

***Financial Distress Prediction using Altman Z score and Stock Prices - A Case of NSE-Listed Indian Manufacturing Companies***

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**Abstract**

The Altman Z-Score Model has been employed to predict financial distress since its original conception in 1968. The model is perceived to be detailed in its methodology for assessing financial failure because it is predicated on values available in a company's financial statements as well as principles established by influences extraneous to the firm's operations. The share price of a business is viewed as a mirror image of its economic position, with its real worth being an attribute well within the framework as a whole. This study aims to investigate the internal dynamics of the Altman Z-Score model and examines its potential as a predictive factor of bankruptcy. It also examines the link between a firm's Altman Z-Score and its mean share value to establish if a causative link exists between these two factors within the Indian Manufacturing Sector and used randomly chosen 20 samples from the sector specifically mentioned for the 5-year period from 2018 to 2022. The research highlights a significant relationship between a company's share price and its Z score, and investors can evaluate these Zeta ( $\zeta$ ) index scores based on key financial parameters before attempting to make any well-informed investment choices in distressed businesses with incredibly low Z-

scores that appear on the brink of bankruptcy or insolvency.

Keywords: Altman Z-Score Model, Stock Prices, Financial Health, Indian Manufacturing Sector, Prediction Models, Bankruptcy

## **Introduction**

During the past half century, India has segued from intensive agriculture to a service-based economy. Numerous economists argue that perhaps the Indian economy has not evolved as quickly as other economies in the world because it has overlooked the secondary sector.

The Indian government has lately mainly concentrated on the manufacturing and services sectors. Given the importance of the manufacturing and services sectors and the number of jobs they can generate; the current government has instituted several initiatives aimed at encouraging its economic expansion. With a sizable educated population and skilled workforce, there are countless opportunities for the manufacturing sector to flourish in the country.

The Indian government's 'Make in India' policy, in addition to the subsequent budget 2023-24 declaration on 'Make AI start-up in India,' are one of the most significant approaches and game changers that aim to attract and lure foreign investors to invest in and initiate manufacturing facilities in the country.

The government is creating all required infrastructure, including a reliable road network and railroads, to ensure the seamless transit of goods and services. The government intends to continue pursuing a stable and successful path that is both environmentally conscious and sustainable. The automotive industry, digital and microchip industries, manufacturing equipment, chemical, healthcare, and avionics businesses are just a few key sectors on the upswing (Dangayach & Deshmukh, 2007).

A company's financial well-being, also referred to as economic strength, is essential to its survival. It is a core part that a company must have to endure, thrive, and eventually return wealth to its shareholders. Financial strength is characterized by the capacity to create profit and an adequate cash stream to cover expenses and pay off debt.

A firm's creditworthiness reflects positively upon the firm's financial strength. To better gauge a corporation's financial condition and long-term resilience, diverse accounting metrics should be examined, including balance sheets, statements of income, statements of cash flows and profitability ratios.

Recognizing a company's current fiscal health is among the most important considerations to make while making investment selections. Shareholders must assess the economic situation of the market worth just before attempting to determine a listed company's long-term viability. Insolvency, scams, and financial crimes are just a few instances of what can actually occur if one is oblivious to the financial standing of the company wherein their investments are made.

### **Business Failure**

The incapability of a company to continue its operational processes because of financial challenges is referred to as a business failure. The failure to pay debts when they become due is a serious factor in a company's breakdown, which might result in bankruptcy or divestiture. Business failure forecasting is extremely crucial for various stakeholder groups such as lenders, stockholders, and regulatory authorities to make educated decisions and manage risks. (Aharony, Jones, & Swary, 2004) characterize business failure as a socially repulsive side effect of resource misappropriation.

Many research findings in predicting financial distress have stemmed from business failure. Fitzpatrick (1932) outlined five levels that result in the collapse of a business. There are five types of insolvency: (1) incubation, (2) fiscal embarrassment, (3) economic insolvency, (4) complete insolvency, and (5) confirmed insolvency. When a business is incubating, its financial struggles are just slowly starting. Fiscal embarrassment occurs when leadership is becoming cognizant of the company's state of distress. Economic insolvency takes place when a business finds it difficult to procure the finances necessary to fulfil its contractual obligation. Complete insolvency emerges when liabilities exceed tangible assets. Ultimately, confirmed insolvency happens when legitimate measures are taken to safeguard the firm's lenders or when divestiture happens (Poston, Harmon, & Gramlich, 2011).

## Altman Z Score model

Edward I. Altman devised the Altman Z-Score framework in 1968 as a financial distress forecasting model. It approximates a Z-Score based on a number of financial indicators, which is an index of the plausibility of corporate failure. The model is based on the assumption that examining a company's financial attributes can foresee its financial distress.

Working capital to total assets, retained earnings to total assets, income before interest and taxes to total assets, the market value of the equity to total liabilities, and sales to total assets are all financial metrics included in the model.

X1: Working Capital/Total Assets (WC/TA) - quantifies a company's liquidity and financial viability in the short to medium term. An elevated ratio indicates that the business seems to have enough resources to satisfy its short-term commitments and is in good financial shape. A lower number, on the contrary, might indeed indicate that the business is undergoing financial woes and is constantly battling to repay its debt payments.

X2: Retained Earnings/Total Assets (RE/TA) - appraises how well companies can recoup profits into future expansion by comparing the amount of retained profits relative to total assets.

The better the RE/TA ratio, the superior a firm's financial affairs are perceived. This ratio is useful in determining a company's risk appetite and potential to generate future earnings.

X3: Earnings Before Interest and Taxes/Total Assets (EBIT/TA) - quantifies the proportion of a company's overall assets that generate an income. A greater ratio signifies that the business yields more earnings from its assets, whereas a negative value implies that the company's assets are not utilized as productively. By examining the EBIT/TA ratio, shareholders can determine how effectively a firm's resources are being utilized and decide whether or not to put more money into it.

X4: Market Value of Equity/Book Value of Total Liabilities (MVE/TL) - calculates a firm's financial stability by dividing its market equity valuation by its book value of total obligations. The said ratio would provide essential information about a firm's cash and willingness to meet its financial commitments. Investors and companies can make educated choices about their

investment portfolios in a firm if they fully comprehend this ratio.

X5: Sales/Total Assets (S/TA) - evaluates a company's capacity to drive revenue in relation to its overall assets and has the potential to figure out whether a business is in distress or not.

It is also utilized to gauge how well a business delivers in comparison to its rivals.

Altman devised the initial Z-score Model for public manufacturing enterprises, denoted as Zeta ( $\zeta$ ), after reviewing the ratios by establishing their predictive value, variable linkage, and predictive performance (Altman, 1968).

$$\text{Zeta } (\zeta) = 0.012X1 + 0.014X2 + 0.033X3 + 0.006X4 + 0.999X5$$

Except for X5, the previous model considered necessary absolute percentage values for all factors. As a by-product, Altman (2013) adjusted his model (2013) to render it more efficient.

$$\text{Zeta } (\zeta) = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5$$

A company can be categorized as "safe" or "distressed" based on its Z-Score.

- A Z-score of 3 or higher indicates that the company is in a "safe zone" and is improbable to cease operations.
- Z-score about 1.8 and 3 - the company is in the 'grey area,' with a reasonable chance of going bankrupt.
- Z-score below 1.8 - the company is in a 'distress zone,' with a significantly greater risk of becoming bankrupt.

The Altman Z-Score model is extensively utilised and has been demonstrated to be a strong predictor of financial catastrophe, especially among small and medium-sized businesses.

## Literature Review

(Korath & Nayak, 2022) employed the Altman Z-Score model to examine the financial turmoil of sample manufacturing firms admitted to insolvency under the Insolvency and

Bankruptcy Board of India between 2017 and 2021. According to the investigation, five unhealthful companies had a poor Z-score, implying that they were financially unstable, whilst still the remaining four better and healthier firms had a higher Z-score, inferring financial resiliency. (Qiu, Rudkin, & Dotko, 2020) has used topological data analysis (TDA) to forecast financial distress using the Altman Z-score framework. The study calculates Z-scores for a random selection of publicly listed firms, then utilises TDA to outline the Z-scores onto a Euclidean space, enabling the visual representation of intricate connections between financial data points. The findings suggest that TDA can offer a subtler comprehension of the connections between economic ratios and corporate breakdown, as well as that TDA representation can define subsets of businesses with similar financial characteristics.

(Foo & Pathak, 2019) investigated the connection between the fiscal well-being of manufacturing firms listed in the Hong Kong market, as evaluated by the Altman Z-Score, and performance outcomes, as measured by the Return on Equity (ROE). The study spans the years 2013 to 2017 and finds a positive statistically significant relationship between ROE and the Z- Score.

(Agarwal & Patni, 2019) quantify Z-scores using financial information from BSE PSU income statements and balance sheets over a ten-year period using the Altman Z-score conceptual framework and employ these results to categorise the Entities either as financially sound or financially distraught. The study also emphasizes the Altman Z-score model's strong points in predicting financial distress in these industries, exhibiting its outstanding performance in contrast to other frequently used forecasting models such as the Springate framework and the Ohlson O-score version.

(Tung & Phung, 2019) provides useful information on the Altman Z-score model's appropriateness for predicting financial distress in the frame of reference of interdisciplinary Vietnamese enterprises. The paper stresses the Altman Z-score model's unique qualities in testing the hypothesis in these businesses and recognises the variables that contribute to financial hardship in these businesses.

(Nandini, Zachariah, & Rao, 2018) used the Altman Z-score model to forecast the financial

distress of ITI Ltd., a government Indian telecommunications company, over a 22-year time frame. Based on the study, the Z-Scores supplied red flags to the corporation about its economic state eight years well before the disorder. The research results inevitably disclosed a glaring shortage of understanding on the part of ITI Ltd, in addition to a rise in debt that led to the firm's inevitable failure.

Batchelor, (2018) improved the Altman Z-Score Model and compared it to the original model. These modifications were made because additional paid-in capital (APIC) supplied an observed amount of market worth depending on the quantity paid in by shareholders rather than the par value of the stock, and dividend payments were paid as a proportion of sales to provide perspective into the amount a business recovered to its shareholders from its sales revenue. The findings showed that the revised model yielded important results in terms of its capacity to anticipate catastrophic failures.

(Venkadasalam, 2016) utilised Altman's Z-EM score framework to evaluate the financial trouble scenario of companies that are listed Malaysian shipping companies from 2008 to 2014. Only four variables are used in the new Z-EM score prototype for non-manufacturing and service sectors such as shipping. These ratios are leverage, earnings, leverage, and liquidity. (Almamy, Aston, & Ngwa, 2016) sought to demonstrate a considerable improvement in the forecasting of business failures by incorporating factor J6, which partitioned operating cash flow by total debt. The Bloomberg database was consulted to gather data, and 1000 British businesses were analysed, with 90 having failed over a 13-year period (2000-2013). Once the two models were contrasted in forecasting collapse for each corporation, it was unearthed that the hybrid method, also known as the J-UK model, was much more credible in the prognostication of failed and non-failed general UK companies before, during, and following Britain's economic meltdown.

(Bashir, Javed, & Iqbal, 2015) employed the Altman Z score and financial metrics to assess financial health as a feasible predictability tool for 104 businesses that were listed on the Karachi exchange in the building projects, chemical, food, technology, and automotive sectors. (Rscolean, Dobra, & Slusariuc, 2012) constructed a financial evaluation process map using the LabVIEW visual programme to calculate and identify the insolvency possibility in

the Z-Score prototype for a specified failure rate correlating to a given time interval estimated using the ratio of overall failed businesses to total the number of businesses (both bankrupt and healthy). The flow diagram is coded to follow the pre-assigned scheduled steps in order to determine the insolvency risk score requisite by the technique selected.

(Harrison, 2005) utilised Altman's 1983 4 z-score prototype on a sample of fifty malfunctioning factories and 11 flawed service industries from 1998 to 2003 to discover the significant distinction in predicting financial distress among businesses with various asset sizes. The study reveals that the findings have little or no direct effect on financial forecasting.

### **Research Methodology**

Only research on the usefulness of the Altman Z score model in foretelling bankruptcy in manufacturing enterprises could be found in a survey of previous papers and publications. There has been a little in-depth study of the connection between a company's stock price and its Altman z score.

The study's primary research goals are to:

1. To assess the Altman Z-Score for listed manufacturing firms in India and, using the data, to determine how predictable business failure is.
2. To assess the level of association between the Altman Z-Score and the company's stock prices.

The following hypothesis is tested.

$H_0$  = There exists no relationship between the Altman Z-Score and Stock Prices of the listed Indian Manufacturing Industries.

The study will be conducted based on the audited financial statements of the 20 listed Indian Manufacturing companies that have been randomly selected for this study. The Altman Z-score and the share price were verified with Top Stock Research (TSR), an independent analytics website that screens stocks and provides information based on inputs from the



company reports and stock exchanges.

The study will also make use of the share prices of these companies as per the National Stock Exchange (NSE) to compare the relationship between their share prices and their Altman Z-Scores. The sampling 5-year period is from 1st April 2017 to 31st March 2022 (2018 to 2022).

### **Analysis and Interpretation**

This study attempts to examine the original study intent by using financial information from a firm over 5 years and evaluating the important variables in the collation of the Altman Z-Score. Tables 1 and 2 illustrate the total value of the Altman Z-Score and stock values for each company in that given year, and the viewpoint of the probability or improbability of failure is derived from and is exhibited in its Z-score heat map.

At last, a correlation test is performed to investigate the hypothesis that there exists a link between stock prices and the Altman Z-Scores of the companies' samples taken. These results were summarized in Table 3 by using a tool developed by Jamovi, a statistical open-source software. A greater value of correlation signifies that the two factors are more likely to be related in nature. It has a range of -1 to 1. The P value attributed to these scores demonstrates the likelihood of a linear association. Values less than 0.05 appear to suggest a linear association, while values higher than 0.05 imply that there is no meaningful relationship and that any semblance of a connection is purely coincidental.

Company	2018	2019	2020	2021	2022
UltraTech Cement Ltd	3.54	2.86	2.79	3.80	5.12
Vadilal Industries	3.21	2.98	2.39	2.98	4.06
Tata Motors Ltd	1.61	0.955	0.917	0.971	1.31
Birla Tyres Ltd	-	-4.70	-0.966	-2.25	-5.83
Sintex Plastics Technology Ltd	10.12	8.35	-2.49	-0.857	-0.325
Sakthi Sugars Ltd	-0.311	-0.447	-0.704	-0.718	-0.720
Nagarjuna Fertilizers & Chemicals Ltd	0.796	-0.507	-0.813	-1.95	-1.23
PC Jeweller Ltd	3.82	2.86	1.98	1.79	1.35
Bata India Ltd	11.65	18.13	7.57	8.43	10.82
NRB Industrial Bearings Ltd	-1.09	-0.908	-1.84	-0.662	-0.933
ITC Ltd	19.09	20.52	13.71	14.71	15.75
Arvind Ltd	2.16	1.91	1.62	1.53	2.10
Amrutanjan Health Care Ltd	16.33	16.65	16.01	20.74	20.20
Sharda Cropchem Ltd	4.02	4.57	2.89	3.55	4.21
Ashok Leyland Ltd	2.46	2.00	1.25	1.31	1.45
Nilkamal Ltd	6.99	7.38	4.94	5.58	5.30
Coromandel International Ltd	3.45	3.53	4.34	6.76	6.36
Schaeffler India Ltd	9.84	13.25	16.21	11.17	69.55
Pidilite Industries Ltd	20.65	24.89	23.08	19.26	26.80
Ambika Cotton Mills Ltd	6.25	5.90	4.55	7.73	12.27

<b>&gt; 3 - Safe Zone</b>
<b>1.8 to 3 - Gray Zone</b>
<b>&lt;1.8 - Distress Zone</b>

**Table 1 : Altman Z-Score Analysis of the selected NSE listed Manufacturing Companies**

Based on the information contained in Table 3, it is feasible to conclude that there is a clear association between a few companies' share prices and their corresponding Altman Z-Scores. Although certain companies expressed associations between the two parameters through estimations, other companies' total score and price fluctuations are sporadic in the relation to each other.

Company	2018	2019	2020	2021	2022
<b>UltraTech Cement Ltd</b>	3950.00	3998.35	3244.85	6737.95	6602.30
<b>Vadilal Industries</b>	845.85	608.15	449.10	895.65	1409.80
<b>Tata Motors Ltd</b>	326.85	174.25	71.05	301.80	433.75
<b>Birla Tyres Ltd</b>	-	0	3.00	22.80	20.90
<b>Sintex Plastics Technology Ltd</b>	57.50	19.95	0.65	3.30	5.45
<b>Sakthi Sugars Ltd</b>	16.25	11.25	7.35	9.40	13.45
<b>Nagarjuna Fertilizers &amp; Chemicals Ltd</b>	15.35	6.90	3.00	6.30	12.95
<b>PC Jeweller Ltd</b>	320.20	82.20	11.45	27.10	20.90
<b>Bata India Ltd</b>	729.95	1405.05	1231.10	1406.20	1961.40
<b>NRB Industrial Bearings Ltd</b>	19.85	20.05	5.40	19.05	27.00
<b>ITC Ltd</b>	255.50	297.25	171.70	218.50	250.65
<b>Arvind Ltd</b>	382.95	90.95	19.65	65.85	115.45
<b>Amrutanjan Health Care Ltd</b>	270.35	309.25	329.95	567.65	794.60
<b>Sharda Cropchem Ltd</b>	381.25	369.95	107.30	286.80	615.00
<b>Ashok Leyland Ltd</b>	145.45	91.30	43.05	113.50	117.25
<b>Nilkamal Ltd</b>	1519.85	1429.65	997.70	1950.75	2028.30
<b>Coromandel International Ltd</b>	525.15	507.50	546.20	774.55	799.60
<b>Schaeffler India Ltd</b>	1172.59	1139.55	940.35	907.25	8784.40
<b>Pidilite Industries Ltd</b>	917.80	1246.25	1356.40	1809.40	2454.30
<b>Ambika Cotton Mills Ltd</b>	1291.15	1121.50	527.95	890.50	2356.30

***Table 2 : Share Prices of the selected NSE listed Manufacturing Companies***

***(In Rs.)***

Thus, based on the majority of the findings, the study can state categorically that for 12 of such 20 companies, the H<sub>0</sub> or Null hypothesis has failed to be rejected because there was no significant relation between share price and the Altman Z-score. In the particular instance of some companies, it has been observed that there is a good association seen between the Z score and their corresponding stock prices.

Nevertheless, when compared to the overall sample, the research showed that these changes

were exacerbated by market dynamics and investor sentiments.

Company	Pearson's Correlation	p-value (at 95% c.f.)	Result
UltraTech Cement Ltd	0.8126	0.094599	Not significant
Vadilal Industries	0.9567	0.010745	Significant
Tata Motors Ltd	0.6597	0.225741	Not significant
Birla Tyres Ltd	-0.4203	0.481406	Not significant
Sintex Plastics Technology Ltd	0.8818	0.047908	Significant
Sakthi Sugars Ltd	0.675	0.211233	Not significant
Nagarjuna Fertilizers & Chemicals Ltd	0.5339	0.354057	Not significant
PC Jeweller Ltd	0.9121	0.030868	Significant
Bata India Ltd	0.0202	0.974282	Not significant
NRB Industrial Bearings Ltd	0.8273	0.083886	Not significant
ITC Ltd	0.9026	0.035952	Significant
Arvind Ltd	0.7329	0.158902	Not significant
Amrutanjan Health Care Ltd	0.887	0.044818	Significant
Sharda Cropchem Ltd	0.7703	0.127501	Not significant
Ashok Leyland Ltd	0.6036	0.281096	Not significant
Nilkamal Ltd	-0.0664	0.916027	Not significant
Coromandel International Ltd	0.9771	0.004146	Significant
Schaeffler India Ltd	0.9937	0.0006	Significant
Pidilite Industries Ltd	0.4619	0.433529	Not significant
Ambika Cotton Mills Ltd	0.9113	0.031286	Significant

**Table 3 : Correlations between stock prices and the Altman Z-Scores of the selected NSE listed Manufacturing Companies**

The strong correlation is caused by variables besides the stock price, that fall outside the scope of our investigation.

The four factors used to measure the Z score, particularly regarding X1, X2, X3, and X4, are the factors that significantly and justifiably influence the Z scores. Variations in the score are

caused by changes in these four indicators and the degree to which they start changing.

This original study's random sample was also constrained to just 20 companies. This could be yet another rationale for why the hypothesis testing did not yield definitive results.

### **Findings, Suggestions and Implications**

The study's general research indicates that employing the Altman Z-Score model as a determinant of financial distress has a significant impact. The majority of the 20 samples collected had their total score correlated to their investment portfolios during a specified timeframe. For certain firms, previous years' scores in the negatives served as a sort of red flag, the ignorance of which might result in bankruptcy in the long term.

For example, despite an increase in share price, Birla Tyres Ltd.'s Altman Z-score showed a downward trend, but the National Company Law Tribunal (NCLT) ordered the initiation of insolvency proceedings in May 2022 due to defaulting payments of Rs. 15.84 crores to SRF Ltd. Firms that have observed positive values in their Altman Z-Scores, on the other hand, do correspond with the firm's financial sustainability and overall soundness. The Altman Z-Score Model has been found to be a dependable predictor of economic failure, at least for manufacturing enterprises, indicating a firm's financial strength through its zones of discrimination, and serving as a utopian model for firms to analyse their economic condition during a given fiscal year.

Based on the findings of this study, a few recommendations can be made. The Altman Z score is based on five dimensions, but there are innumerable other markers of a company's financial stability. Based solely on these five constructs, it fails to portray well enough emerging companies, for example, even though their revenues are too low, indicating a considerable risk. It also neglects to take into consideration factors such as the magnitude of a firm's management or the type of market within which it operates.

All of these elements play a vital role in a business's performance framework. The second proposition can be taken in tandem with the first, and a thorough inquiry into the factors that influence a firm's earnings and endurance is required. At last, the study indicated that share

price is adversely affected not solely by how well the company is doing autonomously, but also by other attributes such as media releases on future revenues, the launch of a novel product, attempting to secure a contract, employee furloughs, predicted buyouts, changes in leadership structure, and so on.

### **Scope for further research and limitations**

The investigation used a small sample size of 20 publicly held manufacturing industries across India. The analysis could've been expanded to encompass multiple sectors and classify the persistence of the Altman Z-score in forecasting financial distress in numerous market segments. Further adaptations to the Altman Z-score parameters could optimize predictive ability in future research. Strong predictive models for financial distress could be employed integrally while advising that investors should take sensible precautions in the marketplaces with the emergence of tech and AI-powered tools.

The Altman Z-Score isn't a realistic model, making it one of the original study constraints. Apart from the ratios included in the method of calculating, it disregards numerous other financial facets of organisations. The scoring system is dependent on information given directly according to each company, which means it is only almost as good as the numbers reported by the corporate entity. The financial information available data is grossly inadequate. Moreover, there is no widely accepted methodology for companies from various industry segments, making decisions based on these comparisons difficult.

### **Conclusion**

Financial health and economic distress are two crucial predictors of a company's overall efficiency and long-term survivability. In the context of the Indian manufacturing industry, a thorough assessment of financial viability and distress is necessary for stakeholders including investors, lending institutions, distributors, and regulatory authorities to make sound decisions. The Indian manufacturing industry has evolved significantly in past decades, evidenced by high competitors in the market, global economic integration, and advancements

in technology. As a direct consequence, acknowledging industrial firms' financial health and economic distress is vital for comprehending the industry's current situation and future development opportunities.

This research is significant because it offers pertinent information about the current state of the Indian manufacturing sector, the variables impacting economic well-being and economic distress, and the repercussions of these markers on corporate profitability. The study's findings can be employed by various stakeholder groups within the Indian manufacturing sector to make well-informed choices and therefore by legislators to implement innovative policies to promote the industry's sustainable development and growth.

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