



Empirical Analysis of Bankruptcy Risk in Indian Commercial Banks: A Study Using Altman's Z-Score Model

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ABSTRACT

Purpose

The study uses the Altman Z-score model to determine if the ten Indian commercial banks that were chosen—five of which are public banks and the other five are private banks—are in financial distress throughout the period of 2017 to 2023.

Methodology

The secondary data used in this study's approach was obtained from annual reports that were posted on several websites, including Trendlyne, Money Control, and annual reports.

Findings

According to the report, all banks are in a safe zone with little chance of going bankrupt in the upcoming years, thus it is evident that investors can put their money wherever for higher profits and it is proven by t-test that there is no significant difference between the Z-scores(Financial stability) of private and public sector banks.

Research limitations

Only a restricted number of Indian commercial banks are included in this study; five are drawn from the public sector and five from the private sector. The data collection period extends from 2017 to 2023.

Managerial implication

The evaluation advises that the management teams of the public banks have to probe into the assets and liabilities of the company i.e. company has to maintain their retained earnings. The management teams have to study their low performance compared to private sector banks. Also, they have to find out why there is a negative score in retained earnings in these banks. Private sector banks have good scores but still, to maintain a good score in coming years they have to strive further.

Originality

This study mainly depicts about financial distress of selected 10 banks of which 5 are from the public sector and 5 are from private sector banks by using the Altman Z-score model and proving that all the banks are in a safe zone for the upcoming years. The research work selected five public and private sector banks from India as samples to compare Altman Z- scores for assessing their financial soundness which adds to its originality.

Keywords- Public and private sectors bank, financial ratios, bankruptcy, investment, Z- Score

INTRODUCTION

The banking sector in India is the cornerstone of the nation's economic growth. As technology has advanced the needs of humans have been taken into consideration and noteworthy changes have been detected in our financial system. There are many initiatives taken by the government to handle the NPA's they are Credit Information Bureau-2000, Corporate Debt Restructuring- 2001, and SARFEASI ACT-2002. Our country India has been ranked 11th as the fastest-growing economy in the world with 6.2% GDP (Mint, 2024). One of the main reasons for the rise in GDP is business investments such as bonds, derivatives, stocks, certificates of deposits, etc. Every common investor wants to invest their money in such a way that at least he will get a minimum return or high

return. According to data from NSDL and CDSL the number of demat accounts in India brimmed over to 12.97 crores which means there is a rise of 26% from the past year (Sonavane). Before investing investors take opinions from financial planners, investment advisors, accountants, etc so that they can invest in profitable firms. For every investor, it is safe to invest in multiple sectors so that investors can alleviate the risk that emerges from market uncertainties. One of the main reasons for investing in different sectors as if one sector goes bankrupt soon then at least he can balance his money through another sector. Various reasons behind bankruptcies are poor financial management, unexpected expenses, unaffordable mortgages, etc. It is important to measure the financial distress of the company. Altman Z score model is used to predict the chances of sectors going bankrupt in the next 2 years. It was developed by American Finance Professor Edward I. Altman in 1968 to measure the financial stability of the manufacturing and non-manufacturing sectors.

LITERATURE REVIEW

Globally many researchers are evaluating the financial distress of banks to know the financial condition of these institutions by using Altman Z- Score formulae. Moreover Chotalia(2014) analyzed six private sector banks (2008-2012), finding all in the grey zone with moderate bankruptcy risks, and recommended operational improvements for better financial health. Khaddafi et al. (2017) assessed 29 Indonesian banks (2011-2013), reporting a significant number in distress and emphasizing the importance of corrective measures. Tumbu (2021) reported widespread financial distress in Kenyan banks (2014-2019), citing low retained earnings as a major factor, and validated the Z-Score model's predictive accuracy. Elia et al. (2021) studied Lebanese Alpha banks (2009-2018), revealing a majority in distress and stressing the need for structural reforms. Nath et al. (2020) analyzed state-owned banks in Bangladesh (2010-2018), identifying financial distress due to non-performing assets and weak governance. Considering their results most of the banking sectors are financially weak so it is important for them to take corrective measures for strengthening their financial position. Parvin et al. (2016) compared six state-owned and six private commercial banks (2010-2014), revealing better performance among state-owned banks and highlighting the need for asset-liability management in private banks. Shafitranata et al.(2020) evaluated Islamic banks (2013-2019), finding most in the safe zone and confirming Altman as a reliable model. Agarwal (2018) studied public sector banks (2012-2017), affirming the reliability of the Z-Score model while noting potential biases. Joshi (2020) evaluated ten public sector banks (2009-2019), linking improved Z-Scores to higher net profits while associating reduced scores with increased GNPA. Gyawali (2023) assessed Nepalese banks (2019-2020), criticizing the Z-Score model for neglecting qualitative factors and human elements in organizations. Seeing their results most of the banks are having low financial risk and least chances of bankruptcy this theory is considered as proper analysis tools for evaluating financial soundness by many authors but the theory has been criticized for ignoring many other factors to evaluate financial soundness in an organization.

OBJECTIVES

- To find out the likelihood of financial distress through the Altman Z-score model of selected Indian Banking companies.
- To know the financial condition and currently which bank has the highest Z-score from the selected banks.
- To compare the bankruptcy risk levels across different categories of commercial banks, such as public sector, private sector, and foreign banks in India.

RESEARCH METHODOLOGY

The research primarily relied on secondary data, gathered from various sources such as Money Control, Trendlyne, and bank annual reports. Financial ratios were calculated using data from the balance sheets, profit and loss accounts, and schedules of public and private sector banks for the years 2017 to 2023, as available in Trendlyne's consolidated annual reports. The study focused on a selected period of seven years, covering both the pre- and post COVID-19 phases, and included a total of 10 banks—five public sector and five private sector banks. Independent t-test was used in the study to compare the financial stability of public and private sector banks.

Sample size

The selection of samples included public sector banks and private sector banks are as follows:-

PUBLIC SECTOR BANKS		PRIVATE SECTOR BANKS	
1.	STATE BANK OF INDIA	1.	HDFC BANK LTD
2.	BANK OF BARODA	2.	ICICI BANK LTD
3.	PUNJAB NATIONAL BANK	3.	KOTAK MAHINDRA BANK LTD
4.	CANARA BANK	4.	AXIS BANK LTD
5.	UNION BANK OF INDIA	5.	INDUSIND BANK LTD

ALTMAN Z- SCORE MODEL (For Non-Manufacturing Sectors)

$$Z = 6.56 \times X_1 + 3.26 \times X_2 + 6.72 \times X_3 + 1.05 \times X_4$$

Where Z= ZETA

X₁= WORKING CAPITAL/ TOTAL ASSETS

X₂= RETAINED EARNINGS/TOTAL ASSETS

X₃= EARNING BEFORE INTEREST AND TAXES/ TOTAL ASSETS

X₄= BOOK VALUE OF EQUITY/ TOTAL LIABILITY

Altman's score with a value of -0.25 indicates bankrupt enterprises, on the contrary, if the value of Altman's score is +4.48 indicates the lowest chance of bankrupt.

After 1985, the Z-score has been widely accepted by many countries, auditors, courts, and management accountants and is also used for loan evaluation. Originally this formula was developed to predict the financial distress of publicly held manufacturing companies whose value of assets is more than \$1 million. In the later stage alterations made by Altman in the formula can predict financial distress of privately held companies as well as non-manufacturing companies.

Interpretation of Z-score

If the Z-score > 2.99 **SAFE ZONE** which means low chances of bankruptcy

Z-score 1.81 to 2.99 **GREY ZONE** which means moderate chances of bankruptcy

Z-score < 1.81 **DISTRESS ZONE** which means high chances of bankruptcy

X₁= Measures the company's liquid assets

X₂= Measures the company's profitability

X₃= Measures the company's earning ability before interest and taxes

X₄= Denotes ownership capital of the company to repay its liabilities

DATA ANALYSIS AND INTERPRETATION

The analysis was mainly based on 10 Indian commercial banks for the prediction of financial distress among selected banks. For the analysis and interpretation, various ratios were calculated given by Altman's formulae.

Z-score analysis of Public Sector Banks**STATE BANK OF INDIA****Table No.-1: The outcomes of Z-score (State Bank of India)**

Year	2017	2018	2019	2020	2021	2022	2023
X ₁ = WC/TA	3.936	3.811	4.106	4.054	3.785	3.712	3.745
X ₂ = RE/TA	0.006	-0.003	0.001	0.013	0.123	0.019	0.029
X ₃ = EBIT/TA	0.409	0.389	0.369	0.376	0.322	0.288	0.315
X ₄ = BVE/TL	0.114	0.100	0.095	0.102	0.102	0.104	0.111
Z-score	4.465	4.297	4.571	4.545	4.332	4.123	4.2
Average of Z-score	4.362						

Source : Author

As per Table 1, the Z-score of SBI Bank from 2017 to 2023 remained above 2.99, indicating strong financial stability and a low risk of bankruptcy. However, there was a slight decline in the Z-score during and after the COVID-19 period, followed by a recovery. By 2023, the Z-Score had risen to 4.2, reflecting a positive trend in the bank's financial health. The average Z-score during this period is 4.362, placing SBI Bank in the "Safe Zone." Given this stability, investing in the bank appears to be a viable option for investors.

BANK OF BARODA**Table No.-2: The outcomes of Z-score (Bank of Baroda)**

Year	2017	2018	2019	2020	2021	2022	2023
X ₁ = WC/TA	4.965	4.723	4.690	4.624	4.683	4.493	4.473
X ₂ = RE/TA	0.006	-0.006	0.003	0	0.003	0.013	0.022
X ₃ = EBIT/TA	0.389	0.383	0.389	0.389	0.362	0.315	0.349
X ₄ = BVE/TL	0.096	0.101	0.105	0.108	0.115	0.120	0.125
Z-score	5.456	5.201	5.187	5.121	5.163	4.941	4.969
Average of Z-score	5.148						

Source : Author

As per Table 2, BOB's Z-score from 2017 to 2023 has consistently remained above 2.99, indicating strong financial stability with a low risk of bankruptcy. However, there was a slight decline in the Z-score during the COVID period, followed by fluctuations in the subsequent years. Despite these variations, the bank has made

efforts to enhance its score in 2023. With an average Z-score of 5.148, BOB is classified in the “Safe Zone,” reflecting its solid financial position. Given this stability, investing in the bank would be a favorable decision for investors.

PUNJAB NATIONAL BANK

Table No.-3: The outcomes of Z-score (Punjab National Bank)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	4.637	4.585	4.631	4.434	4.323	4.467	4.539
X2= RE/TA	0.004	-0.048	-0.039	0	0.006	0.016	0.004
X3= EBIT/TA	0.043	0.376	0.403	0.409	0.430	0.336	0.336
X4= BVE/TL	0.086	0.089	0.082	0.101	0.096	0.102	0.096
Z- score	4.769	5.002	5.077	4.944	4.855	4.911	4.974
Average of Z-score	4.933						

Source : Author

As per Table 3, PNB Bank's Z-score from 2017 to 2023 has consistently stayed above 2.99, indicating robust financial health and a low risk of bankruptcy. Although there was a slight decline in the scores during and after the COVID period, the bank managed to rebound, reaching a score of 4.974 in 2023—a sign of positive improvement. With an average Z-score of 4.933, PNB Bank is securely positioned in the “Safe Zone,” making it an attractive option for investors.

CANARA BANK

Table No.-4: The outcomes of Z-score (Canara Bank)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	4.408	4.519	4.618	4.500	4.592	4.592	4.519
X2= RE/TA	0.006	-0.019	0	-0.006	0.006	0.009	0.019
X3= EBIT/TA	0.456	0.409	0.403	0.409	0.369	0.349	0.389
X4= BVE/TL	0.111	0.115	0.106	0.112	0.114	0.111	0.112
Z- score	4.981	5.024	5.124	5.015	5.081	5.061	5.039
Average of Z-score	5.046						

Source : Author

As per Table 4, Canara Bank's Z-score from 2017 to 2023 has remained above 2.99, indicating strong financial stability with a low risk of bankruptcy. Although there was a slight decline during the COVID period, the scores fluctuated in the following years. However, due to low volatility, the associated risks remain minimal. With an average Z-score of 5.046, Canara Bank falls within the “Safe Zone,” reflecting its financial strength. Given this stability, investing in the bank would be a prudent choice for investors.

UNION BANK OF INDIA

Table No.-5: The outcomes of Z-score (Union Bank of India)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	4.716	4.696	4.670	4.487	4.211	4.375	4.526
X2= RE/TA	0.003	-0.052	-0.016	-0.016	0.006	0	0.016
X3= EBIT/TA	0.456	0.423	0.423	0.423	0.389	0.342	0.383
X4= BVE/TL	0.078	0.069	0.078	0.098	0.106	0.096	0.104
Z-score	5.253	5.136	5.155	4.992	4.712	4.813	5.029
Average of Z-score	5.012						

Source : Author

As per Table 5, Union Bank's Z-score from 2017 to 2023 has remained above 2.99, indicating strong financial stability with a low risk of bankruptcy. Although there was a slight decline during the COVID period, the bank successfully regained its position in 2023, reflecting a positive trend. With an average Z-score of 5.012, Union Bank is classified in the “Safe Zone,” demonstrating its financial strength. Given this stability, investing in the bank would be a wise decision for investors.

Z-Score of Private Sector Banks

HDFC BANK LTD

Table No.-6: The outcomes of Z-score (HDFC Bank Ltd)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	4.554	4.831	4.786	4.631	4.658	4.874	4.950
X2= RE/TA	0.055	0.004	0.046	0.046	0.057	0.078	0.048
X3= EBIT/TA	0.490	0.409	0.450	0.483	0.376	0.322	0.356
X4= BVE/TA	0.178	0.156	0.189	0.180	0.183	0.184	0.178
Z-score	5.277	5.4	5.471	5.34	5.274	5.458	5.532
Average of Z-score	5.393						

Source : Author

As per Table 6, HDFC Bank's Z-score from 2017 to 2023 has remained above 2.99, signifying strong financial stability with a low risk of bankruptcy. Although there was a slight decline during the COVID period, the bank successfully regained its position in 2023, reflecting a positive trend. With an average Z-score of 5.393, HDFC Bank falls within the "Safe Zone," highlighting its financial strength. Given this stability, investing in the bank would be a prudent choice for investors.

ICICI BANK LTD

Table No.-7: The outcomes of Z-score (ICICI Bank Ltd)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	3.299	3.207	4.008	3.975	3.857	4.086	3.22
X2= RE/TA	0.032	0.016	0.006	0.019	0.035	0.042	0.050
X3= EBIT/TA	0.443	0.351	0.362	0.351	0.362	0.322	0.326
X4= BVE/TL	0.165	0.147	0.143	0.150	0.165	0.161	0.160
Z-score	3.939	3.721	4.519	4.495	4.419	4.611	3.756
Average of Z-score	4.208						

Source : Author

As per Table 7, ICICI Bank's Z-score from 2017 to 2023 has remained above 2.99, indicating strong financial stability with a low risk of bankruptcy. Although there was a slight decline during the COVID period, followed by fluctuations in subsequent years, the bank remains a safe investment due to its low volatility. With an average Z-score of 4.208, ICICI Bank is classified in the "Safe Zone," reflecting its financial strength. Given this stability, investing in the bank would be a sound decision for investors.

KOTAK MAHINDRA BANK LTD

Table No.- 8: The outcomes of Z-score (Kotak Mahindra Bank Ltd)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	4.572	4.447	4.493	4.598	4.021	4.145	4.119
X2= RE/TA	0.055	0.055	0.055	0.058	0.065	0.068	0.074
X3= EBIT/TA	0.477	0.420	0.504	0.470	0.409	0.342	0.369
X4= BVE/TL	0.196	0.142	0.205	0.357	0.259	0.268	0.265
Z-score	5.3	5.064	5.257	5.483	4.754	4.823	4.827
Average of Z-score	5.072						

Source : Author

As per Table 8, PNB's Z-score from 2017 to 2023 has remained above 2.99, indicating strong financial stability with a low risk of bankruptcy. The highest Z-score was recorded in 2020 at 5.483. Following this, the score experienced fluctuations until 2023, after which it began to rise again, reflecting a positive trend. With an average Z-score of 5.072, PNB is classified in the "Safe Zone," demonstrating its financial strength.

AXIS BANK LTD

Table No-9: The outcomes of Z-score (Axis Bank Ltd)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	4.834	4.828	4.847	5.116	4.762	4.716	4.821
X2= RE/TA	0.130	-0.004	0	0.003	0.022	0.035	0.025
X3= EBIT/TA	0.490	0.416	0.436	0.443	0.409	0.342	0.322
X4= BVE/TL	0.153	0.142	0.136	0.161	0.168	0.164	0.161
Z-score	5.607	5.382	5.419	5.723	5.361	5.257	5.329
Average of Z-score	5.439						

Source : Author

As per Table 9, Axis Bank's Z-score from 2017 to 2023 has remained above 2.99, indicating strong financial stability with a low risk of bankruptcy. Although there was a slight decline during the COVID period, followed by fluctuations in subsequent years, the bank remains a secure investment due to its low volatility. With an average Z-score of 5.439, Axis Bank is classified in the "Safe Zone," highlighting its financial strength. Given this stability, investing in the bank would be a prudent choice for investors.

INDUSIND BANK LTD

Table No.-10: The outcomes of Z-score (IndusInd Bank Ltd)

Year	2017	2018	2019	2020	2021	2022	2023
X1= WC/TA	4.828	4.801	4.906	5.031	5.044	5.149	5.084
X2= RE/TA	0.052	0.045	-0	-0.001	0.026	0.032	0.048
X3= EBIT/TA	0.517	0.497	0.517	0.598	0.504	0.477	0.483
X4= BVE/TL	0.137	0.126	0.111	0.133	0.143	0.142	0.143
Z-score	5.534	5.469	5.534	5.76	5.717	5.8	5.758
Average of Z-score	5.653						

Source: Author

As per Table 10, IndusInd Bank's Z-score from 2017 to 2023 has remained above 2.99, indicating strong financial stability with a low risk of bankruptcy. Although there was a slight decline during the COVID period, followed by fluctuations in subsequent years, the bank remains a safe investment due to its low volatility. With an average Z-score of 5.653, IndusInd Bank is classified in the "Safe Zone," reflecting its financial strength. Given this stability, investing in the bank would be a wise decision for investors.

Overall Z-score Analysis

Average Z-score analysis of Public Sector Banks

The following table shows the average Z-score of Public Sector Bank from the period between 2017-2023.

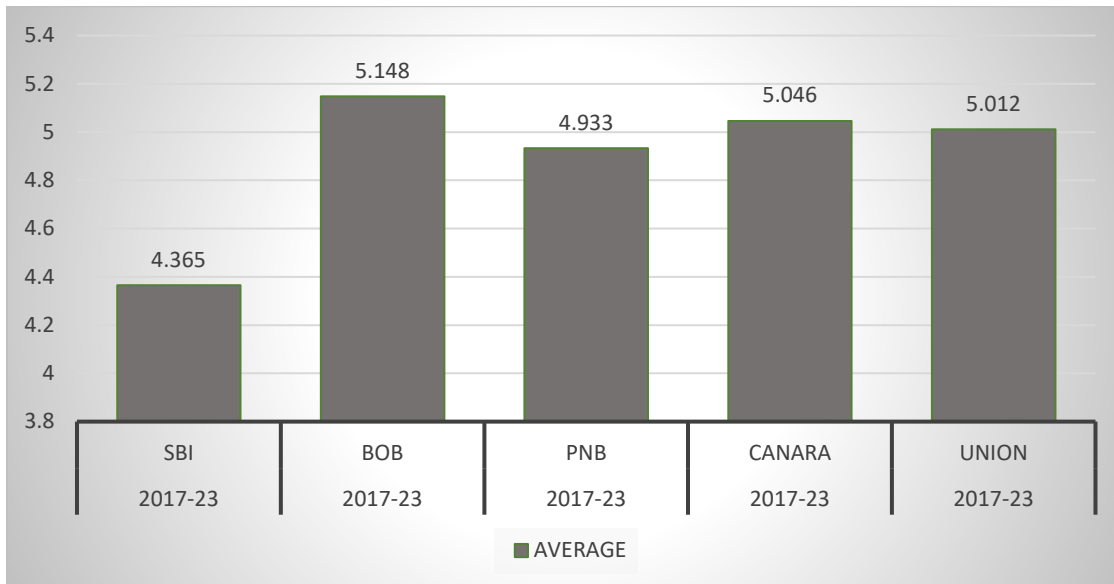


Figure- 1 Graphical Representation of Public Sector Banks

Figure 11 shows a graphical representation of public sector banks, with the Bank of Baroda having the highest Z-score of 5.148 and the State Bank of India having the lowest score of 4.365 among the top five banks, but all of the banks are financially sound and scored above 2.99, indicating a low risk of bankruptcy. All banks must maintain their scores to improve their positions and retain public trust in financial institutions.

Average Z-score analysis of Private Sector Banks

The following table shows the average Z-score of Private Sector Banks from the period between 2017-2023.

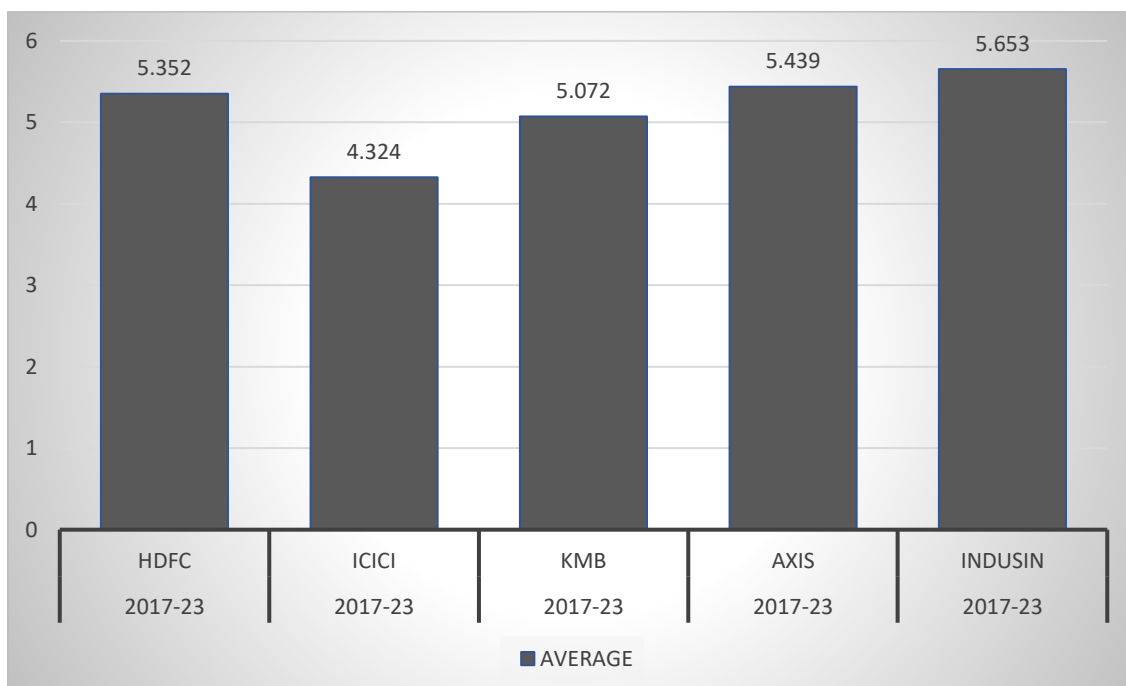


Figure 2- Graphical Representation of Private Banks

Figure 12 depicts a graphical representation of public banks, showing that SBI has the lowest Z-score and BOB has the highest Z-score, 5.148, but all banks are in the safe zone, meaning they have a low risk of bankruptcy, and their scores are all greater than 2.99. All banks must maintain this Z-score to improve their market reputation, create client trust, and become financially healthy in the market.

Independent T-test (Comparison of Z-Score for Public Sector Banks and Private Sector Banks)

Null Hypothesis (H₀): There is no significant difference in the Altman's Z-score between public and private sector banks.

	Bank	N	Mean	Std. Deviation	Std. Error Mean
Z Score	Public Sector	5	4.90080	.309304	.138325
	Private. Sector	5	5.16800	.515770	.230659

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper	
Z Score	Equal variances assumed	1.025	.341	-.993	8	.350	-.267200	.268956	-.887414	.353014
	Equal variances not assumed			-.993	6.548	.356	-.267200	.268956	-.912198	.377798

The descriptive statistics show that private banks have a slightly higher mean Z-score (5.1680) compared to public banks (4.9008), with standard deviations of 0.5158 and 0.3093, respectively, suggesting potentially better financial stability. However, to determine if this difference is statistically significant, Levene's test for equality of variances was conducted, yielding an F-value of 1.025 and a p-value of 0.341, which is greater than 0.05. This indicates that the assumption of equal variances holds, allowing us to refer to the first row of the independent samples t-test. The t-test results ($t = -0.993$, $df = 8$, $p = 0.350$) show that the mean difference of -0.2672 is not statistically significant, as the p-value exceeds 0.05. The 95% confidence interval (-0.8874 to 0.3530) further suggests that the true mean difference could include zero, reinforcing the conclusion that there is no significant difference between the Z-scores of public and private banks.

Findings

The Z-score analysis of Indian banks from 2017 to 2023 highlights their financial stability, with all banks maintaining scores above the critical threshold of 2.99, indicating low bankruptcy risk. Despite a slight decline in scores during and immediately after the COVID-19 pandemic, all banks demonstrated resilience and recovery by 2023, affirming their adaptability to economic disruptions. Among public sector banks, Bank of Baroda achieved the highest average Z-score of 5.148, while SBI had the lowest at 4.362, yet both remained in the safe zone. Private sector banks like IndusInd Bank and HDFC Bank excelled, with average scores of 5.653 and 5.393 respectively, showcasing robust financial health. The t-test results confirm that there is no statistically significant difference between the Z-scores (Financial stability) of private and public sector banks. Overall, the Z-scores suggest that all analyzed banks are safe for investment, with stable market positions and low volatility. To maintain investor confidence and enhance market reputation, it is essential for banks to sustain or improve their Z-scores, reflecting strong financial management and resilience in the dynamic economic landscape.

CONCLUSION

Banks have many customers, including investors and creditors. It is the banks' responsibility to fulfill all obligations to their customers. However, there are risks involved with all banks, thus it is critical to limit risk among these banks by good risk management, as the majority of bank failures are caused by credit risk. So it is equally crucial for clients to understand the bank's financial situation so that they can manage their risk based on information. It has been proven that the Altman Z-score is the most consistent method for predicting bankruptcy, and it is still employed by many investors to limit risk. All ten banks in the public and private sectors are in the safe zone, with no chances of bankruptcy in the coming years. However, the scores of some banks have been slightly impacted by COVID-19, but the banking industry has managed to maintain a score above 2.99, indicating that all banks are not in the distress zone. Although private banks have a slightly higher mean Altman's Z-score, the difference is not statistically significant at the 5% level. This suggests that public and private sector banks have similar financial stability, as measured by Altman's Z-score. Because public sector banks have lower retained earnings than private banks, the former has a higher score than the latter. While the private sector is now

performing well, it must continue to do so in the coming years to ensure greater financial stability. The management teams of public sector banks must look into this issue to increase retained earnings.

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