

A Study on Financial Soundness of Merged Banks in India by using Altman's Z-Score Model and Linear Regression Model

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ABSTRACT

The financial soundness of the banks can be measured with various tools and techniques, in that one of the techniques is Altman Z Score Formula. The Altman Z score tool is used to measure financial stability of a company by using companies past financial data. It is mainly used to test whether the banks will sustain for longer period of time and bankruptcy prediction. And the machine learning linear regression model is used for future Z score Predictions. The sample size of study includes of 6 merged banks in India i.e. Punjab national bank, Canara bank, Indian Bank, Union bank of India, State bank of India and Bank of Baroda by using past 5 years of banks financial statement data. In this study the data analysis techniques are using Altman Z Score & Linear regression model with Accuracy test of linear prediction values.

KEYWORDS– Linear regression, Altman Z Score, Financial Stability, Machine Learning

I. INTRODUCTION

The Indian Banking Sector significantly contributed to the national economic. Whereas the Indian banking sectors is one of the largest service sectors found in the country. Banking industry plays a crucial role in an economic growth of the country in a formal manner. Banks main mission is to lend the loans for the customers for earning the interests and accepts the various kinds of deposits from the public. There are four types of Commercial banking sectors in India: 1. Public sector, 2. Private sector, 3. Foreign banks and 4. Regional Rural banks. According to the study Merged banks are taken as a sample size. In India there are major 6 Banks which merged with other banks. A Bank merger will happen when two or more banks join together to form one company, with new ownership. The list of merged banks in India is given in table No 2.

Altman Z score equation was begun by the Edward Altman in the year 1968, which is mainly used for the prediction of liquidation of the companies. Altman Z Score model helps in analysing the financial health of the company with calculation of financial ratio. Z score can be calculated with the help of company's previous year's balance sheet statement and the income statement. According to Lesmana & Surjanto 2004 Bankruptcy is difficulties faced by a bank includes a decrease in profits, revenue, total assets and market prices.

Machine learning models are planned to discover designs in the information and make forecasts or choices based on those designs. There are many machine learning models are available i.e. linear regression, decision tree, mean, standard deviation, and data distribution etc. These models can be used by the company for financial analytical purpose. In this study the linear regression model is used for predicting the future z score of each bank by using past z score values as a sample size.

II. REVIEW OF LITERATURE:

- [1] Sanesh. C (2016), In this paper has analysed the financial ratios of the Nifty 50 Companies in India. The researcher has identified that Altman score zones in Nifty 50 stocks and suggests that majority of the company's

in NIFTY50 are in safer zone i.e. 26 companies. 5 companies in the distress zone. And the some of the sectors of poor performance are electric generation, distribution, metals and oil gas sectors.

- [2] Japneet Kaur, (2019), the researcher used the selected Indian banks for the analysis of financial distress using Z score model. The study assessed the probability of 87 Indian banks for past 5 years. The research finds that 5% of the selected banks were in safer zone there is less probability of going distress. And 65% of the banks having high chance to go distress zone. Remaining in the grey zone. Study suggests that the banks should look for loan disbursement and take corrective measures to improve their operations.
- [3] Sri Dwiningsih, Alfiah, Muhammad Zakaria Yahya, (2023), The researcher used Altman Z score and Springate model for testing financial distress and the Accuracy level of emtek company using past 6 years of financial data (2017-2022). They found that in springate model gave an 67% of accuracy and 33% of error, and in Altman Z score model 83% Accuracy rate and 17% Grey area Rate.
- [4] Vijay. K & Dr. G. Kartikeyan, (2024), The Researchers have analysed the financial performance of selected automobile companies & Sustainability practices by using the Altman Z score formula and finds that Maruti Suzuki & Bajaj Auto was in safer zone for past 5 years due to good increase in sales & Tata Motors was in Distress zone level due to poor sales, demand factors, high competition. And Study finds that Maruti Company practices Green Technology Sustainability programmes, Tata Motors Practices Zero Greenhouse sustainability, Bajaj Auto Practices society-oriented programmes that is water management, Renewable energy technologies etc.

III. OBJECTIVES OF THE STUDY

- To understand the financial stability of merger banks in India from past 5 years.
- To identify the Altman's Z-score Zones of each merged bank.
- To Predict the future Z-score by using Linear Regression Model with accuracy rate of each merged bank.

IV. RESEARCH METHODOLOGY:

A. Method of data collection

In this study the method of data collection is made up of both primary and secondary data. Were as Primary data was collected by calculating practically through the help of past financial statement and Income statement of particular merged banks. Secondary data is taken through various websites.

B. Research Design

In this study experimental research design is used to find out credit risk and profitability of bankruptcy.

C. Data types and Sources

The Data used in this research paper was secondary quantitative data in the form of published financial statements and income statement of a particular merged banks. Data are mainly collected from the Groww, Money control.com, and particular bank websites. And the output of the Linear regression has been taken from the w3schools website.

D. Samples

The tests in this research were the 6 merged banks in India. The analysis taken from the year of (2019 - 2020 to 2023 - 2024).

E. Tools & Models Used

In this study mainly focused on examination of credit risk. The Researchers have used Altman's Z-Score model to examine the banks financial strength. Altman's Z-Score Model is used for the calculation to identify the financial health of the merger banks. Below mentioned are the Altman's Z-Score Formula for calculations:

Altman's Z-Score Formula is:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1X_5$$

Where:

X_1 = Working capital / Total Assets

X_2 = Retained Earnings / Total Assets

X_3 = Earnings Before Interest and Tax (EBIT) / Total Assets

Table 1: Altman's Z Score Zones	
2.99>	Firms are in
'Safe' Zone	
1.81>2.99	Firms are in
'Grey' Zone	
<1.81	Firms are in
'Distress' Zone	

X_4 = Market value of Equity / Total Liabilities

X_5 = Sales / Total Assets

Machine learning linear regression model is taken for Z-Score Prediction by using past Z-Score data as a sample for better decision making. The machine learning Linear Regression prediction model are calculated using w3schools website for the accurate output.

V. LIMITATION OF THE STUDY

- Only Merger Banks were taken for the study there are other banking sectors yet to focus.
- There are lot of Sectors yet to study using Altman's Z-score model like: IT industry, Textile industry, Healthcare, and Automobiles industry Etc.
- As in this study only Altman's Z-score model is taken for calculation purpose and there are lot of models available to calculate the company's financial performance like springate model, Grover model etc.
- Only linear regression model is used to predict the Z-score there are lot of models yet to focus.

VI. ANALYSIS AND INTERPRETATION

Table 2: List of Banks that were merged

Merged into (Anchor Banks)	Banks Merged	Merger Year
State Bank of India	State Bank of Bikaner & Jaipur State Bank of Hyderabad State Bank of Mysore State Bank of Patiala State Bank of Travancore Bharatiya Mahila Bank	1 st April, 2017
Bank of Baroda	Dena Bank Vijaya Bank	1 st April, 2019
Canara Bank	Syndicate Bank	1 st April, 2020
Indian Bank	Allahabad Bank	1 st April,

		2020
Punjab National Bank	Oriental Bank of Commerce United Bank of India	1 st April, 2020
Union Bank of India	Andhra Bank Corporation Bank	1 st April, 2020

Source: Moneyview

Interpretation: The above-mentioned table are the list of public sector banks that were merged with various other public sector banks. As per the analysis major banks are merged in the period of 2017, 2019, and 2020. The Banks are merged with common motives like Diversification, enhance profitability, reduce in NPA (Non-performing assets) and implementation of new technologies much more.

Name of the Bank	Market Capitalization	Market Price
State Bank of India	₹ 7,70,997 Cr	₹ 852.00
Bank of Baroda	₹ 1,29,801 Cr	₹ 248.95
Punjab National Bank	₹ 1,29,545 Cr	₹ 116.55
Union Bank of India	₹ 1,02,863 Cr	₹ 134.52
Canara Bank	₹ 1,02,362 Cr	₹ 112.46
Indian Bank	₹ 74,400 Cr	₹ 569.60

Table 3: Market capitalization of merged banks (July 2024)

Interpretation: The Above-Mentioned table are the Market Capitalization & Current market prices of merged banks in India. As per the analysis the State Bank of India has a highest Market Capitalization (₹ 7,70,997 Cr) Compare to other banks and the Indian Bank has lowest Market Capitalization (₹ 74,400 Cr).

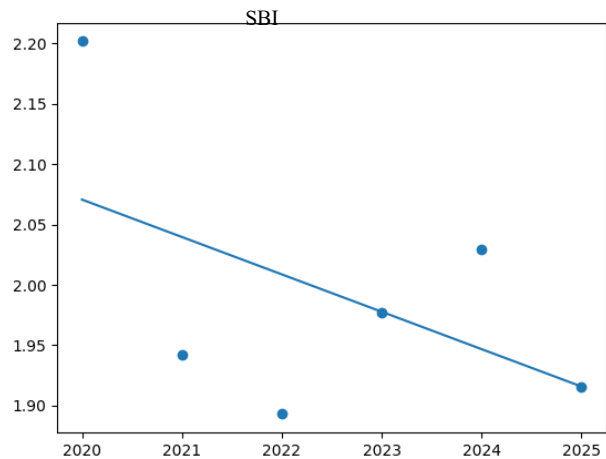
Years	1.2X1	1.4X2	3.3X3	0.6X4	1X5	Z SCORE	Zone
2024	- 0.8106	0.7824	0.4468	0.7279	0.8829	2.0294	Grey
2023	- 0.8254	0.7680	0.4177	0.8219	0.7950	1.9772	Grey
2022	- 0.8107	0.7291	0.3059	0.9097	0.7591	1.8931	Grey
2021	- 0.8131	0.7308	0.2230	1.0062	0.7952	1.9421	Grey
2020	- 0.8352	0.7708	0.2382	1.1650	0.8629	2.2017	Grey

Table 4: Altman's Z-Score Calculation of State Bank of India

Source: Authors Calculation

Interpretation: The above-mentioned table indicates that Altman's Z-score Calculation of State bank of India. The analysis shows that from 2019 - 2020 to 2023 - 2024 the bank stays in the Grey Zone which is between 1.81 – 2.99 Z-Score. In 2019 - 2020 the SBI bank had highest Z-score i.e. **(2.2017)** & in 2021 - 2022 SBI bank had lowest Z-Score **(1.8931)** due to credit risk, poor financial performance and various other factors.

LINEAR REGRESSION PREDICTION GRAPH:



*INTERPRETATION:*The above-mentioned Graph are the prediction of Machine Learning linear regression model for the year 2024-2025. It predicts the Z-Score value i.e. (1.9158)with accuracy of 80.92%by using previous years Z-score data as a sample.

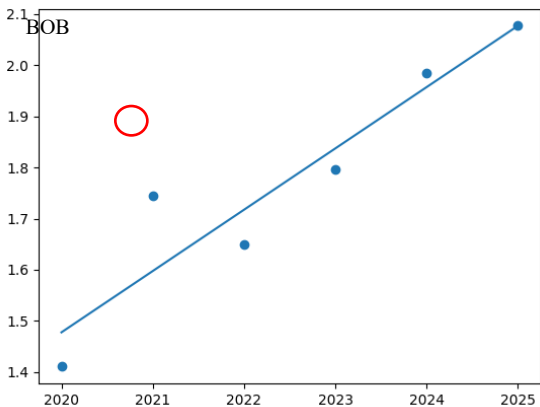
Source: Authors Calculation

Table 5: Altman’s Z-Score Calculation of Bank of Baroda

Years	1.2X1	1.4X2	3.3X3	0.6X4	1X5	Z SCORE	Zone
2024	- 0.8968	0.9406	0.5144	0.5697	0.8568	1.9847	Grey
2023	- 0.8803	0.8916	0.4448	0.6141	0.7259	1.7961	Distress
2022	- 0.8374	0.8866	0.2465	0.6994	0.6550	1.6501	Distress
2021	- 0.8586	0.8848	0.1976	0.7768	0.7447	1.7453	Distress
2020	- 0.8342	0.8275	- 0.0339	0.6924	0.7590	1.4108	Distress

Interpretation: The above-mentioned table indicates that Altman’s Z-score Calculation of Bank of Baroda. The analysis shows that from2019 - 2020to 2022 - 2023 the bank stays in the Distress Zonewhich is below 1.81 Z-score. But In 2023 - 2024the BOBBank is entered into Grey Zonei.e. (1.9847)where aBank of Baroda is Continuously improving their financial performance. which is good sign for the company.

LINEAR REGRESSION PREDICTION GRAPH:



INTERPRETATION: The above-mentioned Graph are the prediction of Machine learning linear regression model for the year 2024-2025. It predicts the Z-Score value i.e. **(2.0769)** with Accuracy rate of 75.81%.

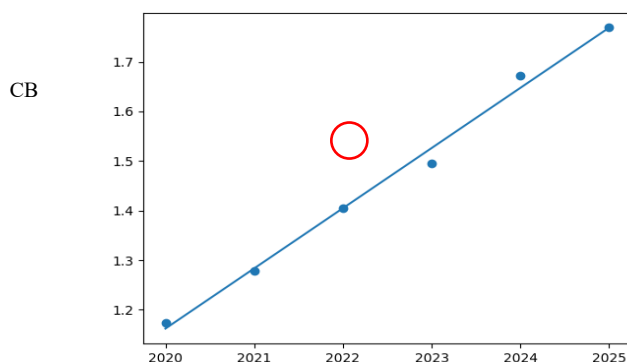
Years	1.2X1	1.4X2	3.3X3	0.6X4	1X5	Z SCORE	Zone
2024	-0.8869	0.7764	0.4296	0.4470	0.9065	1.6726	Distress
2023	-0.8774	0.7277	0.3445	0.4946	0.8052	1.4946	Distress
2022	-0.8403	0.7149	0.2395	0.5421	0.7487	1.4049	Distress
2021	-0.8239	0.6792	0.1085	0.5237	0.7913	1.2788	Distress
2020	-0.8710	0.7585	-0.0673	0.5229	0.8302	1.1733	Distress

Source: Authors Calculation

Table 6: Altman's Z-Score Calculation of Canara Bank

Interpretation: The above-mentioned table indicates that Altman's Z-score Calculation of Canara Bank. The analysis shows that from 2019 - 2020 to 2023 - 2024 the bank stays in the Distress Zone which is below 1.81 Z-Score. But In 2023 - 2024 there is increase in Z-score i.e. **(0.4993)** point compare to 2019 - 2020. However, the company is trying to improve their performance and enter into grey zone for future.

LINEAR REGRESSION PREDICTION GRAPH:



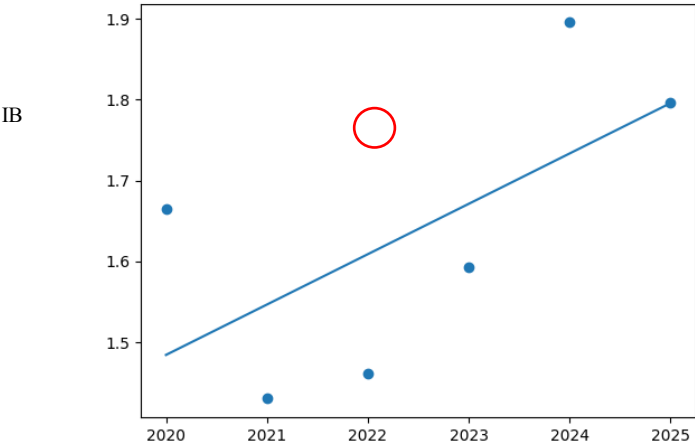
INTERPRETATION: The above-mentioned Graph are the prediction of Machine learning linear regression model for the year 2024-2025. It predicts the Z-Score value i.e. **(1.7691)** with Accuracy rate of 74.81%.

Source: Authors Calculation

Table 7: Altman's Z-Score Calculation of Indian Bank

Years	1.2X1	1.4X2	3.3X3	0.6X4	1X5	Z SCORE	Zone
2024	-0.9628	1.0035	0.4567	0.5907	0.8072	1.8953	Grey
2023	-0.9457	0.917	0.2755	0.6054	0.7400	1.5922	Distress
2022	-0.9042	0.8818	0.1590	0.6387	0.6863	1.4616	Distress
2021	-0.9126	0.8344	0.1640	0.6218	0.7228	1.4304	Distress
2020	-0.9308	0.9695	0.1461	0.6829	0.7972	1.6649	Distress

*Interpretation:*The above-mentioned table indicates that Altman’s Z score calculation of Indian Bank. The analysis shows that from 2019 - 2020 to 2022 - 2023 the bank stays in the Distress Zonewhich is below 1.81 Z-Score. In 2023 - 2024the Indian Bank is entered into Grey Zone i.e. (1.8953)where an Indian Bank is continuously improving their performance. which is good sign for the company to enter into safer zone.
LINEAR REGRESSION PREDICTION GRAPH:



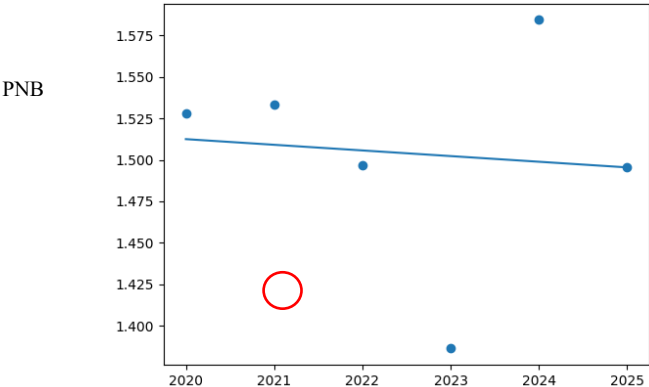
*INTERPRETATION:*The above-mentioned Graph are the prediction of Machine learning linear regression model for the year 2024-2025. It predicts the Z-Score value i.e. (1.7956) with accuracy rate of 77.67%.

Years	1.2X1	1.4X2	3.3X3	0.6X4	1X5	Z SCORE	Zone
2024	-0.9192	0.9130	0.2920	0.5328	0.7656	1.5842	Distress
2023	-0.8923	0.9319	0.1135	0.5701	0.6633	1.3865	Distress
2022	-0.8956	0.9751	0.1188	0.6387	0.6595	1.4965	Distress
2021	-0.921	0.9718	0.1112	0.6356	0.7358	1.5334	Distress
2020	-0.8787	1.0031	0.0320	0.6161	0.7552	1.5277	Distress

Source: Authors Calculation

Table 8: Altman’s Z-Score Calculation of Punjab National Bank

Interpretation: The above-mentioned table indicates that Altman’s Z-score Calculation of Punjab National Bank. The analysis shows that from 2019 - 2020 to 2023 - 2024 the bank stays in the Distress Zonewhich is below 1.81 Z-Score. But In 2023 - 2024the PNB Bank had a highestZ-Score i.e. (1.5842) compare to all other Z-score.
LINEAR REGRESSION PREDICTION GRAPH:



INTERPRETATION: The above-mentioned Graph are the prediction of Machine learning linear regression model for the year 2024-2025. It predicts the Z-Score value i.e. (1.4954) with Accuracy rate of 80.13%.

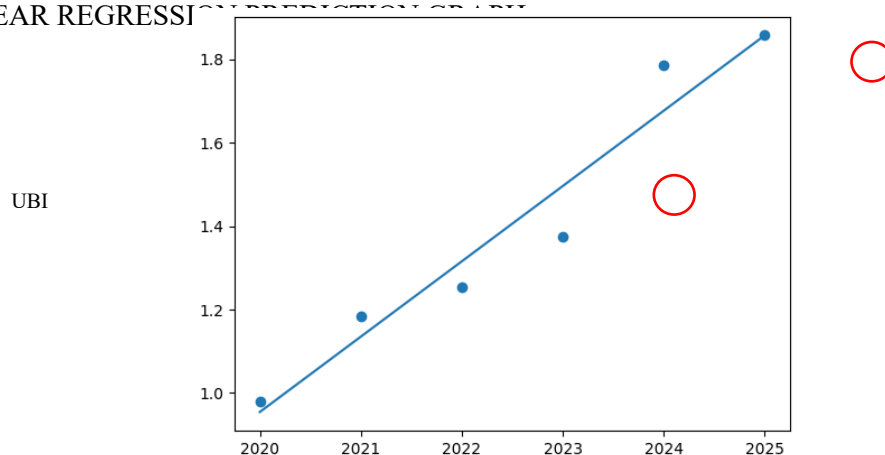
Source: Authors Calculation

Table 9: Altman's Z-Score Calculation of Union Bank of India

Years	1.2X1	1.4X2	3.3X3	0.6X4	1X5	Z SCORE	Zone
2024	-0.9302	0.8972	0.5062	0.4704	0.8430	1.7866	Distress
2023	-0.9236	0.7807	0.3108	0.4542	0.7535	1.3756	Distress
2022	-0.9061	0.7495	0.2366	0.4893	0.6848	1.2541	Distress
2021	-0.918	0.7530	0.0706	0.5061	0.7725	1.1842	Distress
2020	-0.849	0.7676	-0.2465	0.5276	0.7789	0.9786	Distress

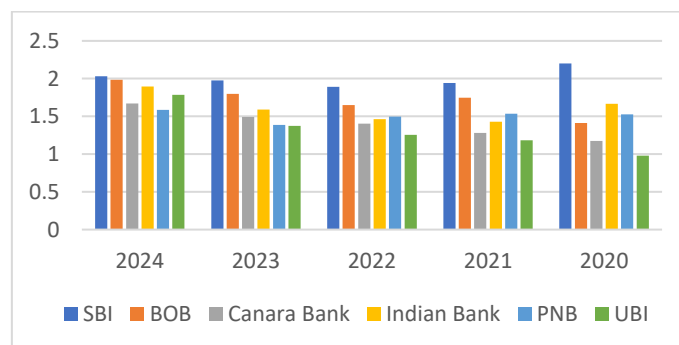
Interpretation: The above-mentioned table indicates that Altman's Z-score Calculation of Union Bank of India. The analysis shows that from 2019 - 2020 to 2023 - 2024 the bank stays in the Distress Zone which is below 1.81 Z-Score. But in 2023 - 2024 the Union Bank of India had highest score i.e. 1.7866 compare to other years. Where the Z-scores are continuously increasing which is good sign for the company.

LINEAR REGRESSION



INTERPRETATION: The above-mentioned Graph are the prediction of Machine learning linear regression model for the year 2024-2025. It predicts the Z-Score value i.e. (1.8580) with Accuracy rate of 71.75%.

GRAPH:



Interpretation: The above-mentioned Graph indicates that Altman's Z-score of 6 merged banks in India. As per the analysis the SBI bank is maintaining above the 1.81 Z-score level compare to all other merged banks. The State Bank of India had highest Z-score i.e. (2.2017) compare to all other banks Z-score.

VII. CONCLUSION:

It is Important for every bank to take a better decision to avoid any problems in the financial position. As per this paper the 6 Merged banks were taken for the study and found the Altman's Z-Score for past 5 Years (2019 - 2020 to 2023 - 2024). The analysis shows that majorly the banks has been merged in India due to strengthening financial stability, reduce NPA- Nonperforming assets, expanding market share etc. As per Altman's Z-Score zone the SBI is standing in Grey Zone for past 5 years and the other majority of merged banks are like Bank of Baroda, Canara Bank, Indian Bank, Punjab National Bank and Union bank of India is staying in the Distress Zone. Due to the performance of the company in the balance sheet & Income statement was low the Z-scores of those banks also low. The SBI had the Highest Z-score i.e. (2.2017) Compare to all other merged banks. And the Union Bank of India has lowest Z-score i.e. (0.9786) Compare to all other merged banks. This happens due to mergers, NPA increases, Low Earnings and other factors. The Linear Regression Model predicts the Z-score for future 2024-2025 is SBI (1.9158), BOB (2.0769), Canara Bank (1.7691), India Bank (1.7956), PNB (1.4954) and UBI (1.8580). As per Accuracy Rate the SBI has the highest Accuracy i.e. (80.92%) & the Union Bank of India has lowest Accuracy Rate i.e. (71.75%) compare to all other merged banks. The banks must look for the machine learning technology for more predictions and better decision making and improvement in adoption of technology like AI (Artificial intelligence), Machine Learning tools for financial analytics, reducing costs by using automated machine works, Digital platforms for customers and Effective AI marketing strategies. Therefore, an investor must think and analysis the financial statements before entering into the merged banks share investment. Every company must decrease their risk factors and always try to increase the Z-score value, so that the company will have a healthy financial position.

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