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Bank board network and financial stability in emerging markets

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ABSTRACT

This study finds that the board network is related to improvements in the financial stability of banks given by asset quality, insolvency risk and volatility of profits. Further, the board network is more critical for the private sector banks in India. The board network also improves the performance of banks, providing evidence in favor of the integrated resource dependence view of the board. Well-connected boards increase information availability and reduce the information asymmetry between the bank and its borrower. For financial firms, restricting the number of directorial positions for bank directors may not have any desirable effect on bank outcomes.

1. Introduction

Corporate governance of banks requires special attention as they differ from non-financial institutions in terms of regulation, capital structure, complexity and opacity of their business structure (Haan and Vlahu, 2016; Levine, 2004). Further, as bank failure generates economy-wide negative externalities, large banks have an implicit guarantee against failure, and this can breed excessive risk-taking tendencies of managers of large banks (Haan and Vlahu, 2016). In general, bank boards are larger than the boards of non-financial firms owing to the complexities of banking operations and regulations. Studies have highlighted that the board structure of banks (Adams and Meheran, 2012; Pathan and Faff, 2013), and ownership structure (Laeven and Levine, 2009) affect bank outcomes. More recently, the study by Abdelbadie and Salama (2019) find that the board network reduces the credit, insolvency, and capital risks of banks in the United States. The review paper on corporate governance in banks by John et al. (2016) also emphasizes that future research on the importance of corporate governance of banks needs to focus on the role of director networks.

This study attempts to understand the bank board network in India – an emerging market economy characterized by a bank-based financial system. The study provides valuable insights regarding the nature of the bank board network in India. We give an account of both direct and indirect connections of the bank boards. The direct connections of the bank are measured by the degree centrality of the board. The bank director by virtue of sittings on multiple boards, will know several other directors. These directors form the direct connections of the bank director. We also capture the indirect connections of the bank directors by considering the second-level connections. When the bank director occupies another board seat, the board members of the connected firm are also likely to know additional directors due to their multiple board seats. The direct connections of the bank director's first connections represent the indirect connections. In the last decade, the direct connections of banks in India have increased from below 20 to around 30 connections by 2019. On the other hand, the average number of indirect connections of the bank has increased from 70 to over 160 connections in the last decade. Even though the number of direct connections is similar for public sector banks (PSBs) and private banks, the indirect connections are higher for private banks than for PSBs in India.

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This study contributes to the literature in several ways. First, we contribute to corporate governance in banks literature by examining how board network affects the financial stability of banks. Houston et al. (2018) and Abdelbadie and Salama (2019) have highlighted the significance of bank board networking on the syndicated loan origination process and risk-taking behavior of banks in the United States, respectively. Our study is closely related to the study by Abdelbadie and Salama (2019). Abdelbadie and Salama (2019) consider only the direct connections of bank directors, whereas our study considers all direct and indirect connections of the bank directors.This is important to understand the diversity of information available to the bank through the board network. Further, accounting for indirect connections enables us to examine whether resources and information available through weak ties matter for financial stability. Studies in the context of banks have not focused on the strength of weak ties.

Second, our study contributes to the social network literature. There is an extensive body of research on the understanding of organizational networks (Borgatti and Cross, 2003). A significant proportion of these studies focus on non-financial and its relation to organizational outcomes. Larcker et al. (2013) find that more central firms in the network enjoy superior performance. Director networks also affect the acquisition behavior of the firms (Renneboog and Zhao, 2014), governance practices (Fracassi and Tate, 2012), and innovation (Helmers et al., 2017). In the context of financial firms, Hochberg et al. (2007) find that more connected venture capital firms experience better performance given by higher likelihood of exiting the investment through a successful IPO route. Few studies (Houston et al., 2018; Abdelbadie and Salama, 2019) have focused on bank networks in the context of developed countries like the United States, Europe, and Australia. Most of the developed economies have a market-based financial system with developed capital markets, which is an additional information channel available to the banks for assessing potential borrowers. However, in emerging market economies with less than fully developed capital markets and bank-based financial systems, the bank board network becomes even more important as an information channel. Our study focuses on the bank-board networks in the context of India and provides further evidence that director networks matter for the transmission of soft information among firms.

Finally, our study provides new evidence regarding the importance of the board network for banks in emerging economies in general and India in specific. Previous studies have highlighted the importance of board networks for non-financial firms in India (Biswas, 2019; Shaw et al., 2016). Further, to the best of our knowledge, the other studies in the Indian context analyzing the role of board networks in non-financial firms did not consider the second-level of connections in their analysis. Accounting for both direct and indirect connections, this study empirically shows that well-connected directors sitting on bank boards can provide valuable strategic advice and help in improving the asset quality of banks. This finding has policy implications regarding the board composition of banks. The central bank in India – Reserve Bank of India – in the 2014 Review of Governance of Boards of Banks in India Report emphasized the importance of independence and skillset of the director for improving board quality, but what constitutes skillset is not clear.

The study investigates the relation between bank board networks and the financial stability of Indian banks. Several studies have documented the relationship between director networks and firm outcomes. Most of the research on the role of director networks focuses on non-financial firms. We analyze whether direct as well as indirect bank board connections are related to the financial stability of the banks in India. We consider multiple financial stability measures - gross and net non-performing asset ratios, insolvency risk score, the volatility of ROA, and capital adequacy ratio. Using an instrumental variable two-stage least square (IV-2SLS) method, we find that a large board network is related to the higher financial stability of banks. The results suggest that a larger board network improves the resources available to the bank. Having more resourceful and experienced directors help banks to improve financial stability through two possible channels. First, the more networked director can help the bank negotiate with the borrowers in the debt restructuring process. Second, the networked director having access to a larger pool of information may reduce the information asymmetry between the borrower and the bank and, in turn, reduce the excessive risk-taking by the borrower. The board network not only improves the financial stability of banks but also is related to the superior performance of banks given by accounting measures of performance. Our results provide support in favor of the integrated resource dependence view of the board. The connected director with vast experience provides strategic advice, which helps the bank to improve performance and reduce over-time volatility in performance. We find that the board network plays a more important role in improving the financial stability of the private banks in India. The directors of the public sector banks (PSBs) often have shorter tenure as they get an appointment on board closer to their retirement age, and this could be driving the insignificant effect of board network on the financial stability of PSBs. The results are robust to alternate definitions of board network variables, alternate estimation strategy and addition of another instrument in the model.

The remaining of the paper is organized as follows. Section 2 develops the conceptual framework of the study. Section 3 elucidates the nature of the board network variable, while Section 4 presents the data and variables and discusses the methodology employed in the study. Section 5 presents the financial stability results and the robustness checks, while Section 6 highlights the possible channels. Section 7 discusses the results, highlights the implications of the study, and points towards the directions for future research.

2. Conceptual framework

The resource dependence theory (Pfeffer, 1972) and the agency theory (Jensen and Meckling, 1976) are the two prominent theories explaining the role of the board in firms. According to the resource dependence view, the board helps organizations to manage external uncertainty and provide access to external information and other resources. On the other hand, the agency theory of the board emphasizes the disciplinary role of the board wherein the board act as monitors on behalf of the shareholders. The agency and resource dependence theories are often viewed as competing theories of the board as there is a trade-off between the role of the board as monitors and resource providers. However, Hillman and Dalziel (2003) argue that there is a need to integrate the resource dependence and agency views to understand the role of the board in modern corporations. This view suggests that firms with higher board capital are likely to perform better as they have access to a large pool of resources. Also, the more experienced and connected directors can

better monitor the managers, given their vast experience and skillset.

One aspect of the board that has received considerable attention in the literature is the importance of the board network on account of director interlocks (see Lamb and Roundy, 2016 for review). Few studies have also examined the role of social networks in the context of banks. The bank CEOs with large social network increases bank risk-taking behavior (Dbouk et al., 2020) finding evidence in favor of weak monitoring hypothesis. The connections of the CEOs reduce the search cost associated with job search in case the CEO is unable to perform in their current role. This implicit insurance increases the risk-taking behavior of the CEOs with a large social network. On the other hand, Abdelbadie and Salama (2019) find that more connected bank boards are likely to reduce the risk-taking behavior of banks in the United States. This study finds evidence in favor of the integrated resource dependence hypothesis. A large board network improves the quality of advice provided by the director to the bank, and the connected directors can better monitor the banks. Fig. 1 presents the conceptual framework depicting the relation between bank board network and financial stability of banks.

The conceptual framework highlights the integrated resource dependence theory based on information transmission between firms and banks through connected directors. The information channel can be directly linked to better monitoring and access to more resources. A connected bank director can better monitor the borrowers (reputation hypothesis) and improve access to resources for the bank. Further, a well-connected bank director is also a proxy for the ability of the director and can signal their higher expertise. The increase in board effectiveness due to the director network can result in the improved financial stability of banks. In this study, we focus on information channels on account of board network and how it impacts the bank outcomes such as financial stability. We proxy information channels available to banks by the number of corporate accounts restructured and number of borrowing firms. Such informational advantage is crucial, especially in economies with less than perfect capital markets.

We test the soft information channel by considering whether having a large network is related to more corporate loans restructured by the banks. When borrowers of banks face financial difficulties to service their debt, banks often negotiate with the stressed borrowers and restructure the loan. The process of corporate loan restructuring is directly linked with the asset quality, as restructured accounts do not get reflected in the non-performing assets of the banks. If the board network provides access to soft information regarding the borrowers or their industry of operation, then having a large network should be associated with a higher number of loans restructured by the bank.

Further, we hypothesize that a bank director sitting on the board of a borrower enables the bank to closely monitor the borrower and ensure that the manager of the firm does not engage in excessive risk-taking. Byrd and Mizruchi (2005) find that bankers sitting on the boards of their borrowers can monitor firms better. On the other hand, Dittimann et al. (2010) find that a banker on board of a non-financial firm provides financial expertise to the borrower and monitors the firm. Either by providing financial expertise or monitoring, the information asymmetry between the borrower and the bank reduces when a bank director sits on its borrower's board. To test this, we examine whether a bank with a larger board network is more likely to sit on the boards of its borrowers.

2.1. *The banking sector in India*

The Indian banking sector is dominated by 25 large public sector banks (PSBs) where the government is the majority shareholder and 21 private banks. The foreign banks in India operate as branches. The asset quality review initiated by the Indian central bank, the Reserve Bank of India, brought the burgeoning non-performing assets (NPAs) problem into the limelight. The NPAs were significantly higher for the PSBs than the private banks in India. The deteriorating asset quality of Indian banks reignited the need to focus on good governance and the role of bank boards in monitoring the risk-management practices and financial stability of banks.

The bank board comes under the regulatory supervision of the Banking Regulation Act, 1949 (Reserve Bank of India), the

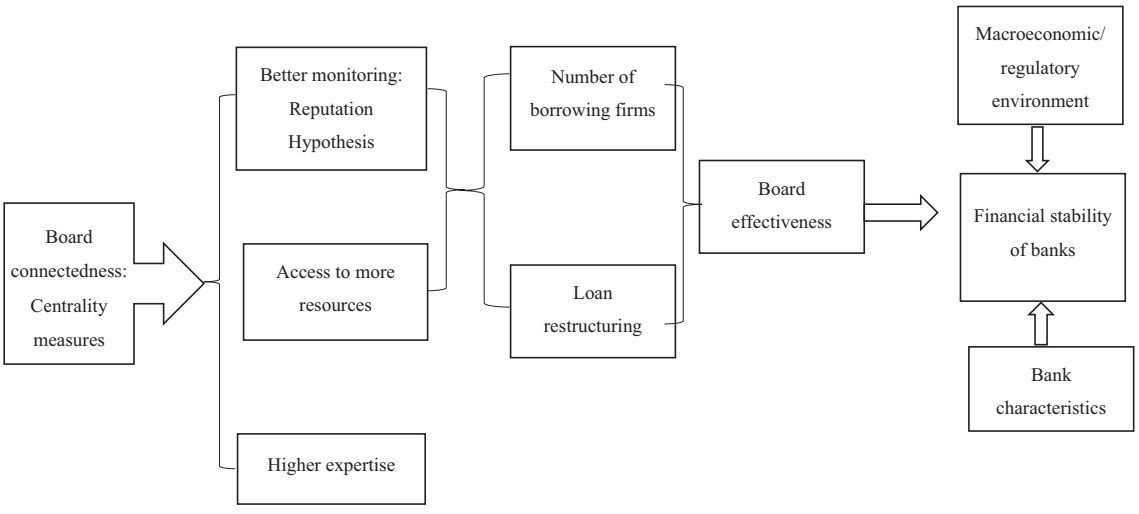

Fig. 1. Conceptual framework presenting the relation between board network and financial stability of banks.

Companies Act, 2013, and the Security and Exchange Board of India (SEBI). The Banking Regulation Act is specially designed for all banks operating in India, and eliminating conflict of interest is at the heart of its provisions. The Companies Act, 2013 is applicable for all companies operating in India, and its provisions are meant for the smooth functioning of a company. SEBI Act, 1992 was enacted to provide the establishment of a board to protect the interests of investors in securities and to promote the development of and to regulate the securities market and matters connected therewith. In all the above-mentioned Acts, there are clauses/ sections which deal with corporate governance of an entity/ bank in general and board structure in particular.

Section 10(A) of Banking Regulation Act, 1949, Section 149 of the Companies Act, 2013 and Clause 49 Listing Agreement (SEBI) deals with the Board of Directors of an entity. With respect to banks, Banking Regulation Act, 1949 supersedes all other regulatory requirements. As per Section 10(A) of Banking Regulation Act, 1949, not less than 51% of the directors need to have special knowledge or practical experience in areas such as accountancy, agriculture and rural economy, banking, cooperation, economics, finance, law, and small-scale industry. This section also makes provisions concerning composition as well as the tenure of a director on the bank board, including the chairman. The banks also need to comply with Sections 149 to 152 of the Companies Act, 2013 and Clause 49 of the Listing Agreement that lists the requirements for the board composition for the companies in India. Further, the PSBs are also regulated by the Ministry of Finance, Government of India. The report on the Review Governance of Boards of Banks in India (Nayak, 2014) highlights that the bank boards of PSBs are disempowered and are characterized by a weak corporate governance structure. In recent years, the emphasis has been put on the significance of independent directors on the board; however, all these regulations do not discuss the significance of bank board networks in corporate governance.

Given the backdrop of deteriorating asset quality of Indian banks and corporate governance challenges faced by the banks, we consider the role of the director network on the financial stability of banks in India. The conceptual model discussed earlier suggests that the bank board network on account of director interlocks will enhance the monitoring ability of the board and reduce information asymmetry between bank and firm, which in turn will improve the financial stability of banks.

3. Bank board network

We can determine different aspects of the board network at the bank-level and also at the director-level. The board data provides an alpha-numeric character uniquely associated with a director and remains constant over time. We construct the network using two approaches, i.e., directly at the bank level and also by aggregating the individual director network. In our main analysis, we follow the former approach. In this approach, if one director sits on the board of another company in addition to the bank, it results in a bank-firm connection. Suppose the board size of a bank during a given year is 6 and the directors 1, 2, and 5 sits on the boards of additional 1, 5, and 4 firms, respectively (Fig. 2). This directly connects the bank to 10 companies in the network. However, the other non-bank directors of these connected companies may also occupy additional board seats, which will lead to indirect bank-firm connections through the interlocked director. Note that the first level of connection of the bank is established when the bank director occupies an additional board seat, whereas the second-level connections occur when the non-bank directors of the directly connected companies occupy additional board seats.

Fig. 3 indicates that on account of board interlocks, a bank in our sample, viz. City Union Bank Ltd. is connected to 10 different companies directly and to 32 other companies at the second level (indirect connections). The first-level connection is represented by company code, whereas the second-level connections are indicated by the number of companies to which the first-level connection is connected.

In our robustness analysis, we consider the director-level connections and then take the average connection for each bank for a given year. In Fig. 4, we consider one director (P00003679) of City Union Bank who occupies a board seat in one more company in addition to this bank. Director P00003679, who is sitting on the board of City Union Bank Ltd. (City Union) and Hatsun Agro Product Ltd. (Hatsun), is connected to all the directors sitting on the board of City Union and Hatsun. Therefore, this director is connected to 19 different directors (12 directors of City Union and 7 directors of Hatsun), which constitutes the direct or the first-level connections. Now two directors of City Union (P00014342 and P00039721) and one director of Hatsun (P000069689) are sitting on boards of 8

Director/ Company	Co1	Co2	Co3	Co4	Co5	Co6	Co7	Co8	Co9	Co10
1	1	0	0	0	0	0	0	0	0	0
2	0	1	0	1	1	0	1	1	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	1	0	0	1	0	0	1	1
6	0	0	0	0	0	0	0	0	0	0

Fig. 2. Example of bank-firm connections due to board interlocks.

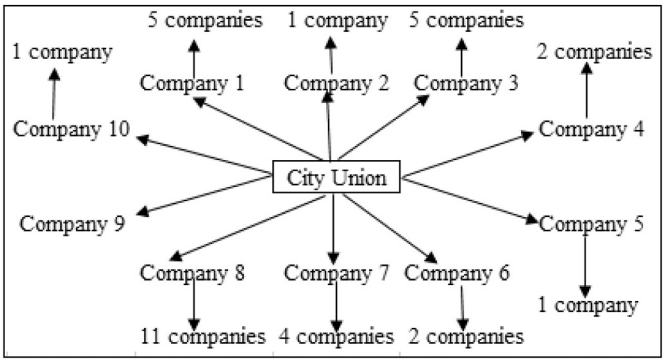

Fig. 3. Board Network at bank-level.
Note: Figure of City Union Bank Ltd. bank connected to other banks/ companies at first and second second level networking.

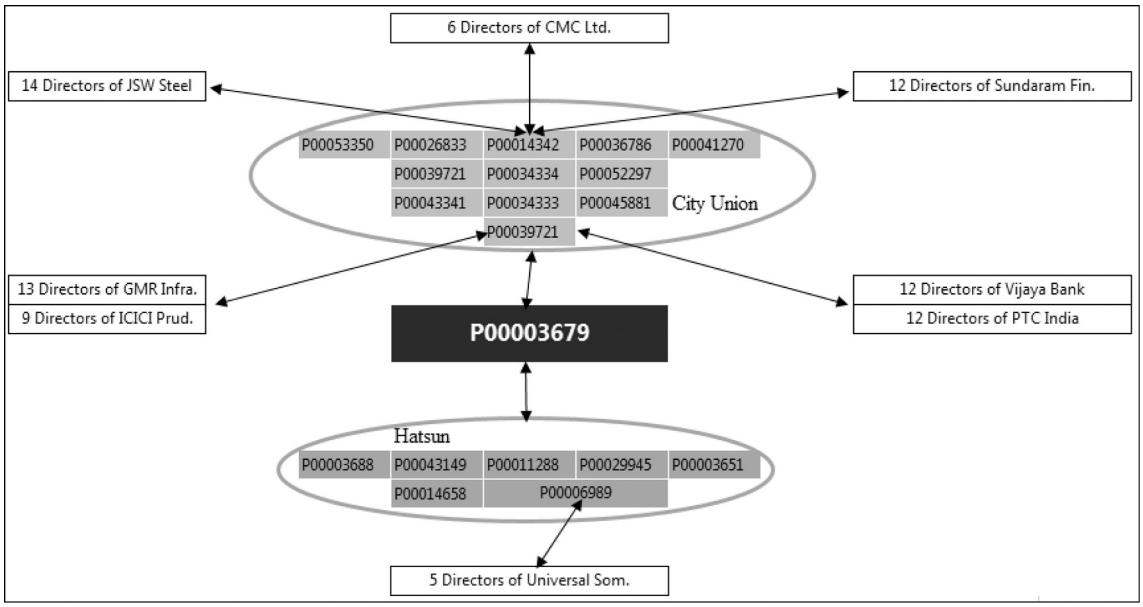

Fig. 4. Board Network at director-level.
Note: Figure of director level connections. Text starting with 'P' represents the director code. P00003679 is sitting on the board of City Union and Hatsun.

other companies. Hence, director P00003679 is connected to 32 directors via 'P00014342' and 46 directors via 'P00039721'. Also, the same bank director is connected to 5 directors via 'P00006989'. Therefore, at the second-level, the bank director is connected to 83 directors in total. Hence, by combining both first and second-level networking, the given director is connected to 102 different directors.

The network at the bank-level and director-level captures different aspects of the network. The board network measure at the bank-level captures the unique number of companies with which the bank is directly or indirectly connected due to board interlocks. This measure takes into account the pool of diverse resources available to the bank. So, in our main analysis, we consider the bank-level board network measure as the resource dependence theory suggests that access to a large and diverse pool of information is the prime channel through which the benefits of board interlocks accrue to any organization. On the other hand, the director-level board network measure will provide both the quantity of information available to the bank and the strength of the network. The strength of the network can increase the quality of information that is transmitted to the bank. Hence, we also consider the network at the director-level to check the consistency of our findings obtained using the bank-level board network measures in our robustness analysis. The director-level network measures will capture the joint effect of the importance of information quantity and quality of information on the financial stability of banks.

Considering the second-level of connection in addition to the first-level of connections of the bank directors is a contribution of this paper. To the best of our knowledge, the other studies in the Indian context focusing on non-financial firms did not consider the second-level connections of directors using both listed and unlisted firms. Section 4.3 defines different board network measures, which are

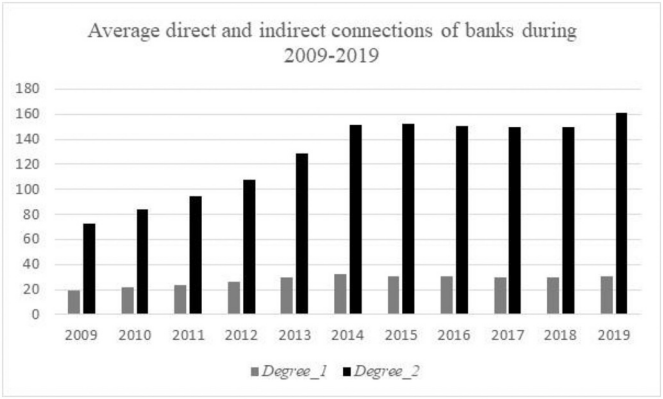

Fig. 5. Director level connections of bank boards since 2009.

based on the graphical representation of the connections in Figs. 2-4.

4. Data and variables

4.1. Data

There are two main sources of data, namely: the Indian Boards database and the Centre for Monitoring Indian Economy (CMIE) database. The direct and indirect connections are constructed using the data obtained from the Indian Boards database maintained by Prime Infobase. This database provides information regarding the names of the board members, appointment and cessation dates, other directorships positions (both listed and unlisted), age, type of director, education, and gender for the list of companies from 2014. Since the data is not available for the board composition of unlisted banks, we only consider the listed commercial banks for the analysis.

The financial data for the banks are obtained from the CMIE's Prowess database. It provides detailed information about listed and unlisted financial and non-financial firms in India, including financial data, ownership information, location and others. Our sample consists of the commercial banks in India for the period 2009–2019.

4.2. Dependent variable

The dependent variable in the analysis is the financial stability of the bank estimated by four different measures, namely: asset quality, distance to default, the volatility of performance, and capital ratio. There are two asset quality measures that give information related to non-performing assets of the bank. A credit extended by the bank is classified as non-performing if the borrower has not paid interest or principal for over 90 days. A higher level of non-performing assets indicates that the bank is under stress as the likelihood of borrower default has increased. This measure is also regularly tracked and reported by the RBI to comment regarding the financial stability and resilience of the banks in the country. We consider the ratio of gross non-performing assets to total loans and advances (*gnpa_loans_adv*) and the proportion of net non-performing assets to total loans and advances (*nnpa_loans_adv*) as the dependent variables in the study. These measures of credit risk outcomes have been considered in other bank studies in the literature (Abdelbadie and Salama, 2019; Sarkar and Sarkar, 2018; O'Sullivan et al., 2016). The second measure is the score defined as the sum of return on assets (ROA) and capital to assets ratio (CAR) divided by the standard deviation of ROA (σROA) during the last five years. This measure gives the distance from default, and higher value suggests that the bank has sufficient profit to cover its debt obligations, hence, less likely to default. This measure of financial stability has been used by several studies (Abdelbadie and Salama, 2019; Ahamed and Mallick, 2017; Elyasiani and Zhang, 2015; Laeven and Levine, 2009). The score variable is highly skewed, and we consider the negative value of the logarithm of the score for the analysis to present the insolvency risk of the bank. The third measure is σROA, which captures the variation in the bank's ROA for the last five-year period. This measure provides the volatility of the accounting performance of the bank, and a lower value suggests a more stable financial outlook (Ahamed and Mallick, 2017; Laeven and Levine, 2009). Finally, capital ratio measured as the ratio of Basel Tier 1 capital requirement to risk-weighted assets (CAR) is a regulatory measure of financial stability of banks. Berger et al. (2008) find that the CAR of large banks in the United States often is higher than the level required by regulation. Further, the study finds that CAR depends on bank characteristics like size, market-to-book ratio, and retail deposits. Studies also suggest that concentrated ownership of banks is related to higher CAR (Shehzad et al., 2010) and the CAR for foreign branches depends upon the health of the parent bank (Mili et al., 2017). A high CAR value reflects a higher financial stability of banks.

4.3. Board network variable

Using the board level data, we obtain direct and indirect connections at the bank-level. The first level degree measure gives direct

Table 1
Summary statistics.

	Min	Mean	Median	Max	SD
	Full sample				
Bank connections					
Degree_1	−1.302	0.041	−0.302	3.500	1.000
Degree_2	−1.568	0.037	−0.273	3.372	1.000
Between	−0.951	0.385	−0.361	3.945	1.012
Close	−1.595	0.384	−0.149	3.968	1.000
Eigen	−1.282	0.012	−0.262	3.905	1.012
Financial stability measures					
gnpa_loans_adv	0.002	0.051	0.029	0.329	0.057
nnpa_loans_adv	0.000	0.026	0.015	0.163	0.029
z-score	0.374	3.643	3.775	6.692	1.092
σROA	0.000	0.427	0.274	3.061	0.421
Capital ratio	0.048	0.107	0.095	0.559	0.042
Bank characteristics					
Leverage	0.000	1.316	1.187	5.971	0.923
NIM	0.000	3.038	2.900	10.440	1.082
Size	−0.693	13.890	14.075	17.421	1.549
Profit_per_emp	−8.800	1.100	0.500	80.500	6.395
Log_deposits	5.991	14.267	14.433	17.747	1.422
N	456				
	Public sector banks				
Bank connections					
Degree_1	−1.270	0.064	−0.279	3.500	0.932
Degree_2	−1.408	−0.136	−0.352	2.424	0.769
Between	−1.281	−0.262	−0.419	2.124	0.668
Close	−1.191	0.225	0.021	3.968	0.958
Eigen	−0.935	−0.242	−0.473	2.0.476	0.643
Financial stability measures					
gnpa_loans_adv	0.006	0.070	0.042	0.329	0.067
nnpa_loans_adv	0.001	0.036	0.024	0.163	0.034
z-score	0.374	3.279	3.359	6.433	0.998
σROA	0.015	0.494	0.348	3.061	0.455
Capital ratio	0.060	0.088	0.087	0.128	0.012
Bank characteristics					
Leverage	0.204	1.330	1.246	5.971	0.785
NIM	0.000	2.660	2.660	3.960	0.566
Size	12.840	14.526	14.567	17.421	0.846
Profit_per_emp	−8.800	1.070	0.400	65.500	6.814
Log_deposits	13.198	14.901	14.932	17.747	0.832
N	254				
Private sector banks					
Bank connections					
Degree_1	−1.302	0.013	−0.329	2.772	1.080
Degree_2	1.568	0.246	−0.011	3.372	1.201
Between	−1.282	0.342	−0.048	3.905	1.234
Close	−1.595	−0.186	−0.500	3.963	1.005
Eigen	−0.951	0.375	−0.180	3.945	1.248
Financial stability measures					
gnpa_loans_adv	0.006	0.070	0.042	0.329	0.067
nnpa_loans_adv	0.000	0.013	0.008	0.074	0.012
z-score	0.726	4.128	4.197	6.692	1.022
σROA	0.000	0.339	0.202	1.824	0.354
Capital ratio	0.048	0.131	0.122	0.5593	0.054
Bank characteristics					
Leverage	0.000	1.299	0.945	5.346	1.075
NIM	0.000	0.013	0.008	0.074	0.012
Size	0.693	13.091	13.159	16.337	1.839
Profit_per_emp	−2.100	1.140	0.600	80.500	5.807
Log_deposits	5.991	13.460	13.548	16.673	1.599
N	202				

The Table gives the minimum, means, medians, maximum and standard deviation of variables used in the empirical analysis. Variable names and descriptions are given in Table A1 of the Appendix.

Table 2
First stage regression output.

Dependent variable: Board network					
	Degree_1	*Degree_2*	*Eigen*	*Close*	*Between*
Board_size	0.035***	0.040***	0.067***	0.025***	0.052***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Private	0.845***	1.064***	1.029***	0.335***	1.283***
	(0.102)	(0.126)	(0.116)	(0.120)	(0.118)
Leverage	0.042***	−0.059	−0.093	−0.012	−0.156**
	(0.067)	(0.075)	(0.061)	(0.075)	(0.069)
NIM	−0.060***	−0.052	0.021	−0.100***	−0.036
	(0.037)	(0.035)	(0.037)	(0.036)	(0.033)
Size	1.054***	1.997**	0.863	0.780	1.744**
	(0.522)	(0.965)	(0.530)	(0.799)	(0.701)
Profit_per_emp	−0.012***	−0.007*	−0.005	−0.012***	−0.004
	(0.005)	(0.004)	(0.005)	(0.003)	(0.005)
Log_deposits	−0.549	−1.583	−0.694	−0.329	−1.345*
	(0.5525)	(0.984)	(0.538)	(0.796)	(0.708)
Constant	−7.335***	−5.894***	−3.480***	−6.131***	−5.988***
	(0.633)	(1.030)	(1.014)	(0.830)	(0.816)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342
Adjusted R^2	0.543	0.533	0.588	0.324	0.629
Residual Std. Error (df = 324)	0.652	0.703	0.695	0.807	0.656

The table below presents the first stage output obtained from regressing the various board network measures on the instrument - *Board_size*, other bank controls and year dummies. The descriptions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

Table 3
Board network and gross non-performing assets of the banks.

Dependent variable: gnpa_loans_adv					
	(1)	(2)	(3)	(4)	(5)
Degree_1	−0.008**				
	(0.003)				
Degree_2		−0.007**			
		(0.003)			
Eigen			−0.004**		
			(0.002)		
Close				−0.011**	
				(0.005)	
Between					−0.005**
					(0.002)
Private	−0.037***	−0.036***	−0.043***	−0.044***	−0.037***
	(0.009)	(0.009)	(0.007)	(0.008)	(0.008)
Leverage	−0.016***	−0.016***	−0.015***	−0.017***	−0.015***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
NIM	−0.020***	−0.022***	−0.022***	−0.021***	−0.023***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Size	0.189***	0.201***	0.179***	0.190***	0.191***
	(0.055)	(0.056)	(0.048)	(0.058)	(0.051)
Profit_per_emp	−0.0004*	−0.0003	−0.0002	−0.0005*	−0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
Log_deposits	−0.182***	−0.196***	−0.179***	−0.181***	−0.188***
	(0.056)	(0.057)	(0.049)	(0.059)	(0.052)
Constant	0.081	0.119	0.175***	0.058	0.138**
	(0.087)	(0.075)	(0.053)	(0.095)	(0.062)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342
Adjusted R^2	0.554	0.570	0.613	0.486	0.608
1st stage F-stat	77.92***	89.78***	253.10***	25.392***	174.036***

The table below presents the second stage output obtained from the IV-2SLS regression of the ratio of gross non-performing assets to total loans and advances on the direct and indirect board network measure, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

Table 4
Board network and net non-performing assets of the banks.

Dependent variable: nnpa_loans_adv					
	(1)	(2)	(3)	(4)	(5)
Degree_1	−0.008**				
	(0.003)				
Degree_2		−0.007**			
		(0.003)			
Eigen			−0.004**		
			(0.002)		
Close				−0.011**	
				(0.005)	
Between					−0.005**
					(0.002)
Private	−0.019***	−0.019***	−0.022***	−0.022***	−0.019***
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Leverage	−0.008***	−0.008***	−0.007***	−0.009***	−0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
NIM	−0.008***	−0.009***	−0.009***	−0.009***	−0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Size	0.065***	0.071***	0.060***	0.066**	0.066***
	(0.025)	(0.026)	(0.022)	(0.027)	(0.024)
Profit_per_emp	−0.0002*	−0.0001	−0.0001	−0.0002*	−0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Log_deposits	−0.062**	−0.069***	−0.061***	−0.062**	−0.065***
	(0.026)	(0.027)	(0.022)	(0.027)	(0.024)
Constant	0.033	0.051	0.078***	0.022	0.060**
	(0.038)	(0.032)	(0.023)	(0.042)	(0.027)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342
Adjusted R^2	0.588	0.605	0.636	0.528	0.631
1st stage F-stat	77.92***	89.783***	253.104***	25.392***	174.036***

The table below presents the second stage output obtained from the IV-2SLS regression of the ratio of net non-performing assets to total loans and advances on the direct and indirect board network measure, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

connections of the bank. This is a count measure and gives the number of companies with which the bank is connected on account of board interlocks. The first level degree measure for bank *i* at the end of year *t* is given by:

$$Degree\_1_{it} = \sum_{j=1}^{k} Connections_{ijt} \tag{1}$$

where $Connections_{ijt}$ is a binary variable which is equal to one if there is a board interlock between bank *i* and company *j* during year *t* and zero otherwise. For example, Fig. 2 indicates that director 2 has a higher first-level degree measure of 5 than director 1 with a degree measure of 1.

Next, we consider the second-level degree measure, which is the number of direct connections of the bank's first-level connections. This measure captures the strength of weak ties in the network. Since the seminal paper of Granovetter (1973), studies have found that weak ties can provide a non-trivial informational advantage to the entities in the network (Geng et al., 2021; Levin and Cross, 2004; Ruef, 2002). The firms that are not directly connected to the bank, but is a direct connection of the firm with which the bank is connected in essence captures the information obtained from weak ties. *Degree_2* is the sum of the first and second-level connections of the bank. The first and second-level degree measures are proxies of the quantity of information available to the bank through the bank directors.

Next, we consider three additional measures, including closeness, betweenness, and the eigen centrality measures. These, along with the second-level degree measure, constitute the indirect connections of the bank. Each of these centrality measures captures a different aspect of the network (Omer et al., 2014). Several studies have employed these measures that examine the effect on networks (Abdelbadie and Salama, 2019; Larcker et al., 2013; Hochberg et al., 2007). The closeness measure (Close) is given by the inverse of the sum of distance between a bank and all other companies in the network. The banks with a higher value of closeness measure are likely to obtain soft information faster than those with a lower value of closeness measure. For a bank, if all the directors are only sitting on the board of the focal bank and do not occupy any other board seat, then the closeness measure is defined as zero.

Table 5
Board network and insolvency risk.

Dependent variable: -Log_zscore					
	(1)	(2)	(3)	(4)	(5)
Degree_1	−0.396**				
	(0.166)				
Degree_2		−0.343**			
		(0.146)			
Eigen			−0.206**		
			(0.084)		
Close				−0.561**	
				(0.253)	
Between					−0.263**
					(0.110)
Private	−0.646***	−0.616**	−0.769***	−0.793***	−0.643***
	(0.243)	(0.254)	(0.200)	(0.225)	(0.239)
Leverage	0.174*	0.137	0.138	0.150	0.116
	(0.098)	(0.096)	(0.088)	(0.105)	(0.089)
NIM	−0.221***	−0.215***	−0.193**	−0.253***	−0.207***
	(0.079)	(0.077)	(0.076)	(0.092)	(0.077)
Size	1.332	1.598	1.092	1.352	1.373
	(1.201)	(1.277)	(1.026)	(1.284)	(1.129)
Profit_per_emp	−0.010*	−0.008	−0.007	−0.012*	−0.006
	(0.006)	(0.005)	(0.005)	(0.007)	(0.005)
Log_deposits	−1.267	−1.591	−1.192	−1.234	−1.403
	(1.189)	(1.263)	(1.033)	(1.262)	(1.122)
Constant	−3.817**	−2.930*	−1.629	−4.351**	−2.488*
	(1.942)	(1.699)	(1.273)	(2.220)	(1.475)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342
Adjusted R^2	0.200	0.205	0.297	0.055	0.280
1st stage F-stat	77.92***	89.78***	253.104***	25.39***	174.04***

The table below presents the second stage output obtained from the IV-2SLS regression of insolvency risk of the bank (negative of the logarithm of the ratio of the sum of ROA and CAR to the five-year volatility of ROA) on the direct and indirect board network measure, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

$$Close_{ijt} = \frac{1}{\sum_{\substack{j=1, \\ i \neq j}}^{k} Distance_{ijt}} \tag{2}$$

For example, the normalized closeness measure for City Union Bank Limited and HDFC Bank Limited suggests that the distance of HDFC Bank Limited is lower than that of City Union Bank Limited, which would indicate information reaches HDFC bank faster than City Union Bank.

The betweenness measure (Between) is defined as the sum of the number of paths that pass through a bank for connecting any two companies in the network. This measure captures the importance of an agent in the network. When a large number of paths cross through the bank, the bank becomes crucial for information transmission within the network. Similarly, a bank with a high betweenness score will have an informational advantage and more power in the network over the other banks. Again, a bank like HDFC Bank Limited has more power in the network than a smaller bank like City Union Bank based on the betweenness score.

Eigen measure captures the power and prestige of the bank in the network. The eigen measure captures to what extent the bank is connected to other well-connected companies in the network. The eigen centrality measure (Eigen) is defined as the value of the eigen vector for the bank in the network.

Since each centrality measure captures a different aspect of the network, in the regression analysis, we compute the standardized score of the bank-level centrality measures for interpreting the coefficients. Further, the centrality measures are likely to be correlated and are included in separate models.

4.4. Other variables

We control for a set of bank characteristics in line with existing literature (Abdelbadie and Salama, 2019; Louzis et al., 2012). We control for bank size (*Size*), the debt-equity ratio of the bank (*Leverage*), bank funding source (*Log_deposits*), the efficiency of banks captured by profit per employee (*Profit_per employee*), and the net interest margin (*NIM*), the ownership structure of the bank given by the private dummy (*Private*) We also control for year effects with the help of year dummies. Table A1 in the Appendix provides the definitions of the variables in the study.

Table 6
Board network and volatility of ROA.

Dependent variable: σROA					
	(1)	(2)	(3)	(4)	(5)
Degree_1	−0.120**				
	(0.057)				
Degree_2		−0.104**			
		(0.050)			
Eigen			−0.063**		
			(0.029)		
Close				−0.171**	
				(0.087)	
Between					−0.080**
					(0.038)
Private	−0.185**	−0.176**	−0.223***	−0.230***	−0.184**
	(0.082)	(0.085)	(0.069)	(0.076)	(0.080)
Leverage	0.026	0.015	0.015	0.019	0.009
	(0.040)	(0.039)	(0.037)	(0.042)	(0.038)
NIM	−0.032	−0.030	−0.023	−0.041	−0.027
	(0.033)	(0.032)	(0.032)	(0.037)	(0.032)
Size	0.829*	0.910*	0.756*	0.835*	0.842*
	(0.454)	(0.478)	(0.405)	(0.474)	(0.436)
Profit_per_emp	−0.002	−0.002	−0.001	−0.003	−0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Log_deposits	−0.850*	−0.949**	−0.828**	−0.840*	−0.892**
	(0.450)	(0.474)	(0.408)	(0.467)	(0.434)
Constant	0.959	1.229**	1.625***	0.797	1.363***
	(0.626)	(0.547)	(0.425)	(0.721)	(0.480)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342
Adjusted R^2	0.183	0.193	0.270	0.077	0.262
1st stage F-stat	77.92***	89.78***	253.104***	25.392***	174.036***

The table below presents the second stage output obtained from the IV-2SLS regression of five-year volatility of ROA on the direct and indirect board network measure, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

4.5. Methodology

We estimate the below given model to analyze the relation between board network variable and financial stability measures:

$$Stability_{it} = \beta_0 + \beta_1 Board\ Network_{it} + \beta_2 Private_i + \sum_{j=1}^{k} \gamma_j X_{ijt} + \varphi_t + \varepsilon_{it} \quad (3)$$

where $Stability_{it}$ is the asset quality measures, minus of logarithm of z-score, *σROA* and capital adequacy ratio variables. The $Board\ Network_{it}$ is the value of the standardized score of the direct (*Degree_1*) and indirect connections of the bank (*Degree_2, Close, Between, Eigen*), $Private_i$ is the dummy which takes the value one for private banks and zero for public sector banks, X_{ijt} is the matrix of control variables, φ_t is the year fixed effect and ε_{it} is the random error term.

We do not employ panel data models with bank fixed-effects since the board network is a slow-changing variable. The board network of a bank is likely to change sluggishly over a period of time; however, in a given year, the network is expected to vary substantially across banks. Introducing bank fixed-effects in the model will absorb the variation in the board network of the bank, even if there exists a cross-sectional relation (Zhou, 2001). Thus, in our empirical specification, we control for the observable bank characteristics along with year effects.

The empirical results obtained from estimating the above specification will be biased and inconsistent if the board network measures are endogenous. The endogeneity can be due to omitted variables, reverse causality, or simultaneity in the system. One can argue that more stable banks can attract well-connected directors on their board, leading to reverse causality. Further, the reputation of the bank in the marketplace can be related to both the financial stability of the bank and the number of directorships of the bank director. We address the endogeneity concerns using an instrumental variable (IV) approach to ensure that the coefficients are consistent. The two-step least squares (IV-2SLS) method in the presence of a valid instrument can tackle the endogeneity in the model. A valid instrument should be correlated with the board network variable and should be otherwise uncorrelated to the financial stability measures.

We use the number of board members on the board (*Board_size*) as an instrument for the board network variable. The study on the role of the bank board network in the US by Abdelbadie and Salama (2019) also considered board size as an instrument. Theoretically, larger boards increase the chances of bank director occupying multiple board seats and this should be related to the number of direct and indirect connections of the bank. We expect a positive and significant relation between the board network measures and the board

Table 7
Board network and capital ratio.

Dependent variable: Capital ratio					
	(1)	(2)	(3)	(4)	(5)
Degree_1	0.002**				
	(0.003)				
Degree_2		0.002**			
		(0.002)			
Eigen			0.001**		
			(0.001)		
Close				0.003**	
				(0.004)	
Between					0.001**
					(0.002)
Private	0.009**	0.008**	0.009***	0.009***	0.009**
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Leverage	−0.011***	−0.011***	−0.011***	−0.011***	−0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
NIM	0.017***	0.017***	0.016***	0.017***	0.016***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
Size	0.146***	0.145***	0.148***	0.146***	0.146***
	(0.019)	(0.019)	(0.017)	(0.019)	(0.018)
Profit_per_emp	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log_deposits	−0.151***	−0.149***	−0.151***	−0.151***	−0.150***
	(0.018)	(0.019)	(0.018)	(0.019)	(0.018)
Constant	0.167***	0.162***	0.155***	0.170***	0.159***
	(0.025)	(0.022)	(0.018)	(0.027)	(0.020)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342
Adjusted R^2	0.796	0.798	0.800	0.793	0.799
1st stage F-stat	77.92***	89.78***	253.104***	25.392***	174.036***

The table below presents the second stage output obtained from the IV-2SLS regression of capital ratio on the direct and indirect board network measure, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

size variable, implying that the instrument is likely to satisfy the relevance condition. However, board size should not be directly related to the financial stability of the banks in the sample. Prior studies did not find any conclusive relation between board size and bank outcomes (Talavera et al., 2018; Akbar et al., 2017). Specifically, in the Indian context, the study by Sarkar and Sarkar (2018) emphasized that the board size is unrelated to the performance and asset quality measures of Indian banks. The recent empirical evidence on the insignificant relation between board size and bank outcomes in India provides confidence that our instrument is likely to satisfy the exogeneity condition. Later, in the robustness analysis section, we relax the assumption that board size is strictly exogenous and employ the plausibly exogenous instrumental variable method (Conley et al., 2012) to re-estimate the main result. Further, in our robustness analysis, we also introduce an additional instrument – the number of listed firms registered in the same city as the bank (*Number_firms*) - and report the Hansen over-identification test results to support our assumption that the instrument indeed satisfies the instrument validity condition.

In the first stage of IV-2SLS estimation, we regress the board network measure on the board size variable and the other bank controls along with year fixed effects, and the specification is given below:

First stage equation:

$$Board\ Network_{it} = \alpha_0 + \alpha_1 Board\ size_{it} + \alpha_3 Private_i + \sum_{j=1}^{k} \varnothing_j X_{ijt} + \vartheta_t + u_{it} \tag{4}$$

In the second stage, the financial stability measure is regressed on the predicted board network variables obtained from the first stage and other controls.

Second stage model:

$$Stability_{it} = \beta_0 + \beta_1 Board\ \widehat{Network_{it}} + \beta_2 Private_i + \sum_{j=1}^{k} \gamma_j X_{ijt} + \varphi_t + \varepsilon_{it} \tag{5}$$

Table 8
Board network and asset quality measures of banks: Public versus private banks.

Panel A: *Dependent variable: gnpa_loans_adv*					
	(1)	(2)	(3)	(4)	(5)
Degree_1	0.029				
	(0.023)				
*Degree_1*Private*	−0.080***				
	(0.026)				
Degree_2		0.051			
		(0.039)			
*Degree_2*Private*		−0.100**			
		(0.046)			
Eigen			0.041**		
			(0.018)		
			(0.023)		
*Eigen*Private*			−0.0.084***		
			(0.023)		
Close				0.054	
				(0.036)	
*Close*Private*				−0.120***	
				(0.038)	
Between					0.056
					(0.038)
*Between*Private*					−0.095***
					(0.045)
Panel B: Dependent variable: nnpa_loans_adv					
Degree_1	0.015				
	(0.012)				
*Degree_1*Private*	−0.041***				
	(0.013)				
Degree_2		0.027			
		(0.020)			
*Degree_2*Private*		−0.052**			
		(0.024)			
Eigen			0.021**		
			(0.009)		
*Eigen*Private*			−0.042***		
			(0.012)		
Close				0.028	
				(0.018)	
*Close*Private*				−0.061***	
				(0.019)	
Between					0.029
					(0.020)
*Between*Private*					−0.049***
					(0.023)
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342

The table below presents the second stage output obtained from the IV-2SLS regression of gross non-performing assets to total loans and advances and net non-performing loans to loans and advances on the direct and indirect board network measure, interaction between private dummy, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

5. Results

5.1. Summary statistics

Fig. 5 presents the trend in average direct and indirect connections of the banks on account of board interlocks. The direct links of banks have increased by over 50% during the last decade (19 connections to around 30 connections). The second-level connections of banks have doubled from close to 73 connections in 2009 to over 160 connections in 2019. The increasing nature of connections in banks reinforces the need to examine whether at all board networks add any value to the banks or is a mere empirical regularity in the data.

Table 1 presents the summary statistics of the direct and indirect connections, financial stability variables, and other control variables for all the banks during the period of analysis and also separately for the PSBs and the private banks. The direct connections of the PSBs and the private banks are comparable; however, at the second-level, the PSBs in India are less connected than the private banks. It is evident that during the study period, the non-performing assets in the Indian banking industry are high, and the average

Table 9
Board network, insolvency risk, volatility of ROA and capital ratio: Public versus private banks.

Panel A: *-Log_ zscore*					
	(1)	(2)	(3)	(4)	(5)
Degree_1	0.244				
	(0.294)				
*Degree_1*Private*	−0.940**				
	(0.426)				
Degree_2		0.364			
		(0.659)			
*Degree_2*Private*		−1.089			
		(0.813)			
Eigen			0.421		
			(0.378)		
*Eigen*Private*			−1.068**		
			(0.510)		
			(0.580)		
Close				0.449	
				(0.627)	
				(0.627)	
*Close*Private*				−1.583**	
				(0.722)	
Between					0.437
					(0.656)
*Between*Private*					−1.008
					(0.791)
Panel B: σROA					
Degree_1	0.019				
	(0.142)				
*Degree_1*Private*	−0.249				
	(0.173)				
Degree_2		0.073			
		(0.216)			
*Degree_2*Private*		−0.274			
		(0.266)			
Eigen			0.104		
			(0.124)		
*Eigen*Private*			−0.285*		
			(0.168)		
Close				0.100	
				(0.203)	
*Close*Private*				−0.426*	
				(0.232)	
Between					0.094
					(0.218)
*Between*Private*					−0.251
					(0.263)
Panel C: Capital ratio					
Degree_1	−0.006				
	(0.007)				
*Degree_1*Private*	0.015*				
	(0.008)				
Degree_2		−0.010			
		(0.011)			
*Degree_2*Private*		0.019			
		(0.013)			
Eigen			−0.008		
			(0.005)		
*Eigen*Private*			0.015**		
			(0.007)		
Close				−0.011	
				(0.009)	
*Close*Private*				0.021**	
				(0.010)	
Between					−0.011
					(0.011)
*Between*Private*					0.018
					(0.013)
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342

The table below presents the second stage output obtained from the IV-2SLS regression of negative logarithm of the zscore, five-year volatility of ROA and capital ratio on the direct and indirect board network measure, interaction between private dummy, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

non-performing assets are much higher for the PSBs compared to the private sector banks in India. The other stability measures (logarithm of z-score and volatility of ROA) also indicate that the deteriorating financial health of PSBs. The average *size* and *log_deposits* of the PSBs are higher than the private counterpart. However, the *NIM* and *profit_per_emp* of the private banks are higher than the PSBs.

5.2. Bank-level board network and asset quality

Table 2 presents the first stage regression of the individual network measure on board size and other control variables. The instrument (*Board_size*) is positive and highly significant for all the network measures ascertaining the relevance of the instrument. The F-statistic of the first stage regression is greater than ten in all specifications, indicating that the instrument is not weak. Table 3 presents the second stage output obtained from regressing gross non-performing assets to total loans and advances (*gnpa_loans_adv*) on the board network measures. The second stage regressions indicate that the board network is related to the asset quality of the bank. For example, column 1 suggests that the one standard deviation increase in *Degree_1* measure is related to 0.8% fall in *gnpa_loans_adv*. The indirect board network measures (*Degree_2*, *Eigen*, *Close*, *Between*) are also an important determinant of the bank's asset quality, even though the marginal effect is highest for the *Close* measure which suggests that in addition to the availability of information, the speed of information transmission could be important for bank's stability.

Table 4 presents the results for the net non-performing assets to total loans and advances (*nnpa_loans_adv*) regression. Similar to the results for the gross non-performing asset measure, we find that a larger board network is related to lower *nnpa_loans_adv,* and the effect is strongest for the closeness measure. One standard deviation increase in *Close* is related to 1.1% fall in *nnpa_loans_adv* (column 3). An increase in other board network measures are also related to 0.4%–0.7% fall in *nnpa_loans_adv* (columns 1,2,4 and 5). The effect of the board network for the banks in the US is much higher in the range of 47% to 59% (Abdelbadie and Salama, 2019). The small effect size of the board network on asset quality measures can be explained by the fact that during the bank board meetings in India, the number of issues tabled and discussed related to risks is comparatively few and most of the discussion is around financial reporting. Further, the number of risk-related issues discussed is negatively related to the NPAs of the banks (Chapter 3, Nayak, 2014). Additionally, we find that the average non-performing asset is lower for private banks and banks with higher deposits, higher net interest margin and higher profit per employee. Further, we find that bigger banks have higher non-performing assets.

In a bank-based economy, the human capital and resources of the bank directors could be crucial for the quality of strategic advice provided to the bank. The well-connected director will be better informed regarding the borrower's (mainly corporate borrowers) credit behavior and help in reducing the information asymmetry between the bank and its borrowers. Further, knowledge regarding potential borrowers through connections can also lower the probability of extending loans to risky borrowers, which in turn is related to lower non-performing assets. We explore this information channel further in Section 6 of the paper.

The results in this section indicate that the access to valuable resources and information available through the board network and the expertise of the well-connected director can help improve the asset quality of banks in India. The findings are in line with the integrated resource dependence view of boards. These results are in line with other bank-specific studies in the context of the United States (Abdelbadie and Salama, 2019), wherein a higher board network is related to the lower credit risk of banks.

5.3. Bank-level board network and insolvency risk

Next, we consider the insolvency risk of the bank given by the minus of the logarithm of the z-score as a measure of the financial stability, and the results are presented in Table 5. We find that one standard deviation increase in *Degree_1* is related to 39.6% fall in insolvency risk (column 1), and one standard deviation increase in indirect connections is related to 20.6% to 56.1% fall in the risk of insolvency (columns 2–5). Again we find that the effect of an increase in closeness measure of the bank has the strongest effect on reducing the insolvency risk of the bank (by almost 56%). The findings indicate that the well-connected bank-directors bring in financial expertise and can help the banks to manage their risk better and lower the probability of insolvency. These findings are also in line with the study by Carpenter and Westphal (2001), which highlights that ties of the board improve the ability of the board to supervise and advise the management effectively. This effective functioning of bank boards can reduce the insolvency risk of the bank. Abdelbadie and Salama (2019) also find that an increase in the board network is related to a fall in insolvency risk of the banks, and the effect size was in their study was in the range of 47%–59%. The lower marginal effects in the Indian context could be attributed to the heavily regulated boards of the PSBs in India.

5.4. Bank-level board network and volatility of ROA

The third financial stability measure in our study is the volatility of ROA during the last five years. The results of using the accounting measure of risk as the dependent variable are presented in Table 6. We find that one standard deviation increase in *DEGREE_1* is related to a 12% fall in σROA (column 1). One standard deviation increase in the score of indirectcentrality measures is related to 6.3% to 17.1% fall in σROA (columns 2–5). The advice of the well-connected bank director can help the banks to smoothen their

Table 10
Effect of board network on performance of banks.

	ROE							*ROA*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Degree_1	0.066***					0.002**				
	(0.024)					(0.001)				
Degree_2		0.057***					0.002**			
		(0.021)					(0.001)			
Eigen			0.034***					0.001**		
			(0.012)					(0.001)		
Close				0.093**					0.003*	
				(0.037)					(0.001)	
Between					0.044***					0.001**
					(0.016)					(0.001)
Private	0.041	0.036	0.061***	0.065***	0.040*	0.006***	0.006***	0.006***	0.006***	0.006***
	(0.026)	(0.028)	(0.020)	(0.025)	(0.024)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Leverage	0.014	0.020	0.020	0.017	0.023*	0.000	0.000	0.000	0.000	0.000
	(0.016)	(0.015)	(0.014)	(0.016)	(0.014)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
NIM	0.045***	0.044***	0.040***	0.050***	0.042***	0.004***	0.004***	0.004***	0.004***	0.004***
	(0.007)	(0.007)	(0.006)	(0.008)	(0.006)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Size	−0.394**	−0.438**	−0.354***	−0.397**	−0.401***	−0.008	−0.009	−0.007	−0.008	−0.008
	(0.163)	(0.171)	(0.134)	(0.179)	(0.148)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)
Profit_per_emp	0.003***	0.002***	0.002***	0.003***	0.002***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log_deposits	0.383**	0.436**	0.370***	0.377**	0.405***	0.009	0.010	0.008	0.009	0.009
	(0.165)	(0.172)	(0.136)	(0.179)	(0.149)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)
Constant	0.005	−0.142	−0.358**	0.093	−0.216	−0.019	−0.024**	−0.031***	−0.017	−0.026***
	(0.256)	(0.220)	(0.153)	(0.290)	(0.176)	(0.012)	(0.011)	(0.008)	(0.013)	(0.009)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342	342	342	342	342	342
Adjusted R^2	0.402	0.411	0.484	0.261	0.475	0.615	0.618	0.640	0.573	0.643
1st stage F-stat	77.92***	89.78***	253.104***	25.392***	174.036***	77.92***	89.78***	253.104***	25.392***	174.036***

The table below presents the second stage output obtained from the IV-2SLS regression of return on equity and return on assets on the direct and indirect board network measure, other bank controls and year dummies using board size and the number of listed firms registered in the same city as an additional IV. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

Table 11
Alternate measure of board network and asset quality of banks.

	Dependent variable: Asset quality measures									
	gnpa_loans_adv					*nnpa_loans_adv*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Degree_1	−0.010**					−0.005***				
	(0.004)					(0.002)				
Degree_2		−0.010***					−0.005***			
		(0.004)					(0.002)			
Eigen			−0.012***					−0.006***		
			(0.005)					(0.002)		
Close				−0.010***					−0.005***	
				(0.003)					(0.002)	
Between					−0.011***					−0.005***
					(0.004)					(0.002)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342	342	342	342	342	342
Adjusted R^2	0.618	0.611	0.584	0.610	0.598	0.637	0.632	0.612	0.632	0.618
First stage F-stat	227.148***	261.15***	113.76***	279.15***	208.29***	307.756***	261.155***	113.764***	279.152***	208.29***

The table below presents the second stage output obtained from the IV-2SLS regression of gross non-performing assets to loans and advances and net non-performing assets to loans and advances on the direct and indirect board network measure, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

Table 12
Alternate measure of board network: insolvency risk, volatility of ROA and capital adequacy ratio.

	-Log_ score					*σROA*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Degree_1	−0.226**					−0.069**			
	(0.091)					(0.032)			
Degree_2		−0.234**					−0.071**		
		(0.095)					(0.033)		
Eigen			−0.288**					−0.088**	
			(0.119)					(0.041)	
Close				−0.215**					−0.065**
				(0.087)					(0.030)
Between					−0.239**				
					(0.100)				
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
observarions	342	342	342	342	342	342	205	342	342
Adjusted R^2	0.292	0.297	0.270	0.295	0.262	0.260	0.265	0.233	0.262
1st stage F-stat	227.148***	208.323***	94.353***	238.970***	176.700***	227.148***	208.323***	94.353***	238.970***

The table below presents the second stage output obtained from the IV-2SLS regression financial stability measures on the direct and indirect board network measures, other bank controls and year dummies. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

performance during peaks and troughs of a business cycle. Also, the availability of soft information on account of a larger board network can help banks perform better even when the macroeconomic environment is not favorable. The effect of one standard deviation increase in closeness measure has the largest marginal effect of reducing the volatility of ROA. The results till now suggest that the speed at which the information reaches the bank seems to be very crucial, along with the quantity of information accessed through the board network.

5.5. Bank-level board network and capital adequacy ratio

The final financial stability measure in our study is the CAR. CAR is used as a tool to assess the financial stability of depository institutions. Table 7 reports the second stage regression output of CAR on the board network measures. We do not find any evidence that a larger board network improves the precautionary capital of banks as given by CAR. On the other hand, Abdelbadie and Salama (2019) find a negative relation between the board network of CAR for the banks in the United States, suggesting that networked directors are in a better position to understand the external environment, thereby reducing the CAR.[1] The insignificant result could be explained by the fact that CAR is mostly viewed as a regulatory requirement by the banks. The well-connected banks in India grappling with huge asset quality problems may not increase CAR substantially to signal better financial health if such signaling may not generate substantial positive externalities such as higher lending or higher loan spreads.

5.6. Public and private banks

Our main results suggest that a well-connected bank board improves the financial stability of banks in India. However, the regression coefficients give us an average effect of board network for the listed banks in India, and the effect could be different for subgroups based on ownership. To assess the differential effect of board network, if any, for the private and PSBs in India, we introduce an interaction between the *Private* dummy and board network variables and re-estimate the models. Table 8 presents the result for the asset quality measures. We find that the improvement in asset quality due to a large board network is driven by the private banks in India. The result can be explained by the fact that several directors on the board of the PSBs are appointed close to their retirement age and have shorter board tenure (Sarkar and Sarkar, 2018). For the year ending 2019, we find that the average tenure of directors sitting on the board of PSBs was 3.18 years compared to 4.79 years for directors on the board of private banks. The directors nearing retirement may not be driven by career advancement objectives and have lower reputational concerns lowering their interest in the operations of the bank driving the insignificant result for the PSBs.

Further, we find that only 46.5% of directors of PSBs have degrees related to economics, finance, or management compared to 64.4% of directors in private banks in 2019. The differences in the share of directors with relevant educational qualifications across private banks and PSBs can be another plausible reason for the insignificant results obtained for the PSBs. Finally, unlike private banks,

[1] Note that the negative results in Abdelbadie and Salama (2019) was also contradictory to their orginal hypothesis of the paper.

σROA	*Capital ratio*				
(10)	(11)	(12)	(13)	(14)	(15)
	0.001				
	(0.001)				
		0.001			
		(0.001)			
			0.002		
			(0.002)		
				0.001	
				(0.001)	
−0.239**					0.001
(0.100)					(0.002)
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
342	342	342	342	342	342
0.262	0.799	0.799	0.795	0.799	0.800
176.71***	227.148***	208.323***	94.353***	238.970***	176.71***

the directors of PSBs did not have an employee stock option scheme (ESOS/ESOP) as a part of their compensation till 2017, which could also be another factor weakening the link between board network and board effectiveness for the PSBs in India.[2] Recently, Acharya and Rajan (2020) point out that in PSBs, directors are often not appointed in a transparent manner and boards are not empowered to appoint CEOs or propose eligible candidates. The lack of operational independence of boards of PSBs could be another reason driving the insignificant results for PSBs. Table 9 presents the result for the insolvency risk, the volatility of ROA, and capital adequacy ratio, and we find that the improvement in financial stability due to a large board network is mainly driven by the private banks and is insignificant for the PSBs in India. However, the board network is unrelated to CAR for both private banks and PSBs in India.

5.7. Board network and bank performance

The financial stability results indicate that the connected directors possibly help in the transmission of soft information and, given their skill set, are better strategic advisers. In that case, it should not only reduce the risk of the banks in the form of improved financial stability but should also be related to the superior performance of banks. The empirical evidence on director networks for non-financial firms suggests that the presence of a large director network facilitates the flow of information in the network and is related to the higher profitability of firms. Larcker et al. (2013) find that for firms in the United States, a large network is related to better performance of firms. Similarly, Hochberg et al. (2007) find that better-networked venture capital firms exhibit a superior portfolio performance.

Next, we examine the relationship between the board network and the performance of banks in our sample. We specifically consider the two accounting measures of performance - return on assets (ROA) and return on equity (ROE). ROA is defined as the ratio of profit after tax to total assets, and ROE is defined as the ratio of profit after tax to shareholder's equity. Table 10 indicates that network centrality measures are related to an increase in ROE in the range of 3.4%–9.3% (columns 1–5). All the network measures are also related to ROA improvement by 0.1%–0.3% on average (Columns 6–10). The positive relation between board network and accounting measures of performance indicates that the soft information and resources available to the banks on account of the board network not only improves the financial stability but is also related to superior performance. We do not find that the improved financial stability on account of board network is associated with a cost like lower performance.

5.8. Robustness check

5.8.1. Alternate network measure

In our main analysis, we have computed the bank-level board network. Now, we consider an alternate definition of the board network variable by calculating the network measures at the director level and then obtain the bank level network measure and standardizing the values by dividing the overall director network by the board size of the bank. The discussions in Section 3.2 earlier highlight that the bank-level board network provides a measure of the availability of a unique set of information to the bank. On the other hand, director-level board network measures capture both the quantity as well as the strength of bank connections. The definition of the director-level board network measures is given in Appendix.

[2] Based on the recommendations of Banks Board Bureau, the Ministry of Finance accepted the proposal to allow employee stock options as a part of compensation for the of employees of public sector banks in March, 2017. https://dipp.gov.in/sites/default/files/CFPC_2017_FINAL_RELEASED_28.8.17_0.pdf.

Table 13
Plausibly exogenous regression output.

	Panel:A											
	gnpa_loans_adv						*nnpa_loans_adv*					
	γ = [0.1, 10]		γ = [0.1, 50]		γ = [0.1, 250]		γ = [0.1, 10]		γ = [0.1, 50]		γ = [0.1, 250]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Lower bound	Upper bound	Lower bound
Degree_1	−360.495	−2.188	−1802.369	−2.188	−9011.740	−2.188	−360.480	−2.182	−1802.3542	−2.182	−9011.724	−2.182
Degree_2	−309.871	−1.924	−1549.264	−1.924	−7746.224	−1.924	−309.858	−1.918	−1549.250	−1.918	−7746.211	−1.918
Eigen	−170.082	−1.326	−850.364	−1.326	−4251.77	−1.326	170.075	−1.321	−850.357	−1.321	−4251.763	−1.321
Close	−572.195	−2.544	−2860.819	−2.544	−14,303.94	−2.544	−572.174	−2.535	−2860.798	−2.535	−14,303.919	−2.535
Between	−227.857	−1.609	−1139.219	−1.609	−5696.027	−1.609	−227.848	−1.604	−1139.209	−1.604	−5696.018	−1.604

	Panel: B																	
	-Log(z-score)						*σROA*						*Capital ratio*					
	γ = [0.1, 10]		γ = [0.1, 50]		γ = [0.1, 250]		γ = [0.1, 10]		γ = [0.1, 50]		γ = [0.1, 250]		γ = [0.1, 10]		γ = [0.1, 50]		γ = [0.1, 250]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Degree_1	−360.95	−2.42	−1802.82	−2.42	−9012.19	−2.42	−360.63	−2.72	−1802.50	−2.72	−9011.87	−2.72	−360.47	0.004	−1802.34	0.004	−9011.71	0.004
Degree_2	−310.27	−2.11	−1549.66	−2.11	−7746.63	−2.11	−309.99	−1.99	−1549.38	−1.99	−7746.34	−1.99	−309.85	0.003	−1549.24	0.003	−7746.2	0.003
Eigen	−170.30	−1.44	−850.58	−1.44	−4251.99	−1.44	−170.15	−1.37	−850.43	−1.37	−4251.83	−1.37	−170.07	0.002	−850.35	0.002	−4251.75	0.002
Close	−572.92	−2.82	−2861.54	−2.82	−14,304.66	−2.82	−572.42	−2.64	−2861.04	−2.64	−14,304.16	−2.64	−572.15	0.005	−2860.78	0.005	−14,303.9	0.005
Between	−228.16	−1.75	−1139.52	−1.75	−5696.33	−1.75	−227.94	−1.67	−1139.31	−1.67	−5696.11	−1.67	−227.84	0.002	−1139.20	0.002	−5696.01	0.002

The table below presents the 95% confidence interval for the board network variables obtained from plausibly exogenous regression for different ranges of gamma after relaxing the exogeneity restriction of the instrument.

Table 14
Number of firms headquartered in the city as an additional IV.

	Dependent variable: Asset quality measures									
	gnpa_loans_adv					*nnpa_loans_adv*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Degree_1	−0.016**					−0.008**				
	(0.007)					(0.003)				
Degree_2		−0.012**					−0.006**			
		(0.006)					(0.003)			
Eigen			−0.008*					−0.004**		
			(0.005)					(0.002)		
Close				−0.024*					−0.011**	
				(0.011)					(0.005)	
Between					−0.010*					−0.005**
					(0.005)					(0.002)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342	342	342	342	342	342
Adjusted R^2	0.558	0.587	0.611	0.485	0.612	0.588	0.611	0.629	0.528	0.632
First stage F-stat	39.290***	51.679***	71.002***	12.663***	92.349***	39.290***	51.679***	71.002***	12.663***	92.349***
Hansen test (p-val)	0.313	0.101	0.303	0.519	0.1735	0.927	0.475	0.207	0.841	0.7021

The table below presents the second stage output obtained from the IV-2SLS regression of gross non-performing assets to loans and advances and net non-performing assets to loans and advances on the direct and indirect board network measure, other bank controls and year dummies using board size and the number of listed firms registered in the same city as an additional IV. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

Table 15
Number of firms headquartered in the city as an additional IV.

		-Log_ score				*σROA*						*Capital ratio*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Degree_1	−0.390**					−0.120**					0.002				
	(0.167)					(0.058)					(0.003)				
Degree_2		−0.300**					−0.095*					−0.000			
		(0.142)					(0.051)					(0.002)			
Eigen			−0.205*					−0.067*					−0.000		
			(0.109)					(0.040)					(0.001)		
Close				−0.562**					−0.170**					0.003	
				(0.252)					(0.087)					(0.004)	
Between					−0.250**					−0.078**					0.001
					(0.109)					(0.038)					(0.002)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342	342	342	342	342	342	342	342	342	342	342
Adjusted R^2	0.203	0.226	0.297	0.055	0.284	0.184	0.205	0.254	0.077	0.264	0.798	0.802	0.802	0.793	0.801
First stage F-stat	39.290***	51.679***	71.002***	12.663***	92.349***	39.290***	51.679***	71.002***	12.663***	92.349***	39.290***	51.679***	71.002***	12.663***	92.349***
Hansen test (p-val)	0.708	0.352	0.148	0.933	0.513	0.942	0.576	0.320	0.873	0.763	0.007	0.006	0.006	0.010	0.001

The table below presents the second stage output obtained from the IV-2SLS regression of insolvency risk, volatility of ROA and capital ratio on the direct and indirect board network measure, other bank controls and year dummies using board size and the number of listed firms registered in the same city as an additional IV. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

Table 16
Monitoring of borrowers as a potential channel.

		Full sample				*Less connected*						*More connected*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Degree_1	42.31***					17.39					44.18***				
	(9.575)					(59.40)					(14.29)				
Degree_2		36.58***					12.50					37.14***			
		(8.954)					(41.17)					(12.70)			
Eigen			22.04***					2.884					19.32***		
			(5.477)					(9.824)					(6.698)		
Close				59.92***					7.549					68.18**	
				(18.62)					(26.55)					(32.51)	
Between					28.13***					7.573					22.26***
					(7.168)					(25.96)					(7.846)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	342	342	342	342	342	153	153	153	153	153	189	189	189	189	189
Adjusted R^2	0.831	0.825	0.829	0.694	0.818	0.722	0.750	0.721	0.705	0.727	0.839	0.839	0.842	0.677	0.825

The table below presents the second stage output obtained from the IV-2SLS regression of the number of borrowing firms in the network on the direct and indirect board network measure, other bank controls and year dummies using board size as the IV. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

Table 17
Restructuring of corporate accounts as a potential channel.

		Full sample				*Less connected*						*More connected*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Degree_1	22.008***					81.429					19.486**				
	(7.627)					(57.693)					(7.638)				
Degree_2		18.885***					55.921					16.471**			
		(6.879)					(42.002)					(7.006)			
Eigen			11.923***					18.119					9.872**		
			(3.960)					(12.823)					(3.914)		
Close				30.798**					66.355					25.906*	
				(14.472)					(73.443)					(13.830)	
Between					14.623***					55.161					10.091**
					(5.275)					(47.658)					(4.041)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	199	199	199	199	199	83	83	83	83	83	116	116	116	116	116
Adjusted R^2	0.543	0.443	0.452	0.009	0.427	0.233	0.141	0.398	0.049	0.062	0.608	0.526	0.530	0.233	0.536

The table below presents the second stage output obtained from the IV-2SLS regression of the number of corporate accounts restructured on the direct and indirect board network measure, other bank controls and year dummies using board size as the IV. The definitions of the variables are provided in Table A1 of the Appendix. We report robust standard errors in parenthesis. * indicates that the coefficient is significant at10% level, **at 5% level and ***at 1% level.

We re-examine the relationship between the board network and the financial stability of the bank by computing the board network at the director-level instead of the bank-level. Table 11 presents the IV-2SLS results obtained from regressing asset quality measures on the director-level board network measures and other controls. The director-level board network measures have the effect of lowering the *gnpa_loans_adv* and *nnpa_loans_adv* at the bank level on an average. Further, the first stage F-statistic values are much higher than the threshold level of 10, suggesting that the instrument is not weak-instrument. The first stage regression output is given in Table A2 of the Appendix. Table 12 presents the results for the insolvency risk, volatility of ROA, and CAR measures. We find that in all the specifications, the director-level board network variable is negatively related to the insolvency risk and the volatility of ROA measures. Again we do not find any relation between network measures and CAR. Our main results in the previous section are robust to this alternate definition of the board network variables.

5.8.2. Plausibly exogenous instrument

One of the critical assumptions of the IV-2SLS method is that the instrument is exogenous. In other words, the instrument board size affects financial stability only through the endogenous board network variable and is otherwise uncorrelated with the financial stability measures. In case the exoegneity assumption is violated, the IV-2SLS estimator can be biased. The strict exogeneity was relaxed by Conley et al. (2012), and they show that even if the instrument is not strictly exogenous, the results may hold under certain restrictions. Using this framework, we consider Eq. (6) below:

$$Y = X\beta + Z\gamma + \varepsilon \tag{6}$$

Where Y is the financial stability variable, X corresponds to the endogenous board network variable and Z is the instrument board size. The results discussed in the previous section assumes that γ=0. According to Conley et al. (2012), if the parameter γ is close to zero, but not necessarily zero, the instrument can still be 'plausibly exogenous'. Specifically, using prior beliefs regarding the range of γ, Conley et al. (2012) find that it is possible to consistently estimate the effect of the endogenous variable on the outcome variable. We use Clarke's (2014) user-written STATA command to obtain the range of estimates of board network centrality measures when γ is positive and ranges from 0.1 to 250. The coefficients presented in Table 13 show that the effect of network measures on financial stability variables is always negative even though the confidence band widens as γ increases. The result of the plausibly exogenous IV technique reinforces that the qualitative results will hold even if board size is not uncorrelated with our financial stability variables.

5.8.3. Additional instrument

To ensure that our 2SLS-IV results are consistent, we introduce another instrument for our board network variable and re-estimate the results. We use the number of listed firms registered (*Number_firms*) in the same city as the registered office of the bank as an additional IV. If there are a large number of firms registered in the city as the bank, the bank-director is more likely to occupy multiple board seats (Elyasiani and Zhang, 2015), satisfying the relevance condition. On the other hand, even if a large number of firms are registered in the city where the bank is registered, it is unlikely to have any effect on the financial stability of banks (exogeneity condition). Tables 14 and 15 presents the second stage results obtained from re-estimating the main results using the *Board_size* and *Number_firms* as the IVs in the first stage. We find that board network measures are negatively related to our financial stability measures. Further, the Hansen's over-identification test *p*-values are greater than 0.05, suggesting that the instruments are exogenous and the coefficient of board network variable in the second stage is consistent. In this new specification, we again find that the marginal effect is highest for the closeness measure (columns 3 and 8 of Tables 14 and 15), emphasizing the crucial role of speed of information in the network.

5.8.4. Effect of bank merger

The Indian banking sector is undergoing consolidation in recent years. During our study period, two PSBs – Vijaya Bank and Dena Bank were merged with one of the largest PSB – Bank of Baroda. The merger was announced in 2018, and the consolidation was completed by early 2019. Post-merger, the size of the board network of Bank of Baroda may increase as the connected directors of the other two banks will also get reflected in Bank of Baroda. To ensure that our results are not driven by this bank merger, we exclude the data for 2019 and re-estimate the board network and financial stability relation for the period 2009–2018. Except for the *gnpa_loans_adv*, the results are qualitatively similar to our main findings for the other financial stability measures. Table A3 in the Appendix presents the results obtained after excluding 2019 from our analysis.

6. Possible channels

The conceptual framework discussed in Section 2 indicates that the information channel and the reputation of networked directors could be the possible channels through which a large board network can improve the financial stability of banks. As mentioned earlier, we use the number of loans restructured by the banks as a proxy for the information channel and whether the bank director sits on the boards of its borrowers as the proxy of the information and the reputation of the connected director.

6.1. Board network and loan restructuring

Table 16 presents the second stage regression output of regressing the number of corporate loans restructured on network centrality measures and other controls. We find that one standard deviation increase in network measures is related to an increase in almost 12 to

22 more corporate accounts being restructured by the banks (columns 1–5). Again the relationship is strongest for closeness measures similar to our main results indicating the importance of speed of information transmission in the network. Further, we also separately estimate the relation for the more networked banks vis-à-vis less networked banks. Banks with a z-score of centrality measure greater than zero are considered as more networked, and the rest are considered less networked banks. This sub-sample analysis further suggests that the loan restructuring and board network are driven by the sub-sample of more networked banks in our sample.

6.2. Board network and borrower monitoring

To test the information and reputation channel, we examine whether a bank with a larger board network is more likely to sit on the boards of its borrowers. Results obtained from the second stage of IV-2SLS indicate that a large board network increases the number of borrowers among the connected firms (See Table 17). This suggests that access to borrower information and better monitoring of borrowers can be another potential channel through which the board network improves the financial stability of banks in India. Again, we also separately estimate the relation for the more networked banks vis-à-vis less networked banks. This sub-sample analysis suggests that on standard deviation increase in various network centrality measures increases the number of firms on which the bank also occupies a board position by 20 to 67 firms on average. However, the relation is insignificant for the sub-sample of lesser networked banks in our sample.

7. Discussions and conclusions

Since the GFC, the policymakers have laid great importance to the corporate governance of banks to ensure that banks do not engage in excess risk-taking behavior. Several studies have examined the link between various aspects of the governance structure of banks, including ownership, board structure, and incentives of the CEOs. In this study, we examine the role of the board network of banks and its relation with financial stability in the context of an emerging market economy like India. We consider only the listed banks in India and construct the first and second-level connections between bank directors and other directors sitting on listed as well as unlisted companies with the help of appointment and cessation dates for the period 2009–2019. We find that the indirect connections of the banks have increased by around 40% during the last decade. Further, the public sector banks in India are less connected than private banks in India.

The direct and indirect connectedness of banks in India is related to financial stability. We find that a well-connected bank board helps banks to improve asset quality, reduce the insolvency risk, and also reduce the volatility of ROA. Further, the performance of banks improves on account of a larger board network. The findings of the study provide evidence in support of the integrated resource-based view of the board. The experienced, connected director may provide strategic advice and help the bank to reduce the volatility in performance. The well-connected bank director provides access to soft information, which helps the bank in loan restructuring process. Finally, well-connected directors are likely to be effectively monitor or provide financial expertise to the borrowers by sitting on the board of the borrower, which in turn improves the financial stability of the bank.

The findings of this study have implications for regulators and investors. The Companies Act, 2013 capped the maximum number of board seats that can be occupied by the directors of listed firms in India at 15. Our study shows restrictions for bank directors may not yield net benefit. We find that the benefit of board network of the bank on account of multiple directorships can outweigh the costs of interlocks. Further, the smaller effect size of board network variables on the financial stability of banks in India compared to the United States evidence suggests that there is a need to increase deliberations on risk-related issues during the board meetings. The insignificant results for the set of PSBs re-emphasize the pressing need for governance reforms in PSBs and aligning the interests of the board with the interests of the stakeholders. Our findings also suggest that leveraging the social capital of the board could be one of the various means which banks can adopt to address the growing non-performing asset problem. For investors, our study indicates that banks having a large board network are likely to have low insolvency risk, and this could be related to a lower unsystematic risk of the stock. Since a large board network is related to the lower volatility of ROA, investors can consider the stocks of well-connected banks, especially during uncertain macroeconomic conditions.

Our study highlights the positive effect of the bank board network in India due to access to soft information. Future research can explore whether other possible channels like better accounting practices or more financial disclosure by connected banks can explain improved financial stability. Houston et al. (2018) find that during the GFC, the information available through the network deteriorated, and more central banks in the network were not more likely to lead or co-lead the syndicate during the crisis. Their study suggests that the significance of the director network may vary over time. Given the time period of our study, we are unable to analyze the time-varying effect of the bank board network on the financial stability of banks in India. Given our study design, one may examine whether the importance of the bank board network in emerging economies like India varies with the macroeconomic shocks like GFC. Finally, few studies also highlight the dark side of director networks. Barnea and Guedj (2009) find that interlocked firms pay higher CEO salaries, CEO pay is less sensitive to performance, and CEO turnover is less likely. Dbouk et al. (2020) find that bank CEOs with a large social network become weak monitors and increases bank risk-taking behavior. Future research may examine whether the banks with well-connected directors are more likely to engage in earnings management, earnings smoothing, recognizing future losses to understand the alternate effects of board networks on bank outcomes in India.

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Appendix A. Supplementary data

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