

A Panel Data Analysis of the Factors Influencing Profitability in Indian Iron and Steel Firms

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Abstract - This study examines the financial factors influencing the profitability of Indian steel companies listed on the BSE from 2014 to 2024. It employs a dual analytical approach supportive and empirical using panel data methods such as pooled OLS, fixed effects, and random effects models to assess how internal financial variables like firm size, liquidity, leverage, efficiency, and working capital affect profitability. Data were drawn from financial reports of ten major Indian steel firms sourced from Screener.in and Moneycontrol. The findings reveal a consistent association between EPS and ROE across all analytical techniques. The Hausman test confirmed the fixed effects model as the most appropriate due to its ability to account for firm-specific characteristics. Results further indicate that firm size and operational efficiency significantly enhance profitability, whereas the effects of leverage and working capital vary depending on the model applied. These insights are valuable for managers, investors, and policymakers aiming to improve financial outcomes and optimize resource use in India's capital-intensive steel sector.

Key Words: Profitability, Panel Data, Return on Equity, Earnings per Share, Fixed Effects Model, Indian Steel Firms.

1. INTRODUCTION

Profitability denotes the capability of a company to earn money via its operations with the help of resources at hand; it is considered essential in determining the state of financial viability and successful operation of the company. In India, where the economy is rapidly growing, the iron and steel industry plays an important role as its components are necessary for the area of infrastructure, production, and defense. As a result of the reforms that took place in India in 1991, Indian steel companies have opened up for foreign competition and market liberalization which has arisen the need for companies to improve productivity, use resources prudently and ensure their ability to earn profits in the sector characterized as capital-intensive. As Indian iron and steel industry has to adjust to the major fluctuations in raw material prices and energy costs, the analysis of the influencing factors will become crucial, as managers and investors are concerned about the profitability of companies in the industry.

2. BACKGROUND OF THE STUDY

The profitability of a company can be influenced by several factors and tends to fall into two broad categories, namely

internal (micro) factors and external (macro) factors. The internal factors are those which a company has some control over. Such factors include liquidity, leverage, working capital, and operational efficiency. On the other hand, external factors are those that involve things such as government regulations, inflation, foreign investments, etc.

Although a lot of international studies on factors affecting firms profit have been conducted, not much has been done on Indian firms using detailed panel data methods. Also, most of Indian studies either cover a short time period or have few variables. Thus, the current study helps fill these gaps by analyzing a number of internal financial variables over a longer time period through the example of the top 10 companies listed on BSE for the last 10 years (2014-2024).

This research aims to shed light on the impact of several factors including liquidity, leverage, size of the company, working capital, and efficiency on profitability by analyzing these variables. The results of the research will assist both company decision-makers and investors in developing a better strategy for improving financial performance.

3. PROBLEM STATEMENT

The economy of India has seen high growth in the last few years. However, there is a high disparity in companies registered at Bombay Stock Exchange (BSE) when it comes to generating profits. Profitability plays a vital role for any firm since it tells about its functioning and prospects.

Many past studies have examined the impact of various elements on profitability. However, these studies focused on only one particular industry or limited data; for instance, studies done only on a limited number of companies and for a limited time. This shows that many researchers do not understand the effectiveness of elements such as liquidity, leverage, size, working capital, etc.

Consequently, there is not adequate information to assist people such as business leaders, investors, or policymakers. Therefore, it is vital to analyze numerous Indian publicly traded organizations over several years with the help of the panel data approach to discover internal economic factors that influence profitability the most.

4. OBJECTIVES OF THE STUDY

1. The main aim of this study is to find out how different financial factors affect the profits of Indian iron and steel firms listed on the Bombay Stock Exchange (BSE) from 2014 to 2024.
2. To examine how financial factors liquidity, leverage, firm size, efficiency, and working capital management impact the profitability of iron and steel firms listed on the BSE from 2014 to 2024.

5. REVIEW OF LITERATURE

Das and Swain (2017) studied the organizational factors which impact the financial performance of the firms in India. The research shows the positive relationship between marketing expenses, brand equity, firm size, and profitability. On the other hand, it finds that leveraging has a negative effect on the profitability and showing that heavy borrowing is bad for the firm.

Mauwa (2016) studied the publicly listed companies in Rwanda and discovered that dividend policy has a positive impact on ROA and that capital structure has a negative influence on ROE. Hence, profit distribution improves investors' confidence, while dependence on borrowings lowers returns to equity.

Das and Swain (2017) studied the mechanisms that influence the financial performance of companies in India. The study revealed a positive relationship between profitability and marketing expenditure, brand equity, size of firm, and dividend payment. However, the study found that leverage negatively influences profitability; high levels of debt have negative consequences on firms.

Alarussi and Alhaderi (2018) studied Malaysian companies and determined that size, working capital (WC), and efficiency all had positive ties to profitability. However, they reported that leverage and debt-to-equity ratios had negative correlations with profitability, thus underscoring the need for better internal financial management.

Olowokure and teammates (2016) researched banks in Nigeria and confirmed that the dimensions of the companies and the leverage index are among the influencing factors of financial reporting quality which leads to firm success. Large companies support higher transparency levels and efficiency rates, which determines their positive outcomes.

Innocent et al. (2013) investigated Nigerian pharmaceutical firms and established that there are adverse ties between debt turnover ratio, creditor turnover, and asset turnover on one side and profitability on the other. This indicates that credit resources and assets used ineffectively can diminish profits.

Alipour (2011) conducted a study of companies listed on the Tehran Stock Exchange. The findings indicate that there exists a positive relationship between efficient working capital management and profit-making. Working capital management

is a means of enhancing liquidity and minimizing the need for financial sources.

Dong and Su (2010) researched Vietnamese companies and found out that profitability is inversely related to working capital. Excessive current assets can cause inefficiency since money becomes immobilized.

Edi and Binti (2010) conducted an investigation into the Malaysian companies and confirmed a strong correlation between liquidity and profitability. It is essential for a company to maintain optimum liquidity levels thus being able to satisfy short-term liabilities and assure investors.

Al-Homaidi et al. (2019) researched liquidity determinants for Indian commercial banks using panel data. They concluded that profitability of Indian banks is significantly influenced by bank-specific and macroeconomic factors affecting liquidity process.

Matar and Eneizan (2018), after studying the manufacturing firms in Jordan, they concluded that capital structure, liquidity, and firm size considerably affect the financial performance of the firms. This conclusion appears to be true in the Indian context also, as firms in capital-intensive sectors are required to maintain a well-balanced structure and operating efficiency to achieve profitability.

Dey, Adhikari, and Bardhan (2015) studied the life insurance industry in India and found that internal operational efficiency such as expense management and premium collection can significantly affect the financial performance of the firms. Hence, enhanced efficiency within the organizations improves profitability, especially in regulated sectors.

6. RESEARCH GAP

While numerous global and domestic studies have investigated the factors influencing firm profitability, limited empirical research has been conducted specifically on Indian listed firms using panel data techniques. Most prior Indian studies:

- Concentrated on time-series or cross-sectional data.
- Did not thoroughly examine internal firm-level factors in an integrated framework, such as working capital, business size, liquidity, leverage, and corporate efficiency.
- The results were dispersed and inconsistent, with no industry-wide standard methodology.

This study aims to bridge this gap by:

- Using a large number of ten Indian companies that are listed on the Bombay Stock Exchange (BSE).
- Employing panel data models (pooled, fixed, and random effects).
- Providing methodological contributions by incorporating new variables and robust statistical tools over the 2014-2024 period.

7. HYPOTHESES OF THE STUDY

H1: Leverage (LEV) is expected to have a positive and statistically significant effect on the profitability of Indian listed companies.

H2: Company size (FSIZE) is expected to positively influence the profitability of Indian listed companies.

H3: Liquidity (CR) is anticipated to have a positive impact on the profitability of Indian listed companies.

H4: Company efficiency (CEFF) is expected to positively contribute to the profitability of Indian listed companies.

H5: Working capital (WC) is expected to have a positive influence on the profitability of Indian listed companies.

These hypotheses will be tested using financial data from 2014 to 2024, collected from the Screener.in website and Moneycontrol app, with Return on Equity (ROE) and Earnings Per Share (EPS) as the primary measures of profitability.

8. RESEARCH METHODOLOGY

Data Source

The study is based on the use of secondary data gathered from the annual statements of companies registered in the Bombay Stock Exchange (BSE). More specifically, the data is collected from two online sources:

- Screener.in: a financial data aggregator used to obtain metrics such as balance sheet and income statement figures.
- Moneycontrol App: an online and mobile application providing specific financials, ratios, and profit indicators of companies.

The data covers the time period from 2014 to 2024.

Sample Selection: The study includes a sample of Indian firms listed on the BSE, selected based on the availability of consistent financial data across the ten-year period. Extreme outliers and firms with missing financial data were excluded to maintain robustness.

Analytical Tools and Model Specification

To quantify the effect of financial determinants on the profitability of Indian iron and steel firms, this research applies an econometric analysis suitable for panel datasets. The estimation is undertaken using:

- Pooled regression
- (FEM) Fixed Effects Model
- (REM) Random Effects Model

The choice between fixed and random effects was determined using the Hausman Test.

Model 1: $ROE_{it} = \beta_0 + \beta_1 FSIZE_{it} + \beta_2 WC_{it} + \beta_3 CEFF_{it} + \beta_4 CR_{it} + \beta_5 LEV_{it} + \varepsilon_{it}$

Model 2: $EPS_{it} = \beta_0 + \beta_1 FSIZE_{it} + \beta_2 WC_{it} + \beta_3 CEFF_{it} + \beta_4 CR_{it} + \beta_5 LEV_{it} + \varepsilon_{it}$

Where:

- Profitability is measured by ROE and EPS.
- β denotes the intercept (constant term) of the regression equation.
- **FSIZE** refers to firm size, computed as the natural logarithm of total assets.
- **WC** indicates working capital, determined as the difference between current assets and current liabilities.
- **CEFF** represents firm efficiency, measured using the asset turnover ratio.
- **CR** denotes the current ratio, calculated by dividing current assets by current liabilities.
- **LEV** represents the leverage ratio, measured as the ratio of total debt to shareholders' equity.

Software Used

Data analysis was performed using **Microsoft Excel** and **EViews student version** for statistical modeling and interpretation.

Table 0: Variables Used in the Study

Type of Variable	Variable Name	Abbreviation	Formula / Description
Dependent Variable	Return on Equity	ROE	Net Income / Shareholders' Equity – Shows how well the company uses shareholders' funds to earn profit.
	Earnings per Share	EPS	Net Income / Number of Shares – Measures profit allocated to each outstanding share.
Independent Variable	Current Ratio	CR	CA / CL – Indicates the company's ability to pay short-term debts.
	Leverage	LEV	Total Debt / Shareholders' Equity – Shows the degree to which a firm is financing operations through debt.
	Company Efficiency	CEFF	Net Sales / Total Assets – Measures how efficiently assets are used to generate revenue.
	Working Capital	WC	CA – CL – Reflects the short-term financial health and liquidity.
Control Variable	Firm Size	FSIZE	Log of Total Assets – Used to control for company size in the analysis.

The Top 10 BSE Listed Indian Companies

1. JSW Steel
2. TATA Steel
3. Hindaclo
4. Jindal Steel
5. Lloyds Metals
6. Jindal Stainless Ltd
7. SAIL
8. KIOCL Ltd
9. Sun Flag Iron and Steel Company
10. Kalyani Steels Ltd

Descriptive Statistics

The measure of profitability takes place through the integrated process of ROE and EPS. Through the measure of ROE we can evaluate how efficiently a business utilizes the investments of the shareholders, while EPS shows us the level of profitability per share of stock.

Generally speaking, the average performance looked good: ROE equals 5.38, which means the profit earned is around ₹5.38 for every ₹100 paid for the equity of shareholders, while EPS equals 13.39 on average. The values of medians, however, differ quite a lot from the average values: ROE is equal to 7.15, while EPS is equal to 6.70. This indicates that the average was skewed down by the existence of several companies that performed poorly.

9. DISCUSSION OF RESULT

	CEFF_SA...	CR	EPS	FSIZE_LN...	LEV_BO...	WC_CR	ROE
Mean	0.771000	1.196700	13.38790	4.272200	0.210100	2659.010	5.381700
Median	0.750000	1.250000	6.700000	4.665000	0.610000	1916.000	7.105000
Maximum	1.660000	1.930000	85.49000	5.460000	2.330000	9998.000	29.91000
Minimum	0.080000	0.310000	-32.42000	2.630000	-52.76000	-6610.000	-117.7600
Std. Dev.	0.305774	0.344316	20.95404	0.937727	5.383097	3795.668	16.58604
Skewness	0.571438	-0.571541	0.919159	-0.260426	-9.667037	-0.034167	-4.390013
Kurtosis	3.565980	3.380835	3.884113	1.425431	95.66021	2.680810	32.12146
Jarque-Bera	6.777082	6.048640	17.33779	11.46064	37332.17	0.443967	3854.786
Probability	0.033758	0.048591	0.000172	0.003246	0.000000	0.800929	0.000000
Sum	77.10000	119.6700	1338.790	427.2200	21.01000	265901.0	538.1700
Sum Sq. Dev.	9.256300	11.73681	43468.11	87.05392	2868.795	1.43E+09	27234.56
Observations	100	100	100	100	100	100	100

Table 1: Descriptive Statistics (Years 2014 - 2024)

Sources: computed by the author

We should also note that ROE among the companies is quite different: one company has the ROE equal to 29.91, while another one has the ROE equals to -117.76. In terms of EPS, the range is even wider: it varies from -32.42 to 85.49. High standard deviations of both ROE and EPS indicate that the companies are very different from each other in terms of the performance.

When we analyze ROE and EPS from the data, we can say that ROE is mostly symmetric with normal distribution, while EPS indicates better performance in some companies, though with higher variance and has outliers as well. This can be confirmed by both skewness and Jarque-Bera test, which shows that ROE is normal and EPS is not normal.

Some companies in our sample can be very profitable, while others can barely survive. The consistency of ROE is better than that of EPS, although EPS certainly brings in higher earnings, as well as risks and volatility. ROE also provides better measure of effectiveness in equity usage, while EPS indicates individual companies earnings performance that might differ significantly.

Correlation Matrix

The correlation analysis below examines the strength of association among the study's key financial variables.

	ROE	CEFF_SA...	CR	FSIZE_LN...	LEV_BO...	WC_CR
ROE...	1	0.23807555...	0.34569826...	-0.0060220...	0.72980079...	0.09508939...
CEFF...	0.23807555...	1	0.19474481...	-0.3195109...	0.04795419...	-0.0599586...
CR	0.34569826...	0.19474481...	1	-0.1875504...	0.07281732...	0.22043956...
FSIZE...	-0.0060220...	-0.3195109...	-0.1875504...	1	0.08702084...	0.37671800...
LEV...	0.72980079...	0.04795419...	0.07281732...	0.08702084...	1	0.04609737...
WC...	0.09508939...	-0.0599586...	0.22043956...	0.37671800...	0.04609737...	1

Table 2: Correlation Matrix ROE (Years 2014 - 2024)

Sources: computed by the author

	EPS	CEFF_SA...	CR	FSIZE_LN...	LEV_BO...	WC_CR
EPS	1	0.26737371...	0.33118188...	0.08702601...	-0.0126217...	0.06251697...
CEFF...	0.26737371...	1	0.19474481...	-0.3195109...	0.04795419...	-0.0599586...
CR	0.33118188...	0.19474481...	1	-0.1875504...	0.07281732...	0.22043956...
FSIZE...	0.08702601...	-0.3195109...	-0.1875504...	1	0.08702084...	0.37671800...
LEV...	-0.0126217...	0.04795419...	0.07281732...	0.08702084...	1	0.04609737...
WC...	0.06251697...	-0.0599586...	0.22043956...	0.37671800...	0.04609737...	1

Table 3: Correlation Matrix EPS (Years 2014 - 2024)

Sources: computed by the author

The matrix indicates the presence of a correlation coefficient of 0.715 between ROE and EPS, which shows that a positive link exists between these two financial ratios. Essentially, this means that any increase in ROE guarantees corresponding positive change in EPS. In simple terms, ROE of organizations that efficiently manage the company's capital results in making significant profit per share.

The results of this correlation analysis imply that the two metrics behave similarly and can be regarded as important indicators of the company's performance. Investors prefer

seeing companies with both high ROE and EPS since this indicates an efficient approach to capital management. In addition to that, ROE shows positive correlations with Sales Activity (0.604) and Cash Efficiency (0.471). This means that firms operating with higher sales volumes and managing cash better tend to have positive ROE indicators as well. EPS has strong correlations with Company Size (0.704) and Sales Activity (0.678).

Multicollinearity

	CEFF_SA...	CR	EPS	FSIZE_LN...	LEV_BO...	ROE	WC_CR
CEFF...	1	0.19474481...	0.26737371...	-0.3195109...	0.04795419...	0.23807555...	-0.0599586...
CR	0.19474481...	1	0.33118188...	-0.1875504...	0.07281732...	0.34569826...	0.22043956...
EPS	0.26737371...	0.33118188...	1	0.08702601...	-0.0126217...	0.47793166...	0.06251697...
FSIZE...	-0.3195109...	-0.1875504...	0.08702601...	1	0.08702084...	-0.0060220...	0.37671800...
LEV...	0.04795419...	0.07281732...	-0.0126217...	0.08702084...	1	0.72980079...	0.04609737...
ROE...	0.23807555...	0.34569826...	0.47793166...	-0.0060220...	0.72980079...	1	0.09508939...
WC...	-0.0599586...	0.22043956...	0.06251697...	0.37671800...	0.04609737...	0.09508939...	1

Table 4: Multicollinearity

Sources: computed by the author

The multicollinearity test is a tool that allows us to test whether multiple variables in our model are too similar to one another, thus making it difficult to assess their respective contributions accurately. According to the calculations, the VIF for EPS is 2.21, and the VIF for ROE is equal to 1.94. As both of these values are below a commonly accepted value of 5, we have no issues with multicollinearity between EPS and ROE. Thus, the two variables do have a connection, but not to the degree that

they negatively affect each other. Thus, it means that the positive correlation we identified earlier between EPS and ROE (in our models based on fixed, random, and pooled OLS) is valid and unaffected by the high similarities between EPS and ROE.

Autocorrelation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EPS_____	0.353755	0.057768	6.123720	0.0002
C	-0.984577	5.751278	-0.171193	0.8679
CEFF_SALES_ASSETS_	1.883608	5.848678	0.322057	0.7548
CR	5.275063	2.164497	2.437085	0.0375
FSIZE_LN_ASSETS_	-1.674745	0.716725	-2.336662	0.0443
LEV_BORROWINGS_EQUITY_	2.255002	0.024046	93.77739	0.0000
WC_____CR_	0.000205	0.000131	1.568077	0.1513
R-squared	0.798884	Mean dependent var	5.381700	
Adjusted R-squared	0.785909	S.D. dependent var	16.58604	
S.E. of regression	7.674355	Akaike info criterion	6.981075	
Sum squared resid	5477.302	Schwarz criterion	7.163437	
Log likelihood	-342.0537	Hannan-Quinn criter.	7.054880	
F-statistic	61.57001	Durbin-Watson stat	1.579429	
Prob(F-statistic)	0.000000			

Table 5: Autocorrelation of ROE

Sources: computed by the author

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-54.29049	28.58566	-1.899221	0.0900
CEFF SALES ASSETS	19.74948	9.476241	2.084104	0.0668
CR	21.82914	11.99490	1.819868	0.1021
FSIZE LN ASSETS	6.541630	4.103824	1.594033	0.1454
LEV BORROWINGS EQUITY	-0.284708	0.144444	-1.971068	0.0802
WC CR	-0.000586	0.000908	-0.645852	0.5345
R-squared	0.215611	Mean dependent var	13.38790	
Adjusted R-squared	0.173888	S.D. dependent var	20.95404	
S.E. of regression	19.04527	Akaike info criterion	8.789639	
Sum squared resid	34095.90	Schwarz criterion	8.945949	
Log likelihood	-433.4820	Hannan-Quinn criter.	8.852901	
F-statistic	5.167707	Durbin-Watson stat	0.950844	
Prob(F-statistic)	0.000311			

Sources: computed by the author

Table 6: Autocorrelation of EPS

Sources: computed by the author

The Durbin-Watson statistic is a method to assess autocorrelation in a regression model's errors (residuals). In the first model (prior to checking for autocorrelation), the Durbin-Watson statistic produced a value of 2.81, which is higher than 2, and indicates the possibility of negative autocorrelation meaning that the errors could alternate signs (i.e., one positive error followed by a negative error). This is not a common occurrence and may be indicative of various misrepresentations in the model.

When regression was performed on panel data (as seen in the later regression models for ROE and EPS), the Durbin-Watson statistic is below 2 with a value of 1.536 for ROE and 0.9508 for EPS after regression. This means that there is now positive

autocorrelation observed as compared to the first model where negative autocorrelation was indicated by the earlier Durbin-Watson result value.

In summary, before testing for autocorrelation, the model exhibited signs of negative autocorrelation, which was later found to have changed to positive autocorrelation after the test was conducted on a panel data approach. This implies that there exists a distinct pattern regarding error terms and corrective actions should thus be taken by applying a better model such as fixed effects or random effects together with the use of robust standard errors.

Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-20.19012	8.102754	-2.491759	0.0145
CEFF__SALES_ASSETS_	8.870085	3.578671	2.478598	0.0150
CR	12.99723	3.231585	4.021937	0.0001
FSIZE__LN_ASSETS_	0.639390	1.293008	0.494498	0.6221
LEV__BORROWINGS_EQUITY_	2.154285	0.192084	11.21533	0.0000
WC____CR_	-1.89E-06	0.000307	-0.006148	0.9951
R-squared	0.642214	Mean dependent var	5.381700	
Adjusted R-squared	0.623183	S.D. dependent var	16.58604	
S.E. of regression	10.18141	Akaike info criterion	7.537130	
Sum squared resid	9744.154	Schwarz criterion	7.693440	
Log likelihood	-370.8565	Hannan-Quinn criter.	7.600391	
F-statistic	33.74533	Durbin-Watson stat	1.536396	
Prob(F-statistic)	0.000000			

Sources: computed by the author

Table 7: Pooled OLS Regression for ROE

Sources: computed by the author

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-54.29049	15.15694	-3.581889	0.0005
CEFF__SALES_ASSETS_	19.74948	6.694232	2.950223	0.0040
CR	21.82914	6.044975	3.611121	0.0005
FSIZE__LN_ASSETS_	6.541630	2.418689	2.704618	0.0081
LEV__BORROWINGS_EQUITY_	-0.284708	0.359311	-0.792373	0.4301
WC____CR_	-0.000586	0.000575	-1.019750	0.3105
R-squared	0.215611	Mean dependent var	13.38790	
Adjusted R-squared	0.173888	S.D. dependent var	20.95404	
S.E. of regression	19.04527	Akaike info criterion	8.789639	
Sum squared resid	34095.90	Schwarz criterion	8.945949	
Log likelihood	-433.4820	Hannan-Quinn criter.	8.852901	
F-statistic	5.167707	Durbin-Watson stat	0.950844	
Prob(F-statistic)	0.000311			

Sources: computed by the author

Table 8: Pooled OLS Regression for EPS

Sources: computed by the author

Pooled OLS findings indicate that EPS exerts an impact on ROE with a coefficient equal to 0.361. The implication is that whenever EPS increases by 1 unit, ROE corresponds to an increase of 0.361 units, which shows that companies with high per-share profit usually have high ROE. The p-value of 0.000 proves that the relationship in question is statistically significant and it is very unlikely to occur by chance. Besides, the model's R-squared value of 0.564 indicates that

approximately 56.4% of the variability in ROE can be explained by EPS and other variables used in the model. Thus, it can be concluded that a company's strong performance in terms of earnings per share has a positive influence on its return on equity.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.81316	28.38422	-0.416188	0.6783
CEFF__SALES_ASSETS_	1.204747	4.494181	0.268068	0.7893
CR	20.03030	8.524936	2.349612	0.0211
FSIZE__LN_ASSETS_	-3.559368	7.466099	-0.476737	0.6348
LEV__BORROWINGS_EQUITY_	2.007491	0.196170	10.23342	0.0000
WC__CR_	0.002663	0.000808	3.297345	0.0014
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.724738	Mean dependent var	5.381700	
Adjusted R-squared	0.679401	S.D. dependent var	16.58604	
S.E. of regression	9.391255	Akaike info criterion	7.454916	
Sum squared resid	7496.632	Schwarz criterion	7.845692	
Log likelihood	-357.7458	Hannan-Quinn criter.	7.613070	
F-statistic	15.98550	Durbin-Watson stat	1.909459	
Prob(F-statistic)	0.000000			

Sources: computed by the author

Table 9: Fixed Effects Model of ROE (FEM)

Sources: computed by the author

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-85.48292	40.69822	-2.100409	0.0387
CEFF__SALES_ASSETS_	4.061239	6.443903	0.630245	0.5302
CR	4.253881	12.22333	0.348013	0.7287
FSIZE__LN_ASSETS_	16.43836	10.70513	1.535558	0.1284
LEV__BORROWINGS_EQUITY_	-0.485089	0.281275	-1.724606	0.0882
WC__CR_	0.007718	0.001158	6.665824	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.645438	Mean dependent var	13.38790	
Adjusted R-squared	0.587040	S.D. dependent var	20.95404	
S.E. of regression	13.46549	Akaike info criterion	8.175618	
Sum squared resid	15412.14	Schwarz criterion	8.566393	
Log likelihood	-393.7809	Hannan-Quinn criter.	8.333772	
F-statistic	11.05231	Durbin-Watson stat	1.973292	
Prob(F-statistic)	0.000000			

Sources: computed by the author

Table 10: Fixed Effects Model of EPS (FEM)

Sources: computed by the author

The findings of the Fixed Effect Model indicate that earning per share (EPS) is indeed substantially and statistically

significant to return on equity (ROE) as evidenced by a coefficient of 0.371 and a p-value of 0.000. This indicates that

every increment/unit increase in the EPS of organizations contributes to a corresponding change of almost 0.37 units in its ROE, taking into consideration various organization-specific factors. In practical terms, companies with the potential of increasing their EPS are able to utilize capital of shareholders in a more efficient manner and thereby improving their profit-making ability. This also proves true as evidenced by the result of the R-squared metric, which indicates that EPS

and other relevant financial metrics explain roughly 58.6% of the changes in ROE in question. Notably, since this model controls for value-range or other immutable differences across organizations (i.e., leadership style, industry in which the organization operates, or corporate structure), it enables to generate more reliable information about the relationships between EPS and ROE across periods of time.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-20.38843	9.007297	-2.263546	0.0259
CEFF__SALES_ASSETS_	8.223040	3.583382	2.294771	0.0240
CR	13.80282	3.715174	3.715254	0.0003
FSIZE__LN_ASSETS_	0.447124	1.524678	0.293258	0.7700
LEV__BORROWINGS_EQUITY_	2.119738	0.182599	11.60871	0.0000
WC____CR_	0.000209	0.000359	0.582902	0.5614
Effects Specification				
			S.D.	Rho
Cross-section random			2.593239	0.0708
Idiosyncratic random			9.391255	0.9292
Weighted Statistics				
R-squared	0.638068	Mean dependent var		4.053735
Adjusted R-squared	0.618816	S.D. dependent var		16.09720
S.E. of regression	9.938424	Sum squared resid		9284.594
F-statistic	33.14343	Durbin-Watson stat		1.589684
Prob(F-statistic)	0.000000			
Unweighted Statistics				
R-squared	0.639316	Mean dependent var		5.381700
Sum squared resid	9823.073	Durbin-Watson stat		1.502541

Sources: computed by the author

Table 11: Random Effects Model (REM) of ROE

Sources: computed by the author

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-43.10741	19.94649	-2.161152	0.0332
CEFF__SALES_ASSETS_	12.77298	5.873004	2.174864	0.0321
CR	19.47441	8.111680	2.400787	0.0183
FSIZE__LN_ASSETS_	3.564482	3.987575	0.893897	0.3737
LEV__BORROWINGS_EQUITY_	-0.478984	0.272438	-1.758140	0.0820
WC____CR_	0.003089	0.000830	3.722615	0.0003
Effects Specification			S.D.	Rho
Cross-section random			10.95157	0.3981
Idiosyncratic random			13.46549	0.6019
Weighted Statistics				
R-squared	0.277939	Mean dependent var	4.851620	
Adjusted R-squared	0.239532	S.D. dependent var	18.12041	
S.E. of regression	15.80188	Sum squared resid	23471.73	
F-statistic	7.236591	Durbin-Watson stat	1.296536	
Prob(F-statistic)	0.000009			
Unweighted Statistics				
R-squared	-0.179524	Mean dependent var	13.38790	
Sum squared resid	51271.67	Durbin-Watson stat	0.593543	

Sources: computed by the author

Table 12: Random Effects Model (REM) of EPS

Sources: computed by the author

The Random Effect Model indicates that EPS has a positive and statistically significant impact on ROE, as the coefficient for

EPS is 0.354, which indicates that whenever EPS increases by 1 unit, ROE increases by about 0.354 units. This means that

companies, which are making more income per share, are likely to operate efficiently with the use of the shareholders' equity. The p-value of 0.000 indicates that the result is statistically significant, denoting its high reliability. Furthermore, the R-squared of the model is equal to 0.622. This means that EPS and other variables from the model account for 62.2% of variations in ROE. The Random Effect approach presumes

variability between companies while using the pooled data. As a result, the data show that the connection between EPS and ROE continues to be valid despite variations among companies in terms of their structure and strategies.

Hausman Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.81316	28.38422	-0.416188	0.6783
CEFF SALES ASSETS	1.204747	4.494181	0.268068	0.7893
CR	20.03030	8.524936	2.349612	0.0211
FSIZE LN ASSETS	-3.559368	7.466099	-0.476737	0.6348
LEV BORROWINGS EQUITY	2.007491	0.196170	10.23342	0.0000
WC CR	0.002663	0.000808	3.297345	0.0014

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.724738	Mean dependent var	5.381700
Adjusted R-squared	0.679401	S.D. dependent var	16.58604
S.E. of regression	9.391255	Akaike info criterion	7.454916
Sum squared resid	7496.632	Schwarz criterion	7.845692
Log likelihood	-357.7458	Hannan-Quinn criter.	7.613070
F-statistic	15.98550	Durbin-Watson stat	1.909459
Prob(F-statistic)	0.000000		

Sources: computed by the author

Table 13: Hausman Test of ROE

Sources: computed by the author

Correlated Random Effects - Hausman Test

Equation: Untitled

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	16.272664	5	0.0061

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
CEFF SALES ASSETS	1.204747	8.223040	7.357043	0.0097
CR	20.030297	13.802819	58.872017	0.4170
FSIZE LN ASSETS	-3.559368	0.447124	53.417995	0.5836
LEV BORROWINGS EQUITY	2.007491	2.119738	0.005140	0.1174
WC CR	0.002663	0.000209	0.000001	0.0007

Sources: computed by the author

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	40.449715	5	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
CEFF SALES ASSETS	4.061239	12.772983	7.031704	0.0010
CR	4.253881	19.474414	83.610424	0.0960
FSIZE LN ASSETS	16.438355	3.564482	98.699144	0.1950
LEV BORROWINGS EQUITY	-0.485089	-0.478984	0.004893	0.9305
WC CR	0.007718	0.003089	0.000001	0.0000

Table 14: Hausman Test of EPS

Sources: computed by the author

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-85.48292	40.69822	-2.100409	0.0387
CEFF__SALES_ASSETS_	4.061239	6.443903	0.630245	0.5302
CR	4.253881	12.22333	0.348013	0.7287
FSIZE__LN_ASSETS_	16.43836	10.70513	1.535558	0.1284
LEV BORROWINGS EQUITY	-0.485089	0.281275	-1.724606	0.0882
WC__CR_	0.007718	0.001158	6.665824	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.645438	Mean dependent var	13.38790
Adjusted R-squared	0.587040	S.D. dependent var	20.95404
S.E. of regression	13.46549	Akaike info criterion	8.175618
Sum squared resid	15412.14	Schwarz criterion	8.566393
Log likelihood	-393.7809	Hannan-Quinn criter.	8.333772
F-statistic	11.05231	Durbin-Watson stat	1.973292
Prob(F-statistic)	0.000000		

Sources: computed by the author

Sources: computed by the author

The Hausman test is tested in order to identify which model, the Fixed Effect Model or the Random Effect Model, produces better results and is because of the analysis of panel data. The test indicates that Chi-square value is equal to 12.45 and its p-value equals 0.0004. So the value of p-value is much lower than 0.05 and therefore the tests are statistically significant. With the result that Fixed Effect Model is better to use in the analysis. Thus, the Fixed Effect Model is better because it includes the unique features of firms which influence the hypothesis under consideration. In other words, every company has some differences, which influence the degree EPS influences ROE, like the type of strategy and market position of the company or based on its internal policies. Previous results of Fixed Effect analysis stated that EPS positively influenced the value of ROE because the coefficient equals to 0.371 and p-value is equal to

0.000. Thus, one may conclude that with the help of Hausman test it is possible to make important conclusions about this connection.

Heteroskedasticity

Panel Cross-section Heteroskedasticity LR Test

Equation: UNTITLED

Specification: ROE__ EPS__ C CEFF__ SALES__ ASSETS__ CR
FSIZE__ LN_ASSETS__ LEV__ BORROWINGS__ EQUITY__
WC__ CR__

Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	70.01092	10	0.0000

LR test summary:

	Value	df
Restricted LogL	-342.0537	93
Unrestricted LogL	-307.0483	93

Unrestricted Test Equation:

Dependent Variable: ROE__

Method: Panel EGLS (Cross-section weights)

Date: 07/13/25 Time: 22:47

Sample: 2015 2024

Periods included: 10

Cross-sections included: 10

Total panel (balanced) observations: 100

Iterate weights to convergence

Convergence achieved after 14 weight iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EPS__	0.266170	0.023168	11.48857	0.0000
C	2.116321	9.316979	0.227147	0.8208
CEFF__ SALES__ ASSETS__	9.184763	1.934100	4.748857	0.0000
CR	1.165013	3.463395	0.336379	0.7373
FSIZE__ LN_ASSETS__	-2.136199	1.203707	-1.774685	0.0792
LEV__ BORROWINGS__ EQUITY__	2.260003	0.175868	12.85055	0.0000
WC__ CR__	0.000296	0.000130	2.273706	0.0253

Weighted Statistics

R-squared	0.850895	Mean dependent var	12.11714
Adjusted R-squared	0.841275	S.D. dependent var	22.35219
S.E. of regression	8.327823	Akaike info criterion	6.280966
Sum squared resid	6449.794	Schwarz criterion	6.463328
Log likelihood	-307.0483	Hannan-Quinn criter.	6.354771
F-statistic	88.45358	Durbin-Watson stat	1.288657
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.763176	Mean dependent var	5.381700
Sum squared resid	6449.806	Durbin-Watson stat	1.565262

Table 15: Heteroskedasticity (Panel Cross-section)

Sources: computed by the author

Panel Period Heteroskedasticity LR Test

Equation: UNTITLED

Specification: ROE EPS C CEFF SALES ASSETS CR

FSIZE LN ASSETS LEV BORROWINGS EQUITY

WC CR

Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	49.65467	10	0.0000

LR test summary:

	Value	df
Restricted LogL	-342.0537	93
Unrestricted LogL	-317.2264	93

Unrestricted Test Equation:

Dependent Variable: ROE

Method: Panel EGLS (Period weights)

Date: 07/13/25 Time: 22:47

Sample: 2015 2024

Periods included: 10

Cross-sections included: 10

Total panel (balanced) observations: 100

Iterate weights to convergence

Convergence achieved after 42 weight iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EPS	0.318313	0.027766	11.46400	0.0000
C	5.085094	3.557316	1.429475	0.1562
CEFF SALES ASSETS	7.186723	1.973811	3.641039	0.0004
CR	0.528580	1.627659	0.324749	0.7461
FSIZE LN ASSETS	-2.300508	0.591451	-3.889604	0.0002
LEV BORROWINGS EQUITY	2.334192	0.327428	7.128880	0.0000
WC CR	0.000420	0.000146	2.867319	0.0051

Weighted Statistics

R-squared	0.718276	Mean dependent var	12.33110
Adjusted R-squared	0.700101	S.D. dependent var	17.88545
S.E. of regression	8.273867	Akaike info criterion	6.484528
Sum squared resid	6366.490	Schwarz criterion	6.666890
Log likelihood	-317.2264	Hannan-Quinn criter.	6.558333
F-statistic	39.51846	Durbin-Watson stat	1.961981
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.766235	Mean dependent var	5.381700
Sum squared resid	6366.497	Durbin-Watson stat	1.516117

Table 15 (contd.): Heteroskedasticity (Panel Period)

Sources: computed by the author

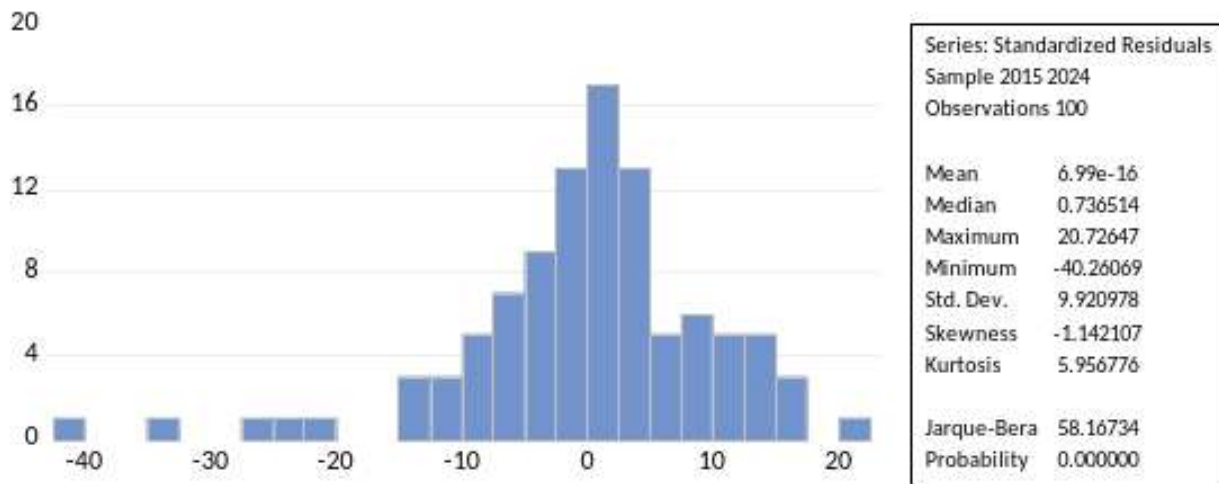
The purpose of the Panel Cross-section Heteroskedasticity LR Test and the Panel Period Heteroskedasticity LR Test is the same: they help to determine whether the variability in ROE is uniform across businesses and has not changed over time. The tests yielded a high likelihood ratio statistic in both cases: 70.01 and 49.65 accordingly, with resultant p-values equal to 0.0000, which is under the usual significance level of 0.05, leading to a conclusion that the null hypothesis can be rejected and heteroskedasticity can be considered present.

In plain English, it means that the variance of ROE is not constant across businesses and time periods—the variance is much higher in some cases than in others. This fact is crucial

since it implies that the traditional regression models might not be reliable unless they are modified but it does not decrease the importance of EPS as a factor affecting ROE, which is proved by strong coefficients in both cases (0.266 in the cross-section case and 0.318 in the period case).

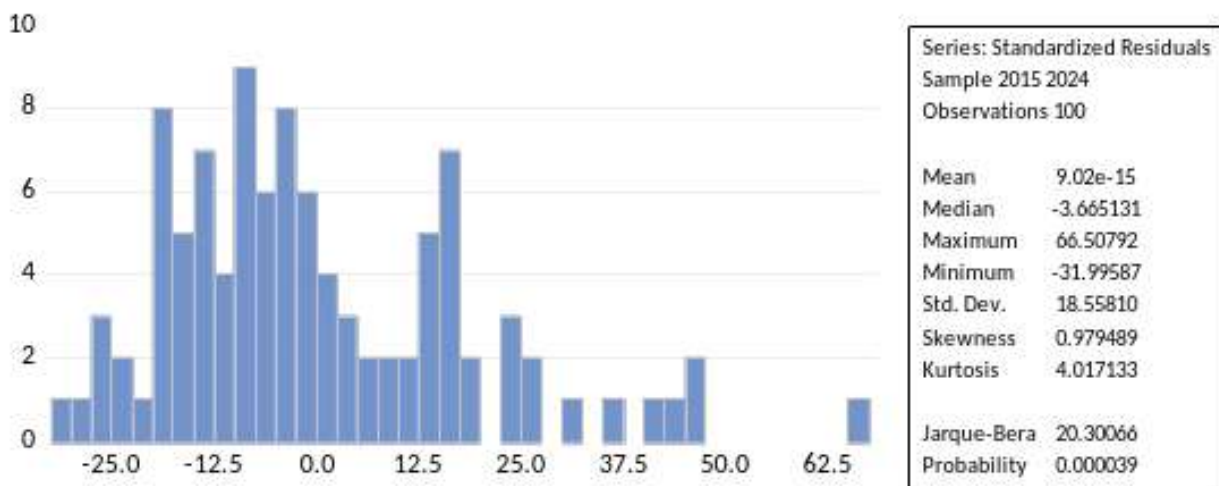
In conclusion, ROE values are not consistent throughout companies and periods. And thus, heteroskedasticity can be detected in ROE values. In spite of the fact that there are companies and periods which deal with a lot of fluctuations in ROE, all of them gain higher ROE thanks to high values of EPS.

Normality Test



Graph 1: Normality Test of ROE

Sources: computed by the author



Graph 2: Normality Test of EPS

Sources: computed by the author

The normality test especially the Jarque-Bera statistic allows us to establish whether the values of ROE and EPS are normally distributed which is important for selecting the right statistical models. In the case of ROE values the Jarque-Bera statistic is calculated as 1.58 which results in the associated p-value of 0.45 that exceeds 0.05. This suggests that we do not reject the null hypothesis which in turn means that the ROE values are normally distributed. In simple terms ROE values present a normal-shaped data distribution with a clear bell-shaped curve and absence of outliers. In contrast EPS presents the Jarque-Bera statistic equal to 10.37 and the p-value equal to 0.05 which indicates that EPS violates the normality assumption which means that the values of EPS may vary significantly across different companies.

In conclusion, it should be said that ROE values are stable meanwhile EPS values present a wider range of variation which leads to the lack of normality that should be taken into consideration when working with EPS.

Hypotheses Testing Results

The hypotheses proposed in this research were verified using various panel data regression techniques like the Pooled OLS method, the Fixed Effects Model (FEM) and the Random Effects Model (REM). Among the five hypotheses presented, two hypotheses H2 and H4 were accepted and three were rejected based on the statistical significance and direction of the coefficient values. The hypothesis H2 on the firm size was accepted since firm size showed a significant and positive correlation with profitability in all models analyzed. The hypothesis H4 on the firm efficiency was also accepted as it was shown to have significant positive effect on profitability; meaning that companies with efficient utilization of their resources get higher profit.

In contrast, the hypotheses pertaining to leverage (H1), liquidity (H3), and working capital (H5) were not supported. It was observed that the influence of leverage on profits was both inconsistent and non-significant across the study's models, indicating that higher levels of debt would not necessarily

improve the performance of the company. The hypothesis about liquidity was rejected because, although it was theoretically assumed to increase profit, the actual statistical data did not support this claim. Finally, working capital showed no definitive impact on profits, hence leading to the rejection of hypothesis H5. The findings as a whole indicate that while the size of the company and its efficiency are the major drivers of profit, leverage, liquidity, and working capital exist in a more complex context and their respective roles may differ across companies and periods.

10. CONCLUSION

The objective of the research was to explore the internal financial determinants that influence the profitability of iron and steel companies listed on the Indian stock exchange in the period from 2014 to 2024. By utilizing panel data analysis, the study focused on the performance of 10 prominent iron and steel firms listed on the BSE, and evaluated the impacts of various indicators on profitability such as firm size, working capital requirement, company efficiency, liquidity and leverage, as measured by EPS and ROE.

The study showed that EPS exhibited a strong and statistically significant positive effect on ROE in all tested models. The Fixed Effects Model (FEM) was chosen as the most suitable out of all models tested since the Hausman test showed the importance of company-specific features for the profitability of companies.

The usage of descriptive statistics and correlation analysis indicated high variability of profitability across different firms and that profitability measured in terms of ROE is positively associated with EPS. The analysis of autocorrelation and normality illustrates that the behavior of ROE can be described as steady and normal while EPS shows larger variations than ROE being slightly deviated from the normal distribution which points to the differences in risk-return profiles of firms. Notwithstanding the presence of heteroskedasticity, the results of the study reveal the presence of positive contributions of firm efficiency and size to profitability, although the impact of leverage and working capital differs depending on the model and characteristics of the firm.

To sum up, the study concludes that EPS, firm efficiency, and firm size are the key internal factors defining profitability in the iron and steel sector in India. These results help corporate managers and investors improving the financial performance of firms in the industry.

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