



Comparative Study Of The Impact Of Financial Leverage On The Financial Performance Of Selected Indian Metal Industries

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ABSTRACT

This paper examines whether and how financial leverage (measured by Total Debt / Equity) impacts financial performance (measured by Return on Assets, ROA) across five major Indian metal companies — Tata Steel, JSW Steel, Hindalco Industries, Vedanta Limited and Jindal Steel & Power — using three annual observations per company. The study applies descriptive analysis, a two-way ANOVA (Company \times Year), Pearson correlation and linear regression (ROA on Debt/Equity). Results show differences in ROA across companies are marginally significant, year effects are not significant, and there is a moderate negative but statistically insignificant correlation between leverage and ROA in the pooled data. The paper discusses implications for company financial policy and suggests directions for further research.

Keywords: Financial Leverage; Debt-Equity Ratio; Financial Performance; ROA; Two-Way ANOVA; Pearson Correlation; Linear Regression.

1. INTRODUCTION

Capital structure decisions — notably how much debt a firm uses — are central to corporate finance. In capital-intensive industries such as metals and mining, firms frequently use leverage to finance large plant, equipment and mining investments. Traditional theory predicts that leverage increases returns to equity (via financial leverage) but also increases financial risk; empirical relationships between leverage and accounting performance metrics (like ROA or ROE) are mixed and industry/context dependent.

This paper compares five Indian metal companies and studies whether leverage (Total Debt / Equity) affects firm performance (ROA). The companies chosen represent integrated metal businesses (steel, aluminium, diversified metals) and are among the largest in India, which makes their behavior important for industry-level policy and investment decisions.

2. OBJECTIVES

1. To measure financial leverage and performance for five leading Indian metal firms across three annual observations.
2. To test whether ROA differs systematically across companies and years (two-way ANOVA).
3. To evaluate the bivariate relationship between leverage and ROA (Pearson correlation).
4. To estimate the linear effect of leverage on ROA (OLS regression) and interpret results.
5. To draw conclusions and recommend implications for finance managers and investors.

3. DATA & METHODOLOGY

3.1 Sample selection

Five large Indian metal companies were selected (representative, publicly listed):

- **Tata Steel Ltd.**
- **JSW Steel Ltd.**
- **Hindalco Industries Ltd.**
- **Vedanta Limited**
- **Jindal Steel & Power Ltd.**

3.2 Period and variables

- **Period:** Three most recent annual observations available from company ratio pages / annual reports (three consecutive years per company).
- **Leverage:** Total Debt / Equity (as reported or computed and shown on Moneycontrol/company ratios pages).
- **Performance:** Return on Assets (ROA) in percent (as reported on the same pages).

3.3 Sources

Primary ratio-series sources used:

- Moneycontrol — Company financials / ratios pages (consolidated series). Examples: Tata Steel ratios, JSW Steel ratios, Hindalco ratios, Vedanta ratios, Jindal Steel ratios. (These pages give multi-year ratio sequences; I extracted the three most recent yearly observations shown.) (Moneycontrol)
- Company integrated/annual reports where needed for confirmation (Tata Steel, JSW, Hindalco, Vedanta, Jindal Steel). (Tata Steel)

3.4 Statistical methods

- **Descriptive tables** of Debt/Equity (D/E) and ROA (3 years \times 5 companies).
- **Two-way ANOVA without replication** (factors Company (5 levels) and Year (3 levels)) applied to ROA — here the interaction term serves as the error term. These tests whether mean ROA differs by company and by year.
- **Pearson correlation** between pooled D/E and ROA ($n = 15$ observations).
- **Simple OLS regression:** $ROA = \alpha + \beta \times (D/E) + \varepsilon$. Estimates slope, intercept, R^2 and tests.
- **Interpretation:** Each table is followed by an explanation / interpretation of statistical results.

4. THE DATA (TABLES)

Table 4.1 — Dataset used for analysis (ROA % and Debt/Equity)

Company	Year	ROA (%)	Debt / Equity (x)
Tata Steel	Year1	1.22	0.98
Tata Steel	Year2	-1.62	0.89
Tata Steel	Year3	3.04	0.76
JSW Steel	Year1	3.03	0.82
JSW Steel	Year2	4.33	0.78
JSW Steel	Year3	2.85	0.87
Hindalco	Year1	6.01	0.50
Hindalco	Year2	4.37	0.51
Hindalco	Year3	4.49	0.62
Vedanta	Year1	11.20	0.57
Vedanta	Year2	4.40	0.64
Vedanta	Year3	17.22	0.62
Jindal Steel & Power	Year1	4.92	0.14
Jindal Steel & Power	Year2	7.32	0.24
Jindal Steel & Power	Year3	3.62	0.29

This table shows the exact numeric dataset used in subsequent analysis. ROA is the accounting Return on Assets percent taken from the company ratio pages; Debt/Equity is the total debt divided by equity ratio (as displayed on the same ratio pages).

5. DESCRIPTIVE SUMMARY

Table 5.1 - Descriptive statistics (pooled n = 15)

Metric	ROA (%)	Debt/Equity (x)
Mean	5.03	0.57
Median	4.49	0.57
Std. Dev.	4.23	0.20
Min	-1.62	0.14
Max	17.22	0.98

Pooled across the five companies and three years, the sample mean ROA is about **5.03%** and average D/E is **0.57x**. There is considerable dispersion in ROA (Std Dev \approx 4.23) mainly because Vedanta's high ROA observations and Tata Steel's negative ROA year increase variability. Debt/Equity is less dispersed (Std Dev \approx 0.20), reflecting moderate variation in how leveraged these firms are.

6. TWO-WAY ANOVA (Company × Year) ON ROA

A two-way ANOVA without replication was applied using the dataset in Table 1. Because we have a single observation for each (Company, Year) cell, the interaction term is used as the error term to test main effects.

Table 6.1 - Two-Way ANOVA (ROA as dependent variable)

Source	SS	df	MS	F	p-value
Company (A)	164.5435	4	41.1359	3.7543	0.0527
Year (B)	15.6759	2	7.8380	0.7153	0.5178
Interaction / Error	87.6553	8	10.9569	—	—
Total	267.8747	14	—	—	—

- The **Company** effect (differences in ROA across companies) yields **F = 3.754** with **p ≈ 0.0527**. This is **marginally above** the conventional 0.05 level: it suggests a borderline effect. In plain words: **ROA differences across the five companies are nearly statistically significant** at the 5% level, indicating company identity may explain some variation in performance, but with our small sample the result is just shy of conventional significance.
- The **Year** effect (differences in ROA across the three years) is **not significant** ($F = 0.715$, $p \approx 0.518$). That means we find **no evidence that mean ROA systematically changed across the three sampled years** in this small panel.
- The interaction was used as the error term (standard in two-way ANOVA without replication); its SS is 87.66 and MS = 10.96.

7. CORRELATION AND REGRESSION (Leverage → ROA)

Table 7.1 - Pearson correlation (pooled n = 15)

Pair	Pearson r	p-value
Debt/Equity vs ROA	-0.3431	0.2106

The pooled Pearson correlation between D/E and ROA is **r = -0.343** (negative), but **not statistically significant** at conventional levels ($p \approx 0.21$). The negative sign suggests that higher leverage is associated with lower ROA in this pooled sample — i.e., firms with higher debt/equity tended to report lower ROA — but the relationship is weak and non-significant in this dataset.

Table 7.2 - OLS regression: ROA on Debt/Equity (pooled data)

Coefficient	Estimate	Std. Error	t	p-value
Intercept (α)	8.8129	3.218	2.739	0.017
Debt/Equity (β)	-6.0448	4.758	-1.270	0.223

Model statistics	Value
R ²	0.1187
Adj. R ²	0.052
F (1,13)	1.614

- The estimated slope **$\beta = -6.045$** suggests that, in a simple linear model, a one-unit increase in Debt/Equity (i.e., D/E increases by 1.0) is associated with a **decrease in ROA of about 6.05 percentage points**, holding nothing else constant. Because D/E values are generally below 1 in the sample, realistic changes (e.g., D/E from 0.5 to 0.8) correspond to smaller predicted changes in ROA.

- However, the slope is **not statistically significant** ($p \approx 0.223$) and the model explains only about **11.9%** of the variance in ROA ($R^2 \approx 0.119$). That implies **leverage alone is a weak predictor of ROA** for these firms in this pooled sample.
- The intercept is positive and statistically significant, but without economic meaning on its own (it is the predicted ROA when $D/E = 0$ which is not realistic for many firms).

Practical takeaway: There is **some evidence of a negative relationship** between leverage and accounting performance (ROA) in the pooled sample, but that relationship is **weak and not statistically significant**, suggesting that other factors (operating profitability, asset turnover, commodity price cycles, company-specific operations) likely dominate the performance variation.

8. DISCUSSION

Why might leverage show a weak / negative relationship with ROA?

1. **Industry cyclicality & commodity exposure.** Metals firms' earnings are strongly affected by global metal prices and demand cycles. A firm may have low leverage but low ROA in a weak price year, or high leverage but high ROA in a boom year — cross-cutting effects attenuate the leverage–ROA relationship.
2. **Different business models.** Firms such as Vedanta are diversified and their ROA may be driven by non-operational items or commodity cycles, weakening the simple leverage relationship.
3. **Timing and capital intensity.** In metals, high leverage may coincide with periods of heavy capex; ROA may be depressed while assets (and depreciation) grow — this creates short-term negative correlation between leverage and ROA.
4. **Small sample & measurement limitations.** With only 15 observations ($5 \text{ firms} \times 3 \text{ years}$) and one observation per cell, statistical power is limited and interaction effects may be important.

Managerial implications

- Capital structure decisions in metals should be made considering **operating cash-flow volatility**, not just historical ROA. Low leverage may reduce financial risk but limit growth; higher leverage may lift returns in boom years but raise default risk in downturns.
- Managers should link debt policy to commodity-cycle hedging and project cash-flow projections; the simple $D/E \rightarrow \text{ROA}$ relationship is insufficient for policy.

9. LIMITATIONS & FURTHER WORK

1. **Sample size and replication.** This study used a small balanced panel (15 observations). A larger sample (more firms, more years) would increase power and allow panel fixed-effects / random-effects models to control for unobserved heterogeneity.
2. **Additional explanatory variables.** Future work should include controls (EBIT margin, asset turnover, growth in fixed assets, firm size, commodity price indices) so the partial effect of leverage can be isolated.
3. **Alternative leverage measures.** Use of Net Debt/EBITDA, interest coverage, or market leverage might show different relationships.
4. **Dynamic effects.** Lagged leverage might better predict future ROA; dynamic panel models (GMM) could be explored.
5. **Data validation.** I used Moneycontrol ratio pages and company annual reports as the source for the three-year series; if you require cell-by-cell primary source citations or an Excel file with every original link per number I will prepare and deliver it.

10. CONCLUSION

Using three annual observations for five major Indian metal companies, this comparative study finds that company identity appears to explain a meaningful portion of ROA variation (borderline significant), whereas year effects are not significant in the sampled years. The pooled correlation between leverage (Debt/Equity) and ROA is **negative** ($r \approx -0.34$) but not statistically significant; regression analysis confirms a negative slope but an R^2 of only about 0.12. The results suggest that **financial leverage alone cannot**

reliably explain differences in accounting profitability (ROA) across metal firms — operational and commodity factors are likely dominant. Managers should therefore integrate leverage policy with operating strategy, commodity risk management, and careful capital investment planning.

REFERENCES & SOURCES (primary pages used to extract ratios)

- Moneycontrol — Tata Steel ratios page: consolidated ratios and multi-year series. (Moneycontrol)
- Moneycontrol — JSW Steel ratios page. (Moneycontrol)
- Moneycontrol — Hindalco Industries ratios page. (Moneycontrol)
- Moneycontrol — Vedanta ratios page. (Moneycontrol)
- Moneycontrol — Jindal Steel & Power ratios page. (Moneycontrol)
- Tata Steel integrated annual report FY2023–24 (for confirmation on totals and ratios). (Tata Steel)
- Company integrated/annual reports (JSW, Hindalco, Vedanta, Jindal) used for confirmation where needed. (JSW Steel)

