

# Analysing Impact of Economic and Firm Parameters on Z-Score of Selective Public Sector Banks of India: An Empirical Analysis

Hiren Jigarkumar Jani\*, Butalal C. Ajmera\*\*

## Abstract

The study focuses on the analysis of 'z-score' and checking the impact of economic as well as firm parameters on the former. The exploratory study applies the period from 2018–19 to 2022–23. The study utilises multiple regression analysis, the result indicates that, GDP (Gross Domestic Product) and CPI (Consumer Price Index) has influence on the 'z-score' of the selective public banks. The Age of the firm has also slight of the influence on 'z-score'. The study is helpful for understanding the current status-quo of the public sector banks of the India. The overall improvement has been marked in every selected bank for the study.

**Keywords:** Z-Score, GDP, Inflation, Bank, Financial Distress

**JEL Classification Code:** G15, G32, G33

## Introduction

The Model of Z-Score was developed by Altman back in 1960's. The model was redefined many times by various institutions and authors. The original model was based upon the assumption of manufacturing companies. The study focuses upon the detailed financial analysis of selected five public sector banks of India. These selected banks are based upon the criteria of market value. The financial stability analysis is conducted using Z-score model, as with the time changed, the model is also reshaped, and the current study is using the model given by the "World Bank". The suggested model is as follows;

$$\left[ Z - Score = \frac{ROA + \frac{Equity}{assets}}{Sd (ROA)} \right]$$

Where,

Z-Score = Tool to verify bank risk,

ROA = Return on Assets,

Equity/Assets = Total Equity/Total Assets,

Sd = Standard Deviation

## Review of Literature

The primary work carried out by "Altman" towards the producing "Z-Score Model", which suggests that financial distress can be measured by using this model, where majority of the parameters are "working capital, retained earnings, earnings before interest and taxes, market value of equity, book value of total liabilities, sales and total assets of the enterprise", which can be used to construct the "Z-Score model" (Altman, 1968). The original 'z-score model' was revised several times by several authors, adding new elements to the original model, so as to increase its reliability and practicality in shifting paradigm. The significant change in the original model was brought in the year 2000, where the "ZETA Model" was associated with the original model; the study was conducted to examine the financial distress of the companies (Altman et al., 2000). The literature review based studies were also conducted for the sake of analysing the impact of "z-score model", the notable study includes the primary analysis of the European and Non-European countries, where the work and development of original model was verified and the results showed that many countries redesigned the original model so as to bring the accuracy to the higher levels (Altman et al., 2014). The model was again redesigned by the same

\* Research Scholar, Department of Commerce, Maharaja Krishnakumarsinhji Bhavnagar University, Gujarat, India.  
Email: hirenjani@mkbhavuni.edu.in

\*\* Professor and Dean, Department of Commerce, Maharaja Krishnakumarsinhji Bhavnagar University, Gujarat, India.  
Email: bcajmera@mkbhavuni.edu.in

author to verify the reliability of the old model; the author found that original model is still pragmatic for most of the countries (Altman et al., 2016). The notable foundation for verifying the ‘financial distress and insolvency’ for the banking industry relies upon the work conducted by (Lepetit et al., 2020), where the redesigned model delves into the primary parameters used to assess the risk of insolvency of banks across the world. Return On Assets is primarily the main variable to assess the effectiveness of the whole model, the impact of Return On Assets on firm’s internal as well as external factors is properly illustrated by the work of (Chew & Yen, 2019), which suggests the former as the fundamental variable to assess the soundness of the firm. Finally, the model developed/given by the “World Bank” for assessing the insolvency risk of the banks across the world provides useful insights and is the integral part of this study. A study applied a modified Altman Z-score model to predict financial distress within the nursing home industry. This study applied a modified Altman Z-score model to predict financial distress within the nursing home industry. By analysing multiple financial ratios, the model aimed to identify facilities at risk of closure, providing a tool for managers and policymakers to intervene proactively for nursing home industry (Lord et al., 2020). This article elucidated the calculation and interpretation of Z-scores, emphasising their role in converting individual test performances into a standardised form. This standardisation facilitates the aggregation of scores from different tests to create composite scores, enhancing the meaningful analysis of student performance (Andrade, 2021). Research focusing

on the Spanish insurance sector compared six different approaches to calculating the Z-score. Utilising data from 183 insurers between 2010 and 2017, the study identified the most effective formula for assessing financial stability, emphasising the importance of selecting appropriate calculation methods for accurate financial soundness analysis (Moreno et al., 2019).

## Research Gap

From above literature reviewed, it is found that majority of the studies have been conducted using ‘Altman z-score model’ with reference to the non-banking industry, and the majority time the studies conducted using said model are not adopted by the one which is given by the world bank. Moreover, the economic impact and firm-specific parameters are not considered for the analysis.

## Research Methodology

### Objectives of the Study

- To compare the ‘z-score’ of the selective banks.
- To analyse the impact of ‘economic as well as firm parameters’ on ‘z-score’ of the selective banks.

### Period of the Study

The period of the study is 5 years from 2018–19 to 2022–23.

## Conceptual Model of the Study

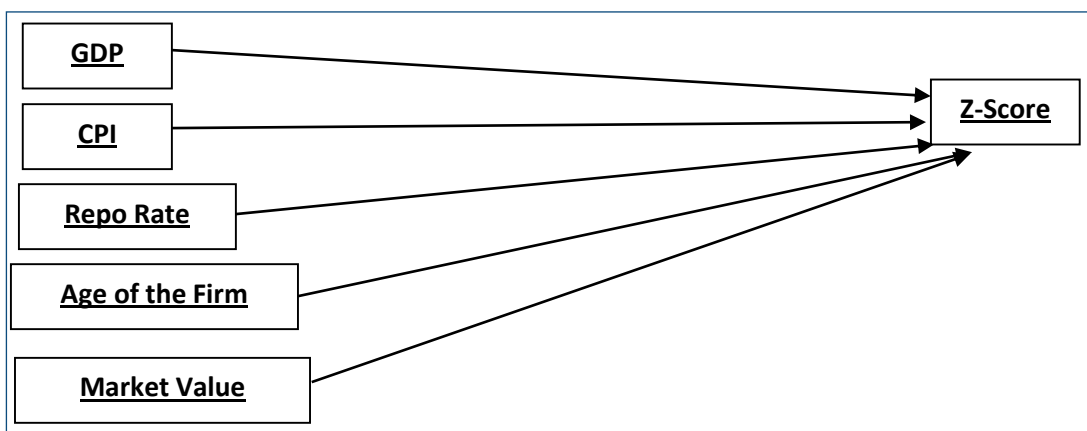


Fig. 1: Conceptual Model of the Study

## Sample of the Study

**Table 1: List of Selected Banks**

Sr. No.	Bank	Market Cap. (In Rs.)
1	State Bank of India (SBI)	6,51,184
2	Punjab National Bank (PNB)	1,09,930
3	Bank of Baroda (BOB)	1,10,512
4	Union Bank of India (UBI)	89,313
5	Indian Overseas Bank (IOB)	89,200

Source: tradebrains.in

The sample size of the study consists five public sector banks of India, such selected five banks are based upon the market value of top public sector banks in India according to their current market value.

## List of Selected Variables

**Table 2: List of Selected Variables**

Sr. No.	Variable	Remarks
1	Z-Score	Dependent Variable
2	Gross Domestic Product (%)	Independent Variable
3	Consumer Price Index (%) (Inflation)	Independent Variable
4	Repo Rate (%)	Independent Variable
5	Age of the Firm (Natural Log)	Independent Variable
6	Market Value (Natural Log)	Independent Variable

## Results and Analysis

### Multiple Linear Regression Model

$$Z = \beta_0 + \beta_1 * GDP_{RATE} + \beta_2 * CPI + \beta_3 * Repo_{Rate} + \beta_4 * Age + \beta_5 * Mktcap$$

### Hypotheses of the Study

H<sub>1</sub> = There is a strong influence of GDP on ‘z-score’ of selective banks.

H<sub>2</sub> = There is a strong influence of CPI on ‘z-score’ of selective banks.

H<sub>3</sub> = There is a strong influence of Repo rate on ‘z-score’ of selective banks.

H<sub>4</sub> = There is a strong influence of Age of the firm on ‘z-score’ among the selective banks.

H<sub>5</sub> = There is a strong influence of Market Cap of the firm on ‘z-score’ among the selective banks.

**Table 3: Z-Score Calculation of State Bank of India**

Year	ROA	Equity	TA	Sd(ROA)	E/A	Z-Score
2018-19	2	2,34,495	38,88,467	34.8454	0.06031	0.05913
2019-20	38	2,51,060	41,97,492	34.8454	0.05981	1.09225
2020-21	48	2,75,561	48,45,618	34.8454	0.05687	1.37915
2021-22	67	3,05,588	53,60,883	34.8454	0.057	1.92442
2022-23	96	3,58,931	59,54,418	34.8454	0.06028	2.75676

The above calculation of ‘z-score’ reflects that, total assets have been increased within selected period, the increase in return on assets have been significant, which reflects

the efficient use of resources. Latest z-score suggests the strong financial position of the bank, having the highest score in the current study.

**Table 4: Z-Score Calculations of Punjab National Bank**

Year	ROA	Equity	TA	Sd(ROA)	E/A	Z-Score
2018-19	-125	45,197	7,89,265	63.4374	0.05726	-1.9695
2019-20	4	63,876	8,51,457	63.4374	0.07502	0.06424
2020-21	15	92,534	12,79,725	63.4374	0.07231	0.23759

Year	ROA	Equity	TA	Sd(ROA)	E/A	Z-Score
2021-22	26	97,581	13,39,301	63.4374	0.07286	0.411
2022-23	18	1,02,880	14,93,648	63.4374	0.06888	0.28483

The above calculation of 'z-score' reflects that, besides the disturbance in the previous years, the banks operation improvement has been improvised over the selective period, the bank has been quite significant using its

available resources, the improvement in the average score has witnessed the resource utilisation capacity of the bank, and future improvement is also promising in nature.

**Table 5: Z-Score Calculations of Bank of Baroda**

Year	ROA	Equity	TA	Sd(ROA)	E/A	Z-Score
2018-19	6	54,996	8,19,671	44	0.0671	0.13824
2019-20	6	76,104	11,99,942	44	0.06342	0.13815
2020-21	7	82,389	12,02,675	44	0.0685	0.16105
2021-22	60	91,868	13,40,137	44	0.06855	1.36863
2022-23	103	1,05,054	15,25,878	44	0.06885	2.34836

The above 'z-score' analysis signifies that over the period bank has been quite significant in using its resources, while the equity witnessed the rise, due to merger of two

major banks into the Bank of Baroda, i.e. Dena Bank and Vijaya Bank, the score has been improved after the merger and having the second highest score in this study.

**Table 6: Z-Score Calculations of Union Bank of India**

Year	ROA	Equity	TA	Sd(ROA)	E/A	Z-Score
2018-19	-59	26,835	4,98,580	58.7299	0.05382	-1.0037
2019-20	-53	33,989	5,55,509	58.7299	0.06119	-0.9014
2020-21	27	64,737	10,82,377	58.7299	0.05981	0.46075
2021-22	47	70,861	11,93,765	58.7299	0.05936	0.80128
2022-23	69	78,803	12,88,357	58.7299	0.06117	1.17591

The above 'z-score' calculations reflect that, the bank has been quite improving in the nature in regard of asset utilisation; the z-score has also improved due to maximum

utilisation of available funds by the bank, as it stands the third highest score in this study.

**Table 7: Z-Score Calculations of Indian Overseas Bank**

Year	ROA	Equity	TA	Sd(ROA)	E/A	Z-Score
2018-19	-135	16,359	2,50,008	159.318	0.06543	-0.847
2019-20	-295	16,154	2,60,726	159.318	0.06196	-1.8513
2020-21	31	16,944	2,74,010	159.318	0.06184	0.19497
2021-22	59	23,000	2,99,377	159.318	0.07683	0.37081
2022-23	76	25,262	3,13,745	159.318	0.08052	0.47754

The above 'z-score' calculations reflect that, the over the period of the study the bank has effectively boosted its use of assets and equity at a significant level, the overall z-score of the bank has also been started improving from the data of past 3 consecutive years.

### Inter-Bank Comparison

$H_0$  = There is no significant difference of 'z-score' among the selective banks.

$H_1$  = There is a significant difference of 'z-score' among the selective banks.

**Table 8: Test of Homogeneity of Variances**

		<i>Levene Statistic</i>	<i>df1</i>	<i>df2</i>	<i>Sig.</i>
Z-score	Based on Mean	.792	4	20	.544
	Based on Median	.357	4	20	.836
	Based on Median and with adjusted df	.357	4	16.626	.836
	Based on trimmed mean	.764	4	20	.561

The above table of analysis of homogeneity indicates that, all significance values are more than 0.05. This indicates that, there are no significant variances across the selective banks, which is important to run the regression model.

**Table 9: One Way ANOVA Test**

	<i>Sum of Squares</i>	<i>Df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
Between Groups	7.800	4	1.950	1.525	.233
Within Groups	25.573	20	1.279		
Total	33.373	24			

The null hypothesis is accepted, as the above result indicates there are no significant differences of 'z-score' across the banks.

**Table 10: Descriptive Statistics of the Study**

	<i>N</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
Z-score	25	-1.969544670147240	2.990754109718380	.821323941919939	1.179206722422691
GDP_RATE	25	-5.8	9.1	4.180	5.3694
CPI	25	3.7	6.7	5.200	1.3038
Repo_Rate	25	4.00	6.50	5.1800	1.08714
Age	25	1.806179973983890	2.110589710299250	1.962884758958007	.110121563042811
Mktcap	25	5.36468199557997	6.71072709017184	5.985789222186599	.405585819460266

**Table 11: Pearson Correlation**

	<i>zscore</i>	<i>GDP_RATE</i>	<i>CPI</i>	<i>Repo_Rate</i>	<i>Age</i>	<i>Mktcap</i>
Z-score	1	.210(.157)	.333(.052)*	.044(.417)	-.316(.062)*	.150(.237)
GDP_RATE	.210(.157)	1	-.373(.033)**	.444(.013)**	.186(.187)	.008(.484)
CPI	.333(.52)	-.373(.033)**	1	-.132(.264)	-.053(.401)	.201(.168)
Repo_Rate	.044(.417)	.444(.013)**	-.132(.264)	1	.096(.323)	-.051(.405)
Age	-.316(.062)*	.186(.187)	-.053(.401)	.096(.323)	1	-.233(.131)
Mktcap	.150(.237)	.008(.484)	.201(.168)	-.051(.405)	-.233(.131)	1

(Values in the parentheses show 1-tailed significance).

(\*,\*\* Significant at 10% and 5%, respectively).

**Table 12: Model Summary**

<i>Model</i>	<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std. Error of the Estimate</i>	<i>Durbin-Watson</i>
1	.619 <sup>a</sup>	.384	.221	1.040503251808995	2.333
a. Predictors: (Constant), Mktcap, GDP_RATE, Age, CPI, Repo_Rate					
b. Dependent Variable: Z-score					

The above table indicates the R-square value of 38.4% having impact on the overall fitness of the model, the Durbin Watson test indicates that, variables are negatively

correlated with each other, here mild negative correlation does not significantly distort the coefficient estimates, therefore does not cause any distortion in model fitness.

**Table 13: ANOVA Test**

	<i>Model</i>	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
1	Regression	12.802	5	2.560	2.365	.079 <sup>b*</sup>
	Residual	20.570	19	1.083		
	Total	33.373	24			

a. Dependent Variable: Z-score

b. Predictors: (Constant), Mktcap, GDP\_RATE, Age, CPI, Repo\_Rate

(\*, significant at 10% value)

The above table of ANOVA test indicates that, the overall model is significant at 10% level. The overall model shows the F-value of 2.365 which is quite sufficient to

assess that, there exists larger evidence to support the hypotheses.

**Table 14: Table Showing Coefficients Calculations**

	<i>Unstandardized Coefficients</i>		<i>Standardized Coefficients</i>			<i>Collinearity Statistics</i>	
	<i>B</i>	<i>Std. Error</i>	<i>Beta</i>	<i>t</i>	<i>Sig.</i>	<i>Tolerance</i>	<i>VIF</i>
Constant	7.422	5.793		1.281	0.216		
Z_Score<---GDP_RATE	0.111	0.048	0.504	2.287	0.034**	0.669	1.495
Z_Score<---CPI	0.452	0.181	0.5	2.502	0.022**	0.812	1.231
Z_Score<---Repo_Rate	-0.086	0.219	-0.079	-0.391	0.7	0.797	1.254
Z_Score<---Age	-4.139	2.027	-0.386	-2.042	0.055*	0.905	1.104
Z_Score<---Mktcap	-0.142	0.556	-0.049	-0.255	0.801	0.888	1.126

(\*,\*\* Significant at 10% and 5% respectively).

The Variance Inflation Factor (VIF) values are all less than 5, which indicates the model fitness and evidence of having no higher multi-collinearity in the model. The above table of coefficients indicates the relation and impact of each selected variable on the overall model of the study. The Gross Domestic Product (GDP) rate has positive impact on 'z-score' and is significant at 5% level, the Consumer Price Index (CPI) (inflation) has positive impact and also impacts the 'z-score' at 5% significance. The Repo rate however, has negative impact on the 'z-score' and is not having statistically significant impact on the 'z-score'. Age of the firm negatively impacts the 'z-score' however, only significant at 10% value. Market cap also negatively influence the 'z-score' with very less statistical influence.

## Conclusion and Practical Implication of the Study

The study conducted on the further research of the 'z-score model' originally developed by the author 'Altman', the intention behind the study was to assess the financial distress of selected public sector banks of Indian economy. From the conducted study, it is found that, the Economic parameters have greater impact on the 'z-score' rather than that of, firm's parameters. The study also helps to analyse the overall impact of both the internal as well as external considerations that affect the overall 'z-score' of those selective public sector banks.

The study helps us to understand that, GDP has slightly more implications towards the overall strength of the

banks. This helps us to understand Fluctuations in exchange rates and trade volumes can significantly impact bank performance. For instance, favourable trade conditions and stable exchange rates often enhance banks' profitability by reducing the risks associated with international transactions (Olokoyo et al., 2021). While in the case of Inflation, it also has the significant impact over the selected banks, here it can be of noteworthy that if banks can accurately anticipate inflationary trends, they may adjust interest rates accordingly to maintain or even enhance profitability. This proactive approach involves increasing lending rates to offset the anticipated rise in costs, thereby preserving net interest margins (Umar, 2014).

## Limitation of the Study

The study is based on the collected data from the financial websites and hence the study is limited up to the selective banks.

## Conflict of Interest

The authors declare no conflict of interest on use of such study for the further research.

## References

- Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589–609. doi:<https://doi.org/10.1111/j.1540-6261.1968.tb00843.x>
- Altman, E. I., Haldeman, R. G., & Narayanan, P. (2000). ZETATM analysis A new model to identify bankruptcy risk of corporations. *Journal of Banking & Finance*, 1(1), 29–54. doi:[https://doi.org/10.1016/0378-4266\(77\)90017-6](https://doi.org/10.1016/0378-4266(77)90017-6)
- Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2014, August 10). *Distressed firm and bankruptcy prediction in an international context: A review and empirical analysis of Altman's Z-Score model*. Retrieved from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2536340](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2536340)
- Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2016). Financial distress prediction in an international context: A review and empirical analysis of Altman's Z-Score Model. *Journal of International Financial Management & Accounting*, 28(2), 131–171. doi:<https://doi.org/10.1111/jifm.12053>
- Andrade, C. (2021a). Z scores, standard scores, and composite test scores explained. *Indian Journal of Psychological Medicine*, 43(6), 555–557. doi:<https://doi.org/10.1177/02537176211046525>.
- Chew, & Yen, H. (2019). *The impact of Return on Assets (ROA) in relation with internal factors and external factors towards Casio Computer Co. Ltd.'s performance*. Retrieved from [https://mpr.aub.uni-muenchen.de/97348/1/MPRA\\_paper\\_97348.pdf](https://mpr.aub.uni-muenchen.de/97348/1/MPRA_paper_97348.pdf)
- Lepetit, L., Strobel, F., & Tran, T. H. (2020). An alternative Z-score measure for downside bank insolvency risk. *Applied Economics Letters*, 1–6. doi:<https://doi.org/10.1080/13504851.2020.1739222>
- Lord, J., Landry, A., Savage, G. T., & Weech-Maldonado, R. (2020). Predicting nursing home financial distress using the Altman Z-Score. *INQUIRY the Journal of Health Care Organization Provision and Financing*, 57. doi:<https://doi.org/10.1177/0046958020934946>
- Moreno, I., Parrado-Martínez, P., & Trujillo-Ponce, A. (2019). Using the Z-Score to analyze the financial soundness of insurance firms. *SSRN Electronic Journal*. doi:<https://doi.org/10.2139/ssrn.3491667>
- Olokoyo, F., Ibhagui, O., Babajide, A., & Yinka-Banjo, C. (2021, March 12). The impact of macroeconomic variables on bank performance in Nigeria. *Savings and Development*, 43. Retrieved from <https://savingsanddevelopment.scholasticahq.com/article/18369>.
- Umar, M. (2014). Conceptual exposition of the effect of inflation on bank performance. *Journal of World Economic Research*, 3(5), 5–59. doi:<https://doi.org/10.11648/j.jwer.20140305.11>.

## Websites

- <https://portal.tradebrains.in/screener-> TradeBrains.
- <https://databank.worldbank.org/metadataglossary/global-financial-development/series/GFDD.SI.01#:~:text=Z%2Dscore%20compares%20the%20buffer%20of%20a%20country's%20banking%20system,than%205%20bank%2Dlevel%20observations-> World Bank.