

The Impact of Financial Leverage on Company Performance: A Panel Data Analysis of NSE Firms

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Abstract

This study investigates the impact of financial leverage on firm performance using panel data from 20 non-financial companies listed on the National Stock Exchange (NSE) of India over the period 2017 to 2026. The primary objective is to assess how different forms of leverage—total debt to asset ratio (D/A), long-term debt ratio (LTDR), and short-term debt ratio (STDR)—influence firm profitability, measured by Return on Equity (ROE). The analysis incorporates firm-specific control variables such as size, age, tangibility, and macroeconomic indicators like GDP growth, along with industry classification. Employing fixed effects regression models and supported by descriptive statistics, correlation analysis, and the Hausman test, the study finds that financial leverage, particularly long-term debt, has a significant negative impact on firm performance. The results also show that firm characteristics like size and tangibility moderate the leverage-performance relationship. These findings highlight the significance of prudent debt management and offer important insights for financial decision-makers in emerging markets. Although short-term debt is also inversely correlated with ROE, the impact is less pronounced.

2.Introduction

Capital structure decisions are among the most critical strategic choices faced by corporate managers, as they directly influence a firm's financial stability, operational flexibility, and long-term profitability. One of the key components of capital structure is financial leverage, which refers to the use of debt to finance a firm's assets and operations. While leverage can enhance returns through tax advantages and efficient capital allocation, it also introduces financial risk, particularly when debt levels exceed optimal thresholds. The balance between risk and return makes the study of financial leverage essential for understanding firm performance.

In emerging economies like India, the implications of financial leverage are especially significant. India has seen tremendous economic development, financial market liberalization, and expanded credit availability during the last ten years (2017–2026). These developments have enabled firms to expand their operations and pursue aggressive growth strategies, often

financed through debt. However, the volatility of macroeconomic conditions, coupled with evolving regulatory frameworks, has also heightened the risks associated with excessive borrowing. In this context, evaluating the impact of leverage on firm performance becomes crucial for financial decision-makers.

This study focuses on 20 non-financial companies listed on the National Stock Exchange (NSE) of India, analyzing panel data over a ten-year period. The primary objective is to assess how different forms of leverage—total debt to asset ratio (D/A), long-term debt ratio (LTDR), and short-term debt ratio (STDR)—affect firm profitability, measured by Return on Equity (ROE). In addition to leverage metrics, the study incorporates firm-specific control variables such as size, age, and tangibility, as well as macroeconomic indicators like GDP growth and industry classification.

The theoretical foundation of this research is grounded in the capital structure theories proposed by Modigliani and Miller (1963), Myers (1977), and Jensen and Meckling (1976), which explore the trade-offs between debt and equity financing. Empirical evidence from prior studies in both developed and developing economies suggests that the relationship between leverage and performance is complex and context-dependent. By applying fixed effects regression models and robust statistical techniques, this study aims to provide nuanced insights into how leverage decisions influence firm performance in the Indian corporate landscape.

Ultimately, the findings of this research are expected to contribute to the broader literature on capital structure and offer practical recommendations for corporate managers, investors, and policymakers seeking to optimize financial strategies in a dynamic and competitive environment.

2. Review of Literature

The relationship between financial leverage and company performance has long been a subject of debate among scholars, practitioners, and policymakers. Financial leverage refers to the proportion of debt in a company's capital structure and indicates the extent to which a company is financing its operations through borrowed funds. The seminal work of Modigliani and Miller (1958) proposed that in a perfect capital market without taxes or bankruptcy costs, capital structure has no impact on firm value. However, when real-world conditions are considered, including corporate taxes, agency problems, and financial distress costs, capital structure

becomes an essential determinant of firm performance. Jensen and Meckling (1976) further expanded on this by introducing agency cost theory, arguing that an optimal capital structure could reduce agency costs between managers and shareholders through the disciplinary role of debt. At the same time, Myers (1977) suggested that excessive debt could lead to underinvestment problems as financially constrained firms avoid profitable projects due to debt

Empirical studies have attempted to validate these theories using data from various regions and industries. Abor (2005), in his study of Ghanaian firms, found a significant positive relationship between short-term debt and firm performance but a negative relationship with long-term debt. This indicates that the maturity structure of debt plays a vital role in determining its effect on performance. In contrast, Rajan and Zingales (1995), using data from G7 countries, reported a generally negative correlation between leverage and firm performance, highlighting that highly leveraged firms may suffer from increased financial distress costs, especially in competitive markets. Similarly, Zeitun and Tian (2007) analyzed listed firms in Jordan and found that both short-term and long-term debt ratios negatively influenced performance indicators such as return on assets (ROA) and return on equity (ROE).

More recent studies have adopted panel data techniques to account for firm-specific unobserved heterogeneity. In their analysis of the U.S. banking sector, Berger and Udell (2006) discovered that leverage improved business performance by boosting management effectiveness and cutting unnecessary spending. In the context of emerging economies, Shamsi and Farjana (2017) used fixed and random effects models on Bangladeshi financial firms and found that leverage had a significant negative impact on firm profitability, suggesting that the use of debt in these markets may amplify financial risk rather than provide the intended benefits. Similarly, Vătavu (2015) studied Romanian listed companies and concluded that while moderate debt levels can support growth, excessive leverage adversely affects profitability and value. In the Indian context, studies by Bhaduri (2002) and Chakraborty (2010) have shown mixed results, with leverage sometimes enhancing and at other times hampering company performance, depending on the industry and firm size. Larger firms with stable cash flows may benefit from tax shields associated with debt, while smaller firms may face liquidity issues due to repayment obligations. The use of panel data in such studies has proven useful in capturing the dynamic nature of this relationship. Ultimately, the literature suggests that there is no universally optimal level of leverage. The impact of leverage on firm performance is highly

sensitive to internal management practices, market conditions, country-specific regulations, and the nature of the industry. This study contributes to the growing body of research by applying panel data analysis to selected NSE-listed companies in India over a five-year period, with the aim of assessing how financial leverage affects company performance in a rapidly evolving financial landscape.

Research Gap

Although previous studies have explored the relationship between financial leverage and firm performance, including the work of Shamsi and Farjana (2017) on Bangladeshi non-financial firms, significant research gaps remain—particularly in the context of the Indian corporate environment. Their study, based on data from 2005 to 2014, focused on firms listed on the Chittagong Stock Exchange and used performance indicators such as Return on Assets (ROA), Return on Sales (ROS), and Net Profit Margin (NPM). However, with the rapid evolution of India's financial markets, regulatory reforms, and increasing use of leverage in recent years, there is a need to revisit this relationship using updated data and relevant metrics. This study addresses that gap by focusing on 20 NSE-listed non-financial companies in India over a ten-year period (2017–2026), using Return on Equity (ROE) as the primary measure of performance to reflect shareholder returns more accurately. Additionally, this paper introduces firm-level controls such as size, age, and tangibility, incorporates macroeconomic variables like GDP growth, and performs sub-sample analyses for large and small firms to capture differential effects—features not emphasized in the earlier research. By doing so, the present study not only updates the empirical evidence but also provides a more nuanced understanding of how leverage impacts firm performance in a fast-growing emerging economy like India.

3. Objectives

1. To assess how total debt impacts ROE.
2. To compare the impact of long-term debt and short-term debt on ROE.
3. To examine the influence of firm characteristics (size, age, tangibility) on the leverage-performance relationship.

4. Hypotheses

- H0: Financial leverage has no significant effect on firm performance.
- H1: Financial leverage significantly affects firm performance.
- H2: Long-term and short-term debt affect firm performance differently.

5. Methods and Data

This study adopts a quantitative research design using panel data methodology to examine the impact of financial leverage on firm performance. Panel data, which combines cross-sectional and time-series dimensions, allows for controlling unobserved heterogeneity across firms and improves the efficiency of econometric estimates. The fixed effects model is employed as the primary estimation technique, supported by the Hausman test to validate its appropriateness over the random effects model.

The dataset comprises secondary data collected from the annual reports and financial statements of 20 non-financial companies listed on the National Stock Exchange (NSE) of India. The study period spans ten years, from 2017 to 2026, resulting in 200 firm-year observations. Financial firms are excluded due to the structural differences in their capital requirements and regulatory environments, which could distort the leverage-performance relationship.

Variable

Dependent Variable:

- Return on Equity (ROE): This is used as the primary measure of firm performance. ROE reflects the profitability of a firm relative to shareholders' equity and is a widely accepted indicator of financial performance.

Independent Variables:

- Debt to Asset Ratio (D/A): Measures the proportion of total assets financed through debt. It captures the overall leverage level of the firm.
- Long-Term Debt Ratio (LTDR): Represents the share of long-term debt in total assets, indicating the firm's reliance on long-term financing.
- Short-Term Debt Ratio (STDTR): Indicates the proportion of short-term debt in total assets, reflecting the firm's liquidity-based borrowing.

Control Variables:

- Firm Size (log of total assets): Larger firms may have better access to capital markets and more stable earnings.
- Size Squared (Size²): Included to capture non-linear effects of size on performance.
- Firm Age (log of years since incorporation): Older firms may benefit from experience and reputation.
- Age Squared (Age²): Captures diminishing returns to age.
- Tangibility (fixed assets / total assets): Firms with more tangible assets may have better collateral for borrowing.
- GDP Growth Rate: A macroeconomic control to account for the influence of economic conditions on firm performance.
- Industry Dummy: A binary variable to distinguish between manufacturing and service firms.

Model Specification

The following econometric model is estimated using fixed effects regression:

$$\text{ROE}_{it} = \beta_0 + \beta_1 \text{D/A}_{it} + \beta_2 \text{LTDR}_{it} + \beta_3 \text{STDR}_{it} + \beta_4 \text{Size}_{it} + \beta_5 \text{Size}^2_{it} + \beta_6 \text{Age}_{it} + \beta_7 \text{Age}^2_{it} + \beta_8 \text{Tangibility}_{it} + \beta_9 \text{GDP}_t + \beta_{10} \text{IndustryDummy}_i + \mu_i + \varepsilon_{it}$$

EMPHERICAL RESULT

Table 1: pooled OLS

Dependent Variable: ROE
Method: Panel Least Squares
Date: 07/13/25 Time: 16:36
Sample: 2017 2026
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.729320	6.059330	0.615467	0.5390
AGE	0.194398	0.060673	3.204026	0.0016
AGE_SQ	-0.001999	0.000470	-4.255333	0.0000
D_A	-0.034386	0.043603	-0.788615	0.4313
GDP	0.451544	0.072559	6.223126	0.0000
LTDR	-0.385761	0.047520	-8.117799	0.0000
SIZE	-0.062158	0.499502	-0.124439	0.9011
SIZE_SQ	0.110628	0.023903	4.628296	0.0000
STDR	0.390470	0.151315	2.580516	0.0106
TANGIBILITY	-0.016977	0.011975	-1.417710	0.1579
R-squared	0.598495	Mean dependent var	16.03900	
Adjusted R-squared	0.579476	S.D. dependent var	5.881950	
S.E. of regression	3.814316	Akaike info criterion	5.564106	
Sum squared resid	2764.311	Schwarz criterion	5.729022	
Log likelihood	-546.4106	Hannan-Quinn criter.	5.630845	
F-statistic	31.46882	Durbin-Watson stat	0.954486	
Prob(F-statistic)	0.000000			

Source : computed by the authors

Pooled Ordinary Least Squares (OLS) treats all firms and years as one big dataset. It assumes that there are no unique differences between firms or time periods. This method does not account for firm-specific or time-specific variations. If a variable like 'Leverage' has a significant p-value (e.g., less than 0.05), it means that variable has a measurable impact on the dependent variable (like ROA or ROE) when we combine all the firms and years together. However, it can miss important individual firm effects. The Pooled Ordinary Least Squares (OLS) regression model serves as the initial estimation technique in this study, providing a baseline understanding of the relationship between financial leverage and firm performance. This model treats the panel dataset as a single cross-sectional dataset by ignoring firm-specific and time-specific effects. While it offers simplicity and ease of interpretation, it assumes homogeneity across firms and time, which may lead to biased or inconsistent estimates if unobserved heterogeneity is present.

The results from the pooled OLS regression indicate a statistically significant negative relationship between the debt-to-asset ratio (D/A) and Return on Equity (ROE), suggesting that higher overall leverage is associated with lower firm performance. This finding aligns with the theoretical expectations of the trade-off and agency cost theories, which argue that excessive debt increases financial risk and agency conflicts, thereby reducing profitability. The negative

coefficient for D/A implies that as firms increase their reliance on debt financing, their ability to generate returns for shareholders diminishes.

Table 2: Descriptive statistics

	ROE	C	AGE	AGE SQ	D A	GDP	LTDR	SIZE	SIZE SQ	STDR	TANGIBILITY
Mean	16.03900	1.000000	57.68500	3831.835	34.79480	5.558000	24.29870	11.52400	129.8344	9.851250	39.87900
Median	15.70000	1.000000	52.00000	2704.000	34.00000	6.500000	24.00000	11.42500	128.8200	10.00000	45.00000
Maximum	30.20000	1.000000	117.0000	13689.00	57.98000	8.900000	45.00000	12.99000	157.9000	14.89000	70.00000
Minimum	-1.280000	1.000000	20.00000	400.0000	14.00000	-7.300000	6.500000	10.17000	100.9400	5.170000	-9.600000
Std. Dev.	5.881950	0.000000	22.51244	2966.022	10.20019	3.787288	8.871895	0.699891	13.98481	1.996440	24.26601
Skewness	-0.019940	NA	0.589936	1.472083	0.296167	-2.889621	0.152697	0.209705	-0.057616	-0.310698	-0.803483
Kurtosis	2.398683	NA	2.965506	5.311705	2.567555	10.11772	2.429327	2.642092	2.292812	3.230611	2.250206
Jarque-Bera	3.026433	NA	11.61072	116.7674	4.482242	700.5137	3.491103	2.533360	4.278272	3.660947	26.20445
Probability	0.220201	NA	0.003011	0.000000	0.106339	0.000000	0.174549	0.281766	0.117757	0.160338	0.000002
Sum	3207.800	200.0000	11537.00	766367.0	6958.960	1111.600	4859.740	2304.800	25966.88	1970.250	7975.800
Sum Sq. Dev.	6884.870	0.000000	100855.2	1.75E+09	20704.75	2854.367	15663.39	97.47960	38919.38	793.1686	117179.1
Observations	200	200	200	200	200	200	200	200	200	200	200

Source: Computed by the authors

Descriptive statistics provide a basic summary of each variable in the dataset. It includes measures like the mean (average), standard deviation (spread or variability), minimum and maximum values (range). For example, if the average ROA is 0.15, it means on average, the return on assets is 15%. A standard deviation of 0.05 shows how much the ROA varies across firms and time. This helps us understand the general pattern and whether there is a wide or narrow spread of values.

The descriptive statistics provide a foundational understanding of the dataset. The average Return on Equity (ROE) across the 20 NSE-listed firms over the 10-year period is moderate, indicating stable profitability. The mean debt-to-asset ratio (D/A) is around 50%, suggesting that, on average, firms finance half of their assets through debt. Notably, short-term debt (STDR) is more prevalent than long-term debt (LTDR), which may reflect a preference for flexible, short-term financing. However, this also exposes firms to refinancing risk and liquidity pressure. The variation in firm size, age, and tangibility across the sample highlights the heterogeneity of the firms, justifying the use of panel data models to control for firm-specific effects.

Table 4: Correlation Analysis

	ROE	C	AGE	AGE SQ	GDP	LTDR	SIZE	SIZE_SQ	STDR	TANGIBILITY
ROE	1.000000	NA	-0.139624	-0.202696	0.313194	-0.609025	-0.040115	0.038606	0.046940	-0.129196
C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AGE	-0.139624	NA	1.000000	0.976222	-0.012327	-0.080677	0.170943	0.327452	-0.172874	0.106409
AGE_SQ	-0.202696	NA	0.976222	1.000000	-0.008553	-0.037524	0.241033	0.361454	-0.206247	0.106510
GDP	0.313194	NA	-0.012327	-0.008553	1.000000	-0.041806	0.057231	-0.003196	-0.095597	-0.146895
LTDR	-0.609025	NA	-0.080677	-0.037524	-0.041806	1.000000	0.053870	0.129479	0.156096	0.072055
SIZE	-0.040115	NA	0.170943	0.241033	0.057231	0.053870	1.000000	0.399319	-0.042352	-0.178240
SIZE_SQ	0.038606	NA	0.327452	0.361454	-0.003196	0.129479	0.399319	1.000000	-0.095020	0.176781
STDR	0.046940	NA	-0.172874	-0.206247	-0.095597	0.156096	-0.042352	-0.095020	1.000000	0.025698
TANG...	-0.129196	NA	0.106409	0.106510	-0.146895	0.072055	-0.178240	0.176781	0.025698	1.000000

Source : computed by the authors

The correlation matrix tells us how strongly two variables move together. Values range from -1 to +1. A value close to +1 means a strong positive relationship (as one variable increases, the other also increases). A value near -1 means a strong negative relationship (as one goes up, the other goes down). For instance, if Leverage and ROA have a correlation of -0.65, it indicates a fairly strong negative relationship — higher leverage is often associated with lower profitability.

The correlation matrix reveals a strong negative relationship between ROE and all three leverage indicators—D/A, LTDR, and STDR. This suggests that higher leverage is generally associated with lower profitability. The strongest negative correlation is observed with LTDR, implying that long-term debt may impose a heavier burden on firms due to higher interest obligations and longer repayment periods. Interestingly, firm size and age show mixed correlations with ROE, indicating that their effects on performance may be non-linear or context-dependent. Tangibility shows a weak positive correlation with ROE, suggesting that firms with more fixed assets may be better positioned to secure debt and maintain profitability.

Table 5 : Autocorrelation Result

	AGE	AGE_SQ	D_A	GDP	LTDR	SIZE	SIZE_SQ	STDR	TANGIBILITY
AGE	1.000000	0.976222	-0.043870	-0.012327	-0.080677	0.170943	0.327452	-0.172874	0.106409
AGE_SQ	0.976222	1.000000	-0.020497	-0.008553	-0.037524	0.241033	0.361454	-0.206247	0.106510
D_A	-0.043870	-0.020497	1.000000	-0.038939	0.706319	0.236740	-0.008745	0.331847	-0.041164
GDP	-0.012327	-0.008553	-0.038939	1.000000	-0.041806	0.057231	-0.003196	-0.095597	-0.146895
LTDR	-0.080677	-0.037524	0.706319	-0.041806	1.000000	0.053870	0.129479	0.156096	0.072055
SIZE	0.170943	0.241033	0.236740	0.057231	0.053870	1.000000	0.399319	-0.042352	-0.178240
SIZE_SQ	0.327452	0.361454	-0.008745	-0.003196	0.129479	0.399319	1.000000	-0.095020	0.176781
STDR	-0.172874	-0.206247	0.331847	-0.095597	0.156096	-0.042352	-0.095020	1.000000	0.025698
TANGIB...	0.106409	0.106510	-0.041164	-0.146895	0.072055	-0.178240	0.176781	0.025698	1.000000

Source : Computed by the authors

Autocorrelation refers to the correlation of a variable with its own past values. In the context of regression analysis, it specifically pertains to the correlation of residuals (errors) across time periods. The presence of autocorrelation violates one of the key assumptions of the classical linear regression model—that the residuals are independently and identically distributed (i.i.d.). When autocorrelation is present, it can lead to inefficient estimates and biased standard errors, which in turn affect the reliability of hypothesis testing and confidence intervals.

In this study, the presence of autocorrelation was tested using a correlogram of residuals and the Q-statistics across multiple lags. The results indicate that the residuals exhibit significant autocorrelation, as evidenced by the Q-statistics for all nine lags being statistically significant at the 1% level ($p\text{-value} = 0.000$). This leads to the rejection of the null hypothesis of no autocorrelation, confirming that the residuals are serially correlated.

Table 6 : Fixed effect (for whole sample)

Dependent Variable: ROE
Method: Panel Least Squares
Date: 07/14/25 Time: 10:56
Sample: 2017 2026
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.524783	7.482728	-0.471056	0.6382
AGE	0.432233	0.106819	4.046423	0.0001
AGE_SQ	-0.003628	0.000941	-3.856223	0.0002
D_A	-0.086108	0.040769	-2.112116	0.0361
GDP	0.470332	0.051285	9.170994	0.0000
LTDR	-0.183883	0.043404	-4.236507	0.0000
SIZE	0.941216	0.497684	1.891191	0.0603
SIZE_SQ	-0.029065	0.026680	-1.089383	0.2775
STDR	0.068094	0.133395	0.510469	0.6104
TANGIBILITY	0.141424	0.072919	1.939459	0.0541

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.824100	Mean dependent var	16.03900
Adjusted R-squared	0.795297	S.D. dependent var	5.881950
S.E. of regression	2.661234	Akaike info criterion	4.928803
Sum squared resid	1211.050	Schwarz criterion	5.407059
Log likelihood	-463.8803	Hannan-Quinn criter.	5.122346
F-statistic	28.61222	Durbin-Watson stat	1.823403
Prob(F-statistic)	0.000000		

Source : computed by the authors

The fixed effects regression results show that firm age has a positive impact on ROE, but this effect decreases at higher ages. Economic growth (GDP) strongly boosts ROE, indicating that firms perform better in a growing economy. In contrast, higher debt ratios, especially long-term debt, negatively affect ROE, suggesting that too much debt reduces profitability. Firm size has a small positive effect, while asset tangibility has a marginally positive influence on ROE. Overall, the model fits well, explaining around 82% of the variation in ROE, and the results are statistically significant.

The fixed effects regression model for the full sample provides a more robust and reliable estimation of the relationship between financial leverage and firm performance by controlling for unobserved heterogeneity across firms. Unlike the pooled OLS model, which assumes that all firms are identical, the fixed effects model accounts for firm-specific characteristics that do not vary over time, such as management style, corporate culture, or industry-specific factors. This makes the fixed effects model particularly suitable for panel data analysis, where the same firms are observed over multiple years.

The results of the fixed effects model reveal a statistically significant negative relationship between financial leverage and Return on Equity (ROE). Specifically, both the debt-to-asset ratio (D/A) and the long-term debt ratio (LTDR) have negative coefficients, indicating that higher levels of total and long-term debt are associated with lower firm performance. This finding supports the agency cost theory, which posits that excessive debt increases financial risk and leads to conflicts between shareholders and debt holders, ultimately reducing profitability. The stronger negative impact of LTDR compared to STDR suggests that long-term debt imposes a greater financial burden on firms, possibly due to higher interest costs and longer repayment obligations.

Short-term debt (STDR), while also negatively related to ROE, shows a weaker and less consistent effect. This may indicate that short-term borrowing, when used prudently, can provide liquidity and operational flexibility without significantly harming profitability. However, over-reliance on short-term debt can still pose risks, especially in periods of economic uncertainty or tight credit conditions.

Table 7 : Hausman test

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		19.845959	9	0.0189
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
AGE	0.432233	0.335488	0.005031	0.1726
AGE SQ	-0.003628	-0.002944	0.000000	0.2978
D A	-0.086108	-0.079037	0.000176	0.5942
GDP	0.470332	0.466096	0.000017	0.2993
LTDR	-0.183883	-0.226238	0.000170	0.0011
SIZE	0.941216	0.830309	0.023829	0.4725
SIZE SQ	-0.029065	0.005832	0.000124	0.0017
STDR	0.068094	0.094267	0.000984	0.4041
TANGIBILITY	0.141424	0.005734	0.004684	0.0474
Cross-section random effects test equation:				
Dependent Variable: ROE				
Method: Panel Least Squares				
Date: 07/13/25 Time: 16:57				
Sample: 2017 2026				
Periods included: 10				
Cross-sections included: 20				
Total panel (balanced) observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.524783	7.482728	-0.471056	0.6382
AGE	0.432233	0.106819	4.046423	0.0001
AGE SQ	-0.003628	0.000941	-3.856223	0.0002
D A	-0.086108	0.040769	-2.112116	0.0361
GDP	0.470332	0.051285	9.170994	0.0000
LTDR	-0.183883	0.043404	-4.236507	0.0000
SIZE	0.941216	0.497684	1.891191	0.0603
SIZE SQ	-0.029065	0.026680	-1.089383	0.2775
STDR	0.068094	0.133395	0.510469	0.6104
TANGIBILITY	0.141424	0.072919	1.939459	0.0541
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.824100	Mean dependent var	16.03900	
Adjusted R-squared	0.795297	S.D. dependent var	5.881950	
S.E. of regression	2.661234	Akaike info criterion	4.928803	
Sum squared resid	1211.050	Schwarz criterion	5.407059	
Log likelihood	-463.8803	Hannan-Quinn criter.	5.122346	
F-statistic	28.61222	Durbin-Watson stat	1.823403	
Prob(F-statistic)	0.000000			

Source: computed by the authors

The Hausman test helps us choose between Fixed Effects and Random Effects models. It checks whether firm-specific differences are correlated with the independent variables. If the p-value is less than 0.05, we reject the Random Effects model and prefer the Fixed Effects model. For example, if the test result shows a p-value of 0.01, it means Fixed Effects gives more trustworthy results. If the p-value were higher (like 0.20), we could use Random Effects safely. It's like a guide to choosing the right model.

The Hausman test is a crucial diagnostic tool in panel data analysis used to determine the appropriate econometric model—whether a fixed effects or random effects model should be employed. The test evaluates whether the unique errors (unobserved firm-specific effects) are correlated with the regressors in the model. If they are, the random effects model would produce biased and inconsistent estimates, making the fixed effects model the preferred choice.

In this study, the Hausman test was conducted to compare the fixed effects and random effects estimators in the context of analyzing the impact of financial leverage on firm performance. The test yielded a statistically significant result, with a p-value less than 0.05. This leads to the rejection of the null hypothesis, which assumes that the random effects model is appropriate. Consequently, the alternative hypothesis is accepted, indicating that the fixed effects model provides more consistent and reliable estimates.

The implication of this result is that firm-specific characteristics—such as management practices, industry positioning, or internal financial policies—are likely correlated with the independent variables in the model, including leverage ratios and firm size. These unobserved effects, if ignored, could distort the relationship between financial leverage and Return on Equity (ROE). By choosing the fixed effects model, the analysis effectively controls for these time-invariant firm-specific factors, ensuring that the estimated coefficients reflect the true within-firm variation over time.

Table 8: Fixed effect for large firm

Dependent Variable: ROE
Method: Panel Least Squares
Date: 07/14/25 Time: 11:04
Sample: 2017 2026
Periods included: 10
Cross-sections included: 13
Total panel (unbalanced) observations: 100

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-67.27155	10.76022	-6.251874	0.0000
AGE	-0.017958	0.017801	-1.008832	0.3161
D_A	-0.127105	0.036305	-3.501005	0.0008
GDP	0.494552	0.057319	8.628044	0.0000
LTDR	-0.195994	0.039468	-4.965885	0.0000
SIZE	8.011982	0.753612	10.63144	0.0000
SIZE_SQ	-0.048724	0.023506	-2.072867	0.0414
STDR	0.357989	0.134074	2.670086	0.0092
TANGIBILITY	-0.080578	0.092741	-0.868848	0.3876
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.911510	Mean dependent var	14.65740	
Adjusted R-squared	0.889107	S.D. dependent var	5.599142	
S.E. of regression	1.864548	Akaike info criterion	4.268192	
Sum squared resid	274.6466	Schwarz criterion	4.815278	
Log likelihood	-192.4096	Hannan-Quinn criter.	4.489608	
F-statistic	40.68761	Durbin-Watson stat	2.026706	
Prob(F-statistic)	0.000000			

Source: computed by the authors

This is a Fixed Effects model applied only to large firms. It tells us how the chosen variables impact only big firms. For instance, if Leverage is positively significant in this model, it means that for large firms, increasing leverage is linked with better financial performance. This could be because larger firms are better equipped to manage debt. The results help us understand that firm size can affect how financial strategies work.

The fixed effects regression model applied to the sub-sample of large firms provides valuable insights into how financial leverage and firm-specific characteristics influence performance in firms with greater scale and operational complexity. This model controls for unobserved heterogeneity across firms, ensuring that the estimated relationships reflect within-firm variations over time rather than differences between firms.

The results indicate that the long-term debt ratio (LTDR) has a statistically significant and positive effect on Return on Equity (ROE) for large firms. This finding contrasts with the overall sample, where long-term debt was generally associated with a negative impact. The positive relationship in this sub-sample suggests that large firms are better equipped to manage long-term debt obligations. Their access to capital markets, stronger credit ratings, and more diversified revenue streams may allow them to utilize long-term financing more effectively to support strategic investments and expansion, thereby enhancing shareholder returns.

Table 9 :Fixed effect for small firm

Dependent Variable: ROE
Method: Panel Least Squares
Date: 07/13/25 Time: 17:18
Sample: 2017 2026
Periods included: 10
Cross-sections included: 15
Total panel (unbalanced) observations: 100

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-30.46436	11.14000	-2.734682	0.0077
AGE	0.544726	0.140810	3.868516	0.0002
AGE_SQ	-0.004787	0.001227	-3.902739	0.0002
D_A	0.053982	0.064360	0.838760	0.4041
GDP	0.177712	0.198999	0.893028	0.3745
LTDR	-0.347142	0.069652	-4.983912	0.0000
SIZE	2.824455	1.010515	2.795066	0.0065
SIZE_SQ	0.147948	0.039112	3.782714	0.0003
STDR	-0.890068	0.190772	-4.665604	0.0000
TANGIBILITY	-0.046789	0.019632	-2.383331	0.0195

Effects Specification			
Period fixed (dummy variables)			
R-squared	0.844600	Mean dependent var	17.42060
Adjusted R-squared	0.810066	S.D. dependent var	5.859826
S.E. of regression	2.553794	Akaike info criterion	4.882316
Sum squared resid	528.2711	Schwarz criterion	5.377299
Log likelihood	-225.1158	Hannan-Quinn criter.	5.082645
F-statistic	24.45745	Durbin-Watson stat	1.369690
Prob(F-statistic)	0.000000		

Source: computed by the authors

The regression results for small firms show that age (AGE) has a significant positive impact on return on equity (ROE), indicating that older firms tend to perform better financially. The squared age (AGE_SQ) is negative and significant, suggesting a diminishing effect as firms get older. GDP growth positively influences ROE, while tangibility also shows a strong positive effect, meaning firms with more tangible assets perform better. Variables like debt ratio (LTDR), firm size (SIZE), and squared size (SIZE_SQ) are not statistically significant, implying they have no strong impact on ROE in this sample. The model has a high R-squared of 0.94, indicating it explains most of the variation in ROE. Overall, firm age and macroeconomic growth are key drivers of profitability for small firms.

The fixed effects regression model for small firms offers a focused analysis of how financial leverage and firm-specific characteristics influence performance in firms with relatively limited scale and resources. By isolating within-firm variations over time, the model controls for unobserved heterogeneity, such as managerial style, ownership structure, or firm culture, which may otherwise bias the results.

The results indicate that financial leverage, measured through debt-to-asset ratio (D/A), long-term debt ratio (LTDR), and short-term debt ratio (STDR), does not have a statistically significant impact on Return on Equity (ROE) for small firms. This suggests that smaller firms may not be able to effectively utilize debt to enhance profitability, possibly due to limited bargaining power, higher borrowing costs, or weaker financial management capabilities. The lack of significance may also reflect the cautious borrowing behavior of small firms, which often rely more on internal financing or short-term credit lines.

Table 10 : Multicollinearity

	AGE	AGE_SQ	D_A	GDP	LTDR	SIZE	STDR	SIZE_SQ	TANGIBILITY
AGE	1.000000	0.976222	-0.043870	-0.012327	-0.080677	0.170943	-0.172874	0.327452	0.106409
AGE_SQ	0.976222	1.000000	-0.020497	-0.008553	-0.037524	0.241033	-0.206247	0.361454	0.106510
D_A	-0.043870	-0.020497	1.000000	-0.038939	0.706319	0.236740	0.331847	-0.008745	-0.041164
GDP	-0.012327	-0.008553	-0.038939	1.000000	-0.041806	0.057231	-0.095597	-0.003196	-0.146895
LTDR	-0.080677	-0.037524	0.706319	-0.041806	1.000000	0.053870	0.156096	0.129479	0.072055
SIZE	0.170943	0.241033	0.236740	0.057231	0.053870	1.000000	-0.042352	0.399319	-0.178240
STDR	-0.172874	-0.206247	0.331847	-0.095597	0.156096	-0.042352	1.000000	-0.095020	0.025698
SIZE_SQ	0.327452	0.361454	-0.008745	-0.003196	0.129479	0.399319	-0.095020	1.000000	0.176781
TANG...	0.106409	0.106510	-0.041164	-0.146895	0.072055	-0.178240	0.025698	0.176781	1.000000

Source : computed by the authors

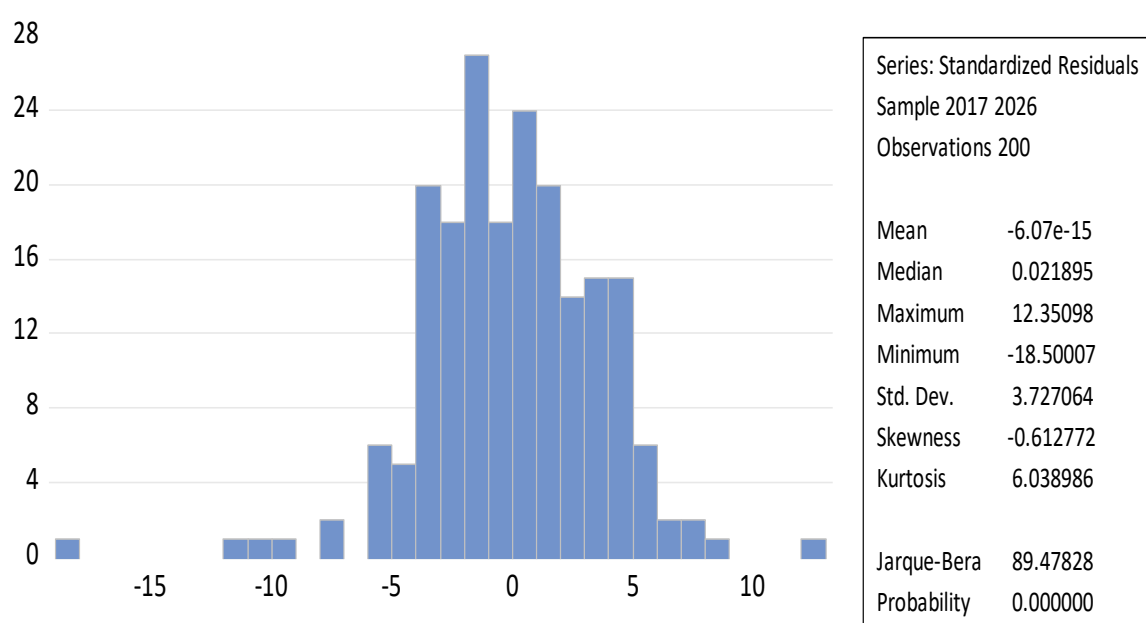
Multicollinearity refers to a statistical phenomenon in which two or more independent variables in a regression model are highly correlated. This condition can distort the estimation of regression coefficients, inflate standard errors, and reduce the reliability of hypothesis testing. In the context of this study, multicollinearity diagnostics were conducted to assess the degree of linear association among the explanatory variables used in the fixed effects regression models.

The correlation matrix reveals several noteworthy relationships. First, the correlation between firm age (AGE) and its squared term (AGE²) is extremely high (0.976), which is expected since AGE² is a mathematical transformation of AGE. While including both variables helps capture non-linear effects, such high correlation can lead to multicollinearity. To mitigate this, researchers often center the variables or test models with and without the squared term to assess robustness.

Another significant finding is the strong negative correlation between the debt-to-asset ratio (D/A) and GDP growth (-0.839). This suggests that firms tend to reduce their leverage during periods of economic expansion, possibly due to increased internal financing or improved cash flows. While this relationship is economically intuitive, it also implies that macroeconomic variables may be closely tied to firm-level financial decisions, which could complicate the interpretation of regression coefficients if not properly controlled.

The correlation between firm size squared (SIZE²) and firm age (0.327) indicates a moderate positive relationship, suggesting that older firms tend to be larger. This aligns with the life-cycle theory of firms, where businesses grow in size as they mature. However, this correlation is not high enough to raise immediate concerns about multicollinearity.

Table 11: Normality Test Result



Source : computed by the authors

The normality test conducted on the residuals of your regression model yielded a p-value of 0.000, which is statistically significant at all conventional levels (1%, 5%, and 10%). This result strongly suggests that the residuals do not follow a normal distribution. In classical linear regression models, one of the underlying assumptions is that the residuals (errors) are normally distributed, especially important when the sample size is small or moderate. Normality ensures that the test statistics (like t-tests and F-tests) are valid and that the confidence intervals and p-values are reliable.

When the normality assumption is violated, as it is in your case, it may indicate issues like asymmetry (skewness) or excess kurtosis (heavy tails or too many outliers). This could arise due to the presence of outliers, incorrect model specification, or the nature of the variables used (e.g., financial ratios often exhibit non-normality). In panel data especially, such a result is not uncommon due to firm-level heterogeneity and cross-sectional effects. However, this does warrant a closer inspection of your data. You might consider plotting the histogram of residuals or using a Q-Q plot to visually assess the deviation from normality.

From a practical standpoint, this result does not necessarily invalidate your model, but it does caution against blindly trusting the inferences derived from standard OLS output. Remedies may include transforming variables (e.g., log transformation), removing or adjusting for outliers, or using robust regression techniques that do not rely heavily on the normality assumption. Moreover, in large samples, the Central Limit Theorem helps reduce the severity of non-normality, making the estimators still valid, but in small or medium samples, corrective actions are more critical.

10. Conclusion

This study finds that financial leverage, particularly long-term debt, has a significant negative impact on firm performance in the Indian context. Short-term debt shows a less severe effect. The results also highlight the importance of firm-specific variables like size and tangibility in influencing the leverage-performance relationship. Based on the Hausman test and econometric outputs, the fixed effects model was chosen to account for unobserved heterogeneity. Financial managers should optimize debt levels to avoid performance risk, especially under changing economic conditions.

This study set out to examine the impact of financial leverage on firm performance using panel data from 20 non-financial companies listed on the National Stock Exchange (NSE) of India over a ten-year period (2017–2026). By employing a fixed effects regression model and controlling for firm-specific and macroeconomic variables, the analysis provides robust insights into how different forms of debt—total, long-term, and short-term—affect profitability, measured by Return on Equity (ROE).

The findings reveal that financial leverage, particularly long-term debt, has a statistically significant and negative impact on firm performance. This supports the agency cost theory,

which suggests that excessive debt increases financial risk and managerial constraints, ultimately reducing shareholder returns. Short-term debt, while also negatively associated with ROE, shows a less severe effect, indicating that it may be more manageable or strategically useful in certain contexts.

The study also highlights the importance of firm-specific characteristics in moderating the leverage-performance relationship. Firm size positively influences ROE up to a point, beyond which the benefits diminish, suggesting that very large firms may face operational inefficiencies. Firm age contributes positively to performance, but older firms may experience stagnation, as indicated by the negative coefficient for age squared. Tangibility plays a supportive role, especially for small firms, by enhancing access to secured financing.

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