Insolvency Risk : Issues and Challenges for Public Sector Commercial Banks of India

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Abstract

This paper thoroughly examined the insolvency risk of four major commercial banks of India namely, State Bank of India, Punjab National Bank, Bank of Baroda, and Canara Bank during the period from 2005–06 – 2017–18 and scrutinized whether the regulatory capital requirement as per the Reserve Bank of India norms was enough to insulate commercial banks from the potential threat of insolvency risk. Moreover, the impact of the main determinants on the parameter used to measure insolvency risk namely, *Z*-score was also analyzed. Our study clearly showed that the insolvency risk of all these banks increased significantly since the value of *Z* - score dipped substantially overtime. Further, the analysis also revealed that the current level of regulatory capital of the banks was not enough to overcome the potential threat of insolvency risk. Finally, percentage of non-performing assets to total advances pertaining to the industrial sector was found to be an important determinant that aggravated the insolvency risk of banks. All these findings clearly highlighted that it is not the opportune time for the Reserve Bank of India to ease-off the regulatory capital norms regarding the capital risk adequacy ratio (CRAR). Besides, there is an urgent need for commercial banks to improve the quality of lending pertaining to the industrial sector of the economy along with stepping up their credit business regarding the personal loan segment. Moreover, too much government intervention distorts the automatic functioning of financial institutions. Rather, a mechanism should be devised to make these institutions more accountable.

Keywords : **capital risk adequacy ratio, insolvency risk, non-performing assets, *Z* - score**

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Ever since the collapse of Lehman Brothers on September 15, 2008, which eventually led to the global financial crisis, there has been unanimity among academicians and policy makers to have such norms that could prevent bank run and financial crises in the future. The concern and efforts shown by academicians and policy makers ultimately resulted in the configuration of broader capital norms for the banking sector in September 2010, which could act as a cushion in times of crisis and prevent the banks from becoming insolvent. These norms came to be known as BASEL III norms and were implemented in a phased manner in India with effect from the financial year 2013–14 and were supposed to be fully implemented by the end of the financial year 2018–19. However, because many of the Indian commercial banks were finding it difficult to maintain the stipulated capital requirements as per the norms laid down by the Reserve Bank of India, therefore, the deadline date has been extended from 2018 – 2019 – 2019 – 2020. Moreover, these norms, which are so essential for offsetting the threat of insolvency risk, have been a bone of contention between the Reserve Bank of India and the

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Government of India that finally resulted in the formation of the Parliamentary Committee on Finance headed by Mr. Veerappa Moily and which has recommended the RBI to relax the norms on capital requirements so that commercial banks could increase their lending for stimulating growth of the economy.

The purpose of the paper is to throw light on whether the recommendations of the Parliamentary Panel Committee on Finance regarding easing of capital requirement norms are justified or not. Besides, efforts are also made to investigate the plausible factors that have significantly affected the insolvency risk of the Indian public sector commercial banks.

Review of Literature

In one of his papers, Altman (1968) classified the limits of *Z* - score for categorization of financial firms into safe, grey, or distress zones. The firms were placed in the category of safe, grey, or distress zones depending on whether the value of *Z*-score exceeded 2.99 or fluctuated in the range of 1.81–2.99 or remained less than 1.81. In the recent past, in a study by Kumar and Kavita (2016), the researchers examined the financial health and bankruptcy risk by applying the Altman *Z*-score model during the period from 2010–11 – 2015–16 on the selected Indian banks namely, State Bank of India, Bank of Baroda, Canara Bank, Punjab National Bank, Union Bank of India, ICICI Bank, Axis Bank, Yes Bank, IndusInd Bank, and Kotak Mahindra Bank. Their study revealed that the selected Indian banks were under the 'safe zone' as per the Altman *Z*-score criteria and, therefore, there was no chance of financial distress. A similar inference was observed in the papers of Maji, Dey, and Jha (2011) and Das (2012). Besides, both also found that the size of the banks was the most significant factor that exerted a negative impact on the insolvency risk. Maji et al. (2011) derived this inference by analyzing five public sector commercial banks namely – State Bank of India, Punjab National Bank, Bank of Baroda, Union Bank, and Indian Bank during the period from 2000–01 – 2009 – 10 ; while, Das's (2012) findings were based on the evaluation of five public, five private, and five foreign banks for the period from 1998 – 2007. In another article, Murari (2012) evaluated the insolvency risk of 80 Indian banks (27 public, 22 private, and 31 foreign banks) with the help of *Z*- index as well as made a relative comparison among public, private, and foreign sector banks during the period from 2005–06 – 2009–10. The findings of this study revealed that the public sector banks were less risky as compared to private and foreign banks and among the public sector banks, the performance of State Bank of India was found to be better than that of other nationalized banks. Chitta, Jain, and Sriharsha (2019) studied the financial soundness of eight Maharatna companies by applying the Altman *Z*-score model during the period from 2014–18. The findings revealed that not all the Maharatna companies were performing as expected. Pillai and Mathew (2017) studied the trend of loan-loss provisions in Indian banks as loan-loss provisions are a systematic way of handling risks of the banking sector. The results showed that size of banks influenced the rate of provisions set aside for handling risks and made a clear distinction on banks ranked high based on size.

Finally, in an important paper, Pradhan (2014) used the back propagation neural network to predict whether the public sector banks in India namely, Oriental Bank of Commerce, Punjab National Bank, and State Bank of India were moving towards bankruptcy or not. Her findings based on the data for the period from 2000–2009 highlighted that the state of banks was expected to show improvement from 2011 onwards, rather than over the entire period of forecast from 2008–09–2019–20. Moreover, the *Z*-score value of Oriental Bank of Commerce was found to be the highest among all the selected banks followed by Punjab National Bank and State Bank of India. Thus, when these banks borrow from Reserve Bank of India, it must accord priority in lending in accordance with their *Z*-score values, that is, the bank having the highest value of *Z*-score namely, Oriental Bank of Commerce should be granted highest priority followed by Punjab National Bank and State Bank of India.

Thus, most of the articles pertaining to insolvency risk have observed that the public sector banks in India are less risky and remain or are likely to stay in a safe zone. However, the recurring enhancement in non-performing

assets of public sector banks and the gradual decline in their return on assets cast doubts on these inferences and findings. It also draws attention towards the insolvency risk of the financial institutions of the country. Hence, there is a need to not only look at the pattern of insolvency risk as measured by *Z*-score, but also to delineate the factors that influence insolvency risk and to evaluate whether capital cushioning in the form of capital risk adequacy ratio, as stipulated by Reserve Bank of India, is enough to offset any major threat of insolvency risk. This paper is ,therefore, an attempt to provide a detailed analysis on these issues, and accordingly, the following objectives are being outlined.

Objectives of the Study

One of the objectives is to estimate the parameter *Z*-score, which measures the insolvency risk of banks and to analyze their behaviour during the period of analysis from 2005–06 – 2017–18. Their behaviour over time would facilitate in shedding light on the extent of insolvency risk faced by banks, and it will hence provide a rationale for the maintenance of capital requirements by banks.

The second objective is to assess whether the regulatory capital requirement as per the Reserve Bank of India norms is enough to insulate commercial banks from the potential threat of insolvency risk. The third objective is to investigate the main determinants of *Z*-score that could significantly explain the variations in it.

All these objectives have important policy implications as well as they facilitate to verify whether the recommendations of the Parliamentary Committee on Finance urging Reserve Bank of India to ease the capital requirements norms are justified or not.

Hypotheses

One of our objectives is to estimate and analyze the behaviour of *Z*-score from 2005–06 – 2017–18. If over time the value of *Z*-score diminishes significantly, then there exists a strong case for the Central bank to lay norms for effective capital requirements. In this context, we have, therefore, hypothesized that :

- **H01 :** There is no significant decline in the value of *Z*-score over time.
- **Ha1 :** There is a significant reduction in the value of *Z*-score over time.

Further, it is in place to mention that in order to test these hypotheses, the value of *Z*-score, which we have symbolized as Z_M is estimated by considering market value of equity of a bank as its capital and not the regulatory capital that banks keep for maintaining capital risk adequacy ratio (*CRAR*) as per RBI's norms.

The investigation of the second objective regarding regulatory capital of the commercial banks being enough to offset any potential threat of insolvency risk is examined by testing the hypothesis between the difference in the regulatory and market capital of a bank and the difference in the corresponding values of *Z*-score based on each type of banks' capital. The formulation of this hypothesis rests on the simple mathematical rationale pertaining to the estimation of *Z*-score, which is computed as the ratio of the sum of return on assets (*ROA*) and capital asset ratio (*CAR*) to standard deviation of return on assets (*SDROA*). In this criterion, capital asset ratio is considered in two ways, one as the ratio of market value of equity (*MVOE*) to total assets, which is represented as K_M and the other is the capital risk adequacy ratio (*CRAR*) and is symbolized as K_R. Thus, corresponding to each type of capital asset ratio, namely K_R and K_M , there exist corresponding values of *Z*-score which are symbolized as Z_M and Z_R, respectively. One can then express the difference between the two *Z*-scores as:

$$Z_R - Z_M = (ROA + K_R) / (SDROA) - (ROA + K_M) / (SDROA)$$

$Z_R - Z_M = (K_R - K_M) / (SDROA)$

$(Z_R - Z_M)\ \alpha\ (K_R - K_M)$, that is, $(Z_R - Z_M)$ is directly proportional to $(K_R - K_M)$

or, $Z_R - Z_M = A(K_R - K_M)$

where, $'A'$ is constant of proportionality and is used to capture the average effect of variables other than $(K_R - K_M)$ on $Z_R - Z_M$.

From the final equation, it follows that if the difference between the regulatory and market capital is significantly positive, then the difference between the two *Z*-scores (Z_R and Z_M) is also positive and significant. However, if instead other factors like return on assets (*ROA*) and standard deviation of return on assets (*SDROA*), which are specific to banks and are therefore, referred to as idiosyncratic factors play an important role in explaining the difference between Z_R and Z_M , then there underlies a need to increase the regulatory capital to overcome the potential threat of insolvency risk as well as lay emphasis on commercial banks to enhance their return on assets by thoroughly scrutinizing the advances which are the main source of their assets. In this context, it is therefore hypothesized that :

- **H02 :** There is hardly any positive significant impact of regulatory capital on insolvency risk.
- **Ha2 :** There is a significant positive impact of regulatory capital on insolvency risk.

The rejection of the null hypothesis implies that regulatory capital of banks is enough to insulate them from any potential threat of insolvency risk. It is only in this case that the recommendation of Parliamentary Committee on Finance regarding diluting or easing-off the capital requirements could be justified. However, if the null hypothesis is not rejected, then it is not the opportune time to dilute banks' capital requirements. Rather, it would be more important to focus on improving the return on assets, especially on the advances which constitute the principal assets of banks.

In order to scrutinize the last objective regarding the principal determinants of *Z*-score that could significantly explain variations in it, the same has been examined by formulating the following hypotheses between *Z*-score and its principal determinants.

- **H03 :** There is hardly any significant impact of each determinant on the *Z*-score.
- **Ha3 :** There is a significant impact of each determinant on the *Z*-score.

Scope of the Study

The scope of the analysis is confined to four important public sector commercial banks namely, State Bank of India, Punjab National Bank, Bank of Baroda, and Canara Bank and the period of analysis is from 2005–06 – 2017–18, but for analyzing the determinants of insolvency risk, the period of analysis is from 2009–10 – 2017–18 because the data is consistently available regarding each determinant of insolvency risk from the year 2009–10 onwards.

Methodology

The evaluation of the first objective and hypotheses require estimation of the values of *Z*-score parameters from 2005–06 – 2017–18 for each bank. The value of the *Z*-score here is symbolised as Z_M and the standard way to estimate is as follows :

$$Z_M = (CAR + ROA) / (SDROA)$$

where, *CAR* is the capital asset ratio, while *ROA* is return on assets and *SDROA* is the standard deviation of return on assets. Moreover, capital asset ratio (*CAR*) is the ratio of market value of equity (*MVOE*) to total assets of banks. Market value of equity (*MVOE*) is estimated by taking the product of number of shares to market price of each share, while estimates of total assets and return on assets (*ROA*) are available in the annual reports of the respective banks, and standard deviation of return on assets (*SDROA*) is estimated by considering a moving quinquennium period ending at the year corresponding to which the standard deviation of return on assets (*SDROA*) is to be estimated, that is, 5 years retrospective window width is considered from the year for which standard deviation of return on assets (*SDROA*) is to be estimated. Further, in order to test the first hypothesis, a simple regression equation between *Z*-score and time is estimated, which is of the following form :

$$Z_M = \alpha + \beta t$$

where, α is the intercept term, β is the regression coefficient associated with time, and Z_M represents *Z*-score.

The scrutiny of the second objective involves testing of the second hypothesis which requires difference in the values of *Z*-scores, namely Z_R and Z_M should be positively and significantly explained by the difference in the ratios of the regulatory capital to total assets (K_R) and market value of equity to total assets (K_M). In order to accomplish it, regression on the panel data pertaining to the log values of the difference between Z_R and Z_M as the dependent variable and log values of the difference between K_R and K_M as independent variables along with the three dummies : d_2, d_3, and d_4, each of which stand for Punjab National Bank, Bank of Baroda, and Canara Bank, respectively, while the intercept term α_0 represents State Bank of India is estimated, which symbolically is expressed as :

$$\ln (Z_R - Z_M) = \ln \alpha_0 + \alpha_1 \ln (K_R - K_M) + \eta_2 d_2 + \eta_3 d_3 + \eta_4 d_4$$

where, ln is the natural log, while η_2, η_3, η_4 are the regression coefficients associated with the three dummies d_2, d_3, d_4, respectively and when $d_2 = 1$ then $d_3 = d_4 = 0$. Similarly, when $d_3 = 1$ then $d_2 = d_4 = 0$. Likewise, when $d_4 = 1$ then $d_2 = d_3 = 0$. Further, α_1 is the regression coefficient associated with the log values of the difference between K_R and K_M and when $d_2 = d_3 = d_4 = 0$, we have the value of the intercept term $\ln \alpha_0$.

It needs to be mentioned that the details of the estimates of two different measures of insolvency risk namely, Z_R and Z_M and two different measures of capital to asset ratio namely K_R and K_M as well as their difference are given in the Appendix Tables A1, A2, A3, A4, and A5. Moreover, estimates of return on assets (*ROA*) as well as standard deviation of return on assets (*SDROA*) of each bank are given in Tables A1, A2, A3, A4. Further, for the year 2005–06, the data of return on assets (*ROA*) is required for the retrospective years of each of the four public sector commercial banks from 2001–02–2004–05, which is given in Appendix Table A6.

In order to assess the third objective, we must verify the last hypothesis namely, the impact of the determinants of insolvency risk on the parameter *Z*-score. This has been dealt by fitting a regression equation on the panel data from 2009–10 – 2017–18 of four commercial banks considered in the analysis, which is of the following form :

$$\ln Z_M = \ln \beta_0 + \beta_1 \ln (NPA/TA)\, Agriculture + \beta_2 \ln (NPA/TA)\, Industry + \beta_3 \ln (NPA/TA)\, Services + \beta_4 \ln (NPA/TA)\, Personal\ Loans + \delta_2 D_2 + \delta_3 D_3 + \delta_4 D_4$$

where, δ_2, δ_3, and δ_4 are the coefficients associated with the dummies D_2, D_3, and D_4, which represent each of the three entities or banks. D_2 represents the Punjab National Bank and when $D_2 = 1$ then $D_3 = D_4 = 0$. Similarly, D_3 represents Bank of Baroda and when $D_3 = 1$, then $D_2 = D_4 = 0$.

Likewise, D_4 represents Canara Bank and when $D_4 = 1$, then $D_2 = D_3 = 0$. Further, β_0 represents the intercept term for the State Bank of India when all the three dummies are zero ($D_2 = D_3 = D_4 = 0$). Moreover β_1, β_2, β_3, and β_4 are the regression coefficients associated with the log values of the variables namely, ratios of the non-performing assets (NPA) to total advances (TA) in each of the four sectors namely, agriculture, industry, services, and personal loan segment. The estimated values of the sector specific percentage of non-performing assets (NPA) to total advances (TA) are reported in the Appendix Table A7.

Analysis and Results

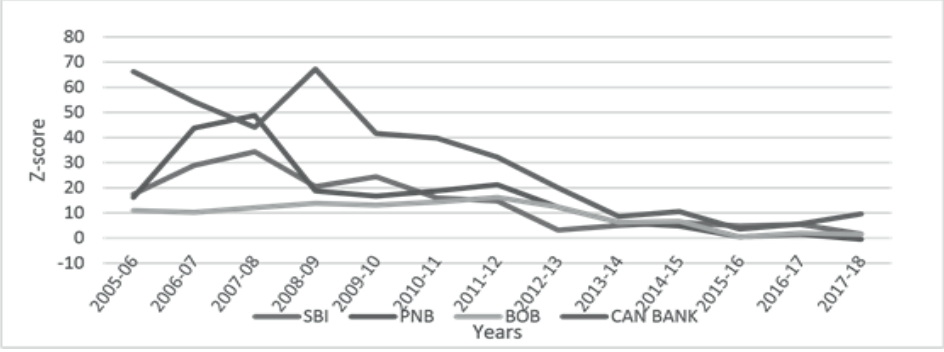
One of the objectives is to estimate and trace the pattern of change in the parameter *Z*-score (Z_M) from 2005–06 – 2017–18 for each of the four public sector banks of India. The estimated values of *Z*-score (Z_M) and its movement overtime is depicted in Table 1 and Figure 1, respectively.

Table 1. Estimates of *Z*-Score Parameter (Z_M) of Four Public Sector Commercial Banks

Years	SBI	PNB	BOB	CAN BANK
2005–06	15.4912	16.1803	10.9587	66.2239
2006–07	28.0835	42.8319	10.2426	54.1819
2007–08	35.5234	48.7668	12.0402	44.1034
2008–09	22.4964	18.7189	13.8329	67.2216
2009–10	23.1588	16.7084	13.0761	41.5519
2010–11	16.0178	18.7389	14.3111	39.7792
2011–12	14.9329	21.1726	16.1601	32.1901
2012–13	3.3113	12.2246	12.3955	19.9678
2013–14	4.8053	4.5358	6.1963	8.5463
2014–15	6.2245	4.8169	4.7037	10.5549
2015–16	4.7703	0.5104	0.4187	3.5524
2016–17	5.4216	1.4925	1.8752	5.6345
2017–18	1.5896	-0.5318	1.3529	9.6066

Source : Annual Reports of State Bank of India (SBI), Punjab National Bank (PNB), Bank of Baroda (BOB), and Canara Bank (CAN) as well as closing prices of shares of each bank were taken from the website in.finance.yahoo.com/ SBI/PNB/BOB/CAN.

Figure 1. Intertemporal Pattern of Change in the Estimates of *Z* - Score (Z_M)



Source : Table 1

From the estimated values of *Z*-score as well as its movement since 2005–06 shows that *Z*-score has the tendency to diminish over time, which highlights that insolvency risk of all the four commercial banks increases as *Z*-score bears an inverse relationship with insolvency risk, that is, as *Z*-score diminishes, insolvency risk increases. In order to assess whether increase in the insolvency risk is significant, we have fitted a simple regression equation between *Z*-score estimates and time for each of the four commercial banks. The results of the estimated regression equations for each of the four banks are given in Table 2.

From Table 2, it is evident that the regression coefficients associated with time for each of the four commercial banks is negative and significant, which reflects that value of *Z*-score has diminished significantly during 2005–06 – 2017–18. The significant decline in the value of *Z*-score over time of all the four major commercial banks in the public sector highlights that the insolvency risk of these banks has substantially enhanced, and it corroborates our alternative hypothesis (Ha1) and rejects the null hypothesis (H01) of no significant decline in the value of *Z* - score over time. The significant decline in the value of *Z*-score raises the issue whether regulatory capital requirements are enough to insulate commercial banks from the potential threat of insolvency risk or not. This has been examined by fitting a regression equation on the panel data of the four commercial banks from 2005 – 06 – 2017–18. The results of the estimated regression equation are given in Table 3.

From Table 3, it is evident that the regression coefficient associated with the log of the difference of regulatory and market capital is positive but not significant at the 5% probability level. It thus rejects the alternate hypothesis (Ha2) and substantiates our null hypothesis (H02) that there is hardly any significant positive impact of the regulatory capital on insolvency risk. Hence, regulatory capital of these banks currently is not enough to ward-off the potential threat of insolvency risk. Public sector commercial banks therefore urgently require maintaining their capital risk adequacy ratio (CRAR) fully in line with the stipulated requirements of the Reserve Bank of

Table 2. Results of Estimated Regression Equation

(Dependent Variable : *Z*-score (Z_M) (Independent Variable: Time, 2005–06 – 2017–18)

Bank	Constant	Regression Coefficient Associated with the Time Variable	R^2	*F*-Value
SBI	30.39 (8.79)	-2.34 (-5.37)	0.7236	28.79
PNB	38.12 (6.68)	-3.15 (-4.38)	0.6360	19.22
BOB	16.24 (7.31)	-1.007 (-3.60)	0.5405	12.94
CAN BANK	69.49 (13.43)	-5.50 (-8.43)	0.8661	71.14

Source : Estimates based on the values of *Z*-score as given in Table 1 and time factor.

Note. Figures in parentheses are *t* - values.

Table 3. Results of the Estimated Regression Equation Based on Panel Data

(Dependent Variable : Difference in the Log values of Z_R and Z_M) (Independent Variable : Difference in the log values of K_R and K_M & dummy variables : d_2, d_3, and d_4)

Regression Coefficients Associated with				Intercept Terms Pertaining to Each Bank				R^2	R^2 (adj)
Ln (*KR*–*KM*)	d_2	d_3	d_4	SBI	PNB	BOB	CAN		
0.984	-0.284	-0.535	-0.451	6.432	6.148	5.897	5.981	0.2486	0.1846
(1.77)	(-1.08)	(-2.06)	(-1.25)	(5.36)	(4.94)	(4.92)	(4.12)		

Source : Estimates based on the values of variables given in Appendix Table A5.

Note. Figures in parentheses are *t* - values.

India. Besides, the constant term is positive and significant, which shows that there are bank specific factors which significantly impact the difference between the regulatory and market value of *Z*-score in a positive way. One such factor is the return on assets (ROA) and since it has diminished substantially over time, the difference in the *Z*-scores too has also declined intertemporally.

Finally, the last objective is to scrutinize the principal determinants of *Z*-score and to evaluate their impact on the insolvency risk. In this context, it is observed that one of the principal assets of all the commercial banks is the advances whose share in total assets of public sector commercial banks is above 50%, and the return on assets of all the four public sector commercial banks showed a declining trend, especially after 2011–12 and became negative in the terminal year of analysis. In such a situation, additional lending by commercial banks through dilution of regulatory capital norms could only deteriorate their financial health and enhance the threat of insolvency risk. Since return on assets is one of the prime factors on which the value of *Z*-score depends and decline in the value of return on assets also results in decline of the value of *Z*-score. Therefore, this positive association between the two has enabled us to comprehend that accumulation of non-performing assets pertaining to advances channelized towards agricultural, industrial, services, and personal loan segments have an important bearing on the value of *Z*-score. Hence, we have diagnosed four important determinants of the *Z*-score, which are the ratios of non-performing assets to gross advances pertaining to each of the four segments of lending namely, agriculture, industry, services, and personal loan categories. In order to verify our preliminary observations that these four are the principal determinants of *Z*-score, then they must significantly explain the variations in *Z*-score. To accomplish this task, we have estimated a panel data regression between them whose results are given in Table 4.

From Table 4, it is evident that there is one factor that significantly explains the variations in the *Z*-score and this variable is namely the percentage of log of non-performing assets to total advances in the industrial sector, while the other two variables are namely, percentage of log of non-performing assets to total advances for agricultural and services sector, respectively though they have a negative impact on the dependent variable, but are not significant. However, the sign of the coefficient of the percentage of log of non-performing assets to total advances in personal loan segment is positive, but is not significant. It is also evident from the estimated equation that of all the variations in the dependent variable, 76% is being explained by the variations in the ratio of non-performing assets of the industrial sector to total advances of this sector. In a nutshell, therefore, the percentage of non- performing assets to total advances of industrial sector is the only determinant that has caused

Table 4. Results of the Estimated Regression Equation Based on Panel Data

(Dependent Variable : Log Values of Z_M) (Independent Variables: Log values of the ratio of non-performing assets (NPAs) to total advances (TA) of agriculture, industry, services, personal loan & dummy variables : D_2, D_3, and D_4)

Variables	Regression Coefficients	Intercept Terms Associated with Each Bank		R^2	R^2 (adj)
Ln (*NPA*/*TA*) *Agr.*	-0.551 (-1.43)	State Bank of India	4.257 (6.66)	0.8076	0.7595
Ln (*NPA*/*TA*) *Ind.*	-0.620 (-3.42)				
Ln (*NPA*/*TA*) *Ser.*	-0.179 (-0.86)	Punjab National Bank	3.898 (6.73)		
Ln (*NPA*/*TA*) *Pl.*	0.088 (0.54)				
D_2	-0.359 (-1.18)	Bank of Baroda	3.71 (5.94)		
D_3	-0.547 (-1.84)				
D_4	-0.121 (-0.27)	Canara Bank	4.136 (12.81)		

Source : Estimates based on the values of variables given in Appendix Table A7.

Note. Figures in parentheses are *t* - values.

significant impact on *Z*-score and as the values of *Z*-score of all the commercial banks showed a declining trend since 2011–12, it was primarily due to the increase in the non-performing assets related to the total advances given to the industrial sector. Our inference thus rejects the third null hypothesis (H03) and accepts the alternate hypothesis (Ha3) regarding the percentage of non-performing assets to total advances of the industrial sector as the principal determinant of the parameter *Z*-score.

Findings and Policy Implications

One of the important findings of our analysis is that there has been a significant decline in the value of *Z*-score with the passage of time of all the four major public sector commercial banks of India, which reflects substantial enhancement in their insolvency risk. Our inferences thus contradict the existing findings of a healthy picture of public sector banks of India as outlined in the studies of Kumar and Kavita (2016), Maji et al. (2011), Das (2012), Murari (2012), and Pradhan (2014). Further, in order to counter the potential threat of insolvency risk of the four public sector banks considered in the analysis, it is necessary that these banks must immediately comply with the capital requirements as stipulated by the Reserve Bank of India (9% of Tier I and Tier II + 2.5% capital conditioning buffer, that is, a total of 11.5% capital risk adequacy ratio) because this capital could only offset the potential threat of insolvency risk in the short run. In the long run, banks must improve their return on assets by properly scrutinizing the borrowers' credit worthiness and the past record of loan repayment, otherwise it is difficult for these banks to get rid of the insolvency risk.

Another important finding from the analysis is that the current level of regulatory capital of the banks is not enough to overcome the potential threat of insolvency risk. Hence, the Reserve Bank of India should not allow banks to ease-off the regulatory capital requirements based on the recommendations of the Parliamentary Committee on Finance. Rather, the Reserve Bank of India must ensure that commercial banks must strictly adhere to RBI's norms regarding capital risk adequacy ratio (CRAR). Moreover, commercial banks must understand that the importance of principal source of their assets is advances, and therefore, they should channelize lending in those business activities which promise positive and timely returns, and in this context, banks must focus on stepping-up their lending activities especially towards the personal loan category.

The main determinants that affect the parameter *Z*-score are the percentage of non-performing assets in total advances in each of the four segments of lending by the commercial banks namely, agricultural, industrial, services, and personal loan categories. This is evident due to the fact that the percentages of non-performing assets in total advances in each of the four sectors together explain around 76% of the variation in the value of *Z*-score. Further, the percentage of non-performing assets in total advances in the industrial sector has a significant negative impact on the *Z*-score, which clearly exhibits that non-performing assets in the industrial sector are an important factor in aggravating the insolvency risk of these banks. Thus, there is a strong need to properly scrutinize the advances given to the industrial sector, otherwise it will continue to erode the overall return on assets of banks and enhance the threat of insolvency risk. The initiative taken in the recent past on January 1, 2019 by the Reserve Bank of India to allow banks for one time restructuring of advances of up to ₹ 25 crores to micro, small and medium enterprises that were in default without marking them as non-performing assets for a period of 15 months, that is, upto March 31, 2020 after keeping just 5% provisions for loss is just contrary to the practice of a sound banking system and will only aggravate the insolvency risk of banks. This coupled with the recommendation of the Parliamentary Committee on Finance to dilute capital requirements of banks would only push public sector banks closer towards the insolvency risk situation. The time has come when the Reserve Bank of India should set up a cell to regularly monitor the functioning of fund and non-fund activities of every public sector commercial bank so that any intentional or unintentional irregularities taking place in the domain of public

sector banks could be timely scrutinized and rectified for the healthy growth of the banking system, which is of utmost importance for effective viability of the financial system of the country.

Conclusion

Our study of the four major public sector commercial banks clearly shows that the insolvency risk of all these banks has increased significantly since the value of *Z*-score dipped substantially during the period from 2005–06 – 2017–18. The *Z*-score values of three public sector banks considered in the analysis namely, State Bank of India, Punjab National Bank, and Bank of Baroda are already in the distress zone as per Altman's criteria, which is indeed a cause of concern, and therefore, it is not the opportune time for the Reserve Bank of India to ease-off the regulatory capital norms as recommended by the Parliamentary Committee on Finance headed by Mr. Veerappa Moily. Rather, the Reserve Bank of India should strictly adhere to the norms regarding maintenance of the capital risk adequacy ratio (CRAR) for the commercial banks at 11.5% of risk weighted assets, because this is the only way by which potential threat of insolvency risk of commercial banks could be mitigated in the short run. However, in the long run, quality of lending needs significant improvement, especially of the industrial sector, since percentage of non-performing assets to total advances pertaining to the industrial sector has a significant negative impact on the *Z*-score that ultimately causes the insolvency risk to aggravate. Moreover, banks should channelize lending in those business activities which promise positive and timely returns, and in this context, banks must focus on stepping-up their lending activities towards the personal loan category. Finally, too much government intervention distorts the automatic functioning of financial institutions. Rather, a mechanism should be devised to make these institutions more accountable by linking the promotions and increments of employees based on the overall performance of each bank and of the branches in which the employees have served. The Reserve Bank of India needs to step-up its monitoring and supervision role of commercial banks.

Limitations of the Study and Scope for Further Research

In all, there were 28 public sector banks as at the end of March 2006, the year from which the insolvency risk and its determinants have been considered for the purpose of analysis, but of these banks, only four public sector banks are included in this paper. This implies that the sample size is a little less than 15%, which is one of the limitations of the study. However, since the banks considered in the study are major public sector banks, therefore, the sample size limitation is not of a serious nature and the results derived from the analysis of these banks pertaining to insolvency risk should have general applicability for other public sector commercial banks of India. This also signifies that there exists enough scope of research to verify our findings by extending the technique used in this paper.

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Appendix

Table A1. Broad Parameters of the Banking Sector with Reference to SBI

Years	Avg. Close Price (₹)	No of Shares (Crores)	*MVOE* (₹ crs)	Total Assets (₹ crs)	K_M	K_R	*ROA*	*SDROA*	Z_M	Z_R
2005–06	76.6	52.62	4030.69	493870	0.0082	0.1353	0.0089	0.00110	15.4912	130.9287
2006–07	94.23	52.62	4958.38	566565	0.0088	0.1245	0.0084	0.00061	28.0835	217.6058
2007–08	169.61	63.14	10709.18	721526	0.0148	0.1188	0.0101	0.00070	35.5234	183.5817
2008–09	132.61	63.48	8418.08	964432	0.0087	0.1425	0.0104	0.00085	22.4964	179.8201
2009–10	190.54	63.48	12095.48	1053413	0.0115	0.1339	0.0088	0.00088	23.1588	162.9395
2010–11	266.24	65.95	17558.53	1223736	0.0143	0.1198	0.0071	0.00134	16.0178	94.7701
2011–12	213.85	67.10	14349.34	1335519	0.0107	0.1386	0.0088	0.00131	14.9329	112.6209
2012–13	216.77	68.40	14827.07	1566211	0.0095	0.1292	0.0017	0.00337	3.3113	38.8152
2013–14	180.09	74.65	13443.72	1792748	0.0075	0.1244	0.0065	0.00291	4.8053	44.9327
2014–15	267.42	74.65	19962.90	2048080	0.0097	0.12	0.0068	0.00266	6.2245	47.6982
2015–16	237.8	77.62	18458.04	2259063	0.0082	0.1312	0.0046	0.00268	4.7703	50.7261
2016–17	240.32	79.73	19160.70	2705966	0.0071	0.1311	0.0041	0.00206	5.4216	65.5585
2017–18	289.52	89.24	25836.92	3454752	0.0075	0.126	-0.0019	0.00351	1.5896	35.3606

Sources : 1. Annual Reports of State Bank of India (SBI) for the years 2001–02–2017–18.

2. in.finance.yahoo.com/ State Bank of India. SBI.

Note. 1. Capital asset ratio (K_M) is the ratio of market value of equity (*MVOE*) to total assets.

2. Standard deviation of return on assets (*SDROA*) is based on the 5 years retrospective window width.

3. Z_M is the ratio of the sum of return on assets (*ROA*) and capital asset ratio (K_M) to standard deviation of return on assets (*SDROA*).

4. Z_R is the ratio of the sum of return on assets (*ROA*) and capital risk adequacy ratio (K_R) to standard deviation of return on assets (*SDROA*).

Table A2. Broad Parameters of the Banking Sector with Reference to PNB

Years	Avg. Close Price (₹)	No of Shares (Crores)	*MVOE* (₹ crs)	Total Assets (₹ crs)	K_M	K_R	*ROA*	*SDROA*	Z_M	Z_R
2005–06	84.11	31.53	2651.99	145267	0.0183	0.1478	0.0109	0.00180	16.1803	88.0716
2006–07	91.12	31.53	2873.01	162422	0.0177	0.1195	0.0103	0.00065	42.8319	198.6373
2007–08	109.52	31.53	3453.17	199020	0.0174	0.1229	0.0115	0.00059	48.7668	227.1775
2008–09	91.5	31.53	2885.00	246919	0.0117	0.1296	0.0139	0.00137	18.7189	104.9938
2009–10	153.52	31.53	4840.49	296633	0.0163	0.1403	0.0144	0.00184	16.7084	84.1457
2010–11	227.9	31.68	7219.87	378325	0.0191	0.1416	0.0134	0.00173	18.7389	89.4148
2011–12	200.74	33.91	6807.09	458194	0.0149	0.1242	0.0119	0.00126	21.1726	107.6975
2012–13	160.24	35.34	5662.88	478948	0.0118	0.1263	0.01	0.00179	12.2246	76.3493
2013–14	120.91	36.20	4376.94	550420	0.0080	0.1152	0.0064	0.00316	4.5358	38.4302
2014–15	186.4	37.09	6913.58	603333	0.0115	0.1221	0.0053	0.00348	4.8169	36.6174
2015–16	128.45	39.27	5044.23	667390	0.0076	0.1128	-0.0061	0.00286	0.5104	37.3456
2016–17	121.84	42.55	5184.45	720330	0.0072	0.1166	0.0019	0.00610	1.4925	19.4406
2017–18	152.79	55.21	8435.80	765830	0.0110	0.092	-0.016	0.00937	-0.5318	8.1083

Sources : 1. Annual Reports of Punjab National Bank (PNB) for the years 2001–02 – 2017–18.

2. in.finance.yahoo.com/ Punjab National Bank. PNB.

Note. Same as in Table A1.

Table A3. Broad Parameters of the Banking Sector with Reference to BOB

Years	Avg. Close Price (₹)	No of Shares (Crores)	*MVOE* (₹ crs)	Total Assets (₹ crs)	K_M	K_R	*ROA*	*SDROA*	Z_M	Z_R
2005–06	45.28	36.7	1661.62	116679	0.0142	0.1365	0.0079	0.00202	10.9587	71.4711
2006–07	47.56	36.7	1745.49	143146	0.0121	0.118	0.008	0.00197	10.2426	63.9092
2007–08	64.18	36.7	2355.28	179599	0.0131	0.1294	0.0089	0.00182	12.0402	75.6404
2008–09	52.24	36.7	1917.08	227407	0.0084	0.1405	0.011	0.00140	13.8329	107.8572
2009–10	94.73	36.7	3476.77	278316	0.0124	0.1436	0.0121	0.00188	13.0761	82.7887
2010–11	165.21	39.4	6509.09	358397	0.0181	0.1452	0.0133	0.00219	14.3111	72.0976
2011–12	161.34	41.3	6663.14	447321	0.0148	0.1467	0.0124	0.00168	16.1601	94.1931
2012–13	148.16	42.3	6267.09	547135	0.0114	0.133	0.009	0.00165	12.3955	86.0527
2013–14	120.15	43.2	5190.39	659504	0.0078	0.1228	0.0075	0.00248	6.1963	52.5292
2014–15	183.69	44.5	8174.20	714988	0.0114	0.126	0.0049	0.00347	4.7037	37.6981
2015–16	160.03	46.35	7417.17	671376	0.0110	0.1317	-0.0078	0.00775	0.4187	15.9735
2016–17	158.17	46.08	7288.66	694875	0.0104	0.1224	0.002	0.00666	1.8752	18.6784
2017–18	160.72	52.91	8503.86	719999	0.0118	0.1213	-0.0034	0.00621	1.3529	18.9637

Sources : 1. Annual Reports of Bank of Baroda (BOB) for the years 2001–02– 2017–18.

2. in.finance.yahoo.com/ Bank of Baroda. BOB.

Note. Same as in Table A1.

Table A4. Broad Parameters of the Banking Sector with Reference to CAN BANK

Years	Avg. Close Price (₹)	No of Shares (Crores)	*MVOE* (₹ crs)	Total Assets (₹ crs)	K_M	K_R	*ROA*	*SDROA*	Z_M	Z_R
2005–06	219.35	41	8993.35	110305	0.0815	0.1122	0.0113	0.00140	66.2239	88.1020
2006–07	235.31	41	9647.91	132821	0.0726	0.135	0.0098	0.00152	54.1819	95.1685
2007–08	259.51	41	10639.75	165961	0.0641	0.1325	0.0092	0.00166	44.1034	85.2471
2008–09	186.88	41	7661.97	178323	0.0430	0.141	0.0106	0.00080	67.2216	190.2446
2009–10	311.48	41	12770.58	264741	0.0482	0.1343	0.013	0.00147	41.5519	99.9477
2010–11	540.08	44.3	23925.72	336078	0.0712	0.1538	0.0142	0.00215	39.7792	78.2624
2011–12	470.76	44.3	20854.82	339299	0.0615	0.1376	0.0095	0.00220	32.1901	66.7259
2012–13	413.96	44.3	18338.41	410309	0.0447	0.124	0.0077	0.00262	19.9678	50.1919
2013–14	280.51	46.1	12931.32	501089	0.0258	0.1063	0.0054	0.00365	8.5463	30.5907
2014–15	385.97	47.5	18333.62	558557	0.0328	0.1056	0.0055	0.00363	10.5549	30.5990
2015–16	265.13	54.3	14396.34	563724	0.0255	0.1108	-0.0052	0.00573	3.5524	18.4450
2016–17	258.89	59.72	15460.72	583519	0.0265	0.1286	0.002	0.00506	5.6345	25.8237
2017–18	342.02	73.32	25077.03	616886	0.0407	0.1322	0.0075	0.00501	9.6066	27.8715

Sources : 1. Annual Reports of Canara Bank (CAN) for the years 2001–02 – 2017–18.

2. in.finance.yahoo.com/ Canara Bank. CAN

Note . Same as in Table A1.

Table A5. Estimates of the Difference Between Measures of Insolvency Risk (Z_R & Z_M) & Capital Asset Ratio (K_R & K_M)

Years	SBI		PNB		BOB		CANARA BANK	
	Z_R–Z_M	K_R–K_M	Z_R–Z_M	K_R–K_M	Z_R–Z_M	K_R–K_M	Z_R–Z_M	K_R–K_M
2005–06	115.4375	0.1271	71.8913	0.1295	60.5124	0.1223	21.8780	0.0307
2006–07	189.5223	0.1157	155.8054	0.1018	53.6666	0.1058	40.9866	0.0624
2007–08	148.0583	0.1040	178.4106	0.1055	63.6002	0.1163	41.1436	0.0684
2008–09	157.3238	0.1338	86.2749	0.1179	94.0243	0.1321	123.0230	0.0980
2009–10	139.7806	0.1224	67.4373	0.1240	69.7126	0.1311	58.3958	0.0861
2010–11	78.7523	0.1055	70.6759	0.1225	57.7865	0.1270	38.4832	0.0826
2011–12	97.6880	0.1279	86.5249	0.1093	78.0331	0.1318	34.5358	0.0761
2012–13	35.5040	0.1197	64.1246	0.1145	73.6572	0.1215	30.2241	0.0793
2013–14	40.1274	0.1169	33.8945	0.1072	46.3329	0.1149	22.0443	0.0805
2014–15	41.4737	0.1103	31.8005	0.1106	32.9945	0.1146	20.0441	0.0728
2015–16	45.9558	0.1230	36.8352	0.1052	15.5548	0.1207	14.8926	0.0853
2016–17	60.1369	0.1240	17.9481	0.1094	16.8032	0.1119	20.1892	0.1021
2017–18	33.7710	0.1185	8.6401	0.0810	17.6108	0.1095	18.2649	0.0915

Source : Derived from Table A1, Table A2, Table A3, Table A4.

Table A6. Return on Assets (*ROA*) of Four Public Sector Commercial Banks of India

Year	SBI	PNB	BOB	CANARA BANK
2001–02	0.70%	0.77%	0.77%	1.03%
2002–03	0.86%	0.98%	1.01%	1.24%
2003–04	0.94%	1.08%	1.20%	1.34%
2004–05	0.99%	1.12%	0.75%	1.01%

Source : Annual Reports of State Bank of India (SBI), Punjab National Bank (PNB), Bank of Baroda (BOB), and Canara Bank (CAN) for the years 2001–02 – 2004–05.

Table A7. Overall and Sector Specific Percentage of NPAs to Total Advances

Banks	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18
SBI (*Agr*)	2.6	6.74	8.92	9.5	8.11	8.84	7.82	5.6	11.06
SBI (*Ind*)	3.89	2.8	4.12	4.37	3.86	5.22	9.74	10.78	17.77
SBI (*Ser*)	3.91	2.93	2.94	4.43	5.18	2.82	2.74	8.15	5.62
SBI(*PLS*)	2.9	2.54	2.92	1.98	1.3	0.82	0.71	5.42	1.21
Total	**13.3**	**15.01**	**18.9**	**20.28**	**18.45**	**17.7**	**21.01**	**29.95**	**35.66**
PNB (*Agr*)	3.65	3.62	5.03	6.33	4.67	5.36	6.01	8.52	10.98
PNB (*Ind*)	0.92	1.7	2.86	5.47	7.2	a8.94	25.34	24.1	33
PNB (*Ser*)	1.93	1.44	3.46	2.8	3.09	7.05	7.09	6.37	14
PNB(*PLS*)	2.18	1.9	2.54	3.31	4.78	4.88	3.27	3.4	4.6
Total	**8.68**	**8.66**	**13.89**	**17.91**	**19.74**	**26.23**	**41.71**	**42.39**	**62.58**
BOB (*Agr*)	3.33	3.47	3.99	4.91	5.15	5.3	10.74	11.25	12.66

BOB(*Ind*)	1.06	1.76	1.12	3.31	5.11	7.17	19.1	19.84	23.92
BOB(*Ser*)	0.82	1.22	2.72	5.27	4.84	5.61	8.06	6.71	12.12
BOB(*PLS*)	3.68	1.72	3.66	6.87	5.71	4.38	5.01	5.43	1.55
Total	**8.89**	**8.17**	**11.49**	**20.36**	**20.81**	**22.46**	**42.91**	**43.23**	**50.25**
CAN(*Agr*)	1.84	2.24	2.13	2.17	2.01	2.4	3.21	3.69	4.57
CAN(*Ind*)	0.77	1.07	1.37	1.96	3.36	5.77	13.48	14.03	18.94
CAN(*Ser*)	0	0	1.83	6.93	1.7	2.61	10.25	10.6	1.6
CAN(*PLS*)	5.95	1.12	4.92	1.88	0.48	0.51	0.75	0.67	0.69
Total	**8.56**	**4.43**	**10.25**	**12.94**	**7.55**	**11.29**	**27.69**	**28.99**	**25.8**

Source : Annual Reports of State Bank of India (SBI), Punjab National Bank (PNB), Bank of Baroda (BOB), and Canara Bank (CAN) for the years 2009–10 – 2017–18.

Note. Agr, Ind, Ser, & PLS, respectively indicate agricultural, industrial, services & personal loan sectors.

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