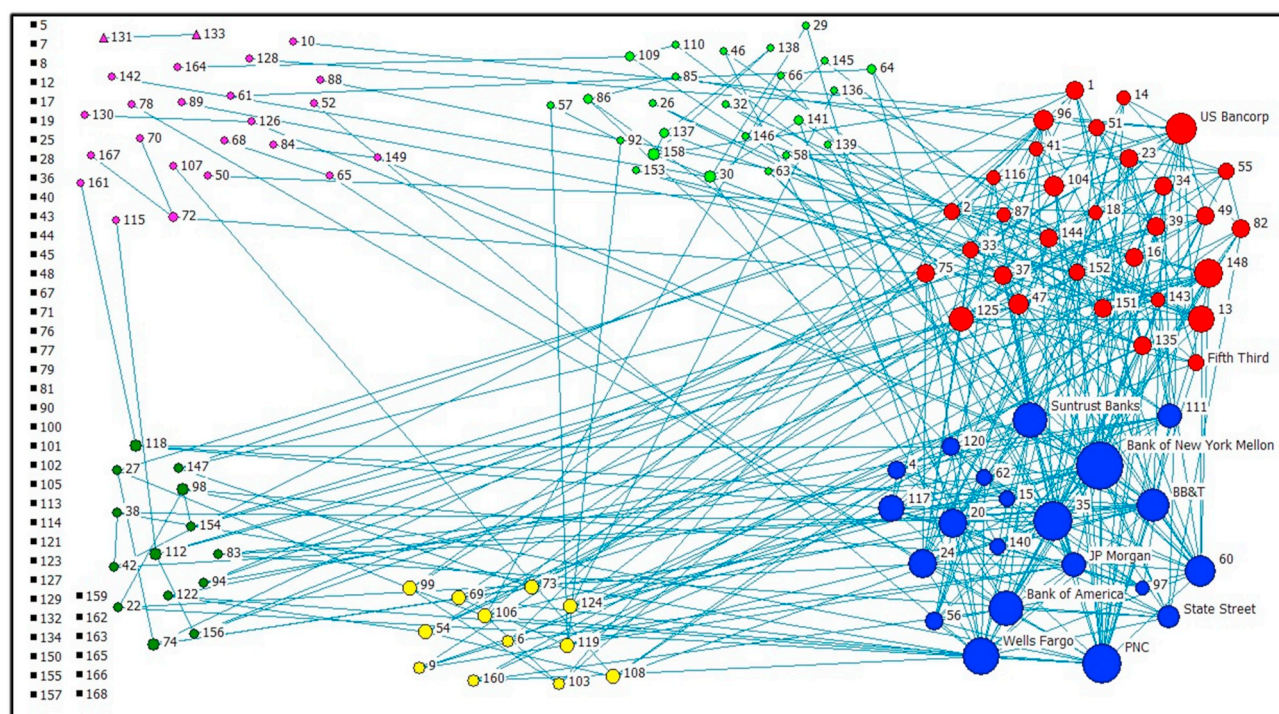


Fig. 4. Indirect interlock network among the 168 US commercial bank in 2010.

Notes: The figure shows the indirect interlock network among the 168 US commercial banks in 2010. The shapes (i.e., circles, squares, and triangles) represent the network sub-groups. The size of each bank (i.e., node) in the network represents the *DEGREE* centrality of the bank. The node's colour reflects the *k*-core (sub-graph) that the node belongs to. Bank name is shown for the ten largest banks in the sample.

possibility of isolated banks.

The size of each bank (i.e., node) in the networks represents the *DEGREE* of the bank. Hence, the larger is the size of the node, the higher is the degree value of that node.⁴ Consistent with Table 3, Bank of New York Mellon in each of the three figures has the largest node over the three years, confirming that it has the largest *DEGREE*. Finally, the node's colour reflects the *k*-core (sub-graph) to which the node belongs. According to Larsen and Ellersgaard (2017, p. 60), “K-cores are a central subcomponent within which all individuals have the highest possible numbers of internal ties. Each individual is assigned a coreness score corresponding to the minimum degree of individuals they are connected to”. Figs. 4, 5, and 6 show that the number of the sub-component increased from seven in 2010 to ten in 2014.

⁴ In the three figures, the bank name is shown for the ten largest banks in the sample.

Table 4 shows the correlation among BFS variables, bank centrality measures, and controls for the 168 US commercial listed banks for 2010, 2012, and 2014. Spearman non-parametric (Pearson) correlation coefficients are in the upper (lower) triangle. A correlation coefficient of 0.80 or more indicates high collinearity among variables, thus econometric problems (Akbar et al., 2017; Gujarati, 2003). As expected, the correlation coefficients (Pearson and Spearman) for all three centrality measures exceeded 0.80; hence, the measures were highly correlated. Avoiding the potential multicollinearity problem then requires examining the impact of each centrality measure separately in different models. After applying different models for each centrality measure, the untabulated results of variance inflation factors (VIF) confirmed the absence of multicollinearity among the regressors in all models.

Table 4 also reports a significant negative correlation between the three centrality measures and *NPA* and *TIER-1* and a significant positive association with *Z-SCORE*. This result suggests that the well-connected

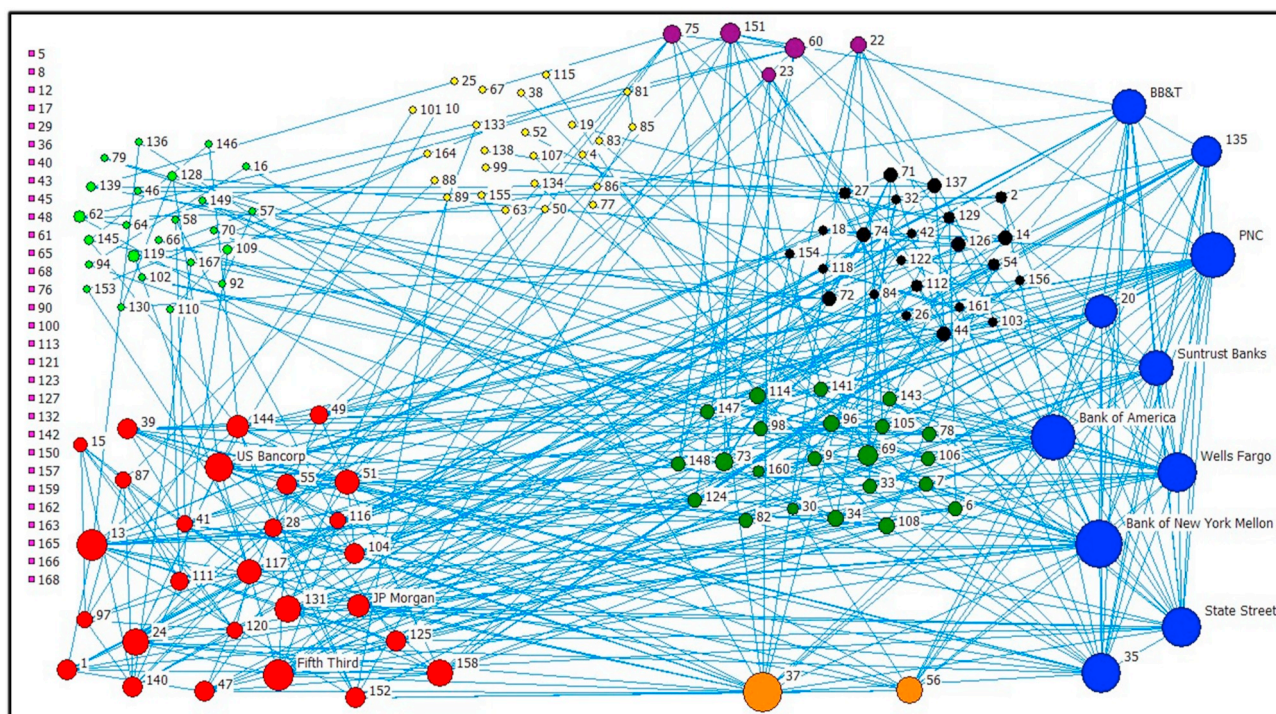


Fig. 5. Indirect interlock network among the 168 US commercial bank in 2012.

Notes: The figure shows the indirect interlock network among the 168 US commercial banks in 2012. The shapes (i.e., circles and squares) represent the network sub-groups. The size of each bank (i.e., node) in the network represents the *DEGREE* centrality of the bank. The node's colour reflects the *k*-core (sub-graph) that the bank belongs to. Bank name is shown for the ten largest banks in the sample.

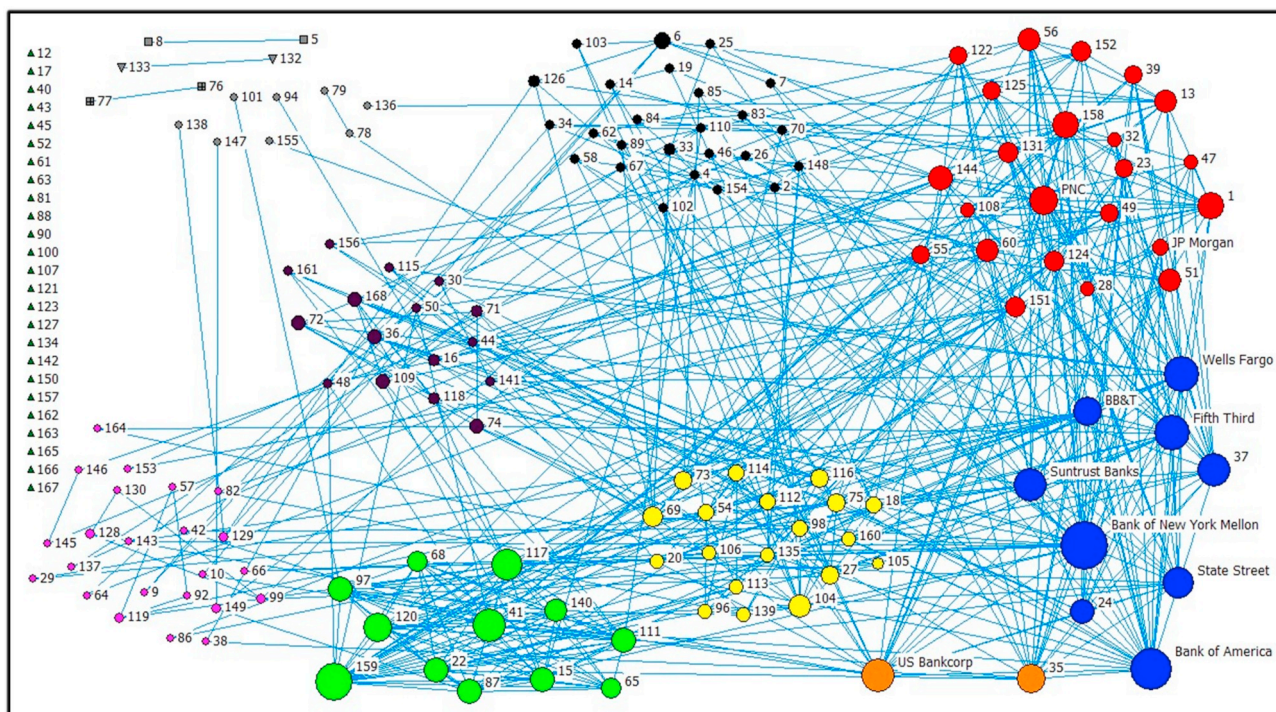


Fig. 6. Indirect interlock network among the 168 US commercial bank in 2014.

Notes: The figure shows the indirect interlock network among the 168 US commercial banks in 2014. The shapes (i.e., circles, squares, triangles, upside-down triangles, and boxes) represent the network sub-groups. The size of each bank (i.e., node) in the network represents the *DEGREE* centrality of the bank. The node's colour reflects the *k*-core (sub-graph) that the bank belongs to. Bank name is shown for the ten largest banks in the sample.

Table 4
Pearson-Spearman correlation matrix of all variables for all (504) bank-years.

	1	2	3	4	5	6	7	8	9	10	11
1) NPA											
2) Z-SCORE	-0.401 ^c										
3) TIER-1	0.090 ^b	-0.457 ^c									
4) DEGREE	-0.173 ^c	0.062	0.129 ^c								
5) REACH	-0.215 ^c	0.092 ^c	0.019	-0.231 ^c							
6) BETWEEN	-0.100 ^b	0.122 ^c	-0.154 ^c	-0.175 ^c							
7) INDEPEND	-0.075 ^a	0.053	-0.171 ^c	0.938 ^c							
8) AGE	-0.016	0.012	-0.035	0.873 ^c							
9) WOMEN	-0.272 ^c	0.081 ^a	0.078 ^a	0.207 ^c							
10) EDU_EXPERT	-0.170 ^c	0.120 ^c	-0.030	0.000							
11) LOGSIZE	-0.211 ^c	0.043	0.080 ^a	0.337 ^c							
12) PROFIT	-0.440 ^c	0.270 ^c	-0.180 ^c	0.669 ^c							
13) VOLATILITY	0.540 ^c	0.016	0.028	0.081 ^a							
14) DELTA	-0.061	0.016	-0.020	0.056							
15) LEVERAGE	0.131 ^c	-0.204 ^c	-0.415 ^c	-0.111 ^b							
16) CEO_AWARD	-0.287 ^c	0.154 ^c	-0.163 ^c	0.358 ^c							
17) LOANS	0.008	-0.097 ^b	-0.304 ^c	-0.195 ^c							
18) DEPOSITS	0.048	-0.065	0.081 ^a	-0.231 ^c							
19) EFFICIENCY	0.311 ^c	-0.420 ^c	-0.079 ^a	-0.013							
20) DIVIDEND	-0.298 ^c	0.485 ^c	0.135 ^c	-0.019							
21) BOARD_SIZE	-0.152 ^c	0.143 ^c	-0.200 ^c	0.406 ^c							
22) N_BANK	-0.046	0.033	0.000	0.051							
1) NPA											
2) Z-SCORE	0.268 ^c	0.590 ^c	-0.070	0.140 ^c							
3) TIER-1	0.004	-0.517 ^c	0.013	-0.167 ^c							
4) DEGREE	0.081 ^a	-0.014	-0.056	-0.370 ^c							
5) REACH	0.116 ^c	-0.258 ^c	0.074 ^a	-0.108 ^b							
6) BETWEEN	0.075 ^a	-0.294 ^c	0.089 ^b	-0.112 ^b							
7) INDEPEND	0.012	-0.244 ^c	0.094 ^b	-0.087 ^a							
8) AGE	0.050	-0.096 ^b	-0.026	-0.165 ^c							
9) WOMEN	0.151 ^c	-0.110 ^b	0.012	-0.125 ^c							
10) EDU_EXPERT	0.017	-0.253 ^c	0.028	-0.108 ^b							
11) LOGSIZE	0.341 ^c	-0.052	0.063	-0.044							
12) PROFIT	-0.437 ^c	-0.437 ^c	0.097 ^b	-0.243 ^c							
13) VOLATILITY	-0.535 ^c	-0.480 ^c	0.093 ^b	-0.007							
14) DELTA	0.100 ^b	-0.091 ^b	-0.088 ^b	0.270 ^c							
15) LEVERAGE	0.239 ^c	0.315 ^c	0.005	-0.022							
16) CEO_AWARD	-0.056	-0.310 ^c	0.257 ^c	-0.166 ^c							
17) LOANS	-0.123 ^c	0.159 ^c	0.057	0.027							
18) DEPOSITS	-0.027	0.034	-0.046	-0.109 ^b							
19) EFFICIENCY	-0.429 ^c	0.366 ^c	-0.030	0.214 ^c							
20) DIVIDEND	0.491 ^c	-0.454 ^c	0.020	-0.085 ^a							
21) BOARD_SIZE	0.096 ^b	-0.216 ^c	0.093 ^b	-0.031							
22) N_BANK	-0.013	0.010	-0.056	-0.088 ^b							

Notes: The table presents the correlation coefficients among the main regression variables for the 168 US publicly listed national and state commercial banks for 2010, 2012, and 2014. The bottom half of the table displays Pearson's parametric correlation coefficients, whereas the upper right half of the table displays Spearman's non-parametric correlation coefficients. All variables are defined with their data sources in [Appendix A](#).
^a, ^b, and ^c indicate the significance at the 10%, 5%, and 1% levels, respectively.

banks can effectively reduce credit risk and insolvency risk but that they exhibit high capital risk. Additionally, the three centrality measures correlate significantly and positively with *LOGSIZE*, *INDEPEND*, *WOMEN*, and *CEO_AWARD*, but negatively with *VOLATILITY*, *LEVERAGE*, *LOANS*, *DEPOSITS*, and *DIVIDEND*. First, this finding implies that well-connected banks tend to be larger and have higher percentages of independent directors and women on their boards. Moreover, it implies that well-connected banks experience less stock price volatility and are more oriented towards issuing stock awards to their CEOs but not towards issuing dividends to the shareholders.

3.4. Research design

Endogeneity is a highly prevalent problem in most corporate finance and CG research (Akbar et al., 2017; Bhagat et al., 2015; Elyasiani & Zhang, 2015; Okazaki & Sawada, 2011; Palvia et al., 2015). The unobservable heterogeneity problem is mitigated by controlling for the effect of director educational and financial background. The possibility that bank risk variables may be determined simultaneously with bank well-connectedness (i.e., the reverse causality problem) is considered next. This potential problem constitutes the main source of the endogeneity that could drive the relationship between BFS variables and centrality measures. For example, banks with high-risk exposures tend to appoint directors with many indirect connections with other bank directors to benefit from director relevant knowledge, skills, and expertise (Homroy & Slechten, 2017) and/or from the possibility of getting rare and valuable information from competitors (Ingram & Roberts, 2000; Okazaki & Sawada, 2011).

Based on these perspectives, we conducted Hausman's (1978) endogeneity test between the bank risk variables and centrality variables along with the other relevant tests to address and control the potential endogeneity issue. Tables 5, 6, and 7 show small *p*-values of the Hausman's endogeneity test. These *p*-values reject the exogeneity of the centrality measures, confirming that standard econometric tools such as the ordinary least squares (OLS) estimator cannot be applied to account for the endogeneity problem. Moreover, because the changes in the board composition are not significant over time (Baselga-Pascual et al., 2018), applying the difference-in-differences (Arellano & Bover, 1995) and generalised method of moments (GMM) (Blundell & Bond, 1998) estimation techniques would not be feasible in our case to mitigate the endogeneity problem. We only have one potential endogenous variable—i.e., the bank well-connectedness variable—in each model. Our models, therefore, would require at most one valid instrumental variable, unlike Baselga-Pascual et al.'s (2018) models, which have seven potentially endogenous variables. Accordingly, applying the identification strategy of instrumental variables (IV) to estimate the two-stage least square (2SLS) models is feasible in this study to alleviate the endogeneity concerns. The validity of the IV approach is conditioned by the extent to which the chosen instrument(s) is highly correlated with the endogenous variable(s) (i.e., centrality variable(s)) but not with the dependent variable(s) (i.e., BFS variable(s)).

We used board size (*BOARD_SIZE*) as our bank-specific instrumental variable (see Okazaki & Sawada, 2011). The larger is the board size, the greater is the possibility that its directors have multiple directorships or active affiliations in many third parties. Therefore, a large bank board is subject to high levels of professional connections with many other bank directors in these third parties and, hence, likely holds a more prominent position in the network. Prior studies report inconclusive evidence for the relationship between bank risk and board size (Akbar et al., 2017; Berger et al., 2014; Elyasiani & Zhang, 2015; Talavera et al., 2018). Thus, *BOARD_SIZE* is expected to have a significant positive association with the centrality measures but to be uncorrelated with the error term of the second-stage regression. The number of banks headquartered in the state where the focal bank is headquartered (*N_BANK*) was also employed as another instrumental variable. The use of *N_BANK* was justified based on directors of banks headquartered in one

state being expected to be more indirectly interlocked with each other. Hence, the higher is the number of banks headquartered in the focal bank's state, the greater is the possibility that the focal bank is well-connected and central in the network (Okazaki & Sawada, 2011). Accordingly, *N_BANK* is expected to have a positive coefficient with the centrality measures but to be uncorrelated with the error term of the second-stage regression. Due to the theoretical plausibility that might exist among the instruments, this study additionally performed the following set of specification tests: the Stock and Yogo's (2005) weak instrument test, Anderson-Rubin joint significance test, and Hasen-Sargan over-identification test. These tests ensured the validity and relevance of the instruments.

In the first stage of 2SLS estimation, as shown in Eq. (1), we regressed each centrality measure (*CENT*) on the two instrumental variables and all the exogenous variables to obtain the predicted values of each *CENT*. Next, these predicted values were used in a second stage that involves regressing BFS variables (*RISK*) on the predicted values of each *CENT* and all the exogenous variables, as shown in Eq. (2).

First-stage model:

$$CENT_{it} = \beta_0 + \beta_1 BOARD_SIZE_{it} + \beta_2 N_BANK_{it} + \Theta X_{it} + \varepsilon_{it} \quad (1)$$

where

CENT_{it} is the bank well-connectedness or centrality measures (namely, *DEGREE*, *REACH*, and *BETWEEN*).

BOARD_SIZE_{it} is number of directors on the bank board.

N_BANK_{it} is the number of banks headquartered in the state in which the focal bank is headquartered.

X_{it} is the set of the control variables (exogenous variables).

Second-stage model:

$$RISK_{it} = \beta_0 + \beta_1 CENT_{it} + \Theta X_{it} + \varepsilon_{it} \quad (2)$$

where *RISK_{it}* is the bank risk variables (namely, *NPA*, *Z-SCORE*, and *TIER-1*).

4. Analyses and findings

4.1. Main regression results

Columns 1, 3, and 5 in Tables 5, 6, and 7, respectively, show the results of the first-stage regression of the two instruments on *CENT*. As predicted, *BOARD_SIZE* and *N_BANK* were positively and significantly correlated with *CENT* measures (*DEGREE*, *REACH*, and *BETWEEN*). For the tests undertaken to ensure model validity, the weak instrument test indicated that the instruments are not weak, but valid. Specifically, the first stage's Kleibergen-Paap rk Wald *F* statistic exceeds the Stock and Yogo (2005) critical value. The small *p*-values of the Anderson-Rubin test also demonstrated the validity of the instruments and joint significance of the system. Moreover, the high *p*-values of the Hansen *J* test, the over-identification test of all instruments, did not reject the null hypothesis, confirming that the instruments are uncorrelated with the error term and suggesting the validity of the instruments.

4.1.1. Bank well-connectedness and credit risk (NPA)

Columns 2, 4, and 6 in Table 5 present the results of the association between the predicted values of bank centrality measures (*DEGREE*, *REACH*, and *BETWEEN*, respectively) and bank credit risk (*NPA*). The coefficients of *DEGREE*, *REACH*, and *BETWEEN* on *NPA* were negative and statistically significant. The findings indicate that, for a one-standard-deviation increase in degree, reachability, and betweenness centrality, the credit risk falls by approximately 51%, 47%, and 59%, respectively. The evidence supports H1 and suggests that bank well-connectedness with other banks limits credit risk.

Table 5
Bank well-connectedness and credit risk (NPA).

	Dependent variable: NPA					
	Model 1		Model 2		Model 3	
	DEGREE _t First-stage (1)	NPA _t Second-stage (2)	REACH _t First-stage (3)	NPA _t Second-stage (4)	BETWEEN _t First-stage (5)	NPA _t Second-stage (6)
BOARD_SIZE _t	3.836*** (0.000)		22.356*** (0.000)		85.644*** (0.000)	
N_BANK _t	0.048*** (0.000)		0.268*** (0.000)		1.207*** (0.000)	
DEGREE _t		−0.090*** (0.003)				
REACH _t				−0.016*** (0.002)		
BETWEEN _t						−0.004*** (0.006)
INDEPEND _t	4.004** (0.040)	0.217 (0.614)	21.651** (0.021)	0.193 (0.633)	39.276 (0.470)	0.015 (0.973)
AGE _t	−0.071 (0.110)	0.001 (0.937)	−0.380 (0.136)	0.001 (0.905)	−1.145 (0.337)	0.003 (0.756)
WOMEN _t	4.300** (0.034)	−0.994** (0.025)	29.252*** (0.009)	−0.919** (0.042)	43.843 (0.446)	−1.221*** (0.006)
EDU_EXPERT _t	−7.438*** (0.000)	−2.033*** (0.000)	−37.398*** (0.000)	−1.953*** (0.000)	−198.537*** (0.000)	−2.119*** (0.000)
LOGSIZE _t	2.102*** (0.000)	0.244*** (0.004)	10.882*** (0.000)	0.226*** (0.003)	58.198*** (0.000)	0.277*** (0.006)
PROFIT _t	−1.438** (0.015)	−0.556*** (0.000)	−4.428 (0.129)	−0.496*** (0.000)	−56.026*** (0.001)	−0.640*** (0.000)
VOLATILITY _t	0.868 (0.244)	0.541*** (0.000)	1.657 (0.679)	0.488*** (0.000)	5.531 (0.790)	0.487*** (0.001)
DELTA _t	0.537 (0.758)	0.440 (0.210)	3.701 (0.668)	0.451 (0.192)	47.332 (0.382)	0.571 (0.141)
LEVERAGE _t	6.605 (0.534)	−1.554 (0.466)	52.372 (0.362)	−1.312 (0.536)	275.461 (0.367)	−1.122 (0.608)
CEO_AWARD _t	0.346 (0.925)	−2.103*** (0.007)	8.189 (0.667)	−2.001*** (0.008)	−19.989 (0.835)	−2.220*** (0.006)
LOANS _t	−2.245 (0.232)	−0.365 (0.388)	−2.257 (0.777)	−0.201 (0.612)	−12.749 (0.821)	−0.214 (0.619)
DEPOSITS _t	−1.492 (0.631)	0.513 (0.438)	1.464 (0.924)	0.668 (0.311)	−107.575 (0.226)	0.240 (0.729)
EFFICIENCY _t	2.294 (0.155)	1.588*** (0.000)	27.321*** (0.001)	1.814*** (0.000)	22.856 (0.597)	1.465*** (0.000)
Intercept	−29.679*** (0.008)	−6.690*** (0.004)	−188.258*** (0.002)	−6.966*** (0.003)	−754.840** (0.018)	−6.947*** (0.004)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	504	504	504	504	504	504
First-stage F-statistics (Kleibergen-Paap Wald rk F-statistics)	22.82		31.15		13.63	
Cragg–Donald statistic for weak instruments based on the Stock and Yogo (2005) critical value	20.57		26.30		13.30	
Strong instruments	Yes		Yes		Yes	
Anderson-Rubin (p-value)		0.009		0.009		0.009
Hansen J		0.057		0.094		0.005
Hansen J (p-value)		0.812		0.759		0.943
Hausman's endogeneity test (p-value)		0.008		0.011		0.004
Second-stage F-statistics		23.71*** (0.000)		24.92*** (0.000)		21.88*** (0.000)

Notes: The table presents the two-stage least squares (2SLS) IV regressions to estimate Eqs. (1) and (2) in the relationship between bank well-connectedness and credit risk. All variables are defined in Appendix A. Columns 1, 3, and 5 present the first-stage (Eq. (1)) in which instruments, namely, *BOARD_SIZE* and *N_BANK*, are used to obtain the predicted values of each centrality measure, namely, *DEGREE*, *REACH*, and *BETWEEN*, respectively. Columns 2, 4, and 6 present the estimation of the second-stage analysis (Eq. (2)) in which the predicted values for each centrality measure are used to predict the relationship between each bank centrality measure and credit risk (*NPA*). The table provides relevant tests undertaken to ensure the validity of the instruments and structure model. All analyses were run with robust standard errors. Coefficients are provided with *p*-values below in parenthesis *, **, and *** indicate the significance at the 10%, 5%, and 1% levels, respectively.

4.1.2. Bank well-connectedness and insolvency risk (Z-SCORE)

A well-connected boardroom signals a board's endowment with highly rare, valuable, and relevant information, knowledge, and expertise. Thus, a well-connected boardroom may offer great help in controlling bank insolvency risk. As H2 predicted, Columns 2, 4, and 6 in Table 6 report a significant positive relationship between the three centrality measures and *Z-SCORE*, revealing that the well-connected banks exhibit low insolvency risk. The results indicate that, for a one-

standard-deviation increase in degree, reachability, and betweenness centrality, the insolvency risk drops by approximately 46%, 43%, and 50%, respectively.

While the evidence reported by prior studies (see Hernandez et al., 2015; Pahnke et al., 2015) identifies the moral hazard of sharing strategic and competitive information, knowledge and skills among competitors, our findings are consistent with evidence reported for the Australian hotel sector by Ingram and Roberts (2000) and for the pre-

Table 6
Bank well-connectedness and insolvency risk (Z-SCORE).

	Dependent variable: Z-SCORE					
	Model 1		Model 2		Model 3	
	DEGREE _t First-stage (1)	Z-SCORE _t Second-stage (2)	REACH _t First-stage (3)	Z-SCORE _t Second-stage (4)	BETWEEN _t First-stage (5)	Z-SOCRE _t Second-stage (6)
BOARD_SIZE _t	3.808*** (0.000)		22.202*** (0.000)		84.901*** (0.000)	
N_BANK _t	0.042*** (0.000)		0.234*** (0.000)		1.124*** (0.001)	
DEGREE _t		0.118** (0.019)				
REACH _t				0.021** (0.014)		
BETWEEN _t						0.004** (0.028)
INDEPEND _t	4.501** (0.024)	−0.934* (0.090)	24.998*** (0.010)	−0.922* (0.078)	44.176 (0.419)	−0.622 (0.232)
EDU_EXPERT _t	−7.596*** (0.000)	0.666 (0.311)	−38.731*** (0.000)	0.585 (0.341)	−200.382*** (0.000)	0.689 (0.328)
LOGSIZE _t	2.156*** (0.000)	−0.454*** (0.000)	11.265*** (0.000)	−0.436*** (0.000)	58.725*** (0.000)	−0.470*** (0.001)
PROFIT _t	−1.574*** (0.008)	−0.326 (0.147)	−5.226* (0.080)	−0.401** (0.046)	−58.288*** (0.000)	−0.244 (0.341)
VOLATILITY _t	0.988 (0.201)	−1.286*** (0.000)	2.296 (0.580)	−1.215*** (0.000)	7.909 (0.708)	−1.214*** (0.000)
DELTA _t	0.427 (0.808)	−0.536 (0.325)	3.011 (0.729)	−0.550 (0.300)	46.379 (0.397)	−0.696 (0.213)
LEVERAGE _t	6.495 (0.547)	−2.717 (0.347)	50.561 (0.388)	−3.031 (0.292)	276.559 (0.361)	−3.170 (0.284)
CEO_AWARD _t	1.257 (0.731)	2.067** (0.048)	13.703 (0.460)	1.921* (0.065)	−10.300 (0.913)	2.282** (0.031)
LOANS _t	−1.974 (0.298)	−0.951* (0.066)	−0.855 (0.925)	−1.169** (0.019)	−9.674 (0.864)	−1.127** (0.033)
DEPOSITS _t	−2.265 (0.463)	−1.779* (0.052)	−3.515 (0.817)	−1.969** (0.023)	−115.708 (0.190)	−1.514 (0.113)
EFFICIENCY _t	2.751* (0.099)	−4.225*** (0.000)	29.980*** (0.001)	−4.530*** (0.000)	30.570 (0.488)	−4.036*** (0.000)
NPA _t	−0.367 (0.132)	−0.080 (0.287)	−2.232* (0.073)	−0.076 (0.307)	−5.692 (0.331)	−0.098 (0.194)
Intercept	−35.758*** (0.001)	19.031*** (0.000)	−220.647*** (0.000)	19.415*** (0.000)	−855.696*** (0.004)	18.867*** (0.000)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	504	504	504	504	504	504
First-stage F-statistics (Kleibergen-Paap Wald rk F-statistics)	19.42		26.51		11.87	
Cragg–Donald statistic for weak instruments based on the Stock and Yogo (2005) critical value	18.04		22.92		12.23	
Strong instruments	Yes		Yes		Yes	
Anderson-Rubin (p-value)		0.029		0.029		0.029
Hansen J		0.974		0.898		1.371
Hansen J (p-value)		0.324		0.343		0.242
Hausman's endogeneity test (p-value)		0.026		0.041		0.026
Second-stage F-statistics		25.75*** (0.000)		27.55*** (0.000)		25.57*** (0.000)

Notes: The table presents the two-stage least squares (2SLS) IV regressions to estimate Eqs. (1) and (2) in the relationship between bank well-connectedness and insolvency risk. All variables are defined in Appendix A. Columns 1, 3, and 5 present the first-stage (Eq. (1)) in which instruments, namely, *BOARD_SIZE* and *N_BANK*, are used to obtain the predicted values of each centrality measure, namely, *DEGREE*, *REACH*, and *BETWEEN*, respectively. Columns 2, 4, and 6 present the estimation of the second-stage analysis (Eq. (2)) in which the predicted values for each centrality measure are used to predict the relationship between each bank centrality measure and insolvency risk (*Z-SCORE*). The table provides relevant tests undertaken to ensure the validity of the instruments and structure model. All analyses were run with robust standard errors. Coefficients are provided with *p*-values below in parenthesis *, **, and *** indicate the significance at the 10%, 5%, and 1% levels, respectively.

1936 Japanese financial sector by Okazaki and Sawada (2011), signalling the value of such leakage on company economic and strategic outcomes. In support of the predictions of the extended RBV, our findings propose that being a well-connected bank through IDIs signals the boardroom's endowment with rare, valuable, and confidential information circulated by other banks regarding borrowers' repayment behaviour and debt risk exposure. Ultimately, a well-connected bank can distinctively eliminate adverse selection problems in accepting lending applications. Along a similar line, Brown, Jappelli, and Pagano

(2009) reported that sharing information about borrowers between banks has a significant impact on improving the lending system. Our results also confirmed Elyasiani and Zhang's (2015) argument regarding the uniqueness of board busyness in the US banking sector, demonstrating that banks with prominent positions in the banking network have privileged information access to critical risk mitigation strategies towards managing insolvency risk.

In addition to the advantage of information sharing, our results lend empirical support to the extended RBV, revealing that the direct

Table 7
Bank well-connectedness and capital risk (*TIER-1*).

	Dependent variable: TIER-1					
	Model 1		Model 2		Model 3	
	DEGREE _t First-stage (1)	TIER-1 _t Second-stage (2)	REACH _t First-stage (3)	TIER-1 _t Second-stage (4)	BETWEEN _t First-stage (5)	TIER-1 _t Second-stage (6)
BOARD_SIZE _t	3.892*** (0.000)		22.625*** (0.000)		85.509*** (0.000)	
N_BANK _t	0.046*** (0.000)		0.256*** (0.000)		1.167*** (0.000)	
DEGREE _t		−0.267** (0.015)				
REACH _t				−0.047** (0.014)		
BETWEEN _t						−0.011** (0.020)
INDEPEND _t	3.851** (0.050)	1.304 (0.290)	20.530** (0.029)	1.238 (0.302)	33.489 (0.536)	0.669 (0.566)
AGE _t	−0.068 (0.123)	0.012 (0.762)	−0.369 (0.135)	0.012 (0.755)	−1.182 (0.319)	0.018 (0.643)
WOMEN _t	3.945* (0.055)	3.797** (0.032)	26.861** (0.016)	4.020** (0.026)	31.815 (0.587)	3.080* (0.070)
EDU_EXPERT _t	−7.859*** (0.000)	0.143 (0.924)	−40.061*** (0.000)	0.336 (0.817)	−205.138*** (0.000)	0.019 (0.990)
LOGSIZE _t	2.065*** (0.000)	0.015 (0.953)	10.686*** (0.000)	−0.028 (0.904)	58.093*** (0.000)	0.096 (0.742)
PROFIT _t	−1.341** (0.024)	−0.511 (0.372)	−3.868 (0.185)	−0.339 (0.535)	−55.571*** (0.001)	−0.755 (0.216)
VOLATILITY _t	0.954 (0.191)	−1.453** (0.014)	2.618 (0.501)	−1.586*** (0.008)	13.570 (0.492)	−1.551*** (0.009)
CEO_AWARD _t	−0.120 (0.974)	−2.185 (0.367)	5.305 (0.777)	−1.891 (0.423)	−14.125 (0.887)	−2.336 (0.335)
LOANS _t	−2.478 (0.185)	−9.720*** (0.000)	−3.657 (0.684)	−9.222*** (0.000)	−9.270 (0.870)	−9.185*** (0.000)
DEPOSITS _t	−1.962 (0.531)	2.502 (0.254)	−1.668 (0.914)	2.945 (0.168)	−119.668 (0.183)	1.715 (0.448)
EFFICIENCY _t	2.587 (0.121)	−0.998 (0.481)	29.880*** (0.000)	−0.264 (0.861)	40.630 (0.363)	−1.268 (0.359)
NPA _t	−0.293 (0.232)	0.366** (0.023)	−1.752 (0.157)	0.361** (0.023)	−4.898 (0.402)	0.392** (0.015)
DIVIDEND _t	−8.315 (0.445)	−0.480 (0.951)	−36.501 (0.512)	0.105 (0.989)	103.156 (0.725)	2.600 (0.742)
Intercept	−24.278*** (0.000)	23.949*** (0.000)	−146.074*** (0.000)	23.595*** (0.000)	−527.297*** (0.000)	24.183*** (0.000)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	504		504		504	
First-stage <i>F</i> -statistics (Kleibergen-Paap Wald rk <i>F</i> -statistics)	21.73		29.81		12.53	
Cragg–Donald statistic for weak instruments based on the Stock and Yogo (2005) critical value	19.65		25.01		12.48	
Strong instruments	Yes		Yes		Yes	
Anderson-Rubin (<i>p</i> -value)		0.025		0.025		0.025
Hansen <i>J</i>		1.156		1.082		1.468
Hansen <i>J</i> (<i>p</i> -value)		0.282		0.298		0.226
Hausman's endogeneity test (<i>p</i> -value)		0.010		0.006		0.026
Second-stage <i>F</i> -statistics		7.66*** (0.000)		8.18*** (0.000)		7.32*** (0.000)

Notes: The table presents the two-stage least squares (2SLS) IV regressions to estimate Eqs. (1) and (2) in the relationship between bank well-connectedness and capital risk. All variables are defined in [Appendix A](#). Columns 1, 3, and 5 present the first-stage (Eq. (1)) in which instruments, namely, *BOARD_SIZE* and *N_BANK*, are used to obtain the predicted values of each centrality measure, namely, *DEGREE*, *REACH*, and *BETWEEN*, respectively. Columns 2, 4, and 6 present the estimation of the second-stage analysis (Eq. (2)) in which the predicted values for each centrality measure are used to predict the relationship between each bank centrality measure and capital risk (*TIER-1*). The table provides relevant tests undertaken to ensure the validity of the instruments and structure model. All analyses were run with robust standard errors. Coefficients are provided with *p*-values below in parenthesis *, **, and *** indicate the significance at the 10%, 5%, and 1% levels, respectively.

professional connections among bank directors through their directorships in the same third parties signal the accumulation of boardroom banking knowledge, skills and expertise. In short, the connected bank directors can, through shared learning, develop homogeneous beliefs and aggregate their overall board qualifications and competencies towards providing relevant professional advice that lowers credit risk, limits negative returns and reduces the chance of bankruptcy. Disseminating beliefs through IDs could then create a banking culture

that reduces belief heterogeneity among banks, thereby reducing disagreement about dealing with bank risk exposures (see [Song & Thakor, 2018](#)). Accordingly, our empirical evidence provides an extension to the findings of [Carpenter and Westphal \(2001\)](#) that show the beneficial impact of appointing directors who have connections with strategically related organisations on the board advisory role. Our findings are also consistent with the latest evidence reported for greenhouse gas-emitting industries by [Homroy and Slechten \(2017\)](#) regarding the positive

impact of the well-connectedness among non-executive directors with similar previous experience in environmental issues on enhancing corporate sustainable practices, revealing that such social connections aggregate board human capital and signal a distinctive advisory role. The results are also consistent with the socialised theory of agency (Wiseman et al., 2012) and evidence reported by Ingram and Roberts (2000), suggesting that the well-connectedness among bank boardrooms signals the board ability, through scanning the external environment and reducing competitive uncertainties, to monitor the opportunistic behaviour. Taken together, the findings provide empirical support for the positive implications of the board networks in the US banking sector.

4.1.3. Bank well-connectedness and capital risk (TIER-1)

Columns 2, 4, and 6 in Table 7 present whether banks endowed with central positions in the banking network hold high or low capital ratios. Our results show significant negative coefficients of *DEGREE*, *REACH*, and *BETWEEN* on *TIER-1*, indicating that the better connected the bank is with other banks, the lower the bank tends to hold high equity capital. The results indicate that, for a one-standard-deviation increase in degree, reachability, and betweenness centrality, bank capitalisation decreases by approximately 54%, 51%, and 61%, respectively. The negative association between a bank well-connectedness and its capital adequacy contradicts H3. Such a negative association seems to be attributable to the confidence that the well-connected boardroom has in understanding better the market and in controlling credit and insolvency risks effectively (see Eastburn & Boland Jr, 2015). In other words, the well-connected bank boardroom does not have to maintain a very high capital ratio as a buffer to mitigate the bank's existing risks. Another potential explanation is the herding effects where banks may mimic the capital structure of their connected banks (see Vithessonthi, 2014). Because IDs among bank directors transfer information and practices, they are expected to propagate low-capitalisation strategies among the connected banks through the contagion effect. Holding low equity capital can then be perceived as a way to ensure conformity and maintain competitive parity among banks.

According to evidence reported by Anginer, Demirguc-Kunt, Huizinga, and Ma (2016), Beltratti and Stulz (2012), and Minton, Taillard, and Williamson (2014), bank good CG reforms, as recommended by regulators, with high incentives to reduce capital equity is characterised as shareholder-friendly CG that maximises shareholder value but, at the same time, shifts risks to other stakeholders. Our findings indicate that the well-connected bank boardrooms signal a new model of shareholder-friendly boards compared with older ones described by Anginer et al. (2016), Beltratti and Stulz (2012), and Minton et al. (2014); boards such as these enhance the shareholder wealth by lowering bank capitalisation without shifting risks towards other stakeholders. Given that we emphasise the impact of bank well-connectedness on capital adequacy during normal times, in our case, well-connected banks still consider maintaining low capital equity as relatively irrelevant to their financial stability. Nevertheless, it is evident that tendencies towards holding low capital ratios are detrimental to the financial stability, especially during distress times compared with that during normal times (Beltratti & Stulz, 2012; Minton et al., 2014). In this respect, one can argue that well-connected banks fail to see the long-term negative by-product of lowering bank capitalisation.

Columns 2, 4, and 6 in Tables 5, 6, and 7, respectively, also show the impact of bank-specific characteristics, as well as board structural and compositional characteristics, on BFS variables. These impacts suggest some interesting associations. In particular, bank size (*LOGSIZE*) was shown to have a significant impact on increasing bank credit risk (*NPA*) and insolvency risk (*Z-SCORE*). Theoretically, a positive (negative)

Table 8
Robustness analysis.

	Dependent variables		
	NPA _{t+1} (1)	Z-SCORE _{t+1} (2)	TIER-1 _{t+1} (3)
Second-stage regression			
DEGREE _t	−0.061** (0.040)	0.135*** (0.003)	−0.250** (0.014)
INDEPEND _t	−0.137 (0.731)	−1.100** (0.041)	1.557 (0.169)
AGE _t	−0.006 (0.455)		0.032 (0.367)
WOMEN _t	−0.764* (0.067)		3.496** (0.035)
EDU_EXPERT _t	−1.817*** (0.000)	0.163 (0.791)	−0.713 (0.600)
LOGSIZE _t	0.162** (0.050)	−0.427*** (0.000)	0.065 (0.788)
PROFIT _t	−0.617*** (0.000)	−0.286 (0.139)	−0.717 (0.144)
VOLITALITY _t	0.244* (0.082)	−1.490*** (0.000)	−0.825 (0.145)
DELTA _t	0.010 (0.978)	−0.394 (0.427)	
LEVERAGE _t	0.308 (0.879)	1.274 (0.646)	
CEO_AWARD _t	−2.541*** (0.001)	1.435 (0.121)	−2.920 (0.204)
LOANS _t	−0.272 (0.516)	−0.483 (0.347)	−10.166*** (0.000)
DEPOSITS _t	0.390 (0.543)	−0.453 (0.614)	0.796 (0.688)
EFFICIENCY _t	1.087*** (0.002)	−3.851*** (0.000)	−0.767 (0.554)
NPA _t		−0.095 (0.165)	0.500*** (0.001)
DIVIDEND _t			0.206 (0.977)
Intercept	−5.755*** (0.009)	14.556*** (0.000)	22.354*** (0.000)
Year fixed effect	Yes	Yes	Yes
Number of observations	504	504	504
First-stage F-statistics (Kleibergen-Paap Wald rk F-statistics)	22.82	19.42	21.73
Cragg–Donald statistic for weak instruments based on the Stock and Yogo (2005) critical value	20.57	18.04	19.65
Strong instruments	Yes	Yes	Yes
Anderson-Rubin (p-value)	0.120	0.005	0.015
Hansen J	0.078	1.028	1.358
Hansen J (p-value)	0.781	0.311	0.244
Hausman's endogeneity test (p-value)	0.139	0.010	0.006
Second-stage F-statistics	22.22*** (0.000)	27.76*** (0.000)	10.06*** (0.000)

Notes: The table presents the relationship between bank well-connectedness with the other US commercial listed banks and the following year's bank risk exposures, namely, credit risk, insolvency risk, and capital risk over the period 2010–2015. All variables are defined in Appendix A. Column 1 in Tables 5, 6, and 7, respectively, presents the first-stage (Eq. (1)) in which instruments, namely *BOARD_SIZE* and *N_BANK*, are used to obtain the predicted values of bank centrality measure, namely, *DEGREE*. The table presents the estimation of the second-stage (Eq. (2)) in which the predicted values for the *DEGREE* are used to predict the relationship between the bank centrality measure and the following year's bank risk exposures. The table provides relevant tests undertaken to ensure the validity of the instruments and the structure model. All analyses were run with robust standard errors. Coefficients are provided with *p*-values below in parenthesis *, **, and *** indicate the significance at the 10%, 5%, and 1% levels, respectively.

coefficient of the *LOGSIZE* on the *NPA* (*Z-SCORE*) is consistent with an unstable banking hypothesis, a too-big-to-fail hypothesis, and agency theory, indicating that large banks tend to undertake riskier decisions. Consistent with the findings reported by Bhagat et al. (2015), Elyasiani and Zhang (2015), and Saghi-Zedek and Tarazi (2015), the positive association between the bank size and risk seems to be attributable to the high tendencies of large banks to adopt risky loan strategies that can lead to high spreads (rent). However, our results do not show a significant association of bank size and bank adherence with the regulatory capital requirement. We also report, in line with Elyasiani and Zhang (2015), that *VOLATILITY* has a negative impact on BFS by increasing the bank credit risk, insolvency risk, and capital risk. The positive coefficient of *VOLATILITY* suggests that risky decisions could affect different dimensions of the banking system and lead different types of bank risk exposures to increase together (Elyasiani & Zhang, 2015).

Interestingly, we found a positive (negative) relationship between the bank *EFFICIENCY* and *NPA* (*Z-SCORE*). According to the skimping hypothesis proposed by Berger and DeYoung (1997), a possible reason for the negative association between bank cost efficiency and risk is that banks may neglect loan quality or fail to maintain bank solvency to maximise cost efficiency (Louati et al., 2016; Louzis, Vouldis, & Metaxas, 2012). We also report evidence that the bank low liquidity (*LOANS*) has a significant negative impact on bank adherence to capital regulation. Based on the “financial fragility structure” effect, the negative association between the *LOANS* and *TIER-1* may indicate that banks that aim to attract more depositors and grant more loans (illiquid asset) adhere less to hold high capital ratios (Berger et al., 2009; Distinguin, Roulet, & Tarazi, 2013). Moreover, the results showed that banks with high credit risk are more likely to hold high equity capital, suggesting that banks increase their equity capital as a cushion strategy to mitigate credit risk (Berger et al., 2009).

Regarding the CG control variables, consistent with findings reported by Elyasiani and Zhang (2015), we found that a high fraction of independent directors on the bank board is associated with a high risk of insolvency. This positive association can be explained by the moral hazard problem proposed by Pathan (2009), suggesting that shareholder incentives for excessive risk-taking impose performance pressures and encourage independent directors to undertake risky decisions. Additionally, our findings present that a high percentage of women on the board (*WOMEN*) has a significant negative relationship with *NPA* and *TIER-1*, revealing that women are more risk-averse and have more incentives to reduce bank risks (Palvia et al., 2015). Additionally, the significant negative coefficient of *EDU_EXPERT* on *NPA* suggests that directors holding accounting, finance, and/or banking certificates are more skilful and well-educated in applying efficient techniques for credit risk management. Furthermore, consistent with agency theory, *CEO_AWARD* has a negative impact on bank credit risk and insolvency risk, indicating that equity-based compensation is a successful means to motivate CEOs to mind their interests as owners and hence eliminate risks (Bouslah et al., 2018; Mehran & Rosenberg, 2008). Nevertheless, *CEO_AWARD* seems to have no significant impact on capital risk.

4.2. Additional analysis and robustness tests

Prior literature (see Anginer et al., 2016; Okazaki & Sawada, 2011; Palvia et al., 2015) has highlighted the importance of examining the impact of the CG mechanism's lagged data, particularly that of board characteristics, on bank accounting and financial data. Two main reasons were noted. First, instead of emphasising the contemporaneous effect of the board characteristics, lagged data capture the persistence and consistency implications of the one-year lagged values of the board structure on bank performance and/or risk. Second, using one-year lagged values further mitigates any endogeneity concerns that are generated by the reverse causality. Hence, the current research examined whether bank well-connectedness has a persistent and

consistent impact on the following year's bank risk exposures. In doing so, we regressed the dependent variables of 2011, 2013, and 2015 against the independent variables and controls of 2010, 2012, and 2014, respectively. The second-stage results reported in Table 8 show that bank well-connectedness with other banks, measured by *DEGREE* centrality, has a significant persistent and consistent effect on the following year's BFS variables.⁵ The findings suggest that bank well-connectedness with other banks provides a sustainable advantage to manage bank credit and insolvency risks effectively and a source of confidence or herd behaviour to continuously act as a shareholder-friendly board during the following year.

Bank capital represents the cushion that reflects bank willingness to undertake risks (Bushman, Hendricks, & Williams, 2016). Accordingly, the negative association between bank well-connectedness and capital adequacy may suggest that our results are driven by bank regulatory pressures rather than the interbank networks. Specifically, because well-connected banks have tendencies towards lowering capital adequacy, they do not have a sufficient buffer that would undertake riskier profiles. Accordingly, it can be argued that well-connected banks cannot take on high risks, particularly credit and insolvency risks, because they are not already well-capitalised. To address this concern, following Ben-David, Palvia, and Spatt (2017), we reran our analyses after excluding banks whose Tier 1 risk-based capital does not “far exceed what the regulations define as well-capitalised ([two] percentage points higher than the minimum)” (D'Erasmus, 2018, p. 2). According to Basel III's Prompt Corrective Action (PCA) categories issued by the FDIC (2018), the well-capitalised category is 8% Tier 1 risk-based capital. We found that approximately 5% of banks were not very well-capitalised over the sample period (i.e., hold Tier 1 risk-based capital less than 10%), suggesting that most of the banks in the sample already had precautionary motives and a sufficient capital buffer to undertake riskier decisions (D'Erasmus, 2018). The results showed that, after excluding these few banks, neither the direction nor the statistical significance of the main effect in Tables 5 and 6 is changed, suggesting that regulatory pressures do not drive our main results (Tables with detailed results are available on request).⁶

5. Discussion

5.1. Theoretical, practical and policy implications

Because our findings indicate that interbank networks have a positive impact on reducing bank risk exposures (i.e., credit and insolvency risks), these results have theoretical implications on the extended RBV, revealing a creation of internal value in the form of board social capital from the external connections among bank directors. Our findings suggest that being professionally well-connected with competitors through indirect interlocks, particularly in a setting that prevents any direct interlocks between competitors, offers both benefits of aggregating board human capital with relevant knowledge and skill and advantages of trust and exchanging rare, confidential and related information among competitor boardrooms. Accordingly, this study further extends the extended RBV by proposing professional communications among competitors as a resource that leverages board quality. In some respects, this resource may provide a source of confidence or herd behaviour that could cause well-connected banks to fail to see a low-

⁵ For brevity, we show only the result of the *DEGREE* centrality measure. The regression results for *REACH* and *BETWEEN* provide consistent evidence. Tables with detailed results are available on request.

⁶ By applying the well-capitalised categories under Basel II, which represents a 6% Tier 1 risk-based capital, we find that approximately 1% of banks are not very well-capitalised over the sample period (i.e., hold Tier 1 risk-based capital less than 8%). The results still provide consistent evidence after excluding these few banks. Tables with detailed results are available on request.

capitalisation strategy as irrational or overly risky. By emphasising the interbank networks, our conceptual framework enables us to investigate the extent to which US banks can benefit from their well-connectedness.

In the context of the banks, our findings contribute to corporate governance literature by linking the effect of the US interbank networks on the bank financial stability with the contribution of Lang and Lockhart (1990) and John et al.'s (2016) call for further research that may consider the role of board networks in the banking sector. For those banking studies that have continuously counted the number of director interlocks, adopting a decomposition approach for director interlocks helps to counter the myth regarding the actual role of board social capital in the banking sector. The finding that indirect interlocks among bank directors, as a unique board social capital, has a significant impact on bank financial stability fills the gap of the under-investigated area of research regarding the implications of the professional connections among US competitors through indirect interlocks. Therefore, our empirical evidence contends the importance of the relationships among competitors to a highly regulated sector such as the banking sector in dealing with common risks and potential hazards.

This study also offers some policy implications for bank directors and the Interlocks Act. We contend that bank directors make good use of their well-connectedness in the third parties to meet their fiduciary obligations conscientiously, thus restoring the trust of various stakeholder groups. For depositors, borrowers and regulators, we show that a well-connected boardroom is a unique resource that manages credit and insolvency risks effectively. For investors, shareholders of a well-connected bank are better off because well-connected banks have no tendencies to maintain high capital ratios. Hence, banks with well-connected boardrooms attempt to reach an optimal point in which the shareholder value is maximised while minding the well-being of other stakeholders (Srivastav & Hagendorff, 2016). Regarding US regulators, as policy assessments tend to ignore the implications of the professional communications among bank directors, our evidence suggests that policymakers need to further improve the Interlocks Act and bank governance reforms to fully achieve their intended goals.

5.2. Limitations and suggestions for future research

As with all research efforts, this study possesses some limitations. Our study used archival data. Therefore, we recommend that future studies conduct in-depth interviews to offer useful insights into the type and timing of information circulated among bank directors and how such communications aggregate their banking competencies. While our sample covers the post-crisis period to examine the impact of interbank networks on bank financial stability under normal economic conditions, future studies should explore the impact of interbank connections

during the banking financial crisis. Future studies should also frame the case over a complete business cycle to provide more consistent insights into the longer-term perspective. This study focused on bank financial stability. We recommend that future studies explore the association between interbank networks and accounting quality, hedging strategies, community impact and environmental responsibility, and merger and acquisition activity. Our study was limited to US banks due to the scope of the Interlocks Act so that our findings are not generalisable outside the US context or to non-banking sectors. Therefore, we recommend that future studies analyse the implications of professional communication among directors of competing companies in less well-regulated industries as well as in countries with different legal governance.

6. Conclusion

In the contemporary context of an interconnected environment, prohibiting competitors from constructing social and professional connections is no longer effective. In this study, we investigate the structure and implications of the professional connections among bank directors. By constructing an up-to-date unique dataset of director biographies for 168 US commercial banks, we demonstrate that prohibitions set out in the Interlocks Act have been circumvented by the establishment of indirect interlocks that allow for mass professional connections among bank directors. Using empirical evidence, we are the first to reveal, after controlling for endogeneity, that banks with well-connected boards present low credit and insolvency risks and that their boards do not have to maintain a very high capital ratio as a cushion to alleviate the bank existing risks. Using the extended RBV, our study demonstrates that bank well-connectedness signals board social capital that enhances board ability to fairly represent various stakeholder interests and to act in a shareholder-friendly manner that maximises shareholder wealth. Hence, professional connections among US commercial banks are a crucial determinant of bank financial stability.

Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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Appendix A. Variable definition and data sources

Variable name	Abbreviation	Variable definition	Original source
Dependent variables			
Credit risk	NPA	Accounting-based measure of asset quality which equals to non-performing assets over total loans. Nonperforming assets is the classification for loans that are in default or are in arrears on scheduled payments of principal or interest. It includes: <ol style="list-style-type: none"> Loans and leases carried on a non-accrual basis Loans which are 90 days past due both accruing and non-accruing Renegotiated loans Real estate acquired through foreclosure Repossessed movable property, and excludes past due loans not yet placed on non-accrual status (unless specifically included in non-performing assets by the bank). 	BANK COMPUSTAT
Insolvency risk	Z-SCORE	The natural logarithm of $((ROA + CAR)/\sigma(ROA))$, where ROA represents the return on assets which is calculated as the ratio of net income over assets, CAR represents the capital-asset ratio, and $\sigma(ROA)$ represents the standard deviation of ROA.	BANK COMPUSTAT

Capital risk	TIER-1	The Basel Tier 1 capital ratio which is calculated as follows: equity capital plus minority interests less portion of perpetual preferred stock and goodwill as a percent of adjusted risk-weighted assets. The minimum requirements under the Basel II and Basel III are 4% and 6%, respectively.	BANK COMPUSTAT
Independent variables			
Degree centrality	DEGREE	The first-degree connections of the focal bank which is calculated by summing the number of banks that a focal bank is connected with through their director indirect interlocks in the same third parties.	BoardEx Database
Reachability centrality	REACH	The number of banks in the sample that the focal bank can reach occurs in two steps. It is calculated by summing the bank degree centrality and degree centrality of its first-degree connections. For instance, if bank “A” has a degree centrality of four, this means that bank A is connected with four banks. If each one of these four banks has a degree centrality of two, then the REACH of bank “A” is 12 (i.e., $4 + (4 * 2)$).	BoardEx Database
Betweenness centrality	BETWEEN	The number of the shortest paths linking any two banks in the network that pass through the focal bank.	BoardEx Database
Control variables			
Board independence	INDEPEND	Ratio of the number of independent non-executive directors on the board to the total number of directors on the board.	BoardEx Database Bloomberg
Board age	AGE	The average age of board members is calculated by summing the director ages over the number of directors on the board.	BoardEx Database Bloomberg Proxy state- ment
Women on the board	WOMEN	Ratio of the number of women on the board to total number of directors on the board.	BoardEx Database Bloomberg Proxy state- ment
Education background and financial experience	EDU_EXPERT	Ratio of the number of directors who hold accounting, finance, and/or banking certificate to the total number of directors on the board.	BoardEx Database Bloomberg Proxy state- ment
Bank size	LOGSIZE	The natural logarithm of bank total assets.	BANK COMPUSTAT
Bank risk	VOLATILITY	The natural logarithm of the annualized standard deviation of the relative price change for the 260 most recent trading days closing price, expressed as a percentage. It measures the risk that the price of the bank stock fluctuates that is calculated from the standard deviation of day to day historical price changes.	Bloomberg
Market-to-book	PROFIT	The natural logarithm of the ratio of the last price per share over the book value per share.	BANK COMPUSTAT
Leverage	LEVERAGE	Ratio of book value of total liability to book value of total assets.	Bloomberg BANK COMPUSTAT
CEO pay-performance sensitivity	DELTA	Ratio of the change in CEO compensation to annualized standard deviation of the relative price change for the 260 most recent trading days closing price.	BoardEx Database Bloomberg
CEO stock award	CEO_AWARD	The natural logarithm of total stock award that has been given to a bank CEO in a fiscal year.	Bloomberg
Bank funding	DEPOSITS	Ratio of total deposit to total liability.	BoardEx Database Bloomberg
Liquidity	LOANS	Ratio of total loan to total assets.	BANK COMPUSTAT Bloomberg
Cost efficiency	EFFICIENCY	Bank cost efficiency measured through comparing costs to revenues. It is calculated as $(\text{Operating Expenses} / ((\text{Net Interest Income} + \text{Commissions \& Fees Earned} + \text{Other Operating Income (Losses)} + \text{Trading Account Profits (Losses)} + \text{Gain/Loss on Investments/Loans} + \text{Other Income (Loss)} - \text{Commissions \& Fees Paid}) + \text{Taxable Equivalent Adjustment or Net Revenue} - \text{Net of Commissions Paid}) * 100$.	Bloomberg
Dividends payout	DIVIDEND	The natural logarithm of the ratio of total dividends to total assets.	BANK COMPUSTAT
Instrumental variables			
Board size	BOARD_SIZE	The natural logarithm of the number of directors on the board.	BoardEx Database Bloomberg
Number of banks	N_BANK	The natural logarithm of the number of banks headquartered in the state where the focal bank is headquartered.	BANK COMPUSTAT

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