

CASE STUDY



Altman's Z-Score and the financial health of Tata Steel: An empirical investigation

Shital Vekariya

Department of Accounting & Financial Management, The Maharaja Sayajirao University of Baroda, Vadodara, India

ABSTRACT

Tata Steel is one of the leading steel companies in India and plays an important role in supporting the industrial growth and infrastructure of the country. However, it faces many financial challenges due to various factors like high investment requirements, international market fluctuations, and ever-changing demand cycles etc. The present study uses the Altman's Z-Score model to examine the financial condition and probable risk of bankruptcy between 2020 and 2024 of TATA STEEL COMPANY. The present model analyses various key aspects like liquidity, profitability, debt levels, and efficiency level of the company.

The study also demonstrates that Altman's Z-Score is very powerful tool for identifying early signs of financial loss, especially in the industry which requires heavy capital investments. It also emphasizes on how much company has strong financial planning to handle various economic instabilities and long-run stability. For investors, regulators, company leaders, the results which provides practical insights into Tata Steel's financial journey and highlights broader lessons for managing various probable risks in the steel industry.

By using audited income statement, Balance sheet and other financial statements, the analysis draws conclusion that Tata Steel can maintain a position in the safe zone until 2022, after which its Z-Score declined from peak, placing it into the grey zone. This sudden shift is because of rising debt levels and deteriorating profitability.

KEY WORDS

Financial distress; Altman's Z-Score; Sustainable business; TATA steel company; Bankruptcy Prediction; Corporate Financial Health

ARTICLE HISTORY

Received 2 July 2025;

Revised 31 July 2025;

Accepted 7 August 2025

Introduction

The financial sustainability of large corporation's house is one of the major worry for investors, politicians, regulators and especially capital-intensive industries like steel. India's large steel producing company, Tata Steel has recently faced numerous challenges due to changing global demand, debt, and the economic disruptions caused by the COVID-19 pandemic. Tata Steel's financial health must be needed to assess thoroughly to detect both short-term liquidity and long-term solvency issues.

What is meant by corporate financial distress?

Financial distress occurs when a company is struggling in payment of its bills, loans, or other obligations. It means the business is feeling under pressure because debts are rising, profits are falling, and cash flow is not enough to cover expenses. If this situation continues for a long time, the company may gradually face insolvency or situation of bankruptcy. Bankruptcy prediction has long been a crucial aspect of financial analysis, serving as an early warning system to identify firms at risk of financial distress or insolvency [1].

Why to Use the Z-Score?

The Altman Z-Score is a tool developed to predict whether a company is at risk of bankruptcy or not. It is calculated by combining financial ratios such as profitability, liquidity, debt levels, and efficiency and converting into one single score.

- If the score is high, the company is to be considered as safe.

- If the score is in the middle range (grey zone), the company faces moderate risk, and it should be watched closely to convert into safe zone.
- If the score is low, the company is in the distress zone and may be moving toward bankruptcy.

The Z-Score is useful because it gives a quick, and overall picture of a company's financial health and acts as an early warning system for managers, investors, and regulators. It helps them to act before such situation arises and becomes too serious.

Altman Z-Score

The reason why the Altman Z-Score is popular in analysing financial health is its accuracy and easy to understand. The Z-Score provides the quantitative approach for prediction of financial distress. It is very useful tool for investors, analysts, and corporate managers in evaluating a company's health and stability. However, the Z-Score is applicable across various sectors of the market, and making it a popular model [2].

The Z-Score is calculated as follows:

$$Z = 1.2(X1) + 1.4(X2) + 3.3(X3) + 0.6(X4) + 1.0(X5)$$

Where:

X1 = Working Capital / Total Assets

X2 = Retained Earnings / Total Assets

X3 = Earnings before Interest and Taxes (EBIT) / Total Assets

$X_4 = \text{Market Value of Equity} / \text{Total Liabilities}$

$X_5 = \text{Total Sales} / \text{Total Assets}$

Calculation of X_1 : Formula: $X_1 = \frac{\text{Working Fund}}{\text{Total Assets}}$

Explanation of formula:

- This ratio helps to assess a company's ability to pay off its short-term debts using the total assets considering total assets can be sold out whenever required to convert into cash.
- Working Capital (Current Assets - Current Liabilities) indicates whether a company has enough resources to recover its short-term debts including current liabilities.
- Total Assets represent the total financial strength of the company.

Analysis:

- High Ratio suggests Strong liquidity and short-term financial health.
- Low Ratio suggests weak liquidity and potential cash flow issues.
- Negative Ratio suggests the company has more liabilities than total assets giving alarm to financial distress.

Calculation of X_2 : Formula: $X_2 = \frac{\text{Retained Earning}}{\text{Total Assets}}$

Explanation of formula:

- It measures how much profit of the company has been reinvested instead of distributing among shareholders as dividends.
- Retained earnings of the company represent past accumulated profits over the time and reflect the company's ability to finance its own growth without much relying on debt.
- It also indicates whether the company has strong financial foundation in form of accumulated profit.

Analysis:

- High Ratio indicates strong financial health and well-managed profits.
- Low Ratio indicates weak financial position and excessive rely on debt.
- Negative Ratio indicates the company has accumulated losses instead of retained earnings in form of a reserve.

Calculation of X_3 : Formula: $X_3 = \frac{\text{EBIT (Earning before Interest \& Taxes)}}{\text{Total Assets}}$

Explanation of formula:

- EBIT (Earnings before Interest & Taxes also known as Operating Profit) represents profitability before interest and tax expenses.
- This ratio indicates how effectively the company is generating profit from its total assets.
- It is a key indicator of operational efficiency and overall financial health of the company.

Analysis:

- High Ratio indicates strong profitability and effective asset utilization.
- Low Ratio indicates weak profitability and potential inefficiencies.

- Negative Ratio indicates operating losses which might turn into financial trouble.

Calculation of X_4 : Formula: $X_4 = \frac{\text{Market value of Equity}}{\text{Total Liabilities}}$

Explanation of formula:

- It suggests whether a company rely more on borrowed funds or funds from investors to run its business activities.
- Market Value of Equity means Market Value of Share \times Number of Shares
- Total Liabilities include both short-term and long-term debt obligations.

Analysis:

- High Ratio indicates lower financial risk and strong investor confidence.
- Low Ratio indicates high debt burden and probable financial stress.
- Negative Ratio indicates the company has more liabilities than its owners fund, which is an also a kind of red flag for bankruptcy.

Calculation of X_5 : Formula: $X_5 = \frac{\text{Sales}}{\text{Total Assets}}$

Explanation of formula:

- It shows how well a company turns its assets into income.
- If the ratio is high, it shows the company is making good use of its assets. A low ratio, on the other hand, points to poor or inefficient use.

Analysis:

- High Ratio indicates efficient utilization of total assets and strong generation of sales revenue.
- Low Ratio indicates weak asset efficiency and slow sales turnover.
- Negative Ratio indicates extremely rare and indicate accounting errors or major financial distress.

Interpretation of the Z-Score

From the above explanation of formula, we can conclude that

- Company is in safe zone if its Z-score is above 2.99. It means that the company is financially sound and unlikely to face bankruptcy.
- Company is in grey zone if its Z-score is between 1.81 and 2.99. It means that the company's financial health is uncertain and may need improvement.
- Company is in distress zone if its Z-score is below 1.81. It means that the company is in serious financial trouble and faces a high chance of failure.

Review of Literature

A quantitative analysis has conducted on financial distress in the Indian pharmaceutical sector using the Altman Z-Score Model. The study assessed the financial risk of 10 pharmaceutical companies with different market capitalizations over eight years (2015- 2022). The findings revealed that most large, mid-sized, and small pharmaceutical firms were financially stable, while some companies fell into the grey zone, indicating moderate risk. However, Wockhardt Ltd., Nectar

Lifes cience Ltd., Lyka Labs Ltd., and Wanbury were in the bankruptcy zone, requiring urgent financial restructuring [3].

A study carried out to examine financial distress in India's Fast-Moving Consumer Goods (FMCG) sector using the Altman Z-Score model. Their research focused on assessing the financial condition of five leading FMCG companies, ITC, Britannia, Hindustan Unilever (HUL), Nestlé India, and Dabur, over a ten-year span from 2014 to 2023. The goal was to understand how these companies' financial health changed over time. The results showed that all five firms were financially sound and fell within the safe zone according to the Z-Score model. However, the study noted a significant drop in Britannia's score, which fell from 6.1 in 2017 to 3.77 by 2023. This decline pointed to increased financial instability. The researchers attributed this fluctuation to the economic disruptions caused by the COVID-19 pandemic, which temporarily affected the financial performance of companies across the sector. Despite these challenges, the overall conclusion was that the FMCG sector remains strong, with little risk of bankruptcy [4].

A study on the financial distress prediction of Indian steel companies using the Altman Z-score model analyzed the financial statements of ten steel companies over five years (2016-2021), including Tata Steel, JSW Steel, Jindal Steel, and SAIL, and others. The study suggested that companies in distress should implement better financial management strategies to improve liquidity and solvency. The objective was to evaluate their financial health and predict the likelihood of bankruptcy. The findings revealed that companies like Tata Steel, JSW Steel, and Jindal Steel fell into the distress zone, indicating a high probability of financial distress, while others like APL Apollo Tubes Ltd were in the very much safe zone. The conclusion emphasized that the Altman Z-score remains a reliable tool for assessing corporate financial health and can serve as a valuable indicator for investors and management [5].

It is explored that the financial health of Tata Motors Ltd. is assessed using Altman's Z-score model. The authors aimed to analyze Tata Motors Ltd. by applying the Altman Z-score model. The research is focused on evaluating the company's financial status over five years, using data from 2017 to 2021. The core analysis involved by applying the Altman Z-score model to this data. Their analysis revealed that Tata Motors Ltd. was in a distress zone during the period of the study. However, the authors noted that more recent data suggested the company was making efforts to recover from this distress [6].

The research has been conducted on 25 companies from five leading sectors in the areas of Oil and Gas, Automobile, IT, Pharmaceutical, and Textile. The study aimed to classify companies into different financial distress levels using discriminant analysis over a 10-year period (2008-09 to 2017-18). One significant finding was that Vijay Textiles Ltd. was in the distress zone, indicating high financial risk. The study has recommended that such companies should reduce long-term debt and focus more on equity to improve its financial stability. The research concluded that retained earnings to total assets and EBIT to total assets were the most critical financial indicators for predicting financial distress [7].

The study focused on 12-year period (2010-2022) and focused to assess the financial stability of selected pharmaceutical firms. The research focused on 10 major pharmaceutical companies listed on the National Stock Exchange (NSE). The analysis revealed that the pharmaceutical sector was in good financial health, and most of the companies falling within the safe zone according to the Altman Z-score model. However, the study acknowledged that financial distress could arise due to poor management, market competition, and economic downturns, making continuous financial monitoring. The author suggested that companies should maintain strong financial discipline and adopt risk management strategies to avoid financial distress [8].

A study on the financial health of major 20 FMCG companies in India using the Altman Z-Score Model analyzed financial data of various companies listed on the Bombay Stock Exchange (BSE), covering segments such as personal care, food & beverages, dairy, soaps, detergents, and tobacco products. The research aimed to check the probability of bankruptcy and evaluate whether the Z-score is a reliable tool for predicting financial distress. The results showed that most of the companies were financially stable and fell within the safe zone, while a few were initially in the grey zone but improved over time. The study found a positive correlation between financial ratios and the Altman Z-score, confirming the model's reliability [9].

It is verified that the financial distress of five major Indian pharmaceutical companies using the Altman Z-score model over a period of five year (2017-2022) carried out to assess the likelihood of bankruptcy and to evaluate the financial health of the pharmaceutical sector. The study found that the Z-score for the pharmaceutical sector was above 4.5, significantly higher than the distress threshold of 1.8, indicating that the sector was financially stable. The authors concluded that Indian pharmaceutical firms were in good financial health, but continuous monitoring was necessary. The study recommended that companies should track financial indicators regularly and use financial models like the Altman Z-score for decision-making [10].

Research Gap

Many studies have used Altman's Z-Score to check financial distress in Indian companies, but very few have looked closely at individual firms in the steel industry over time. Most of the past researches either compares multiple companies at one point or focuses on general sector trends, without tracking how a major company like Tata Steel's financial health has changed year by year.

Also, earlier studies haven't paid much attention to how events like the COVID-19 pandemic affected the Z-Score components, especially in countries like India, where stock prices (used in X4) and working capital (used in X1) can change quickly and unpredictably. This makes it harder to rely on the original Z-Score model without adjusting it for local conditions.

This study helps fill these gaps by:

- It analyses Tata Steel's financial health over five years using Z-Score.
- It shows how retained earnings and short-term profits can talk about two different stories.

- It shows how retained earnings and short-term profits can talk about two different stories.
- It also pointing out where the Z-Score model may need adjustments for Indian market conditions

Research Objectives

- To evaluate the financial stability of Tata Steel through the application of Altman's Z-Score framework.
- To determine company's classification within the Z-Score spectrum, safe, grey, or distress zone, based on their financial performance.

Population:

The population for this study includes all steel companies operating in India, particularly those listed on the stock

exchange. However, this research focuses specifically on Tata Steel as it is one of the largest and most influential companies in the Indian steel industry.

Sample units:

This study focuses on a Tata Steel. This company is selected based on their market prominence, financial impact, and availability of financial data.

Sampling Frame:

The sampling frame includes the financial statements of Tata Steel.

Z-Score Analysis of Tata Steel

The researcher has analysed the data based on the financial data published on official website of the company as follows:

Table 1 . Raw Data of Tata Steel (all figures are in crores).

Particulars	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24
Current assets	19,959.03	28,890.78	31,289.57	40,515.56	36,765.14
Current liabilities	30,871.30	29,313.32	53,664.83	51,791.43	50,640.40
Retained earnings	32,106.96	46,480.00	76,498.67	86,491.20	86,727.36
Total assets	1,50,392.56	1,80,491	2,21,986.22	2,42,695.73	2,45,634.06
Non-current liabilities	42,683.14	55,238.21	42,887.63	54,295.42	57,300.01
Sales	64,869.00	60,435.97	1,29,021.35	1,42,913.32	1,40,987.43
Total liabilities	73,554.44	84,551.53	96,552.46	1,06,086.85	1,07,940.41
MP	269.80	812.00	1,085.30	₹ 113.20	177.9
No of shares	1,144.75	1,198.58	1,222.17	1,222.15	1,248.35
PBT	6,610.98	17,795.13	44,090.65	20,089.70	9,172.15
Finance cost	3,031.01	3,393.84	2,792.08	3,974.63	4,178.61
EBIT	9,641.99	21,188.97	46,882.73	24,064.33	13,350.76
Market cap	308853.55	973246.96	1326421.1	138347.38	222081.465

The descriptive statistics in above Table 1 summarised the various data on current assets, current liabilities, total assets, sales, EBIT etc. (Table 1) [11].

Calculations of Ratio for Tata Steel

Working Capital to Total Assets Ratio

Table 2 . (X₁)

Particulars	March-20 (Rs.)	March-21 (Rs.)	March-22 (Rs.)	March-23 (Rs.)	March-24 (Rs.)
Working capital	-10,912.27	-422.54	-22,375.26	-11,275.87	-13,875.26
Total assets	1,50,392.56	1,80,490.93	2,21,986.22	2,42,695.73	2,45,634.06
Formula : $X_1 = \frac{\text{Working Capital}}{\text{Total Assets}}$					
Working capital/total assets (X ₁)	-7.26%	-0.23%	-10.08%	-4.65%	-5.65%

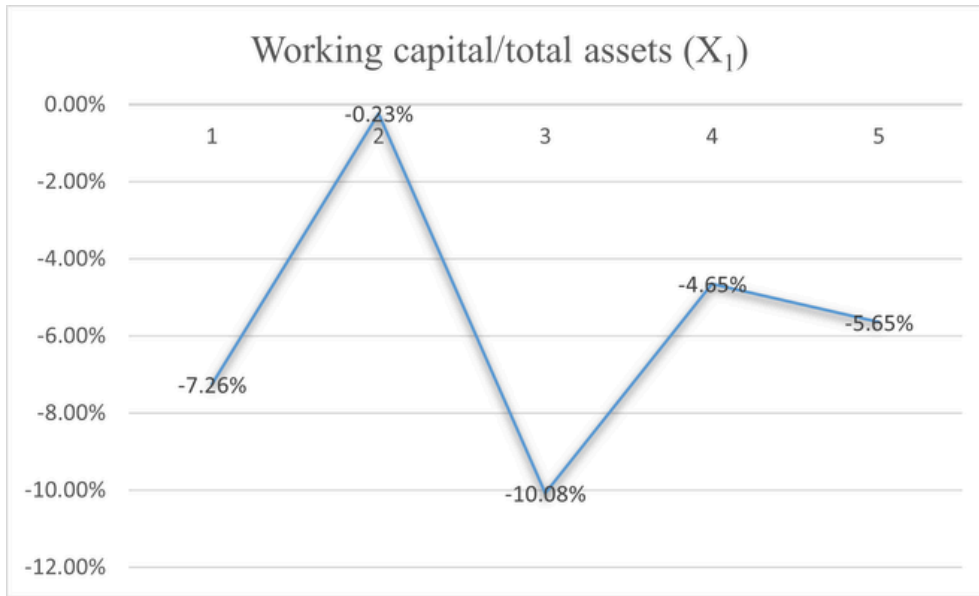


Figure 1. Working Capital / Total Assets (Liquidity Ratio)

Analysis:

- The ratio has been negative for most of the years, indicating liquidity issues because of COVID-19 pandemic situation.
- It slightly improved on Mar-22 but declined again on Mar-23 and Mar-24, suggesting difficulty in managing

short-term obligations.

- This indicates a reliance on external financing or insufficient current assets relative to total assets (Table 2) (Figure 1).

Why to Use the Z-Score?

Table 3 . (X₂)

Particulars	March-20 (Rs.)	March-21 (Rs.)	March-22 (Rs.)	March-23 (Rs.)	March-24 (Rs.)
Retained earnings	32,106.96	46,480.00	76,498.67	86,491.20	86,727.36
Total assets	1,50,392.56	1,80,490.93	2,21,986.22	2,42,695.73	2,45,634.06
Formula : (X ₂) = $\frac{\text{Retained Earning}}{\text{Total Assets}}$					
Retained earnings/total assets (X ₂)	21.35%	25.75%	34.46%	35.64%	35.31%

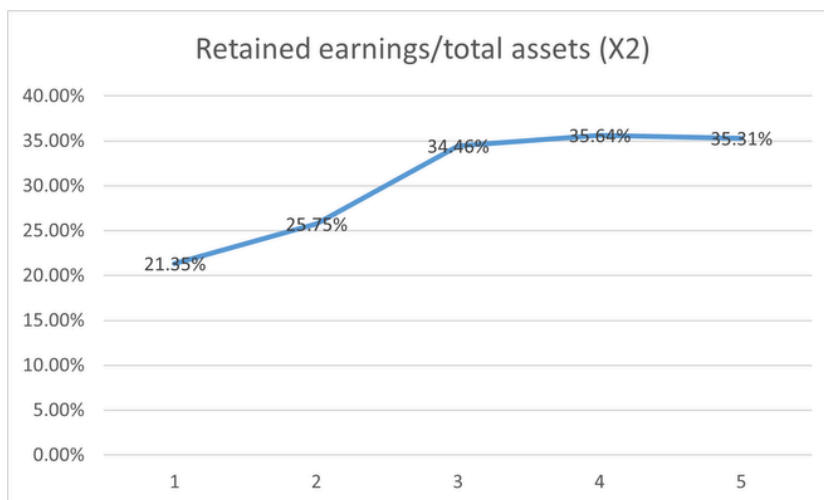


Figure 2. Retained Earnings / Total Assets.

Analysis:

- The ratio has been consistently increasing from 21.35% in Mar-20 to 35.31% in Mar-24, which is a positive indicator.
- Retained earnings are cumulative, reflecting profits

retained over many years. A rising X2 means past profits were not distributed as dividends but reinvested.

- The company is maintaining a strong internal financing structure, enhancing long-term sustainability with the help of retained earnings (Table 3) (Figure 2).

Table 4 . (X₃)

Particulars	March-20 (Rs.)	March-21 (Rs.)	March-22 (Rs.)	March-23 (Rs.)	March-24 (Rs.)
EBIT	9,641.99	21,188.97	46,882.73	24,064.33	13,350.76
Total assets	1,50,392.56	1,80,490.93	2,21,986.22	2,42,695.73	2,45,634.06
Formula : (X ₃) = $\frac{\text{EBIT}}{\text{Total Assets}}$					
EBIT/total assets (X3)	6.41%	11.74%	21.12%	9.92%	5.44%

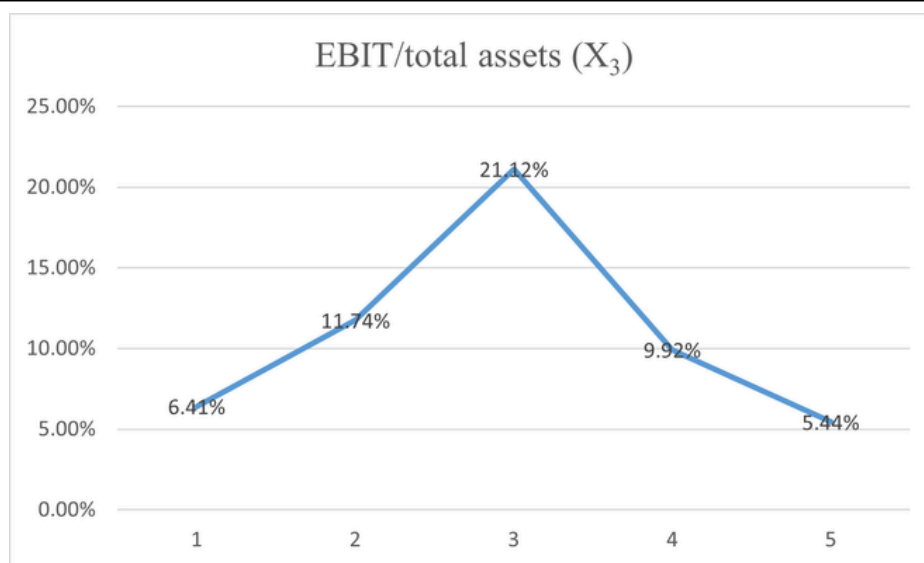


Figure 3. Earnings before Interest and Taxes (EBIT) / Total Assets.

Analysis:

- EBIT to total assets saw an upward trend until Mar-22, peaking at 21.12%, indicating strong operational profitability. In 2022, Tata Steel posted exceptionally high EBIT due to favourable steel prices and strong global demand, which significantly boosted this ratio.
- In 2022, Tata Steel had strong earnings due to high global steel demand and favourable pricing situation.
- However, it dropped significantly on Mar-23 and Mar-24, which could be due to increasing costs, declining

revenue, or macroeconomic challenges despite having good accumulated retained earnings.

- High X3 value means the company was productive and profitable, which adds significant weight to the Z-Score.
- Since X3 has a high multiplier (3.3) in the Z-Score formula, even a small increase in EBIT can boost the overall score considerably.
- A declining trend in profitability may indicate lower efficiency in total asset utilization (Table 4) (Figure 3).

Market Value of Equity to Total Liabilities Ratio

Table 5 . (X₄)

Particulars	March-20 (Rs.)	March-21 (Rs.)	March-22 (Rs.)	March-23 (Rs.)	March-24 (Rs.)
Market capitalization	308853.55	973246.96	1326421.1	138347.38	222081.465
Total liabilities	73,554.44	84,551.53	96,552.46	1,06,086.85	1,07,940.41
Formula : (X ₃) = $\frac{\text{Market Value of Equity}}{\text{Total Liabilities}}$					
Market Capitalization/Total Liabilities (X4)	419.90%	1151.07%	1373.78%	130.41%	205.74%

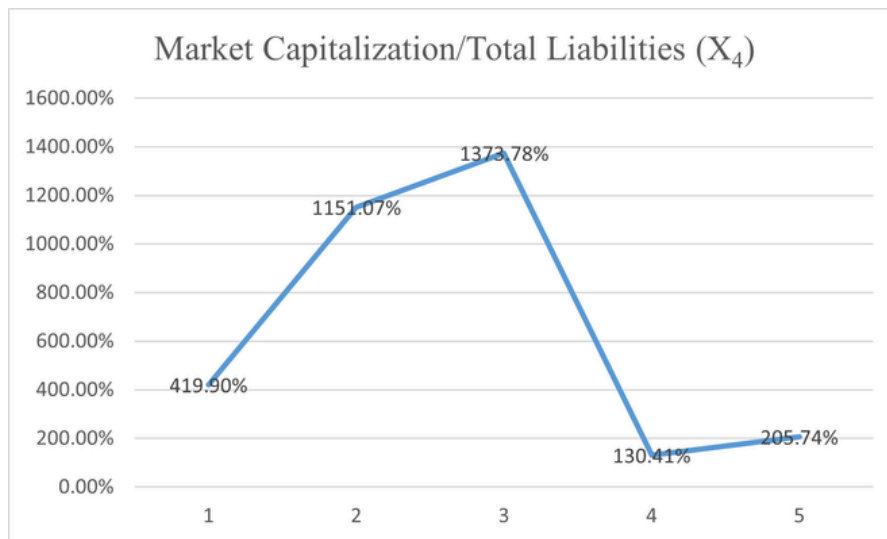


Figure 4. Market Value of Equity / Total Liabilities (Financial Leverage Ratio).

Analysis:

- The ratio was at its highest in Mar-21 (1151.07%) and Mar-22 (1373.78%), indicating strong investor confidence and high valuation relative to liabilities.
- In 2022, Tata Steel's share price rose, increasing its market capitalization.
- However, it dropped sharply in Mar-23 (130.41%), suggesting a fall in market confidence, potential debt accumulation, or stock price correction due to post-pandemic situations. While it slightly improved in Mar-24

(205.74%), the volatility suggests market fluctuations impacting Tata Steel's valuation.

- A higher X₄ means the company's equity was strong relative to its liabilities, showing low bankruptcy risk from the market's perspective.
- Though X₄ has a smaller weight (0.6), it still helps offset weaknesses in liquidity or short-term financial stress (Table 5) (Figure 4).

Total Sales to Total Assets Ratio

Table 6 . (X₅)

Particulars	March-20 (Rs.)	March-21 (Rs.)	March-22 (Rs.)	March-23 (Rs.)	March-24 (Rs.)
Total sales	64,869.00	60,435.97	1,29,021.35	1,42,913.32	1,40,987.43
Total assets	1,50,392.56	1,80,490.93	2,21,986.22	2,42,695.73	2,45,634.06
Formula : (X ₅) = $\frac{\text{Total Sales}}{\text{Total Assets}}$					
Total Sales/Total assets (X ₅)	43.13%	33.48%	58.12%	58.89%	57.40%

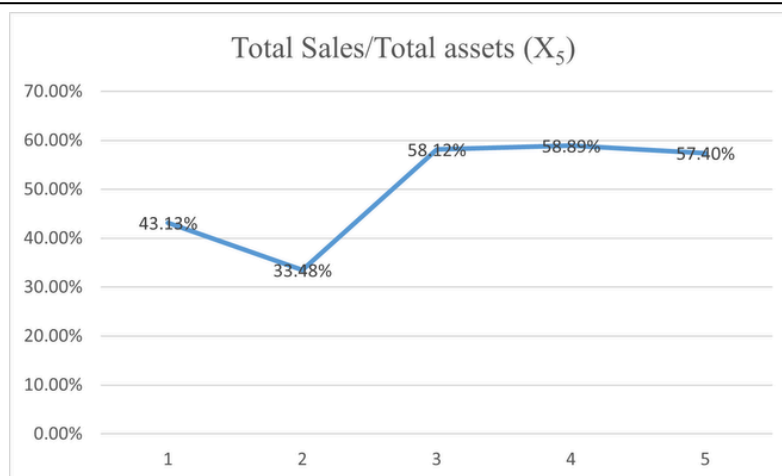


Figure 5. Sales / Total Assets

Analysis:

- The ratio increased significantly in Mar-22 and Mar-23, reaching nearly 58.89%, showing effective utilization of assets to generate revenue.

- A slight decline in Mar-24 (57.40%) suggests stabilization but indicates a need for continued efficiency improvements.
- The overall trend is positive, reflecting strong operational performance (Table 6) (Figure 5).

Z-Score Analysis of TATA Steel

Formula: $Z = 1.2(X1) + 1.4(X2) + 3.3(X3) + 0.6(X4) + 1.0(X5)$

Table 7 . (In points)

Particulars	March-20 (Rs.)	March-21 (Rs.)	March-22 (Rs.)	March-23 (Rs.)	March-24 (Rs.)
Final score	3.37	7.99	9.88	2.14	2.41
Financial stability	Strong	Strong	Strong	Grey zone	Grey zone

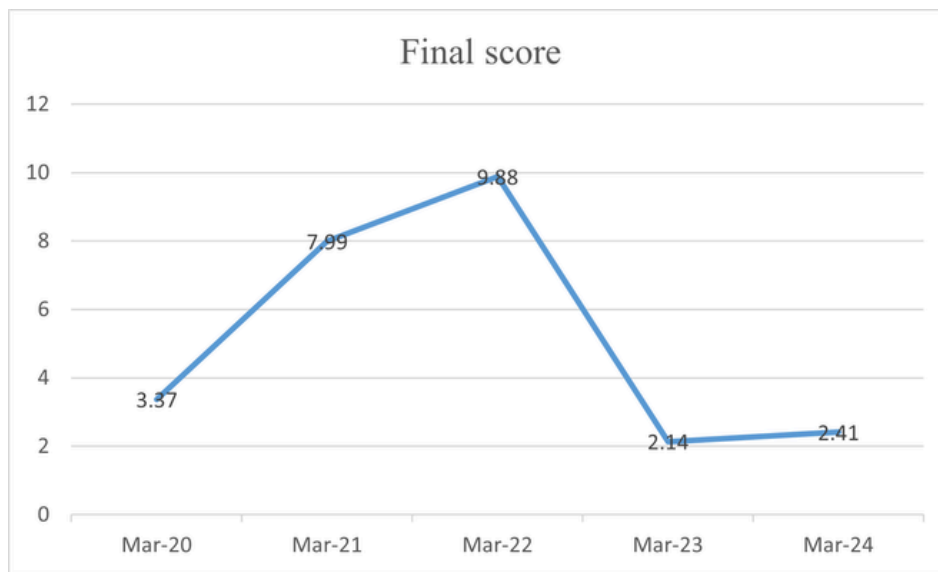


Figure 6. Z-Score Analysis of Tata Steel

Key Observations:

- 2020–2022 Surge: Tata Steel's Z-Score rose sharply from 3.37 to 9.88, indicating robust financial health, likely driven by strong profitability, efficient asset utilization, and favourable market conditions.
- Post-2022 Decline: A steep drop to 2.14 in 2023 signals emerging financial stress. This may reflect rising debt, declining margins, or macroeconomic headwinds.
- 2024 Stabilization: A modest rebound to 2.41 suggests partial recovery, but the company remains in the grey zone, requiring close monitoring (Table 7) (Figure 6).

Findings of the Research

- Tata Steel showed strong financial health from 2020 to 2022, staying in the safe zone according to the Altman Z-Score. This was mainly due to high amount of operating profits and strong market performance.
- In 2023, the company's Z-Score dropped sharply, moving it into the grey zone. This change was linked to rising debt and lower profitability, which alarmed

growing financial pressure.

- By 2024, there was a slight improvement in the score, but Tata Steel remained in the grey zone, and faced moderate financial risk.
- The liquidity ratio (X1) stayed negative in most years, which usually lowers the Z-Score. However, other ratios like profitability (X3) and market value (X4) were strong enough in 2022 to keep the overall score high.
- The retained earnings ratio (X2) increased steadily, showing that the company had built up profits over time. But it did not considered as reflector for recent drops in earnings, which affected short-term financial performance.
- The study shows that Altman's Z-Score is a useful tool showing signs of financial trouble, especially in industries like steel which requires large investments.
- It also highlights the need for companies like Tata Steel to manage their debt, focus on efficiency, and maintain investor confidence to stay financially stable in the long run business [12-15].

Conclusions

Steel is one of the core industry sectors in the economy. Normally manufacturers are passing through scorching times. Only financially strong companies can survive in a long period of time. The research study examines how Tata Steel's financial condition has been changed between 2020 and 2024. Initially, the company was financially strong and placed in the safe zone according to the Altman Z-Score. However, after 2022, its score dropped, moving it into the grey zone, which indicates growing financial concerns. This decline was mainly due to an increase in debt and a fall in operating profitability, suggesting that the company may be facing financial operating pressure but at the same time company has good financial support to inform them of retained earnings to survive in long run.

The research points out that Tata Steel needs to improve its cash flow, make better use of its total assets, and maintain the confidence among their investors. The Altman Z-Score is shown to be a useful tool for spotting early signs of financial trouble and helping companies take timely action to avoid bankruptcy. The study offers practical insights for business leaders, investors, and financial institutions, showing how Tata Steel's financial journey reflects broader challenges in managing financial risk within the steel industry.

References

- Joshi S, Davda R. Altman's z-score model in the Indian context: a critical analysis of its effectiveness and limitations. *Int J Creat Res Thoughts*. 2025;13(5):127-132. <https://ijcrt.org/papers/IJCRT25A5743.pdf>
- Altman EI. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *J Finance*. 1968;23(4):589-609. <https://doi.org/10.2307/2978933>
- Othman MS, Nagina R, Saini A. Predictive Analysis of Financial Distress in Pharma Sector: A Quantitative Approach Using Altman's Z-Score Model. *Int J Relig*. 2024;5(11):1991-2007. Available at: <https://ijor.co.uk/ijor/article/view/5844>
- Kumar S, Sakthivel R, Sathya K N, Wilson, J. An Empirical Investigation into Financial Distress in the FMCG Sector in India: A Comparative Analysis Using Altman Z-Score and Descriptive Statistics. *Qeios*. 2024;4(3):1-9. <https://doi.org/10.32388/H1QOZN>
- Bannigol, K. Analysis of Indian Iron and Steel Industry Using Altman's Z-Score Model. *Int J Curr Res*. 2023;15(6):25148-25153. Available at: <https://www.journalcra.com/sites/default/files/issue-pdf/45577.pdf>
- Chavda K, Mehta MJ. An Altman's Z Score Model Analysis of Tata Motors Ltd. 2023. Available at: [https://www.gaggyan.org/res/articles/\(39-43\)%20AN%20ALTMANS%20Z%20SCORE%20MODEL%20ANALYSIS%20OF%20TATA%20MOTORS%20LTD.pdf](https://www.gaggyan.org/res/articles/(39-43)%20AN%20ALTMANS%20Z%20SCORE%20MODEL%20ANALYSIS%20OF%20TATA%20MOTORS%20LTD.pdf)
- Koshti J, Marvadi C. Validating Z Score Model For Evaluating Financial Health Of Selected Indian Companies. *Int J Manag Public Pol Res*. 2023;2(2):115-125. <https://doi.org/10.55829/ijmpr.v2i2.164>
- Acharyya K. Assessing the feasibility of Altman's "Z" score model in identifying companies on the verge of financial collapse: a study on select Indian pharma companies. *ESSBC Journal of Business Studies* January. 2023;1(1):25-34. Available at: <https://egrassbcollege.ac.in/wp-content/uploads/2023/03/Paper-3.pdf>
- Gorkhe MD, Khartode AS. Prediction of Financial Distress in Selected FMCG Companies Using the Altman Z-Score Model. *ShodhKosh: J Vis Perform Arts*. 2023;4(2):797-810. <https://doi.org/10.29121/shodhkos.v4.i2.2023.1671>
- Pravin P, Dhabaliya DA. Analysis of Financial Distress Using Altman's Z-Score Model in Selected Indian Pharmaceutical Companies. *Journal of Advanced Research in Economics and Administrative Sciences*. 2023;4(4):1-3. <https://doi.org/10.47631/jareas.v4i4.626>
- Raw Data of Tata Steel. 2025. Available at: <https://www.tatasteel.com/>
- Jaffer Sayed, Ahmed Badiuddin. Financial Health Analysis Using Altman's Z Score - A Comparative Study of Select steel companies. *International Journal in Management and Social Science*. 2017;5(5):276-282. <https://www.indianjournals.com/article/ijmss-5-5-033>
- Karpagalakshmi S. Analysis of financial strength of select firms from Indian steel industry using altman's "z" score analysis. *Int J Res Cult Soc*. 2018;2(11):38-41. Available at: <https://ijrcs.org/wp-content/uploads/IJRCS201811007.pdf>
- Singh S. Altman's Z-Score Analysis of Tata Steel Limited for Measuring Financial Health. *Int J Res Anal Rev*. 2020;7(4):751-757. <https://ijrar.org/papers/IJRAR2AA1647.pdf>
- Thenmozhi S, Tamilselvi K. Financial health of selected iron and steel companies in India - z score model. *International Journal in Management and Social Science*. 2015;3(2):278-289. <https://www.ijmr.net.in/current/UvFg7VUbZ9BrTuU.pdf>