

A Study on Financial Performance of UPMRC using Altman's Z Score Analysis

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Abstract

Urban metro rail systems in India occupy a distinctive financial position: they are capital-intensive public infrastructure entities expected to combine social affordability with commercial viability. This paper examines the financial health of the Uttar Pradesh Metro Rail Corporation (UPMRC) over an eight-year period, FY 2017-18 to FY 2024-25, using Edward Altman's Z"-Score model calibrated for non-manufacturing firms and emerging-market entities [$Z'' = 6.56(X_1) + 3.26(X_2) + 6.72(X_3) + 1.05(X_4)$]. Drawing exclusively on audited annual report data, the four constituent ratios - working capital to total assets, retained earnings to total assets, EBIT to total assets, and book value of equity to total liabilities are computed for each year and aggregated into a composite Z"-Score. The results show that UPMRC has not achieved the Safe Zone ($Z'' > 2.60$) in any year of its operating history and has instead oscillated between the Grey Zone and the Distress Zone, touching a series low of 0.51 in FY 2019-20 and re-entering the Distress Zone in FY 2024-25 at 0.76. The findings indicate a structural pattern of profitability erosion, negative retained earnings accumulation, and a thinning equity cushion rather than a transient, pandemic-induced disturbance. The paper situates these findings within the broader literature on Z"-Score applications to Indian public sector undertakings and metro rail financing, identifies a research gap in entity-specific, multi-year Z"-Score studies of metro rail corporations, and offers suggestions for improving UPMRC's long-term solvency position.

Keywords: Altman Z"-Score, UPMRC, financial distress, metro rail, public sector undertaking, bankruptcy prediction, emerging market model

1. Introduction

India's urban rail transit sector has expanded rapidly over the past two decades, with metro systems now operating or under construction in more than twenty cities. The Uttar Pradesh Metro Rail Corporation (UPMRC), incorporated to implement and operate metro rail systems across the state, commenced commercial operations on the Lucknow Metro corridor in 2017 and has since been entrusted with the execution of metro projects in Kanpur, Agra, Meerut, and other urban centres. Like most Indian metro corporations, UPMRC operates within a financing model that combines equity contributions from the central and state governments, long-term concessional debt from multilateral and bilateral lenders, and internally generated revenue from farebox and non-farebox sources.

This financing structure creates an inherent tension. Metro rail projects require enormous upfront capital investment that is only recovered, if at all, over multi-decade horizons, while fare levels are politically constrained to remain affordable for daily commuters. Consequently, most metro rail entities in India report losses in their formative years and depend on non-fare revenue streams, government grants, and periodic fare revisions to approach financial sustainability. Assessing the underlying financial health of such entities is therefore not a straightforward exercise using conventional profitability ratios alone; distress-prediction models that integrate liquidity, profitability, leverage, and solvency dimensions into a single composite measure offer a more holistic diagnostic.

The Altman Z-Score, and its later variants developed for non-manufacturing and emerging-market firms, is one of the most widely used and empirically validated tools for this purpose. This paper applies the Altman Z"-Score model to UPMRC's audited financial statements for the period FY 2017-18 to FY 2024-25, the entirety of the corporation's operating history for which annual report data is available, to assess whether the corporation's underlying financial position has strengthened, weakened, or remained structurally distressed over time.

2. Review of Literature

The Z-Score model was originally developed to classify publicly listed manufacturing firms into bankrupt and non-bankrupt categories using multiple discriminant analysis applied to five weighted financial ratios (Altman, 1968). The model demonstrated strong predictive accuracy in its original sample and was subsequently refined and extended to a range of firm types and market contexts ([Altman, 2000](#)).

Because the original model's sales-to-total-assets ratio and market-value-based leverage ratio were poorly suited to unlisted, service-oriented, or emerging-market firms, [Altman, Hartzell, and Peck \(1995\)](#) developed the Z"-Score, which removes the asset-turnover ratio entirely and substitutes book value of equity for market value in the leverage ratio. This four-variable model, expressed as $Z'' = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4$, was designed specifically for non-manufacturing and emerging-market companies, a category into which state-owned infrastructure corporations such as UPMRC clearly fall, since their equity is not publicly traded and their operations are service-based rather than manufacturing-based.

The application of the Z"-Score and its variants to Indian public sector undertakings has produced a substantial and growing body of literature. [Joshi \(2020\)](#) applied the Altman Z-Score model to select Indian public sector banks and found considerable variation in financial soundness linked to asset quality and non-performing assets, concluding that the model remains a useful early-warning tool for institutions carrying high proportions of stressed assets. [Reddy, Reddy, and Nirosha \(2025\)](#) examined the applicability of the Altman Z-Score framework to Indian public sector undertakings more broadly, classifying sample PSUs into safe, grey, and distress zones and arguing that the model offers actionable insight for improving fiscal responsibility, operational efficiency, and governance in India's public enterprise ecosystem. Similar Z-Score-based distress assessments have been conducted for other categories of Indian PSUs, generally reporting a mixed picture in which several public enterprises remain in the grey or distress zones for extended periods, reflecting the structural burden of legacy debt, subdued profitability, and thin equity bases characteristic of many state-owned entities.

A separate but closely related strand of literature addresses the financial sustainability of metro rail systems specifically. Studies of the Delhi Metro Rail Corporation (DMRC) - India's oldest and most extensively studied metro operator has repeatedly highlighted the gap between farebox revenue and operating costs, the declining farebox recovery ratio, and the corporation's growing dependence on non-

farebox revenue streams such as property development, advertising, and station leasing to remain solvent. Comparative and sector-wise studies have similarly emphasised that non-fare box revenue, land value capture, and continued government budgetary support are central determinants of long-run financial viability for Indian metro systems, given that fares alone are rarely sufficient to cover operating expenses, let alone debt service obligations. This body of work provides useful contextual grounding for interpreting UPMRC's own revenue and capital structure, even though it does not apply a formal distress-prediction model.

Research Gap

While the Z"-Score model has been applied extensively to Indian banks and to PSUs in sectors such as cement, telecommunications, and manufacturing, and while a separate literature has examined the farebox-versus-non-farebox revenue dynamics of Indian metro systems, there is a distinct scarcity of research that applies a formal, multi-year Altman Z"-Score distress analysis to an individual Indian metro rail corporation using its full audited financial history. Existing metro-sector studies tend to rely on descriptive ratio analysis, operating-profit narratives, or single-year snapshots rather than a composite, internationally validated distress-prediction framework applied consistently across a multi-year panel. Moreover, no identified study has applied the Z"-Score model specifically to UPMRC, a relatively young metro corporation whose complete operating history spanning a pre-pandemic ramp-up phase, the COVID-19 ridership shock, and a post-pandemic recovery period offers a distinctive window into how a greenfield Indian metro entity's solvency position evolves through its earliest and most financially vulnerable years. This paper addresses that gap by constructing and interpreting a year-wise Z"-Score trend for UPMRC across its entire available reporting history, FY 2017-18 to FY 2024-25.

3. Objectives of the Study

- To compute the Altman Z"-Score for UPMRC for each financial year from 2017-18 to 2024-25 using audited annual report data.
- To classify UPMRC's financial health for each year into the Safe, Grey, or Distress zone on the basis of the computed Z"-Score.
- To examine the year-wise trend and the relative contribution of each of the four constituent ratios (X_1 - X_4) to the composite Z"-Score.

4. Research Methodology

This study adopts an analytical and quantitative research design based entirely on secondary data drawn from UPMRC's audited annual financial statements for FY 2017-18 through FY 2024-25. The unit of analysis is the corporation as a whole, and the study period represents the complete operating history for which annual report data was available at the time of writing.

The Altman Z"-Score model for non-manufacturing and emerging-market entities was selected in preference to the original 1968 manufacturing-firm model because UPMRC is (a) a service-sector infrastructure entity rather than a manufacturer, (b) wholly or predominantly government-owned with no actively traded market value of equity, and (c) an emerging-market corporation operating within India's public infrastructure financing framework. The Z"-Score is computed as:

$$Z'' = 6.56(X_1) + 3.26(X_2) + 6.72(X_3) + 1.05(X_4)$$

where X_1 is working capital to total assets (a measure of short-term liquidity), X_2 is retained earnings to total assets (a measure of cumulative profitability and reinvestment), X_3 is EBIT to total assets (a measure

of operating efficiency independent of financing structure), and X_4 is book value of equity to total liabilities (a measure of the leverage cushion available to absorb losses before insolvency). Each ratio was calculated year-wise from the corresponding line items in UPMRC's balance sheet and statement of profit and loss, and the four weighted components were summed to arrive at the composite score for each year. The resulting Z''-Score for each year was classified using Altman's established cut-off points for the emerging-market model: a score above 2.60 indicates the Safe Zone, a score between 1.10 and 2.60 indicates the Grey Zone, and a score below 1.10 indicates the Distress Zone. Year-on-year change in the Z''-Score was also computed to identify the direction and magnitude of movement between consecutive years, and the contribution of each weighted ratio to the overall score was examined to isolate the specific driver(s) of movement in each period. The analysis is descriptive and trend-based in nature, consistent with the exploratory objective of establishing, for the first time, a complete Z''-Score profile for this specific metro rail corporation.

5. Data Analysis

Table 1 presents the year-wise computation of UPMRC's Altman Z''-Score for FY 2017-18 to FY 2024-25, showing the four constituent ratios, their weighted contributions, the composite score, and the resulting zone classification.

Table 1: Altman Z''-Score Computation - UPMRC (FY 2017-18 to FY 2024-25)

Year	X_1 (Liquidity)	X_2 (Profitability)	X_3 (Operational Efficiency)	X_4 (Solvency)	6.56(X_1)	3.26(X_2)	6.72(X_3)	1.05(X_4)	Z''-Score	Zone
2017-18	0.20	-0.01	0.00	0.57	1.33	-0.04	-0.02	0.60	1.86	Grey Zone
2018-19	0.12	-0.02	-0.01	0.35	0.81	-0.06	-0.07	0.36	1.04	Distress Zone
2019-20	0.08	-0.05	-0.03	0.38	0.51	-0.17	-0.22	0.40	0.51	Distress Zone
2020-21	0.16	-0.08	-0.04	0.37	1.04	-0.26	-0.24	0.38	0.93	Distress Zone
2021-22	0.28	-0.08	-0.02	0.30	1.87	-0.25	-0.15	0.32	1.78	Grey Zone
2022-23	0.29	-0.08	-0.02	0.34	1.89	-0.26	-0.11	0.36	1.88	Grey Zone

2023-24	0.23	-0.11	-0.01	0.28	1.52	-0.37	-0.08	0.29	1.35	Grey Zone
2024-25	0.16	-0.14	-0.01	0.25	1.06	-0.46	-0.10	0.26	0.76	Distress Zone

Source: UPMRC Annual Reports (FY 2017-18 to 2024-25)

Table 2 sets out the year-wise trend, the direction of year-on-year change, and the principal financial development underlying each year's score.

Table 2: Year-wise Z''-Score Trend and Financial Observations - UPMRC

Year	Z''-Score	Zone	Key Financial Observation	YoY Change
2017-18	1.86	Grey Zone	First operational year; positive retained earnings (X2 = 0.08) and equity buffer at series high (X4 = 0.57). Score near the Safe Zone boundary.	-
2018-19	1.04	Distress Zone	Full-year operations commence. Retained earnings turn negative; long-term debt nearly doubles; X1 contracts sharply. Score falls below the 1.10 threshold.	↓ 0.82
2019-20	0.51	Distress Zone	Series nadir. All four variables deteriorate simultaneously; X3 contribution reaches -0.22 as the operational cost structure fully sets in.	↓ 0.53
2020-21	0.93	Distress Zone	COVID-19 causes ridership collapse. Government equity infusion partially lifts X1, but X3 at -0.24 reflects peak EBIT losses.	↑ 0.42
2021-22	1.78	Grey Zone	Post-pandemic recovery drives X1 to 0.28, contributing 1.87. Score rebounds strongly back into the Grey Zone.	↑ 0.85
2022-23	1.88	Grey Zone	Series peak score. X1 at a series high of 0.29 (contribution 1.89); revenue recovery at its strongest; Grey Zone position consolidates.	↑ 0.10
2023-24	1.35	Grey Zone	Grey Zone retained but score softens. Exceptional interest charge inflates net loss to a record ₹99,686 lakh; X2 drops sharply to -0.11.	↓ 0.53
2024-25	0.76	Distress Zone	Re-entry into the Distress Zone. X2 reaches a series worst of -0.14 (contribution -0.45); X4 at a series low of 0.25; equity base eroded by eight years of losses.	↓ 0.59

Source: Compiled by the researcher

Across the full eight-year period, UPMRC's Z''-Score has never reached the Safe Zone threshold of 2.60. The corporation began its operating life in FY 2017-18 at 1.86 (Grey Zone), close to but still short of the

Safe Zone boundary, before falling sharply over the following two years to a series low of 0.51 in FY 2019-20; a Distress Zone reading that reflects the simultaneous deterioration of all four component ratios as the corporation moved from a single-corridor pre-operational entity to a fully operational, debt-servicing organisation. The score partially recovered through the COVID-affected FY 2020-21 (0.93) and rose more substantially over FY 2021-22 and FY 2022-23, reaching a series peak of 1.88 in FY 2022-23 as post-pandemic ridership recovery lifted working capital and operating performance. However, this recovery proved short-lived: the score fell to 1.35 in FY 2023-24 and further to 0.76 in FY 2024-25, placing UPMRC back in the Distress Zone at the end of the study period. The corporation has therefore spent five of its eight years of operation (2018-19, 2019-20, 2020-21, and 2024-25, together with the borderline 2023-24 reading) in or near the Distress Zone.

5.2 Findings & Discussion

Examination of the individual weighted components shows that X_1 (working capital to total assets) is the most volatile and dominant driver of year-on-year movement in the composite score, owing to its large coefficient of 6.56. Working capital contracted sharply between FY 2017-18 and FY 2019-20 as current liabilities linked to project execution rose faster than current assets, and it later expanded strongly in FY 2021-22 and FY 2022-23 on the back of post-pandemic revenue recovery and improved cash positions, before contracting again in FY 2023-24 and FY 2024-25.

X_2 (retained earnings to total assets) has been negative in every year except the first and has deteriorated in a near-monotonic fashion, moving from -0.01 in FY 2017-18 to -0.14 in FY 2024-25. This pattern reflects the cumulative build-up of losses typical of a capital-intensive infrastructure entity in its early operating decades, and it is the component most indicative of a structural, rather than cyclical, weakness in UPMRC's financial position: unlike working capital, which can recover with a single strong revenue year, accumulated retained earnings can only be rebuilt through sustained profitability over many years.

X_3 (EBIT to total assets) has remained negative throughout the study period, ranging from a near breakeven -0.01 in the first two years to a low of -0.04 in FY 2018-19, before settling in the -0.01 to -0.02 range in more recent years. The persistently negative EBIT margin on total assets confirms that UPMRC's core operations, inclusive of depreciation on its substantial fixed asset base, have not yet generated positive operating income at any point in its history.

X_4 (book value of equity to total liabilities) has declined steadily from a series high of 0.57 in FY 2017-18 to a series low of 0.25 in FY 2024-25, indicating that the corporation's liability base; largely long-term concessional debt has grown considerably faster than its equity base over the study period. This finding is consistent with the observation in Table 2 that an exceptional interest charge inflated the net loss to a record level in FY 2023-24, further eroding the equity cushion available to absorb future losses.

6. Conclusion

Taken together, these patterns suggest that UPMRC's oscillation between the Grey and Distress zones is driven less by any single anomalous event and more by two persistent structural features: an operating cost base (inclusive of depreciation and interest) that consistently exceeds operating income, and a liability structure that has grown faster than the corporation's equity base. The FY 2020-21 dip is attributable to the COVID-19 ridership shock, but the subsequent decline in FY 2023-24 and FY 2024-25 occurred in a non-pandemic environment and was driven instead by an exceptional interest charge and the continued accumulation of losses, indicating that the underlying distress condition is structural rather than confined to the pandemic period. This is broadly consistent with the wider literature on Indian metro rail financing,

which identifies the gap between farebox revenue and total operating and debt-service costs as the central determinant of financial sustainability for metro corporations, and with prior Z-Score-based studies of Indian PSUs, which similarly find that public enterprises in capital-intensive, socially mandated sectors frequently remain in the grey or distress zones for extended periods despite continued government support. This study applied the Altman Z"-Score model to UPMRC's audited financial statements for FY 2017-18 to FY 2024-25 and found that the corporation has not achieved the Safe Zone in any year of its operating history, oscillating instead between the Grey Zone and the Distress Zone, with a series low of 0.51 in FY 2019-20 and a return to the Distress Zone at 0.76 in FY 2024-25. The analysis of individual ratio contributions indicates that this pattern is driven primarily by persistently negative retained earnings and EBIT margins, combined with a steadily thinning equity-to-liability cushion, rather than by any single transient shock. While the COVID-19 pandemic clearly worsened UPMRC's financial position in FY 2020-21, the corporation's decline in the two most recent years of the study period, FY 2023-24 and FY 2024-25, occurred independently of the pandemic and points to an underlying structural vulnerability in its capital structure and operating economics. These findings are consistent with the broader literature on Z-Score-based distress assessment of Indian public sector undertakings and with sector-specific studies emphasising the financing gap faced by Indian metro rail corporations, and they underscore the importance of continued, close monitoring of UPMRC's solvency position as the corporation matures and its debt obligations grow.

7. Suggestions

- UPMRC should pursue a more aggressive diversification of non-farebox revenue streams, including station-area commercial leasing, advertising, and transit-oriented property development, to reduce dependence on farebox collections that alone are insufficient to cover operating and debt-service costs.
- Given the steady decline in X_4 (equity to total liabilities), the corporation should explore phased conversion of a portion of outstanding long-term debt into government equity infusions, which would strengthen the balance sheet without adding to the interest burden.
- Periodic, formula-linked fare revisions, rather than infrequent and delayed adjustments, would help align farebox revenue growth more closely with rising operating costs and reduce the volatility observed in the working capital ratio.
- Management should closely monitor and seek to minimise exceptional and non-recurring charges, such as the interest charge that materially widened the FY 2023-24 net loss, since such items disproportionately affect the retained earnings and equity components of the Z"-Score.
- Future research should extend this analysis comparatively across other Indian metro rail corporations to establish sector-wide distress benchmarks and to determine whether UPMRC's Grey-to-Distress oscillation is characteristic of newly operational Indian metro systems in general or specific to UPMRC's own capital structure.
- UPMRC should consider adopting the Z"-Score, alongside its existing ratio-based reporting, as a recurring internal early-warning indicator to track the trajectory of its financial health on a consistent, year-on-year basis.

8. Limitations of the Study

- The Z"-Score model, although refined for non-manufacturing and emerging-market firms, was originally calibrated on private, revenue-generating corporations and was not designed specifically for

state-owned infrastructure entities that operate under an explicit socio-economic mandate and continued government financial support; its distress classifications should therefore be read as an analytical proxy rather than a literal bankruptcy prediction.

- The study relies entirely on secondary, audited annual report data; any restatements, changes in accounting policy, or classification differences across years in the underlying financial statements are carried through into the ratio computations without independent verification.
- The eight-year study period, while covering the corporation's full operating history to date, remains relatively short for a capital-intensive infrastructure asset with a multi-decade economic life, and long-run conclusions about UPMRC's terminal financial trajectory should be drawn with caution.
- The analysis is confined to a single entity (UPMRC) and does not benchmark the results against other Indian metro rail corporations such as DMRC, Bangalore Metro, or Chennai Metro; comparative interpretation is therefore limited.
- The COVID-19 pandemic (FY 2020-21) represents a structural anomaly in the data series; its effects on ridership and revenue may distort trend interpretation if not read alongside the surrounding years.

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