



Reliability and accuracy of Z Atman's model in service sector – Evidence from India

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Abstract

The predication of bankruptcy of business units is essential elements consider by the various stakeholders particularly investors while taking financial and investment decision. The Z atman's model is one of the popular bankruptcy model used in world. Present study is an attempt to measure the reliability and accuracy of Z Atman's model in bankruptcy prediction in service sector. The study selected four bankrupted companies and data collected prior to filing insolvency petition and analyzed as per the model elements. The study companies included Kingfishers Airlines, Jet Airlines, Lanco infrastructure and Dewan housing Finance Corporation. The study found that Z Atman's model successfully predicted bankruptcy of selected four companies.

Keywords: bankruptcy, financial distress, Z Atman's model and service sector

Introduction

Service sector is considered as backbone of the every country in world where India with contribution of more than 55 percent to GDP. The effective working of service sector leads to growth of other sector in the economy. In the contrast, failure of banking sector result in disruption of the entire economy but also causes of the loss of public confidence and huge impact on the society. Bankruptcy refers to inability working conditions of the company due to financial issues (Manajemen dan Perbankan). The term bankruptcy is also popular with different words such as winding up, insolvency, liquidation, financial risk, financial distress, and bad credit. The company bankrupt due to both internal and external factors such as huge debt, low sales, profitability, poor management capacity, outdated product, huge competition, poor capital, huge losses etc., and external causes of adverse government policies, technology affect, adverse economic conditions, political issues etc., Zhang & Zheng, H. (2020) [2]. Besides, countries' socio-economic hardship is one the trigger for Bankruptcy of companies that are already exposed to instable financial position. In some cases, companies even having good position will experience difficulties in meeting funds for operational activities owing to country's economic crisis (Winy and Luciana, 2005) [3]. Thus, bankruptcy prediction is emerging topic among the financial researchers and practitioners. It is revealed that financial statements reflect adequate information regarding company's financial condition in one period and describe the company's condition in the future (Saudi *et al.*, 2019) [4].

In general bankruptcy prediction can be done through traditional techniques, hybrid models, and advanced models like machine learning and Artificial Neural Networks. The traditional models included Grover model traditional models like Altman, Springate, Pilarski model, Ohlson or Zmijewski, Bankometer in the banking sector. Among all these models "Bankometer" is a standard and reliable model due to recommendation of International Monetary Fund (IMF) in the tear of 2000. Therefore, present study used "Z Atmans" to measure the performance and possibility of bankruptcy of selected companies from services sector in emerging countries in general and from India in particular.

Review of Literature

Lilik Purwanti *et al.* (2024) [5] study applied various bankruptcy prediction models on the banking sector of Indonesia which faced lot of financial challenges due to failure of various sector during covid 19 period. The study applied and compared the reliability and accuracy of different models such as Altman, Springate, Zmijewski, Grover, and Ohlson in selected banks during 2019-2022 period. The study found that, Grover model could predict bankruptcy with 60 percentage of accuracy whereas Altman, Springate, and Zmijewski model's prediction result are 0%, 0%, and 15% accuracy. Therefore, the study supported the Grover model in prediction of bankruptcy.

Felita Bella (2021) adopted S-Score model in prediction of banks, grouped into small, medium and large banks in Indonesia. The study found differences in bankruptcy predictions between small, medium and large banks. In contrast, the study revealed insignificant difference in bankruptcy predictions between large and medium banks. Besides, the results revealed the lowest average bankruptcy among small banks and highest average bankruptcy among large banks.

Deepika Dhingra *et al* (2024) [6] examined the accuracy and reliability of four bankruptcy models such as Altman Z score, Zmijewski, Pilarski and Springate model in the case of Jew Air ways in India during the period of 2011-2018. The study found that, Zmijewski model merged as more relevant and accurate model with accuracy prediction rate of 2.278 whereas rest of three models result as springate 0.103 and lower by other two models.

Simrat Kaur (2024) [7] applied four bankruptcy models such as logistic regression, random forests (RFs), artificial neural networks (ANNs) and decision trees (DTs) in the context of Indian enterprises. The study selected 48 companies out of which 24 bankrupted and 24 non bankrupted companies. The study found that, among all the companies RF predictive technique outperformed the other predictive strategies in terms of accuracy.

Swice good and Clark (2001) deployed DA, BPNN, and human judgment to predict bank failure. They found that BPNN outperformed and provided the maximum accuracy when compared to the rest of the models. Neural network

(NN) is perhaps the most significant forecasting tool to be applied to the financial markets in recent years and is gaining its prominence.

Z-Atman’s Model Description.

Edward Atman’s in 1968. The outcome of this model is popular by Z-score which is result of integration of key financial metrics such as working capital, retained earnings, equity market value, EBIT, and sales Altman, E.I (1983). The five variables used to measure five aspects such as liquidity, profitability, leverage, solvency and activity, This model measures the financial distress or bankruptcy is measured beyond normal metric of profitability and liquidity (Altman, 1968). Since ever, this model was refined and improved its reliability and accuracy as Z-score model

and widely using by academicians, research analysts and corporate entities in analyzing the financial distress or bankruptcy prediction. In the present study we used the Z-score of Edward Atman’s revised model in 2014 (Atman *et al* 2014).

$$(Z \text{ Score} = \{(1.2 \times X_1) + (1.4 \times X_2) + (3.3 \times X_3) + (0.6 \times X_4) + (1.0 \times X_5)\})$$

- X₁ - Ratio of net working capital to its total value of assets.
- X₂ - Ratio of retained profits to its total value of assets.
- X₃ - Ratio of earnings before interest and taxes (EBIT) to its total assets.
- X₄ - Ratio of Market value of equity to the book value of its total liabilities.
- X₅ - Ratio of total sales to its total value of assets.

Table 1: Z-Score model prediction Scale

Z score	Indication
1.8 and less	Severe financial distress and change for bankruptcy immediately
Between 1.8-2.7	Alarming situation and change for bankruptcy in two years
Between 2.7 to 2.99	Caution period need to take reforms
3 and above	Financially healthy and sound

Research Gap

The bankruptcy measurement of is various crucial aspects in measuring the financial soundness of the company and insolvency position. The measurement of accuracy and reliability of Z Atman’s model in prediction of bankruptcy is services sector in need of the hour. The present study fulfills this research gap and rise new line of argument in the subject domain. One again this study measures the accuracy and reliability of Z Atman’s model in financial distress situation of selected service sector companies in Indian context.

Objectives of the Study

The present study analyzes the reliability and accuracy of Z Atman’s model in prediction of bankruptcy in service sector in India.

Research methodology

In the present study four bankrupted companies are selected from the service sector. These companies filed bankruptcy petition at National Company Law Tribunal (NCLT) in

different years. These companies included Jet Air Ways (2020-2022), Kingfisher Air lines (2010-2012), Dewan Housing Fiance (2020-2022) and Lanco Infrastructure (2015-2017). The present study is an analytical, applied and empirical research in nature and model examination of prediction of bankruptcy or financial distress of corporate sector in the economy. The selected prediction model is Z-Atman’s bankruptcy model proposed in 1968 which is widely accepted and applied by the academicians and researchers across the countries in the world. As per the model five ratios are considered as proportion of working capital, retained earnings, EBIT, Market value of equity and sales in relation to total assets/liabilities. In the study ratios are individual ratios are calculated and incorporated in the formulae and presented every year Z-score. Thus, statistical techniques used in the study are financial ratios. The data is collected from secondary data published in the annual reports of the selected companies in their respective period.

Data Analysis and Interpretation Findings of the Study

TABLE:2 Z-SCORE CALCULATION OF Kingfisher Airlines						
	Ratios	RATIOS (Rs. Cr)	TA or TL (Rs. Cr)	Ratios (x)	1.2X1+1.4X2+3.3 X3+0.6X4+1.0X5	Z- Score
2011-2012						
A	Working Capital/TA	-6817.1	9,080.03	-0.75	-0.90	
B	Retained Earnings/TA	-6,213.15	9,080.03	-0.68	-0.96	
C	EBIT/TA	-2169.75	9,080.03	-0.24	-0.79	-1.97
D	MV of Equity/TL	577.65	9,080.03	0.06	0.04	
E	Sales/TA	5,823.91	9,080.03	0.64	0.64	
2010-11						
A	Working Capital/TA	-3113.27	8,253.20	-0.38	-0.45	
B	Retained Earnings/TA	-4,002.07	8,253.20	-0.48	-0.68	
C	EBIT/TA	-207.84	8,253.20	-0.03	-0.08	-0.38
D	MV of Equity/TL	497.78	8,253.20	0.06	0.04	
E	Sales/TA	6,495.56	8,253.20	0.79	0.79	
2009-10						

A	Working Capital/TA	-2912.9	7,978.95	-0.37	-0.44	
B	Retained Earnings/TA	-4,268.84	7,978.95	-0.54	-0.75	
C	EBIT/TA	-1110.45	7,978.95	-0.14	-0.46	-0.99
D	MV of Equity/TL	265.91	7,978.95	0.03	0.02	
E	Sales/TA	5,092.27	7,978.95	0.64	0.64	

Source: Compiled by the Author

TABLE3 Z-SCORE CALCULATION OF DEWAN HOUSING FINANCE						
	Ratios	RATIOS (Rs. Cr)	TA or TL (Rs. Cr)	Ratios (x)	1.2X1+1.4X2+3.3 X3+0.6X4+1.0X5	Z- Score
2021-22						
A	Working Capital/TA	-31856.95	70,366.86	-0.45	-0.54	
B	Retained Earnings/TA	-20,950.87	70,366.86	-0.30	-0.42	
C	EBIT/TA	-19898.56	70,366.86	-0.28	-0.93	-1.76
D	MV of Equity/TL	313.82	70,366.86	0.00	0.00	
E	Sales/TA	8,802.79	70,366.86	0.13	0.13	
2020-21						
A	Working Capital/TA	40061.35	85,837.83	0.47	0.56	
B	Retained Earnings/TA	-5,877.16	85,837.83	-0.07	-0.10	
C	EBIT/TA	-12522.81	85,837.83	-0.15	-0.48	0.09
D	MV of Equity/TL	313.82	85,837.83	0.00	0.00	
E	Sales/TA	9,343.12	85,837.83	0.11	0.11	
2019-20						
A	Working Capital/TA	59498.49	1,06,475.25	0.56	0.67	
B	Retained Earnings/TA	7,744.92	1,06,475.25	0.07	0.10	
C	EBIT/TA	8227.87	1,06,475.25	0.08	0.26	1.15
D	MV of Equity/TL	313.82	1,06,475.25	0.00	0.00	
E	Sales/TA	12,902.52	1,06,475.25	0.12	0.64	
Average zo score =						

Source: Compiled by the Author

TABLE3 Z-SCORE CALCULATION OF LANCO INFRASTRUCTURE						
	Ratios	RATIOS (Rs. Cr)	TA or TL (Rs. Cr)	Ratios (x)	1.2X1+1.4X2+3.3 X3+0.6X4+1.0X5	Z- Score
2016-17						
A	Working Capital/TA	-3844.37	18,067.96	-0.21	-0.26	
B	Retained Earnings/TA	707.40	18,067.96	0.04	0.05	
C	EBIT/TA	140.48	18,067.96	0.01	0.03	-0.07
D	MV of Equity/TL	330.26	18,067.96	0.02	0.01	
E	Sales/TA	1,757.53	18,067.96	0.10	0.10	
2015-16						
A	Working Capital/TA	-1447.69	19,046.50	-0.08	-0.09	
B	Retained Earnings/TA	1,482.14	19,046.50	0.08	0.11	
C	EBIT/TA	480.34	19,046.50	0.03	0.08	0.25
D	MV of Equity/TL	273.78	19,046.50	0.01	0.01	
E	Sales/TA	2,744.94	19,046.50	0.14	0.14	
2014-15						
A	Working Capital/TA	-1230.28	20,490.52	-0.06	-0.07	
B	Retained Earnings/TA	1,785.21	20,490.52	0.09	0.12	
C	EBIT/TA	54.68	20,490.52	0.00	0.01	0.14
D	MV of Equity/TL	245.09	20,490.52	0.01	0.01	
E	Sales/TA	1530.71	20490.52	0.07	0.07	

Source: Compiled by the Author

TABLE3 Z-SCORE CALCULATION OF JET AIRWAYS						
	Ratios	RATIOS (Rs. Cr)	TA or TL (Rs. Cr)	Ratios (x)	1.2X1+1.4X2+3.3 X3+0.6X4+1.0X5	Z- Score

2021-22						
A	Working Capital/TA	-19306.9	5,632.02	-3.43	-4.11	
B	Retained Earnings/TA	-17,620.10	5,632.02	-3.13	-4.38	
C	EBIT/TA	-997.78	5,632.02	-0.18	-0.58	-9.05
D	MV of Equity/TL	113.6	5,632.02	0.02	0.01	
E	Sales/TA	55.27	5,632.02	0.01	0.01	
2020-21						
A	Working Capital/TA	-18479.22	5,760.10	-3.21	-3.85	
B	Retained Earnings/TA	-16,618.04	5,760.10	-2.89	-4.04	
C	EBIT/TA	-765.54	5,760.10	-0.13	-0.44	-8.29
D	MV of Equity/TL	113.6	5,760.10	0.02	0.01	
E	Sales/TA	144.42	5,760.10	0.03	0.03	
2019-20						
A	Working Capital/TA	-18427.95	6,926.61	-2.66	-3.19	
B	Retained Earnings/TA	-15,693.46	6,926.61	-2.27	-3.17	
C	EBIT/TA	-123.24	6,926.61	-0.02	-0.06	-6.37
D	MV of Equity/TL	113.6	6,926.61	0.02	0.01	
E	Sales/TA	281.78	6,926.61	0.04	0.04	
Source: Compiled by the Author						

Table 02: It is observed from the study that, Kingfishers Airline working capital to TA assets ratio was -0.44 in 2009-10 which is decreased further to -0.45 in 2010-11 and turned to negative of -0.90 in 2011-12. The retained earnings to TA were in 2009-10 with -0.75 which turned into negative in next two years such as -0.68 and -0.96. Similarly, EBIT to TA was -0.46 in 2009-10 and -0.08 in 2010-11 and -0.79 in 2011-12. The market value to total assets drastically to was dropped 0.02 in 2009-10, it was 0.04 in 2010-11 and 0.04 in 2011-12. The sales to total assets ratio was 0.64 in 2009-10 increase to 0.79 in 2010-11 and 0.64 in 2011-12. The overall, fluctuated but reported negative in three years of study period Z scores stood as evidence for failure of the Kingfishers such as -0.99 in 2009-10, -0.38 in 2010-11 and -1.97 in 2011-12. This indicates that Z Atman's model effectively and successfully predicted bankruptcy of the Kingfishers Airlines earlier

Table 03: It is observed from the study that, Dewan housing finance working capital to TA assets ratio was 0.67 in 2019-20 which is decreased further to 0.56 in 2020-21 and turned to negative of -0.54 in 2021-22. The retained earnings to TA were also positive in 2019-20 with 0.10 which turned into negative in next two years such as -0.10 and -0.42. Similarly, EBIT to TA was 0.26 in 2019-20 turned into negative of -0.48 in 2020-21 and -0.42 in 2021-22. The market value to total assets drastically to was dropped to zero or less than one percent in total assets in three consequent years. The sales to total assets ratio was 0.64 in 2019-20 fell to 0.11 in 2020-21 and 0.13 in 2021-22. The overall, gradual decrease in Z scores stood as evidence for failure of the Dewan housing finance such as 1.15 in 2019-20, 0.09 in 2020-21 and -1.76 in 2021-22. This indicates that Z Atman's model effectively and successfully predicted bankruptcy of the Dewan housing finance company earlier.

Table 04: It is observed from the study that, Lanco Infrastructure working capital to TA assets ratio was -0.07 in 2014-15 which is decreased further to -0.09 in 2015-16 and -0.26 in 2016-17. The retained earnings to TA were gradually declined from 0.12 in 2014-15 and 0.11 and 0.05 in next two years. Similarly, EBIT to TA was 0.01 in 2014-15 and -0.08 in 2015-16 and 0.03 in 2016-17. The market value to total assets drastically to was constant at 0.01 in three years of study period. The sales to total assets ratio 0.07 in 2014-15 increase to 0.14 in 2015-16 and again drop to 0.10 in 2016-17. The overall, fluctuated but in financial distress zone in three years of study period Z scores stood as evidence for failure of the Lanco Infrastructure such as 0.14 in 2014-15, 0.25 in 2015-16 and -0.07 in 2016-17. This indicates that Z Atman's model effectively and successfully predicted bankruptcy of the Lanco Infrastructure earlier.

Table 05: It is observed from the study that, Jet Airways working capital to TA assets ratio was negative in three years such as -3.19 in 2019-20, -3.85 in 2020-21 and -4.11 in 2021-22. The retained earnings to TA were also negative in 2019-20 with -3.17 which continued in next two years such as -4.04 and -4.38 in 2021 and 2022 respectively. Similarly, EBIT to TA was 0.26 in 2019-20 turned into negative of -0.48 in 2020-21 and -0.42 in 2021-22. The market value to total assets drastically to was dropped to zero or less than one percent in total assets in three consequent years. The sales to total assets ratio was 0.04 in 2019-20 fell to 0.03 in 2020-21 and 0.01 in 2021-22. The overall, gradual decrease in Z scores stood as evidence for failure of the Jet Airways such as -6.37 in 2019-20, -8.29 in 2020-21 and -9.05 in 2021-22. This indicates that Z Atman's model effectively and successfully predicted bankruptcy of the Jet Airways company earlier.

Table 6: Z-Atman's Model Predication Performance In Selected Companies

Company	Year wise Z-score			Z-Atman's Model
	I	II	III	
Jet Airways	-6.37	-8.29	-9.05	Successful
ZONE	Distress	Distress	Distress	
Kingfisher Airlines	-0.99	-0.38	-1.97	Successful
ZONE	Distress	Distress	Distress	
Dewan Housing Finance Corporation	1.15	0.09	-1.76	

ZONE	Distress	Distress	Distress	Successful
Lanco Infratech	0.14	0.25	-0.07	
ZONE	Distress	Distress	Distress	Successful

Conclusion

The financial soundness and weakness is critical factors in assessing the life of a business organization from various stakeholders' perspective. The measurement of possibility of bankruptcy is essential from investor's point of view to take investment decisions. Therefore, Z Atman's model is one of the popular model use to predict bankruptcy chance in corporate sector. Present study concludes that, Z Atman's model successfully predicted bankruptcy or financial distress situation of all selected our companies in service sector. This present study stood as evidence for reliability and accuracy Z Atman's model in successful prediction of bankruptcy.

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