Analysing bank stability in India: Evidence from 2007/08-2016/17

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Abstract

This paper develops an index of bank stability for 66 commercial banks operating in the Indian banking industry for the period 2007/08-2016/17. An index is obtained by combining five dimensions, namely capital adequacy, asset quality, management efficiency, earning capacity and liquidity. The choice of dimensions is derived from the CAMEL framework as defined by the Reserve Bank of India, which is the modus operandi for measurement of banking stability. The aggregation of dimensions is done using the weights calculated by employing PCA approach. The empirical findings reveal that an improvement is seen among Indian banks in terms of stability in the early years of the sample period. A higher value of a bank stability indicator is observed in 2008/09, and the index value showed a decline from 2008/09 onwards. The categorization of banks into high, moderate and less stability suggests that majorly banks in India are moderately stable, with the number of banks belonging to less stable category risen from 7 in 2007/8 to 23 in 2014/15. The results further suggest that the high stable category is mainly dominated by the foreign banks and none of the public sector bank belongs to this category for the entire study period. The condition of public sector banks is found to be pitied on the dimensions of asset quality and profitability, while private and foreign banks fared relatively better on these two fronts. Liquidity condition remained more or less stable for Indian banks.

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1. Introduction

The financial turmoil of 2007-09 was a pronounced concussion to many developed and developing nations, the effects of which have spread across in the world economy very quickly. This devastating event was surprisingly a shock to many economists, although some economists had by that time envisaged such possibilities. Initially, when the event happened in the US and then in Europe, developing countries believed that they are resilient (Blanchard et al., 2010 [1]). However, this was not the case and the effects of this global financial crash proved to be more harmful than conjectures. Many banks became insolvent and they faced big losses. This financial turmoil created the situations of instability in the financial sector in general, and banking sector, in particular.

Recent literature has raised widespread concerns about the possible causes that might have led to such a crisis. It is believed that the rapid deregulation and the globalization of financial markets, mingled with the innovation of new financial instruments may have created conditions of the dreadful financial crisis (James, 2009 [2]; Diamond and Rajan, 2011 [3]). Further, over-expansion and excessive diversification of the banking sector have made it more vulnerable (Eichengreen and Arteta, 2000 [4]). The pro-cyclical nature of credit growth during the pre-crisis years was also one of the many factors responsible for the asset quality deterioration during recent years (Lokare, 2014 [5]). A decade has passed since the global financial crisis (GFC) and the debate on how exactly this has happened is over. Now the salient issue, in front of all, is how to retrocede the possibility of re-occurrence of such kind of distressing events. The question thus arises on how to develop an effective mechanism so that the policymakers and regulators could (i) identify the possibility of events that might put the banking system off track or make it fragile, and (ii) minimize the cash costs to bank creditors in case of adverse financionomic situations, and put the banking system quickly back on track (Caprio and Honohan, 2010 [6]).

Given this backdrop, the issue of bank stability has become more pervasive both in the developed and developing economies, especially after 2007/08. Considering this, the central banks across the globe have documented the financial stability as an important policy mandate. The Reserve Bank of India (RBI, India's central bank) has also recognized the financial stability as an important objective along with inflation control and macroeconomic stability (Reserve Bank of India, 2010 [7]). Since 2009, the RBI has been monitoring closely the stability of the banking sector and different dimensions influencing the banking stability. It is perceived that unsecured or uncollateralized lending and overexposure to sensitive sectors in lending can potentially deteriorate the asset quality and can create fragility in the banking system by increasing the credit risk. Lack of adequate liquidity, an insufficient capital buffer, an inefficient management, and declining profitability also augment risk to the banking stability (Reserve Bank of India, 2018 [8]). Thus, a healthy, sound and stable banking system is indispensable for an emerging nation, like India.

The key research questions that arise include: How have the stability conditions of banks in India evolved aftermath global financial crisis of 2007/08? Is there any difference in the performance in terms of bank stability across the distinct ownership groups? If there is a difference in performance across the distinct ownership group, then which dimensions and variables of bank stability are responsible for that? The present study attempts to find answers to these questions. The main objective of the study is to analyze the stability conditions of commercial banks in India over the period from 2007/08 to 2016/17. In order to achieve this objective, the study constructs the bank stability index using Principal Component Analysis (PCA) weighted CAMEL framework. Relatively few attempts have been made to measure the bank stability in India using comprehensive multi-dimensional index-based approach (see, for example, Ghosh, 2011 [9]; Bhattacharya and Roy, 2012 [10]; Ahmad and Mazlan, 2015[11]). The other objective of the study is to see the significance of the difference in the stability levels of banks across distinct ownership groups, if exist.

The present study contributes to the existing literature in the following ways. First, it constructs the bank stability index (BSI) using the more comprehensive and broader framework as defined by the RBI based on CAMEL approach. Further, the aggregation of dimensions of bank stability, namely, capital adequacy, asset quality, management efficiency, earning capacity and liquidity, is done using principal component analysis (PCA) for the reckoning of weights for different dimensions of the BSI. The use of index-based approach is viewed as a more reliable approach because it accounts for the broader set of underlying dimensions of the banking stability. Given this, the present study offers the PCA based weighted CAMEL approach to construct and analyze the banking stability in India for a period 2007/08-2016/17. To the best of the authors' knowledge, there is perhaps no such study, which assigns the weights to different dimensions of bank stability using PCA approach. Second, the study categorizes and ranks the commercial banks in India into high, moderate and less stable banks for the study period. Finally, through this study, we aim to assess the stability conditions of the banks in India in the most recent years, particularly covering the post-crisis years from 2007/08 to 2016/17, which is perhaps a renewed attempt by the authors.

The rest of the paper is organized as follow. Section 2 presents the review of the literature on measurement of banking and financial stability across nations. Section 3 discusses the variables, dimensions and construction methodology used in this study. Section 4 provides the empirical results. Section 5 is concluding in nature.

2. Review of literature

It is well established in the literature that the global financial crisis (GFC) had impacted the emerging economies, however, the magnitude of the effect was limited. Broadly, Indian banking sector, though remained resilient to the GFC (Eichengreen and Gupta, 2013 [12]; Gulati and Kumar, 2016 [13]; Kumar et al.,

2016 [14]), but it had cuddled the growth of the balance sheets of banks across the distinct ownership groups. The resilience was more because of less exposure of the Indian banks to the riskier assets, strong macroeconomic fundamental, and the prudential regulatory and supervisory framework. The recent efforts have been made in the literature by Ghosh (2011 [9]) and Bhattacharya and Roy (2012 [10]) on the measurement of banking stability in India for the period from 1997-2007. Ghosh (2011 [9]) constructed an index of bank stability of the public sector banks in India using three indicators, namely, loan loss provisions, capital adequacy ratio, and return on assets. Their empirical findings reveal that the majority of the Indian banks have remained moderately stable during the study period. Bhattacharya and Roy (2012 [10]) attempted to identify the periods of distress in the Indian banking sector using the index based approach for the period 1994-2007. They found declines in the real output, inflation, interest rate spread, and real effective exchange rate increases the probability of distress in the Indian banking sector.

Besides, Gersl and Hermanek (2007 [15]) critically analyzed the stability indicators for measuring the financial stability, as suggested by the IMF. They argued that the aggregate financial stability indicator may serve as the first step towards better operationalization of the concept of financial stability and building a more appropriate framework for measuring financial stability.

Dhal et al. (2011 [16]) measured the bank stability using the CAMEL approach and explored the relationship of stability with other variables. The study was based upon quarterly data for a sample of 39 banks in India. They found that financial stability, growth, and inflation share a medium to long-term relationship. Further, the financial stability can ensure growth without posing much threat to price stability.

Swamy (2014 [17]) examined the relationship between different indicators of banking stability measures. The study establishes that liquidity in the bank-dominated financial system is reciprocally related to the asset quality, capital adequacy, and profitability of the banking system. A shock to a particular variable of stability not only directly affects the particular variable but also gets transmitted to other variables through the dynamic structure.

Kiley and Sim (2014 [18]) developed a macroeconomic model in which the balance sheet of financial institutions plays a vital role in the determination of asset price and economic activity. They found that capital injections conditioned upon voluntary recapitalization can be a more useful tool than purchasing assets. They also highlighted that the marginal effects of policies can be larger during crises because of the nonlinear interactions between some financial frictions and policy actions.

Kocisova (2014 [19]) examined the stability of the banks in the European Union for the year 2004. This study used capital adequacy, asset quality, earnings and profitability, and liquidity to construct banking stability index. Using the equal weighting scheme for different variables, the study found that the Luxembourg and the Estonia have the most stable banking sectors.

Ahmad and Mazlan (2015 [11]) relied on credit, liquidity, and market risk for the

construction of bank stability index for Indian banks. They used the bank's credit to the local private sector, bank's real deposits, bank's financial leverage, time-interest-earned ratios as a proxy for credit, market, and liquidity risk. The study explains the trend in bank fragility for both locally-based and foreign-based banks and found that both bank-specific variables and macroeconomic variables do not have any effect on the foreign-based bank's fragility.

Fielding and Rewilak (2015 [20]) analyzed the association of financial fragility and credit booms across the banks operating in the USA, Greek, and Canada for the period 2012-2015. The authors argue that a combination of fragility and boom may create the conditions responsible for the crisis, it might neither be fragility nor boom alone, which make a significant difference to the probability of occurrence of the crisis. Further, the study suggests that if the average annual return on a bank's assets is more than 1.5 percent, then large fluctuation in liquidity has not been harmful to the banking system.

Laeven and Tong (2016 [21]) conducted a study on banks operating in 32 countries and used three major indicators, namely, tier 1 capital, loans to total assets ratio, and deposits to total assets ratio. On the basis of these indicators, they measured the stability condition of banks. Further, this study concluded that better-capitalized banks are less prone to systematic risk. It also exhibits that bank size is negatively associated with the stability.

From the deeper scrutiny of the literature, it is clear that the numerous research efforts have been made by the academicians, policy makers and regulators in the developed nations, particularly, in the US and Europe. However, the research pertaining to the developing nations, especially India is limited. Relatively few researchers have attempted to measure the bank fragility/stability in India and that too done by the means of few financial indicators (Ghosh, 2011 [9]). The study by Dhal et al. (2011 [16]) adopted the CAMEL approach to examine the stability in India. Further, majorly studies have used equal-weights for different dimensions of bank stability.

3. Variables, dimensions and construction methodology

3.1 Data

The required bank-level data on the financial variables used in the construction of the bank stability index is culled from the annual editions of the "Statistical Tables Relating to Banks in India", a publication by the Reserve Bank of India. The sampled commercial banks include 26 public sector banks, 18 private banks and 22 foreign banks operating in India over the period of 2007/08 to 2016/17. Therefore, we analyzed the stability conditions of the 66 commercial banks for ten years, yielding 660 bank-year observations.

3.2   Variables and dimensions of the bank stability index (BSI)

For the construction of bank stability index (BSI), we relied on the CAMEL framework as defined by the Reserve Bank of India in its Financial Stability Report 2018. The total of 13 financial ratios is clubbed into five dimensions, namely capital adequacy, asset quality, management efficiency, earning capacity and liquidity, of the bank stability index. Table 1 describes the financial variables, dimensions and their relationship with the bank stability. In this study, we used capital adequacy as the first dimension of the BSI. This dimension depicts the shock absorbing capacity of banks under the situations of internal or external economic shocks (Ahsan, 2016 [22]). Generally, the shocks cause bank panics, which can harm the stability of the banking system adversely. The level of capital base, thus provides a signal to bank's stakeholders about the preparedness of banks to face any potential risk. The central bank, RBI has continually focused on the soundness dimension and has made stringent regulations for the banks to raise the capital adequacy gradually, so that Basel III norms can be met timely. Two financial ratio indicators have been included under this dimension, namely, capital to risk weighted assets ratio (CRAR) and Tier 1 to tier 2 capital ratio. CRAR is the most important and widely accepted measure of capital adequacy.

The second dimension of the BSI is the asset quality. The quality of lending assets is one of the major factors that affects the health of a banking system in terms of their stability. It reflects that how the banking assets are performing. The variables included in this dimension are net nonperforming assets (NPAs) to total advances and gross NPAs to total advances. Gross NPAs refers to the total amount of loan that the bank has failed to recover, on the other hand, net NPA refers to the amount of bad loans, which remains after making provisions for such bad loans. The third dimension deals with the management efficiency, which suggests that how efficiently the operations of banks are conducted. The high level of efficiency can minimize the operating costs, boost the profits and improves the stability. The three variables included in this dimension are the ratio of the intermediation cost to total assets, the wage bill to intermediation cost, and the wage bill to total expenses. The fourth dimension of the BSI is earning capacity, which incudes four variables - return on assets (ROA), return on equity (ROE), ratio of operating profit to total assets and net interest margin. These are the key sources of earning for a bank, which captures the profitability of the bank. The fifth and last dimension is the liquidity that captures the bank's capability to supply enough liquidity to its customers. If the bank fails to provide enough liquidity, then this can create panic among the customers, which may have harmful repercussions for the economy. The level of liquidity, thus influences the ability of a banking system to withstand sudden shocks in liquidity demand (Kocisova, 2014 [19]). The variables included in this dimension are - the ratio of the liquid asset to total assets and demand deposits to total assets.

3.3   Construction of BSI using PCA approach

As discussed above, this study adopts the principal component analysis (PCA) approach for the construction of composite index of bank stability. First, we obtain the five dimensional indices of bank stability index, namely capital adequacy, asset quality, management efficiency, earning capacity, and liquidity. For the construction of dimensional indices, we assign equal-weights to normalised value of each financial variable representing a particular dimension. Then in the next step the aggregation of the dimensional indices is done using the PCA weights to construct the stability index (BSI) for each bank (see Table 1). In particular, each financial variable is adjusted to have positive link with the bank stability index through the process of normalistaion and inverse normalisation (by taking reciprocal of the variables that are negatively associated with BSI). For instance, a financial ratio (x) that is negatively associated with the BSI, i.e., a higher value of this ratio would suggest that bank stability is low, is adjusted by taking inverse of this ratio (1/x). Then, the variables are empirically normalised so that the value of a variable will range between 0 and 1. In this study, we employed a min-max normalisation as follows:

$$I_i = \left(\frac{A_i - \min(I)}{\max(I) - \min(I)} \right)$$

where Ai is the actual value of the variable, min(I) is the minimum value of the variable, max(I) is the maximum value of the variable. Ii is the normalized value of the variable. This adjustment and normalisation ensures that a higher the value of the variable, higher is the stability and vice versa.

Table 1: Dimensions and indicators of the Bank Stability Index

No.	Dimensions	PCA weights (%)	Variables (weights)	Impact on stability	Adjustment and Normalisation[#]
1	Capital adequacy	22	(i) Capital to risk weighted assets (CRAR) (0.5)	+	Normalisation
			(ii) Tier1/tier2 ratio (0.5)	+	Normalisation
2	Asset quality	23	(iii) Net NPA to total advances (0.5)	-	Inverse Normalisation
			(iv) Gross NPA to total advances (0.5)	-	Inverse Normalisation
3	Management efficiency	13	(v) Intermediation cost to total assets (0.33)	-	Inverse Normalisation
			(vi) Wage bills to intermediation (0.33)	-	Inverse Normalisation
			(vii) Wage bills to total expense (0.33)	-	Inverse Normalisation
4	Earning capacity	20	(viii) Return on assets (0.25)	+	Normalisation
			(ix) Return on equity (0.25)	+	Normalisation
			(x) Net interest margin (0.25)	+	Normalisation
			(xi) Operating profit to total assets (0.25)	+	Normalisation
5	Liquidity	22	(xii) Liquid assets to total assets (0.5)	+	Normalisation
			(xiii) Demand deposits to total assets (0.5)	+	Normalisation

Notes: '#' indicates that inverse of those indicators that perceive to have a negative impact on stability is taken before normalisation.
Source: Authors' elaboration from the Financial Stability Report 2018

Before applying PCA to dimensions, we performed the two preliminary tests. We relied on the KMO (Kaiser-Mayer-Olkin) test to check the adequacy of the sample, and Bartlett's test of sphercity to examine whether the correlation matrix is an identity matrix or not. In our case, the value of KMO test statistics of 0.721 suggests that our sample size is adequate. Further, we find that the result of Bartlett's test is significant indicating that the correlation matrix is not an identity matrix (see Appendix Table A1 for test results). The absolute and relative weights are thus generated by performing the PCA analysis (see Appendix Table A2 for weights). The components with eigenvalues more than one are retained. Then, eigenvalues are multiplied with the respective varimax rotated component. Adding up the resultant values give the weights to the respective dimension. For calculation of the weighted dimensional index and the value of the bank stability index for a particular bank, the normalised value of each dimension is then

multiplied with its respective percentage point weightage and summed up as

$$\sum_{i=1}^{n} d_i \times w_i$$

where d_i = normalised value of the variable/dimension and w_i = percentage point weightage assigned to each variable/dimension. However, if absolute value of weights is to be considered for aggregation then it is divided by the sum of absolute weights.

4. Empirical results and discussion

4.1 Stability level of banks in the industry

In this section, we analyze how the stability of commercial banks evolved during the study period. Table 1 presents the mean values of the dimensional indices and the overall bank stability index in the Indian banking industry during the period 2007/08-2016/17. The empirical results reveal that a significant improvement was seen in the stability conditions of the Indian commercial banks during the initial years of sample period (see Fig. 1). This finding of our study is consistent with the Financial Stability Report 2010, which reports that a strong improvement was observed in the stability conditions of the banking sector during that period. This improvement is credited by the RBI to the regulatory reforms and other development measures, which were cautiously adopted to improve the efficiency, profitability and stability conditions of the banking industry in India. However, this trend in BSI got reversed and the seen the decline. After attaining the highest level of stability in 2008/09 (as indicated from the mean level of BSI for the year 2008/09 i.e., 0.269), the mean BSI deck to the lowest point of 0.210 in 2014/15, thus exhibiting a 23 percent weakening in the BSI. This picture can be viewed from two perspectives, firstly, the BSI is stabilizing itself and rise in the BSI after 2007/08 was temporary. Another way of looking it is that the industry as a whole failed to sustain the augmentation in the stability levels, which it achieved in the year just after 2007/08.
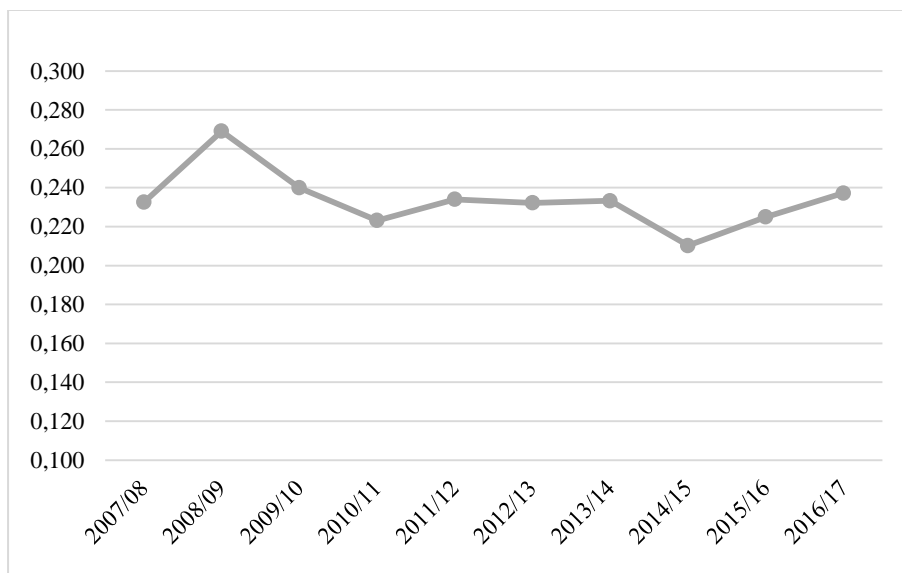
Fig.1: Evolution of Bank Stability Index in India

Of the dimensions of bank stability, capital adequacy and earnings capacity have shown significant improvement during the study period, as evident from the Table 2. The capital adequacy dimension caught the momentum from 2010/11 onwards and since then it has shown a rising trend. This is predominantly because the commercial banks are required to meet the Basel III capital regulatory norms by 2018/19, which is clearly visible from the improvement in the bank stability conditions as proxied by the dimensional index of capital adequacy in Indian banking industry.

Table 2: Mean values of dimensional indices and overall bank stability index in the industry- 2007/08-2016/17

Year	Capital adequacy	Assets quality	Management Efficiency	Earnings	Liquidity	BSI
2007/08	0.023	0.068	0.037	0.063	0.041	0.233
2008/09	0.028	0.092	0.039	0.077	0.033	0.269
2009/10	0.030	0.053	0.034	0.090	0.032	0.240
2010/11	0.022	0.056	0.031	0.075	0.039	0.223
2011/12	0.023	0.062	0.038	0.074	0.037	0.234
2012/13	0.031	0.043	0.038	0.087	0.032	0.232
2013/14	0.030	0.045	0.040	0.086	0.032	0.233
2014/15	0.035	0.039	0.038	0.069	0.028	0.210
2015/16	0.037	0.046	0.038	0.078	0.026	0.225
2016/17	0.040	0.044	0.036	0.086	0.031	0.237

Source: Authors' calculations

The asset quality and liquidity dimensions have shown a decline during the study period. Asset quality though have improved in the post-GFC year in 2008/09, however, it deteriorated significantly onward 2008/09. During the study period, the quality of assets in Indian banking industry remained an area of key concern and liquidity situation tightened, however, several resolution measures were undertaken to address these issues in the industry (Reserve Bank of India, 2010). Few reasons for the reduction in the liquidity also include the payout to the government for telecom auctions and faster growth in the loans and advances in comparison to deposits in the banking industry during the analyzed period. Management efficiency dimension has experienced mild fluctuations and remained more or less stable.

4.2   Bank stability across ownership groups in India

During the study period, the stability of the public sector banks (PSBs) in India remained low. It is clearly visible from the Fig. 2 that foreign banks are the top performers in terms of bank stability and public sector banks are at the bottom.
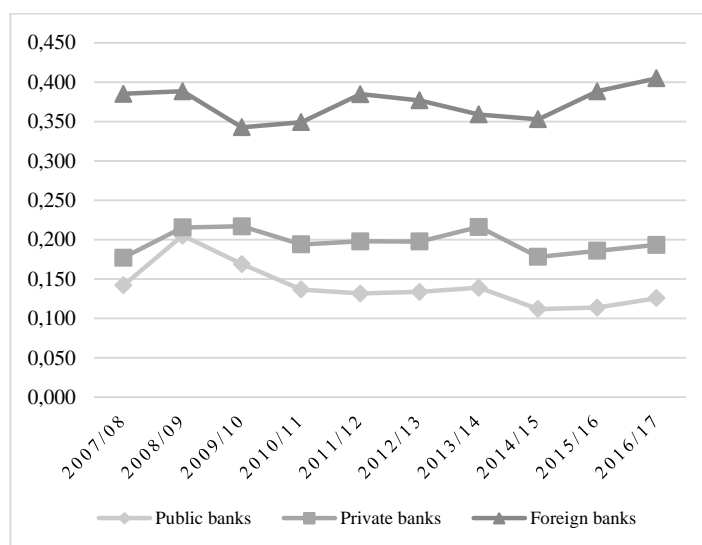
Fig. 2: Trends of Bank Stability Index across the distinct ownership groups

Table 3 reports that in the case of PSBs, although the improvement in stability levels was seen in 2007/08, but later on, it declines and reach to the lowest of 0.112 in 2014/15. The BSI values for the private banks have also shown a decline in 2009/10 onwards, however, it remained stagnant during 2010/11 to 2012/13 and then slightly improved from 2014/15 onward. The average value of BSI for public sector banks for the period from 2007-08 to 2016-17 ranges between 0.112 and 0.169, and it ranges between 0.405 and 0.343 in case of foreign banks. For private banks, the mean BSI varies from the minimum of 0.177 in 2007/08 to a maximum of 0.217 in 2009/10.

Table 3: Mean values of dimensional indices and overall bank stability index across distinct ownership groups

Panel A: Public sector banks						
Year	Capital adequacy	Assets quality	Management Efficiency	Earnings	Liquidity	BSI
2007/08	0.004	0.022	0.036	0.054	0.026	0.142
2008/09	0.005	0.077	0.038	0.065	0.020	0.205
2009/10	0.005	0.020	0.035	0.087	0.023	0.169
2010/11	0.004	0.006	0.031	0.071	0.025	0.137
2011/12	0.003	0.005	0.040	0.062	0.021	0.132
2012/13	0.004	0.001	0.040	0.069	0.020	0.134
2013/14	0.004	0.004	0.043	0.070	0.019	0.139
2014/15	0.005	0.001	0.041	0.049	0.016	0.112
2015/16	0.007	0.002	0.039	0.053	0.013	0.114
2016/17	0.010	0.001	0.036	0.058	0.020	0.126
Panel B: Private banks						
2007/08	0.013	0.036	0.037	0.057	0.034	0.177
2008/09	0.018	0.063	0.038	0.069	0.027	0.215
2009/10	0.019	0.046	0.034	0.088	0.030	0.217
2010/11	0.015	0.042	0.031	0.073	0.032	0.194
2011/12	0.012	0.050	0.037	0.073	0.026	0.198
2012/13	0.018	0.030	0.037	0.088	0.024	0.198
2013/14	0.020	0.042	0.036	0.093	0.025	0.216
2014/15	0.024	0.020	0.034	0.078	0.022	0.178
2015/16	0.025	0.019	0.033	0.091	0.018	0.186
2016/17	0.027	0.011	0.032	0.101	0.022	0.193
Panel C: Foreign banks						
2007/08	0.055	0.149	0.038	0.080	0.063	0.385
2008/09	0.064	0.134	0.040	0.099	0.052	0.388
2009/10	0.068	0.098	0.034	0.096	0.047	0.343
2010/11	0.050	0.127	0.031	0.080	0.062	0.349
2011/12	0.056	0.139	0.036	0.088	0.066	0.385
2012/13	0.075	0.104	0.038	0.107	0.053	0.377
2013/14	0.070	0.095	0.040	0.100	0.053	0.359
2014/15	0.079	0.101	0.039	0.087	0.047	0.353
2015/16	0.082	0.120	0.040	0.098	0.047	0.388
2016/17	0.086	0.123	0.039	0.106	0.051	0.405

Source: Authors' calculations

The dimension wise analysis reveals that the asset quality remained the weaker dimension across bank groups, especially in PSBs, during the study period. During the initial years, the credit flow to real estate remained stable, however, NPA level recorded an increase of 8 percent in the quarter ending September 2010 for the public sector banks. For this, the RBI announced a set of measures to control the

rise in the NPA levels. Capital adequacy showed a rising trend and it improved significantly in all the bank groups, particularly foreign banks. The PSBs have shown uncertainty on the earnings dimension throughout the study period and it was highest in 2009/10 (i.e., 0.087). The RBI in its Financial Stability Report (June 2018) highlighted that profitability of public sector banks is decreasing because banks are making provisions for the bad and doubtful debts. While the situation for private and foreign banks is relatively better on this dimension. Liquidity deteriorated, however, the management efficiency dimension remained subdued across all the banking groups in India. Private sector banks are performing well on different dimensions of bank stability in comparison to public sector banks but also experienced deterioration in the asset quality during the study period. Foreign banks are the top performers in terms of bank stability on all the dimensions. The BSI level of foreign banks has experienced a slight fluctuation and it was higher in 2016/17. The dimensional index for capital adequacy and earnings have increased substantially and exhibited a rising trend for foreign banks. Management efficiency of foreign banks has remained more or less stable. However, the liquidity condition of foreign banks has shown deterioration during the study period.

Fig. 3 show the kernel distribution of the stability index of banks belonging to public, private and foreign banks in India. For PSBs, the distribution of BSI is leptokurtic with the lower class interval in comparison to other ownership groups and the value of BSI concentrated between 0.03 and 0.3. The foreign banks followed by private banks signifies the density plot, which is right to public sector banks, suggesting the better stability conditions of these bank groups relative to public sector banks in India as the average BSI value is higher in comparison to public sector banks, however, the dispersion in BSI of foreign banks is highest. Next, we test the significance of the differences in the distribution of BSI across the public, private and foreign bank groups in India. We find that the mean values of BSI significantly differ across ownership groups using sample t-test and Kruskal-Wallis (KW) test, indicating that the stability condition significantly differ across banking groups in India.
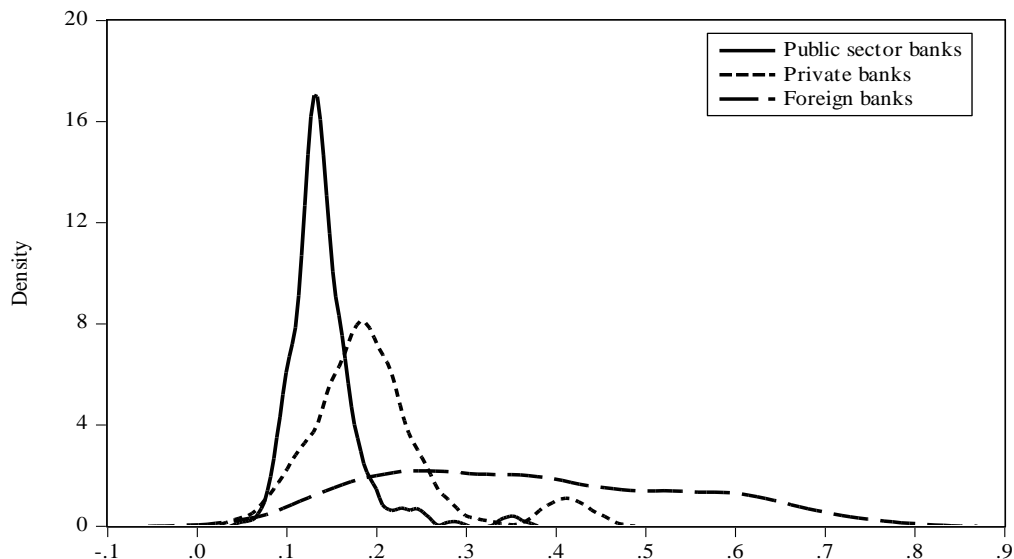
Fig. 3: Kernel distribution of the bank stability index across distinct ownership groups

Table 4: Testing the significance of the difference between the mean of BSI across ownership groups.

Null hypothesis (H_0)	t-statistics	p-value	Decision	KW-H statistics	p-value	Decision
Public vs. Private	-10.100	0.000*	Reject H_0	102.834	0.000*	Reject H_0
Private vs. Foreign	-13.148	0.000*	Reject H_0	127.839	0.000*	Reject H_0
Foreign vs. Public	21.917	0.000*	Reject H_0	275.110	0.000*	Reject H_0

Notes: (*) indicates results are significant at 5 percent level of significance.
Source: Authors' calculations

We now compare the dimensional indices of bank stability at initial (2007/08) and last year (2016/17) of the study period using the radar chart. In the Fig. 4(a), we observe that only two dimensions, i.e., earnings and capital adequacy showed an improvement over the study period in the Indian banking industry. However, the bank stability in the industry is seen to be clearly affected by the low level of asset quality. No changes have been seen in management efficiency dimension. Fig. 4(b) captures the movements in the different dimensions of BSI of public sector banks. It clearly reflects that there is deterioration in the asset quality of public sector banks. Radar chart shows a slight improvement in capital adequacy and earning capacity. However, there is some decline in the liquidity front. The management efficiency remained at the level at which it was in the year 2007/08. So, it has not shown improvement and it remained more or less stable.

Fig. 4(c) shows that how the contribution of the different dimensions of stability of private banks have changed. It shows that there is a significant improvement in the earnings of private sector banks. However, there is a decrease in the asset

quality. Capital adequacy has improved, however, liquidity has declined marginally. Management efficiency has slightly deteriorated if we compare with the efficiency level of 2008.

Fig. 4(d) shows that the different dimensions of banks stability of foreign banks. Radar diagram visibly depicts that there is the significant improvement in the earnings and capital adequacy of foreign banks. However, there is deterioration in the asset quality, but less than public and private banks. A significant improvement in the capital adequacy suggests that foreign banks are trying to build a strong capital base in the industry, so that they can meet any internal or external economic shocks. Liquidity has also narrowed marginally for this bank group, however, the dimension of management efficiency has remained less varied. At last, we also found that private and foreign banks have shown significant improvement in the earnings dimension, however, public sector banks are not turning up this pace. The largest improvement in the earnings is seen in the case of private sector banks.
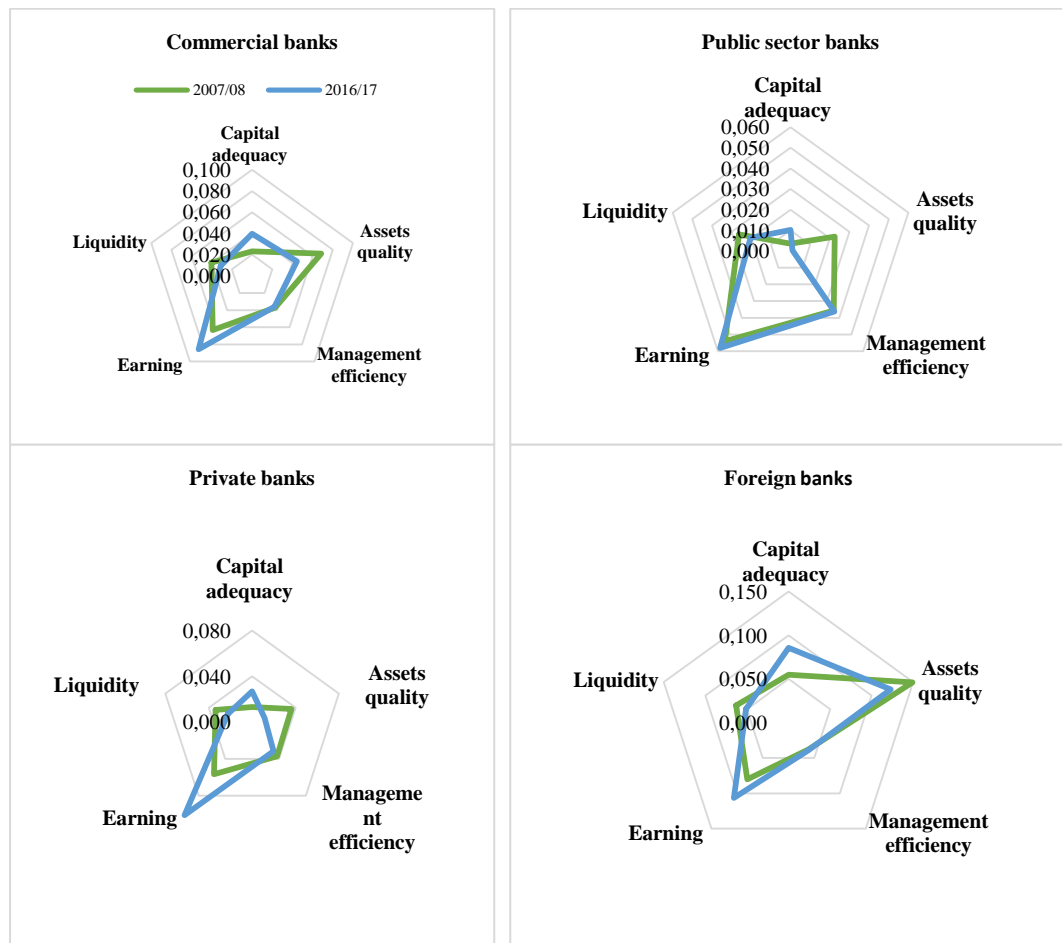

Fig. 4: Dimensions of BSI across banking groups in 2008 and 2017

4.3   Categorization of banks on the BSI

In this sub-section, we followed Ghosh (2011 [9]) and categorized the sampled 66 commercial banks are categorized into three categories, namely, highly stable, moderately stable and less stable, as shown in Table 5. Banks falling in the top ten percentile and bottom ten percentile of the BSI are classified as high stable and less stable banks, respectively. Top and bottom index values are 0.445 and 0.121, respectively, which implies banks with BSI value 0.445 and above have been considered as highly stable, and 0.121 and below as less stable banks. Further, banks with BSI value ranging between 0.121 and 0.445 have been categorized as moderately stable banks. The study reveals that the number of less stable banks has increased from 7 in 2007/08 to 23 in 2014/15, however, this number declined to 13 in 2015/16 and 9 in 2016/17. The majority of the banks falling in the less stable category are public sector banks. In 2015, out of 23 less stable banks, 19 are public sector banks, 3 belong to private banks and only 1 foreign bank. Most banks in India fall into the category of moderately stable with none of the public banks qualified for the high stability category during the study period, however one private sector bank qualified for this category only in 20013/14. This category remained dominated by foreign sector banks. The number of moderately stable banks declined from 52 in 2007/08 to 37 in 2014/15, however, this number increased to 48 in 2016/17.

Table 5: Categorization of banks as per their respective BSI value.

Year	High Stable				Moderately stable				Less stable			
	Total	PSBs	PBs	FBs	Total	PSBs	PBs	FBs	Total	PSBs	PBs	FBs
2007/08	7	0	0	7	52	22	15	15	7	4	3	0
2008/09	8	0	0	8	56	26	16	14	2	0	2	0
2009/10	5	0	0	5	58	26	16	16	3	0	2	1
2010/11	8	0	0	8	45	18	15	12	13	8	3	2
2011/12	9	0	0	9	44	17	15	12	13	9	3	1
2012/13	8	0	0	8	51	21	17	13	7	5	1	1
2013/14	8	0	1	7	54	23	16	15	4	3	1	0
2014/15	6	0	0	6	37	7	15	15	23	19	3	1
2015/16	7	0	0	7	46	16	15	15	13	12	1	0
2016/17	9	0	0	9	48	18	17	13	9	8	1	0

Source: Authors' calculations

5. Conclusions, policy implications and direction for future research

In the past decade, the issue of the bank stability has gained a significant attention in the developed and developing countries. It is well established fact in the literature that stability of the banking sector plays a vital role in the economic development of a nation. This paper thus aims to analyze the stability conditions of 66 commercial banks operating in the Indian banking industry over the period 2007/08 to 2016/17. For the measurement of stability levels, we constructed a multi-dimensional index of bank stability by aggregating five dimensions, namely capital adequacy, asset quality, management efficiency, earning capacity and liquidity using weights as calculated by employing Principal Components Analysis (PCA) approach. The choice of dimensions is based on the CAMEL framework as defined by the Reserve Bank of India, which is the modus operandi for the measurement of banking stability.

The empirical findings of the study reveal the following. First, the Indian banking industry has seen an improvement in terms of stability in the early years of the sample period, with a higher value of a bank stability index is observed in 2008/09, and the index value showed a decline from 2008/09 onwards. Second, asset quality and earnings dimensions have played relatively more important role in the determination of bank stability during the study period. Broadly, the study suggests that the trend in bank stability index is clearly determined by these two dimensions. Third, a comparison across ownership groups reveals that the stability condition of the public sector banks in India remained low and foreign banks are the top performers in terms of bank stability. Further, the asset quality has deteriorated across all ownership groups. However, this dimension remained sluggish for public sector banks. The BSI of private sector banks has remained stable. However, the asset quality of private banks is also deteriorating, while this deterioration in asset quality is being compensated by the improved earnings of the private banks in order to sustain bank stability index.

Fourth, the bank categorization into high, moderate and less stability suggests that majorly banks in India are moderately stable, with the number of banks belonging to the less stable category risen from 7 in 2007/08 to 23 in 2014/15. The results further reveal that the high stable category was mainly dominated by the foreign banks and none of the public bank qualified for this category during the whole study period however, one private sector bank qualified for this category in 2013/14. We found that the stability of the Indian banks has started improving from 2014/15 onwards, which is evident from the BSI values.

On the whole, the commercial banks in India, particularly PSBs need to pay an attention in improving its assets quality and earnings capacity. With the purpose to enhance the asset quality significant measures have been taken by the RBI, wherein many PSBs were put under Prompt Corrective Action (PCA) mechanism, and also restructuring and refinancing mechanism is adopted, wherever possible.

At present, voices are being raised to initiate the privatization/or M&As of those PSBs, which are becoming inefficient. However, a considerable amount of blame for the inefficient functioning of PSBs could be assigned to the political interventions in the loan disbursement. No doubt, the NPA of PSBs is a burning issue for the Indian banking sector to deal with, However, the efforts are being made to target the stock through restructuring, refinancing, etc. However, little attention has been paid to flow part, for example, regarding the names of the loan defaulters are not disclosed publicly. So, they are allowed to get loans from other financial entities and this will enlarge the severity and magnitude of the problem loans and can hit the banking system immensely.

5.1   Policy implications

The use of PCA weighted index based CAMEL approach for the construction of the composite index is a more comprehensive approach, which accounts for the relative policy strength of each financial variable and dimension. This can be used by the policy makers as a tool to access the stability conditions of banking firms. This weighted index-based approach is a more reliable way to rank the banks on the basis of their relative strength in particular ownership group and across distinct ownership groups. Regulators can use this criterion as a mean to identify the tedious entities. With the help of this analysis, the policy makers can target the areas of banking sector which are under-performing. The Bank Stability Index (BSI) can be further employed to access the nexus between bank stability and other macroeconomic variables in order to better target the banking stability issue.

5.2   Limitations and directions for future research

The key limitation of this study is that we have not included the variables of external vulnerability to the sector in the construction of BSI, which can significantly impact the stability of the Indian banking sector. Further, the study assigns the same weights across the distinct ownership groups, however, for making a useful comparison the weights may vary across distinct ownership groups depending upon their policy priorities. The present study has mainly focused on how the banking stability has evolved in the aftermath of global financial crisis, however, there is a scope of conducting an analysis, which can throw light on the stability of banking sector pre- and post- this event. Such a comparison will depict a clearer picture of the whole episode.

The future works can be extended by introducing the external and macroeconomic factors in defining and determining bank stability. The study can be conducted to understand the link between bank stability and its potential determinants. This study has used static (time invariant) weights for individual dimensions of BSI, however, the future researches can explore for the possibility to use time-varying weights allocation in the construction of the composite index of bank stability.

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Table A1: PCA Bank Stability Index

Appendix A: KMO and Bartlett's tests

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.721
Bartlett's Test of Sphericity	Chi-Square (10)	599.924
	p-value	.000

Source: Authors' calculations

Table A2: Principal component analysis for weights construction in the Stage 2

Dimensions	Components		Eigenvalues		Weights	
	1	2	2.254	1.051	Absolute	Percent
I. Capital adequacy	0.814	0.048	1.836	0.050	1.886	22
II. Assets quality	0.724	0.258	1.633	0.272	1.904	23
III.Management efficiency	-0.023	0.966	-0.051	1.015	1.066	13
IV. Earnings capacity	0.669	-0.203	1.509	-0.213	1.722	20
V. Liquidity	0.786	-0.087	1.771	-0.091	1.863	22
Total Weight					8.440	100

Source: Authors' calculations

Table B1: Bank stability index of public sector banks in India

Appendix B: Bank stability index and respective ranking of banks across distinct ownership groups

Bank	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Average	Rank
Andhra Bank	0.196	0.344	0.250	0.173	0.151	0.138	0.136	0.110	0.134	0.146	0.178	1
Corporation Bank	0.191	0.286	0.221	0.169	0.163	0.162	0.160	0.130	0.125	0.168	0.177	2
Indian Bank	0.175	0.348	0.220	0.155	0.139	0.131	0.136	0.116	0.135	0.156	0.171	3
State Bank of Hyderabad	0.200	0.238	0.194	0.168	0.155	0.149	0.152	0.133	0.148	0.127	0.166	4
Punjab National Bank	0.136	0.362	0.188	0.154	0.141	0.137	0.141	0.110	0.100	0.152	0.162	5
Bank of Baroda	0.126	0.246	0.192	0.172	0.170	0.152	0.162	0.134	0.111	0.156	0.162	6
Union Bank Of India	0.206	0.253	0.176	0.136	0.123	0.133	0.139	0.107	0.127	0.143	0.154	7
Idbi Bank Ltd	0.137	0.179	0.173	0.162	0.168	0.156	0.170	0.127	0.128	0.127	0.153	8
State Bank of	0.127	0.176	0.167	0.136	0.133	0.141	0.145	0.134	0.152	0.098	0.141	9

Bikaner and Jaipur											
Oriental Bank of Commerce	0.124	0.187	0.169	0.145	0.120	0.133	0.152	0.114	0.125	0.132	0.140	10
Syndicate Bank	0.137	0.176	0.146	0.126	0.136	0.149	0.150	0.124	0.097	0.128	0.137	11
Punjab and Sind Bank	0.142	0.233	0.178	0.121	0.103	0.112	0.127	0.092	0.130	0.132	0.137	12
State Bank of India	0.132	0.149	0.150	0.122	0.129	0.137	0.141	0.121	0.135	0.147	0.136	13
Allahabad Bank	0.134	0.169	0.170	0.138	0.144	0.121	0.134	0.105	0.114	0.131	0.136	14
Bank of India	0.148	0.223	0.146	0.118	0.120	0.131	0.137	0.102	0.099	0.132	0.136	15
Canara Bank	0.121	0.155	0.165	0.156	0.126	0.127	0.139	0.109	0.101	0.136	0.134	16
State Bank of Mysore	0.150	0.189	0.154	0.131	0.109	0.126	0.127	0.110	0.123	0.093	0.131	17
UCO Bank	0.096	0.138	0.153	0.121	0.124	0.146	0.180	0.146	0.092	0.113	0.131	18
Dena Bank	0.133	0.160	0.157	0.139	0.150	0.147	0.139	0.100	0.078	0.104	0.131	19
State Bank of Travancore	0.127	0.200	0.160	0.138	0.115	0.123	0.120	0.097	0.128	0.099	0.131	20
Vijaya Bank	0.134	0.159	0.141	0.106	0.118	0.122	0.134	0.107	0.126	0.143	0.129	21
Bank of Maharashtra	0.128	0.162	0.145	0.094	0.121	0.143	0.132	0.109	0.124	0.110	0.127	22
State Bank of Patiala	0.132	0.190	0.159	0.128	0.132	0.118	0.131	0.099	0.090	0.054	0.123	23
United Bank of India	0.103	0.127	0.135	0.120	0.130	0.127	0.102	0.107	0.082	0.127	0.116	24
Indian Overseas Bank	0.158	0.155	0.128	0.116	0.114	0.111	0.131	0.081	0.072	0.092	0.116	25
Central Bank Of India	0.097	0.132	0.154	0.111	0.088	0.106	0.094	0.086	0.081	0.122	0.107	26

Source: Authors' calculations.

Table B2: Bank stability index of private banks in India

Bank	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Average	Rank
Nainital Bank Ltd	0.394	0.425	0.438	0.403	0.409	0.431	0.450	0.432	0.229	0.223	0.383	1
Yes Bank Ltd.	0.239	0.252	0.406	0.385	0.388	0.403	0.411	0.214	0.236	0.223	0.316	2
HDFC Bank Ltd.	0.208	0.204	0.236	0.197	0.236	0.208	0.250	0.218	0.261	0.260	0.228	3
RBL Bank Limited	0.251	0.277	0.287	0.206	0.219	0.200	0.202	0.167	0.169	0.193	0.217	4
Axis Bank Limited	0.197	0.262	0.231	0.202	0.209	0.197	0.228	0.200	0.222	0.208	0.216	5
Karur Vysya Bank Ltd	0.217	0.323	0.241	0.265	0.189	0.171	0.182	0.153	0.192	0.192	0.213	6
City Union Bank Limited	0.169	0.199	0.206	0.198	0.198	0.201	0.211	0.205	0.226	0.230	0.204	7
Indusind Bank Ltd	0.117	0.158	0.192	0.193	0.212	0.199	0.232	0.202	0.262	0.269	0.203	8
Tamilnad Mercantile Bank Ltd	0.173	0.267	0.233	0.190	0.181	0.202	0.191	0.170	0.190	0.190	0.199	9
Federal Bank Ltd	0.175	0.304	0.195	0.186	0.167	0.163	0.186	0.167	0.160	0.175	0.188	10
Kotak Mahindra Bank Ltd.	0.137	0.153	0.192	0.167	0.171	0.177	0.207	0.194	0.201	0.231	0.183	11
Jammu & Kashmir Bank Ltd	0.169	0.174	0.229	0.171	0.235	0.197	0.235	0.136	0.145	0.104	0.180	12
ICICI Bank Limited	0.145	0.169	0.170	0.155	0.146	0.164	0.194	0.175	0.190	0.209	0.172	13
South Indian Bank Ltd	0.147	0.161	0.174	0.149	0.169	0.155	0.164	0.117	0.130	0.158	0.152	14
Karnataka Bank Ltd	0.130	0.174	0.130	0.103	0.110	0.133	0.142	0.131	0.156	0.163	0.137	15
Lakshmi Vilas Bank	0.100	0.172	0.141	0.162	0.116	0.122	0.135	0.120	0.144	0.155	0.137	16

Ltd												
DCB Bank Limited	0.125	0.092	0.101	0.093	0.125	0.140	0.167	0.160	0.174	0.177	0.135	17
Catholic Syrian Bank Ltd	0.093	0.114	0.100	0.067	0.081	0.094	0.103	0.047	0.061	0.124	0.088	18

Source: Authors' calculations

Table B3: Bank stability index of foreign banks in India

Bank	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Average	Rank
Krung Thai Bank	0.694	0.667	0.624	0.608	0.636	0.654	0.692	0.709	0.704	0.739	0.673	1
Mashreq Bank	0.596	0.601	0.607	0.601	0.663	0.733	0.606	0.576	0.688	0.632	0.630	2
Bank of Ceylon	0.325	0.659	0.562	0.539	0.639	0.670	0.620	0.590	0.581	0.569	0.575	3
Shinhan Bank	0.550	0.547	0.597	0.551	0.529	0.531	0.585	0.558	0.552	0.539	0.554	4
Mizuho Bank Ltd	0.445	0.565	0.545	0.615	0.599	0.369	0.311	0.292	0.493	0.528	0.476	5
Ab Bank Ltd	0.316	0.364	0.338	0.580	0.576	0.461	0.447	0.491	0.424	0.751	0.475	6
Abu Dhabi Bank	0.569	0.556	0.361	0.254	0.576	0.611	0.306	0.262	0.437	0.446	0.438	7
Bank Of America	0.452	0.430	0.442	0.445	0.446	0.445	0.455	0.247	0.465	0.515	0.434	8
JP Morgan Chase Bank	0.263	0.242	0.184	0.459	0.453	0.489	0.507	0.524	0.531	0.559	0.421	9
Societe Generale	0.422	0.392	0.353	0.321	0.388	0.403	0.382	0.364	0.402	0.395	0.382	10
BNP Paribas	0.374	0.202	0.401	0.368	0.304	0.355	0.368	0.366	0.380	0.419	0.354	11
Sonali Bank	0.526	0.318	0.330	0.218	0.297	0.360	0.317	0.309	0.350	0.328	0.335	12
Bank of Nova Scotia	0.390	0.429	0.444	0.408	0.423	0.220	0.272	0.191	0.243	0.225	0.325	13
CTBC Bank Ltd.	0.388	0.500	0.275	0.264	0.245	0.236	0.324	0.318	0.323	0.327	0.320	14
Deutsche Bank	0.268	0.277	0.231	0.235	0.381	0.255	0.331	0.272	0.296	0.277	0.282	15
SBM Bank	0.415	0.454	0.181	0.152	0.206	0.317	0.251	0.285	0.265	0.258	0.278	16

Ltd.												
Credit Agricole Bank	0.390	0.372	0.161	0.315	0.379	0.371	0.176	0.338	0.139	0.127	0.277	17
Citibank	0.210	0.201	0.199	0.174	0.188	0.205	0.220	0.224	0.258	0.312	0.219	18
HSBC Bank Ltd.	0.193	0.203	0.192	0.181	0.195	0.191	0.233	0.182	0.259	0.290	0.212	19
Standard Chartered Bank	0.188	0.172	0.202	0.194	0.155	0.180	0.200	0.200	0.198	0.283	0.197	20
Barclays Bank	0.151	0.172	0.116	0.091	0.058	0.101	0.164	0.389	0.421	0.239	0.190	21
DBS Bank Ltd.	0.350	0.222	0.192	0.113	0.129	0.128	0.131	0.079	0.138	0.148	0.163	22

Source: Author's calculations