Financial Distress Prediction: Empirical Evidence from Selected Banks in India

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Abstract

The banking sector plays a pivotal role in the economic development of most of the countries. The financial crisis of 2007–2008, also known as the global financial crisis is considered by many economists to be the worst financial crisis since the Great Depression of the 1930s. It resulted in the threat of total collapse of large financial institutions and downturns in stock markets around the world. It is believed that an examination of indicators that led to the problems suffered by Indian banks will be of enormous benefit. Indian banking sector is ideal for this study as the banks enjoyed profitability during the pre-crisis period and were the most severely affected by the financial crisis in 2008. The models exhibit high classification accuracy of more than 90% in the identification process. Logistic regression and Artificial Neural Network was used to analyze the data sample from 2004 to 2013. Capital adequacy, Return on Equity and Management efficiency are essential to the financial health of banks and these parameters are measured using the financial ratios. It is hoped this study would identify financial ratios that would measure the financial health of the banks which would be useful to bankers and regulators in identifying problem banks in India. The results would throw light on the various strategies to be adopted by Banks and Government regulators to manage crisis effectively.

Keywords: Bank Failure, Financial indicators, Logistic regression, ANN.

1. INTRODUCTION

The financial crisis of 2007–2008, also known as the global financial crisis and 2008 financial crisis, is considered by many economists to be the worst financial crisis since the Great Depression of the 1930s. It resulted in the threat of total collapse of large financial institutions, the bailout of banks by national governments, and downturns in stock markets around the world. In many areas, the housing market also suffered, resulting in evictions, foreclosures and prolonged unemployment. The crisis played a significant role in the failure of key businesses, declines in consumer wealth estimated in trillions of US dollars, and a downturn in economic activity leading to the 2008–2012 global recession and contributing to the European sovereign-debt crisis.

Questions regarding bank solvency, declines in credit availability and damaged investor confidence had an impact on global stock markets, where securities suffered large losses during 2008 and early 2009. Economies worldwide slowed during this period, as credit tightened and international trade declined. Governments and central banks responded with unprecedented fiscal stimulus, monetary policy expansion and institutional bailouts.

2. BANK PERFORMANCE INDICATORS

The financial performance of banks is important for shareholders, depositors and other creditors. It takes on a special significance from a social perspective, when a bank experiences financial distress and eventually fails. It is important to identify which areas of a bank’s operations should be examined.

Capital adequacy can reduce risk and absorb losses. The role of capital as a buffer against loan losses may prevent the failure of a bank whose customers default on their loans. In addition, capital can
support the financing and operation of a bank, provide protection to depositors and other creditors, and inspire confidence in depositors and regulators.

Management efficiency plays a big role in determining the future of the bank. The management has an overview of a bank’s operations, manages the quality of loans and has to ensure that the bank is profitable. The management sets the profitability objective and, in conjunction, determines the risk level to be undertaken by the bank.

The net operating margin, net interest margin, and non-interest margin are efficiency measures as well as profitability measures. They indicate how well management and staff have been able to keep the growth of revenues ahead of rising expenses.

Profitability is one of the most important performance dimensions for any bank. Two popular profitability measures that bank regulatory authorities and analysts use are return on assets (ROA) and return on equity (ROE). Each of these ratios looks at a different aspect of bank profitability. The ROA ratio is obtained by dividing a bank’s net income by its average assets.

Liquidity is a class of financial metrics that is used to determine a company's ability to pay off its short-terms debts obligations. Bankruptcy analysts and mortgage originators frequently use the liquidity ratios to determine whether a company will be able to continue as a going concern.

The presence of interest income/interest expense suggests that banks were in financial distress due to weak management policies. High interest expenses implying a high cost of funding might have adverse impacts on the earnings of the banks.

The existence of operating efficiency indicates that the problem banks could not control their operating expenses, resulting in operating inefficiency.

The current ratio is a financial ratio that measures whether or not a firm has enough resources to pay its debts over the next 12 months. The current ratio is an indication of a firm's market liquidity and ability to meet creditor's demands.

Total debt to Assets is a measurement representing the percentage of a corporation's assets that are financed with loans and financial obligations lasting more than one year. A year-over-year decrease in this metric would suggest the company is progressively becoming less dependent on debt to grow their business.

The net income to assets ratio provides a standard for evaluating how efficiently financial management employs the average dollar invested in the firm's assets, whether the funds came from investors or creditors.

Financial leverage ratios are also called debt ratios. They measure the ability of the business to meet its long term debt obligations, such as interest payments on debt, the final principal payment on debt, and any other fixed obligations like lease payments.

Equity multiplier is defined as a measure of financial leverage. Akin to all debt management ratios, the equity multiplier is a method of evaluating a company’s ability to use its debt for financing its assets.

### 3. THE MODEL AND ESTIMATION

To investigate the banks’ financial distress indicators logistic regression and artificial neural network model was used. Logistic regression is appropriate when the dependent variable can be grouped into discrete states (Cramer, 1991). Let the set of explanatory variables be denoted by X and the explained
variable is described by the binary variable \( Y \) which takes a value of 0 if the bank is in distress and 1 otherwise. The explanatory variables are capital adequacy, interest income/interest expense, management efficiency, operating efficiency, profit margin, ROA, ROE, liquidity, current ratio, total debt to assets, net income to assets financial leverage, equity multiplier, source of revenue. These are significant indicators of problem firms and banks in past studies (Sinky, 1975; Martin, 1977).

The parameters of the model are estimated using the maximum-likelihood method where the coefficients that make the observed results most ‘likely’ are selected.

The model consist of independent variables deemed to be having the ‘best’ fit for the one, two and three years prior to distress data samples. To sequentially add the ‘best’ variable to the model, forward stepwise selection procedure in logistic regression was employed. Forward stepwise selection method is based on the principle that regressors are added to the model one at a time until there are no remaining regressors that would significantly improve the regression. The relative contribution of each variable and the inter correlation between variables were also considered during the selection process.

The existence of unfavorable collinearity between the independent variables may cause the results to be biased. To form the models, parsimonious judgment has to be exercised to select ratios that are not significantly correlated with each other while not sacrificing the fit of the model.

Financial data of selected banks were collected from the annual reports published by the banks. The sample consists of banks for which necessary data for the period 2004-2013 were available.

The bank sample sizes for India is 32. The banks were separated into two categories: ‘problem’ and ‘non-problem’ banks. Banks were classified as ‘problem’ when their Capital Adequacy ratio (Tier I) ratio is less than 4% or Capital Adequacy (Tier II) ratio is less than 8%. Out of the sample bank sizes, the ‘problem’ banks for India are considered as 5.

To select suitable variables for the model, consolidated data from 2004 to 2013 was analyzed. Different combinations of independent variables shown in the logit results table are those that best identify the problem banks in each time period.

A multilayer perceptron (MLP) is a feed forward artificial neural network model that maps sets of input data onto a set of appropriate output. MLP utilizes a supervised learning technique called back propagation for training the network. The inputs to the network correspond to the attributes measured for each training tuple. Inputs are fed simultaneously into the units making up the input layer. They are then weighted and fed simultaneously to a hidden layer. The number of hidden layers is arbitrary. The weighted outputs of the last hidden layer are input to units making up the output layer, which emits the network's prediction. The network is feed-forward in that none of the weights cycles back to an input unit or to an output unit of a previous layer.

**4. RESULTS AND ANALYSIS**

Financial Distress model were established for Indian Banks and consolidated model is determined for the period of study. The model with the ‘best’ result for every time period is shown in Tables 1 and 2. The model is as follows:

\[ Z = 0.8457 + 5.7948X_1 - 1.9643X_2 + 1.3183X_3 - 1.0899X_4 + 0.9835X_5 \]

Where

- \( X_1 = \) Liquidity
- \( X_2 = \) Net income to assets
- \( X_3 = \) Equity multiplier
- \( X_4 = \) Profit margin
- \( X_5 = \) ROE
The classification accuracy measures the performance of the model. High overall classification accuracy of 86% for Logistic regression analysis and 84.42% for Multiple Layer perceptron suggests that the model is good and fits the data well. The acceptance or rejection of the null hypothesis where the coefficients of the independent variables are zero is indicated by the significance of the model. A small significance level implies that the null hypothesis can be rejected and the model is useful in this analysis.

The program SPSS for Windows was used to estimate the models for each individual country. The results and analysis is presented below.

For the Indian banking industry, the results are reported in Table 1 and Table 2. The models presented in the table consist of 5 predictive ratios that includes profit margin, ROE, equity multiplier, Liquidity, Net income to assets in total under Logistic Regression method and 3 predictive ratios that includes Source of Revenue, Liquidity and Net income to assets under multiple layer Perceptron. These ratios are found to be most useful among the original 15 ratios used in the identification process. For the different time periods tested, profit margin, equity multiplier, liquidity, ROE and net income to assets can consistently identify problem banks under Logistic Regression. Sources of Revenue, Net income to Assets and Liquidity are the predicting ratios under Artificial neural Network.

The presence of profit margin in the results suggests that most Indian banks were in financial distress due to weak management policies. A low net income to assets ratio indicates that the earnings are low for the amount of assets. An equity multiplier is the reflector of the extent of leverage used by a company to finance its assets in addition to reflecting the value of a company's assets as well as the value of its shareholders' equity. A company's ability to turn short-term assets into cash to cover debts is of the utmost importance when creditors are seeking payment. When a bank’s ROE is very high, it appears to be performing well from the viewpoint of the shareholders. It may also mean that the bank is heavily leveraged and considerably riskier.

4.1 Explanations of the results

Capital adequacy, interest income/interest expense, ROA and sources of revenue are four common financial indicators found to be able to identify problem banks in most of the countries. Banks in Asia, on the whole, may have to pay more attention to these areas of bank performance.

Capital adequacy is measured by variations of the basic capital/assets ratio. It indicates whether a bank has sufficient reserves at its disposal. It will be able to present a picture of an average problem bank with a relatively inadequate and deteriorating capital position. Interest income/interest expense measures the number of times interest expense is covered by the interest income. Interest rates are positively related to the profitability of a bank. Unanticipated changes in interest rates can significantly affect the profits of a bank. Interest income/interest expense analyses the marginal revenue available from loans relative to the marginal cost of deposits. This ratio may not detect banks with risky loans and high interest rate exposure.

Profitability is one of the most important performance dimensions for any bank. Two popular profitability measures that bank regulatory authorities and analysts use are return on assets (ROA) and return on equity (ROE). Each of these ratios looks at a different aspect of bank profitability. The ROA ratio is obtained by dividing a bank’s net income by its average assets.

A low ROA may either be due to conservative lending and investment policies or excessive operating expenses. On the other hand, a high ROA may be the result of efficient operations, a low ratio of time and savings deposits to total deposits, or of high yields earned on the assets.
In terms of classification accuracy, Bangladesh is the highest and China is the lowest. The reason for this may be due to the better data reliability for the Indian bank. Table 6 gives the classification accuracy of the selected countries.

5. CONCLUSION AND RECOMMENDATIONS

The purpose of this study was to investigate empirically financial ratios that could better identify problem banks in India and attempt to develop accurate problem bank identification models. Logistic regression technique and Artificial Neural Network was utilized to accomplish this with ratios serving as financial distress indicators. This model consists of a set of independent ratios that served as the ‘best’ variables to identify problem banks from an original list of 15 ratios. The models exhibit high classification accuracy in the identification process. The financial indicators represent measures of capital adequacy, interest income/interest expense, ROA and sources of revenue are essential to the financial health of banks in India. Banks must adhere to regulatory requirements for capital. However, regulatory adherence is only the beginning of capital management. The responsibility of management is to utilize the bank’s capital as effectively as possible. Banks should try to explicitly acknowledge and attempt to quantify their risk in terms of capital required to absorb it. Banks ought to evaluate and choose the ‘best’ source of capital, generated either internally or externally, to meet their needs and goals.

References


Appendix

List of Ratios Examined:
1. Capital adequacy=Net worth/ Total Asset
2. Interest Income/Interest expense
3. Management efficiency= Interest expense/ total loans
4. Operating efficiency= Operating expense/ Net income before Tax
5. Profit Margin= Net income before Tax/ Total gross income
6. Sources of Revenue= Interest income/ Total Gross Income
7. Current ratio= Current asstes/ Current liabilities
8. Total debt /Total assets
9. ROA= Net Income/total Assets
10. ROE=NET Income/Shareholders Equity
11. Financial Leverage=Total debt/ Shareholders Equity
12. Equity multiplier = Total assets / Shareholders Equity
13. Liquidity = Liquid Assets / Total Assets
14. Net Income to Assets = Net profit before tax / Total Assets

Table 1: Coefficient of the ratios under Logistic regression

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Constant</td>
<td>0.8457</td>
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<tr>
<td>Interest income/ interest expense</td>
<td>0.6896</td>
</tr>
<tr>
<td>Management efficiency</td>
<td>0.094</td>
</tr>
<tr>
<td>Operating efficiency</td>
<td>0.8496</td>
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<tr>
<td><strong>Profit margin</strong></td>
<td><strong>1.0899</strong></td>
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<tr>
<td>Source of revenue</td>
<td>0.2147</td>
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<tr>
<td>Current ratio</td>
<td>0.0012</td>
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<tr>
<td>Total debt to asset ratio</td>
<td>0.017</td>
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<tr>
<td>ROA</td>
<td>0.1547</td>
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<tr>
<td><strong>ROE</strong></td>
<td><strong>0.9835</strong></td>
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<tr>
<td>Financial leverage</td>
<td>0.6943</td>
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<tr>
<td><strong>Equity multiplier</strong></td>
<td><strong>1.3183</strong></td>
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<tr>
<td><strong>Liquidity</strong></td>
<td><strong>5.7948</strong></td>
</tr>
<tr>
<td>Capital adequacy Tier I</td>
<td>0.6166</td>
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<tr>
<td>Capital adequacy tier II</td>
<td>0.8045</td>
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<tr>
<td><strong>Net income to assets</strong></td>
<td><strong>1.9643</strong></td>
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</table>

Table 2 Coefficient of the ratios under Multiple Layer Perceptrons

<table>
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<tr>
<td>Threshold</td>
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<tr>
<td>Interest income/ interest expense</td>
<td>-0.07773</td>
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<tr>
<td>Management efficiency</td>
<td>-0.03439</td>
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<tr>
<td>Operating efficiency</td>
<td>-0.02953</td>
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<tr>
<td>Profit margin</td>
<td>0.074134</td>
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<tr>
<td><strong>Source of revenue</strong></td>
<td><strong>0.125485</strong></td>
</tr>
<tr>
<td>Current ratio</td>
<td>-0.119303</td>
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<tr>
<td>Total debt to asset ratio</td>
<td>0.071293</td>
</tr>
<tr>
<td>ROA</td>
<td>0.051894</td>
</tr>
<tr>
<td>ROE</td>
<td>-0.03599</td>
</tr>
</tbody>
</table>
Financial leverage -0.09727
Equity multiplier 0.031948

<table>
<thead>
<tr>
<th>Liquidity</th>
<th>0.177691</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital adequacy Tier I</td>
<td>0.036164</td>
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<tr>
<td>Capital adequacy tier II</td>
<td>0.096841</td>
</tr>
<tr>
<td>Net income to assets</td>
<td>0.195474</td>
</tr>
</tbody>
</table>

List of Banks studied:

1. Axis Bank
2. City Union Bank
3. Bank Of India
4. HDFC Bank
5. ICICI Bank
6. Jammu & Kashmir Bank
7. Karnataka Bank
8. Karur Vysya Bank
9. Kotak Mahindra Bank
10. Laxmi Villas Bank
11. South Indian Bank
12. Yes Bank
13. State Bank Of Travancore
14. State Bank Of Bikaner
15. State Bank Of Mysore
16. Allahabad Bank
17. Andhra Bank
18. Bank Of Baroda
20. Canara Bank
21. Central Bank
22. Corporation Bank
23. IDBI Bank
24. Indian Bank
25. Punjab National Bank
26. State Bank Of India
27. Tamilnadu Mercantile Bank
28. Union Bank Of India
29. IndusInd Bank
30. Ing Vysya Bank
31. Development Credit Bank
32. Dhanalaxmi Bank