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Relationship between capital structure and financial performance of selected steel companies in India

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Abstract
This study examines the relationship between capital structure and financial performance of selected steel companies in India using panel data over the period 2013–2022. Capital structure is proxied by the debt–equity ratio, while financial performance is measured through return on assets, return on equity, return on capital employed and earnings per share. Firm size and current ratio are included as control variables. The study employs panel unit root and cointegration tests to determine long-run relationships, followed by Dynamic Ordinary Least Squares estimation to obtain consistent long-term coefficients. The findings indicate the presence of a stable long-run association between profitability indicators and leverage, with differential impacts across performance measures. The results suggest that internal profitability plays a significant role in determining financing structure decisions in capital-intensive industries like steel. The study contributes empirical evidence to the capital structure literature within the context of emerging market manufacturing firms.

Keywords: Capital structure, financial performance, panel data analysis, steel industry, India

Introduction

The relationship between capital structure and financial performance has remained one of the most enduring and debated issues in corporate finance since the seminal work of Modigliani and Miller (1958), who initially proposed that under perfect market conditions capital structure is irrelevant to firm value. Subsequent theoretical developments, however, relaxed these assumptions and introduced real-world frictions such as taxes, bankruptcy costs, and information asymmetry, thereby establishing competing perspectives on how leverage influences corporate outcomes. The Trade-Off Theory posits that firms determine an optimal debt–equity mix by balancing the tax advantages of debt against the expected costs of financial distress (Kraus & Litzenberger, 1973), while the Pecking Order Theory argues that firms prioritize internal funds over external debt and equity due to asymmetric information and signaling considerations (Myers & Majluf, 1984) [19]. Agency Theory further suggests that debt may serve as a disciplinary mechanism to reduce managerial opportunism, though excessive leverage can intensify agency conflicts between shareholders and creditors (Jensen & Meckling, 1976). Despite extensive empirical inquiry across developed and emerging markets, the direction and magnitude of the leverage–performance relationship remain inconclusive, as findings vary by industry structure, institutional context, and macroeconomic environment. Within this broader discourse, the steel industry presents a particularly compelling setting for investigation. Steel production is inherently capital intensive, requiring large fixed investments in blast furnaces, rolling mills, logistics networks, and technological upgrades. Such heavy capital commitments necessitate substantial external financing, making capital structure decisions central to operational continuity and competitive positioning. In India, the steel sector occupies a strategic role in nation building, supplying critical inputs to infrastructure, construction, automobiles, railways, energy, and defence. The industry has expanded rapidly over the past two decades, supported by policy initiatives, rising domestic demand, and integration into global value chains. At the same time, it faces cyclical volatility arising from fluctuations in global steel prices, raw material costs, exchange rates, trade barriers, and macroeconomic shocks. These structural characteristics create a financial environment in which leverage choices can significantly influence profitability, liquidity, and long-term sustainability. High levels of debt may facilitate expansion and capacity augmentation, yet they also elevate interest burdens and vulnerability to downturns. Conversely, conservative financing may enhance financial stability but limit growth opportunities in periods of strong demand. The research problem addressed in this study emerges from this tension: whether and how capital structure influences the financial performance of selected steel companies in India, and whether the observed relationship supports prevailing theoretical frameworks or reflects industry-specific dynamics. Although prior empirical studies have examined leverage–performance interactions in manufacturing or cross-sector samples, relatively few have focused exclusively on the Indian steel industry, where financial structures, regulatory frameworks, and market conditions differ substantially from those of developed economies. Moreover, existing findings are contradictory, with some studies reporting a positive relationship between leverage and performance due to tax shields and monitoring effects, while others document a negative association attributed to financial distress costs and interest obligations. This lack of consensus underscores the need for a focused, sector-specific investigation that integrates profitability indicators such as return on assets, return on equity, return on capital employed, and earnings per share with leverage measures such as the debt–equity ratio, while controlling for liquidity and firm size. The rationale for undertaking this study is therefore multifaceted. From a theoretical standpoint, it contributes to the ongoing refinement of capital structure theories by testing their relevance within a major emerging

economy's core industrial sector. Emerging markets exhibit distinct institutional characteristics, including evolving financial systems, varying access to credit, and differing corporate governance standards, which may influence financing behavior (Booth *et al*., 2001) [2]. Empirical evidence from India can thus enrich comparative understanding and potentially challenge assumptions derived from developed-market data. From a managerial perspective, insights into the leverage–performance nexus can inform strategic financial planning, enabling managers to align financing policies with profitability objectives and risk tolerance. In a sector characterized by long gestation periods and substantial fixed costs, optimizing the capital mix is essential for maintaining solvency and shareholder value. From an investor and policymaker viewpoint, understanding how leverage affects performance can enhance credit assessment, investment appraisal, and regulatory oversight, thereby contributing to financial stability and sustainable industrial growth. Ultimately, examining the relationship between capital structure and financial performance in selected Indian steel companies not only addresses a significant gap in empirical literature but also provides practical guidance for stakeholders navigating an industry marked by high capital intensity, cyclical volatility, and strategic national importance.

Literature review

The academic literature on the relationship between capital structure and financial performance in Indian steel companies reflects a rich yet largely mixed empirical tradition, with many studies highlighting both theoretical complexity and industry-specific dynamics. Capital structure, broadly defined as the mix of debt and equity financing employed by firms, has long been theorized to affect financial performance through tax shields, agency costs, and financing flexibility (Trade-Off and Pecking Order theories), with early research in the Indian context suggesting similar moderating influences (profitability, size and liquidity) on leverage decisions (see studies on determinants of capital structure in Indian firms). However, when attention is shifted specifically to the Indian steel sector, empirical evidence paints a more nuanced picture that underscores the importance of both leverage and firm-specific performance metrics.

Several scholars have directly examined the interplay between capital structure and financial performance in Indian steel firms. A notable study by Yadav (2023) [23] investigated listed steel firms on the Bombay Stock Exchange, finding that leverage measures such as the debt-to-assets ratio exert a significant negative influence on profitability, specifically on Return on Assets (ROA), when assessed through OLS and correlation analysis over a seven-year period. This suggests that increased financial leverage may reduce operational efficiency in a capital-intensive sector like steel, where debt servicing pressures can erode returns. Earlier work by Takeh and Navaprabha (2015) [16] similarly reported negative correlations between capital structure proxies (like total debt ratio) and financial performance indicators (ROA, ROE, ROCE) in Indian steel firms over a 2007–2012 sample period, reinforcing the view that leverage can be detrimental to profitability when interest costs and risk premiums are high .

Other research has broadened the focus beyond simple profitability measures to incorporate comparative analyses within the steel sector. For instance, a recent empirical comparative study of JSW Steel, Tata Steel and Jindal Steel & Power highlighted variations in financial performance metrics such as liquidity, efficiency and asset utilization across steel firms, pointing to heterogeneous outcomes that financial leverage alone cannot fully explain. Moreover, longitudinal profitability analyses of large-cap steel firms demonstrate that corporate performance can be volatile and inconsistent, with companies like Tata Steel showing stronger returns and others displaying cyclical downturns, underlining the contextual interplay between operational performances and financing structure in this sector.

Beyond sector-specific studies, broader research on manufacturing and listed firms in India also reinforces the complex nature of the leverage–performance nexus, where profitability and firm performance are influenced by a confluence of factors including size, asset tangibility, growth opportunities, market conditions and macroeconomic cycles. For example, panel evidence across Indian firms indicates that macroeconomic cycles and business conditions significantly influence the relationship between capital structure and performance, with debt financing having a measurable effect on firm outcomes across different market scenarios. These broader findings lend theoretical support to observations in the steel sector that leverage decisions are not isolated financial engineering choices but are shaped by industry conditions, competitive pressures and risk management considerations.

Importantly, much of the literature on Indian steel companies has identified a predominantly negative relationship between leverage and profitability, an outcome consistent with the arguments of the Pecking Order Theory, which suggests that firms prefer internal financing and that excessive external borrowing can erode shareholder returns. However, some research hints at trade-offs, where certain leverage measures may exhibit differential impacts under varying operational conditions or performance indicators, emphasizing that no single theory fully encapsulates the dynamics in this context.

Despite this growing scholarship, gaps remain. Most studies are limited by cross-sectional designs, short time periods, or reliance on simple correlation and regression frameworks. There is a clear need for more rigorous panel data approaches and dynamic analyses that account for long-run equilibrium relationships among capital structure and performance variables. In particular, understanding how leverage influences profitability metrics such as ROA, ROE, ROCE, and EPS over time while controlling for firm size and liquidity factors remains an area ripe for deeper empirical exploration and methodological refinement in the Indian steel industry.

Data and methodology

The empirical investigation into the relationship between capital structure and financial performance of selected steel companies in India is grounded in a carefully structured research design aimed at generating robust, reliable, and generalizable results. This study adopts a quantitative research approach, following a causal research design that enables examination of the extent and nature of influence of financial performance indicators on capital structure outcomes, consistent with prior empirical studies that seek to determine functional relationships between financial determinants and firm behavior (Hussain & Mateen, 2013; Fosu, 2013) [8]. The population of interest comprises all steel companies listed on major Indian stock exchanges such as

the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE), reflecting the institutional importance of publicly traded entities in understanding broader industry dynamics. From this population, a purposive sample of firms was selected based on criteria including continuous listing for the study period, availability of complete financial data, and representativeness of both large-scale and mid-scale players, which ensures comparability across firms with similar business environments and exposure to common industry shocks. The study period spans a decade (2013 [4]–2022), enabling analysis of long-term trends and mitigating potential distortions from short-term cyclical fluctuations, consistent with panel research norms that emphasize extended time horizons for economic inference (Baltagi, 2008) [1]. Secondary data were sourced from audited annual reports of selected firms, financial databases such as Prowess IQ and Bloomberg, and publicly accessible repositories, ensuring that the data are reliable, verifiable, and reflective of actual operational performance as reported to stakeholders. This aligns with best practices in empirical finance research that rely on standardized secondary sources to enhance data accuracy (Gujarati & Porter, 2009) [7].

The study operationalizes key variables using established definitions in the literature. Capital structure is proxied by the Debt–Equity Ratio (DER), which measures the extent to which a firm uses borrowed funds relative to shareholder equity, reflecting long-accepted practice in capital structure research (Titman & Wessels, 1988; Takeh & Navaprabha, 2015) [16, 17]. Financial performance is assessed using multiple indicators including Return on Assets (ROA), Return on Equity (ROE), Return on Capital Employed (ROCE), and Earnings per Share (EPS), each capturing distinct dimensions of profitability and value creation (Yadav, 2023; Ghosh, 2006) [5, 23]. Control variables such as Current Ratio (a measure of liquidity) and Firm Size (log of total assets) are incorporated to isolate the impact of profitability measures on capital structure from alternative financial influences, consistent with multifactor models employed in previous studies (Hussain & Mateen, 2013; La Rocca *et al*., 2011) [8, 10]. Liquidity is included due to its documented influence on debt capacity and short-term repayment ability, while firm size is included because larger firms may have greater access to external finance and diversified risk exposures, as highlighted in prior research (Booth *et al*., 2001; Fosu, 2013) [2, 4].

Given the panel nature of the data comprising cross-sectional variation across firms and time-series dynamics, the methodology adopts advanced econometric techniques that address both unobserved heterogeneity and dynamic relationships. The initial stage involves panel unit root tests (Levin, Lin & Chu; and Im, Pesaran & Shin) to assess the stationarity properties of the time series for each variable and to avoid spurious regression problems that can arise when non-stationary series are used in regression models, as recommended in panel econometrics (Baltagi, 2008; Wooldridge, 2015) [1, 18]. Since stationarity is a prerequisite for reliable inference, first-difference transformations are applied where necessary to achieve integration of order one (I(1)) for all variables, following established protocols in time-series econometrics (Dickey & Fuller, 1979; Maddala & Wu, 1999) [3, 11]. Following confirmation of integration, panel cointegration tests (Pedroni and Kao) are employed to examine whether a long-run equilibrium relationship exists among variables, acknowledging the possibility that profitability and capital structure may co-evolve over time despite short-run fluctuations. These cointegration techniques are widely accepted in the literature for testing long-run linkages among integrated variables in panel settings (Pedroni, 1999; Kao, 1999[9, 12]; Maddala & Kim, 1998). The presence of cointegration justifies the use of long-run estimators such as Dynamic Ordinary Least Squares (DOLS), which corrects for endogeneity bias and serial correlation by including lagged and leading differences of regressors, producing asymptotically efficient estimates of long-run coefficients (Saikkonen, 1992; Stock & Watson, 1993) [14, 15]. This methodological choice strengthens causal interpretation and mitigates bias arising from omitted variables or simultaneity, consistent with best practice in longitudinal financial analysis.

Empirical results and analysis

Table 1: Panel Unit Root Test at Level

Variable	LLC Statistic	Prob.	IPS Statistic	Prob.	Order
DER	-1.214	0.112	-0.984	0.163	Non-Stationary
ROA	-1.562	0.059	-1.338	0.090	Non-Stationary
ROE	-1.402	0.080	-1.265	0.104	Non-Stationary
ROCE	-1.325	0.093	-1.148	0.127	Non-Stationary
EPS	-0.884	0.189	-0.742	0.228	Non-Stationary
Current Ratio	-1.098	0.136	-0.912	0.181	Non-Stationary
Firm Size	-0.762	0.223	-0.648	0.259	Non-Stationary

Table 2: Panel Unit Root Test at First Difference

Variable	LLC Statistic	Prob.	IPS Statistic	Prob.	Order
DER	-5.842	0.0000	-4.921	0.0000	I(1)
ROA	-6.112	0.0000	-5.304	0.0000	I(1)
ROE	-5.973	0.0000	-5.118	0.0000	I(1)
ROCE	-5.488	0.0000	-4.762	0.0000	I(1)
EPS	-6.421	0.0000	-5.677	0.0000	I(1)
Current Ratio	-4.992	0.0000	-4.118	0.0000	I(1)
Firm Size	-3.842	0.0001	-3.215	0.0006	I(1)

The panel unit root results (Tables-1 and 2) indicate that all variables, Debt–Equity Ratio (DER), profitability indicators (ROA, ROE, ROCE, EPS), liquidity (Current Ratio), and Firm Size are non-stationary at level but become stationary after first differencing. The rejection of the null hypothesis of unit root at first difference across LLC and IPS tests

confirms that the series are integrated of order one, I(1). The consistency of results across multiple testing frameworks strengthens the reliability of the findings. The LLC test, which assumes common unit root process across cross-sections, and the IPS test, which allows for heterogeneous autoregressive parameters, both confirm stationarity at first difference. The presence of I(1) variables suggests that the variables share a stochastic trend over time, which is consistent with the structural nature of financial and leverage indicators in capital-intensive industries. Steel firms operate under cyclical macroeconomic conditions, global commodity price fluctuations, and structural investment cycles, which naturally generate trending behavior in profitability and leverage measures. Since all variables are integrated of order one, the appropriate next step is to test for panel cointegration to determine whether a long-run equilibrium relationship exists between financial performance and capital structure. If cointegration is established, Dynamic OLS is appropriate.

Table 3: Pedroni Panel Cointegration Test Results

Test Statistic	Statistic Value	Prob.
Panel v-Statistic	2.318	0.0102
Panel rho-Statistic	-2.147	0.0158
Panel PP-Statistic	-3.984	0.0000
Panel ADF-Statistic	-3.621	0.0001
Group rho-Statistic	-1.984	0.0234
Group PP-Statistic	-4.215	0.0000
Group ADF-Statistic	-3.744	0.0001

Most of the panel and group statistics (Table-3) are significant at the 5% level, leading to rejection of the null hypothesis of no cointegration. Both within-dimension and between-dimension statistics confirm the existence of a long-run equilibrium relationship among DER, profitability indicators, and control variables. The consistency across PP and ADF statistics strengthens the evidence of cointegration.

Table 4: Kao Panel Cointegration Test

Test	ADF Statistic	Prob.
Kao ADF Test	-3.462	0.0003

The Kao ADF statistic (Table-4) is statistically significant at 1%, rejecting the null hypothesis of no cointegration. This confirms the presence of a stable long-run relationship between capital structure and financial performance variables. The Kao test result reinforces the findings from the Pedroni framework, suggesting robustness of the long-run association.

The panel cointegration analysis provides compelling evidence of a stable long-run equilibrium relationship between capital structure and financial performance in the Indian steel sector. The rejection of the null hypothesis of no cointegration across Pedroni and Kao methodologies demonstrates robustness and methodological consistency. The Pedroni test, which accounts for cross-sectional heterogeneity, indicates that both within-dimension and between-dimension statistics are statistically significant. This suggests that despite firm-specific characteristics and operational differences among steel companies, the fundamental long-run relationship remains intact. The Kao test further validates this finding under homogeneous slope assumptions, reinforcing the structural linkage between leverage and profitability. From an economic standpoint, the existence of cointegration suggests that capital structure decisions are not arbitrary or purely reactive but are systematically influenced by long-term profitability performance, liquidity conditions, and firm scale. Financially stronger firms adjust leverage in a manner consistent with internal funding capacity, while firm size and liquidity constraints also shape borrowing behavior over time. The presence of cointegration also justifies the estimation of Dynamic OLS (DOLS) test.

Table 5: Panel DOLS Long-Run Estimation Results (DV: DER)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROA	-0.168	0.041	-4.098	0.0001
ROE	-0.084	0.024	-3.500	0.0007
ROCE	-0.097	0.029	-3.344	0.0012
EPS	-0.013	0.003	-4.333	0.0000
Current Ratio	-0.364	0.102	-3.568	0.0006
Firm Size	0.588	0.131	4.488	0.0000
Constant	4.215	0.874	4.822	0.0000
R2 = 0.79	Adjusted R2 = 0.75		Long-run Variance = 0.00	

The DOLS estimation results confirm the presence of a statistically significant long-run relationship between financial performance indicators and capital structure in the Indian steel industry. The R^2 value of 0.79 suggests that nearly 79% of the long-run variation in the debt–equity ratio is explained by profitability, liquidity, and firm size variables, indicating strong explanatory power. All profitability indicators (ROA, ROE, ROCE, and EPS) exhibit negative and highly significant coefficients.

ROA shows a sustained increase in asset profitability reduces long-run leverage. This implies that operational efficiency enables firms to finance expansion internally. ROE shows higher shareholder returns are associated with lower debt reliance, indicating that internally generated equity returns substitute external borrowing. ROCE shows efficient utilization of long-term capital reduces the need for additional leverage. EPS shows higher earnings per share significantly lower long-term debt ratios, reflecting accumulation of retained earnings. These findings strongly validate the Pecking Order Theory, which posits that firms prefer internal financing over debt and external equity. The long-run elasticity suggests that profitability improvements systematically reduce leverage over time. The negative and significant coefficient indicates that firms with stronger liquidity positions maintain lower leverage in the long run. This suggests that short-term financial strength reduces dependency on borrowed capital. Liquidity acts as a financial buffer, especially in a cyclical industry such as steel, where cash flow volatility can influence financing needs. Firm size shows a positive and significant coefficient, implying that larger firms maintain higher leverage ratios in the long run. This supports elements of the Trade-Off Theory as larger firms have better access to credit markets, face lower bankruptcy risk, and benefit from tax shields associated with debt. Thus, while profitability supports Pecking Order behavior, firm size aligns partially with Trade-Off considerations.

Conclusion

The empirical investigation provides the long-run relationship between financial performance and capital structure in the Indian steel industry. The panel unit root results demonstrate that all variables, Debt–Equity Ratio (DER), ROA, ROE, ROCE, EPS, Current Ratio, and Firm

Size are non-stationary at level but become stationary after first differencing. The rejection of the null hypothesis of a unit root at first difference under both LLC and IPS tests confirms that each series is integrated of order one, I(1). This outcome indicates that the variables follow common stochastic trends over time, which is consistent with the structural and cyclical characteristics of capital-intensive industries such as steel. Establishing the order of integration ensures that subsequent long-run estimations are not affected by spurious regression problems. Given that all variables are I(1), panel cointegration tests were conducted to verify the existence of a stable long-run equilibrium relationship. The Pedroni test results reveal that both within-dimension and between-dimension statistics are statistically significant at conventional levels. Similarly, the Kao ADF statistic rejects the null hypothesis of no cointegration. The consistency of these findings across heterogeneous (Pedroni) and homogeneous (Kao) specifications confirms that financial performance, liquidity, firm size, and leverage move together in the long run. This implies that capital structure decisions are structurally linked to firm-level performance indicators rather than being purely short-term or opportunistic adjustments. The Dynamic OLS (DOLS) estimation further quantifies this long-run relationship. The model exhibits strong explanatory power, indicating that nearly four-fifths of the variation in DER is explained by the included variables. All profitability indicators carry negative and statistically significant coefficients. These results suggest that higher profitability systematically reduces reliance on debt financing over time. Firms generating stronger returns on assets, equity, and capital employed, as well as higher earnings per share, tend to finance operations through retained earnings rather than external borrowing. This pattern strongly supports the Pecking Order framework, where internal funds are preferred to debt due to lower information asymmetry and financing costs. Liquidity, proxied by the Current Ratio, also shows a negative and significant effect on leverage, indicating that firms with stronger short-term solvency positions maintain lower debt–equity ratios. Liquidity therefore functions as a stabilizing buffer, particularly important in an industry exposed to demand fluctuations and price volatility. In contrast, firm size exhibits a positive and significant association with leverage, implying that larger firms maintain relatively higher debt levels. This finding aligns with elements of the Trade-Off perspective, as larger firms benefit from easier access to credit markets, lower perceived default risk, and potential tax advantages from debt usage. The empirical results reveal a clear long-run equilibrium in which profitability and liquidity reduce leverage, while firm size increases it. The findings highlight that capital structure decisions in the steel sector are shaped by sustained financial performance and structural firm characteristics, reflecting a dynamic interaction between internal funding capacity and market-based borrowing opportunities.

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