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Influence of financial leverage on firms' investment choice - An empirical study of select BSE-listed Indian steel companies

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Abstract
This research investigates the influence of financial leverage on firms' investment choices, focusing on a sample of select BSE-listed Indian steel companies over the period 2015 to 2024. Given the capital-intensive nature and cyclical characteristics of the steel industry, understanding the relationship between financial structure and investment behavior is crucial. Drawing upon theoretical foundations such as the pecking order theory and the debt overhang hypothesis, this study employs panel data regression techniques, including fixed effects and system GMM models, to control for firm-specific heterogeneity and endogeneity. The empirical findings reveal a significant negative relationship between leverage and investment, supporting the view that higher debt levels restrict investment due to financial constraints and agency costs. Additionally, profitability, firm size, and growth opportunities positively influence investment, while liquidity shows mixed effects. The results emphasize the importance of maintaining an optimal capital structure to ensure sustainable investment capacity.

Keywords: Leverage, investment decision, steel industry, India, panel data analysis
JEL Codes: G31, G32, L61, C33.

Introduction

Investment decisions are fundamental to corporate strategy and long-term growth. The Indian steel industry, being one of the largest and most strategic sectors in the country, faces unique challenges concerning capital structuring due to cyclicality, high fixed costs, and global competition. In this context, the present study aims to investigate the impact of leverage on the investment decisions of select BSE-listed Indian steel companies. This inquiry is rooted in classical and modern capital structure theories and seeks to unravel the relationship between a firm's financing choices and its investment behavior.

Empirical research has long debated the influence of leverage on investment decisions, with mixed findings across sectors and economies. A significant body of literature demonstrates that high levels of leverage may constrain investment due to increased debt-servicing obligations and reduced internal financing capacity, particularly during downturns [1]. Others argue that in certain contexts, leverage disciplines managers and enhances investment efficiency [17]. These divergent perspectives underscore the importance of contextualized empirical analysis, especially in economies like India, where financial markets are transitioning, regulatory regimes are evolving, and sector-specific factors are profound.

In India, the steel industry plays a pivotal role in economic development, being a core sector with substantial linkages to infrastructure, construction, and manufacturing. According to [22], India ranks among the top global steel producers, with significant public and private sector participation. The capital-intensive nature of the industry necessitates continuous investment in plant modernization, technological upgradation, and capacity expansion. These investments are long-gestation and require substantial funding, making leverage a vital component of the strategic financial decision-making process. However, the Indian steel industry also faces considerable volatility due to fluctuations in raw material prices, exchange rates, trade policies, and environmental regulations. These externalities amplify financial risk, thereby influencing leverage-related decisions. Moreover, the non-financial nature of steel firms implies that most of them rely heavily on asset-based borrowing, and changes in asset values can significantly alter the leverage-investment relationship. Given these dynamics, it becomes imperative to analyze how leverage affects investment decisions in this critical sector, particularly for firms listed on the BSE Ltd., which represents the formal corporate segment of the Indian economy.

Investment decisions, broadly classified into capital budgeting or fixed investment decisions, involve the allocation of resources to long-term assets with the expectation of generating future cash flows. In a leveraged firm, these decisions are intricately linked to the cost and availability of capital. High leverage can reduce the firm's ability to undertake new investment projects due to the increased burden of debt repayment and heightened perception of risk by external investors. Alternatively, moderate leverage may signal confidence and discipline, attracting further investment [2, 3].

The theoretical link between leverage and investment is also captured in models such as the Tobin's Q theory, where investment is positively related to the firm's market valuation relative to replacement cost [31]. If leverage reduces Q by increasing perceived financial risk, it may deter investment. Conversely, if debt signals firm quality, Q may rise, encouraging investment. Hence, leverage can have either a positive or negative effect on investment, contingent on firm-specific and macroeconomic factors.

The Indian corporate environment, particularly after the liberalization reforms of 1991, has undergone significant transformations in terms of access to capital markets, deregulation, and entry of foreign institutional investors. Despite these advances, many Indian firms still face

financial constraints, leading them to rely on debt capital. The steel industry, in particular, has seen considerable restructuring, mergers and acquisitions, and technological modernization efforts, all of which require robust financial strategies. Therefore, understanding the leverage-investment relationship in this sector holds not only academic value but also practical significance for managers, investors, and policymakers.

Recent empirical studies in emerging markets, including India, have produced mixed results. For instance, [32] found that leverage adversely affects investment in firms with greater growth opportunities, while [21] reported that financial constraints play a more critical role than leverage per se. In India, [27, 6] identified negative leverage-investment relationships, especially for firms with low internal funds. However, more sector-specific investigations are needed to account for industrial heterogeneity, regulatory frameworks, and evolving market structures.

Given the above backdrop, this study aims to bridge the research gap by focusing on the BSE-listed Indian steel companies, which represent a segment characterized by large-scale operations, significant fixed assets, and varying degrees of leverage. By empirically examining the impact of financial leverage on investment decisions using panel data analysis, the study intends to contribute to both theoretical and practical understanding of capital structure behavior in the Indian context.

Literature Review

The literature review synthesizes the theoretical underpinnings and empirical findings related to the impact of leverage on investment decisions, with a focus on emerging economies and specifically on capital-intensive industries such as the Indian steel sector.

1. Theoretical Foundations

Under [23], investment decisions are determined solely by the firm's profitability and future cash flows, implying that leverage should have no effect on investment. However, real-world deviations from these assumptions necessitate more nuanced theories. The Trade-Off theory implies that moderate leverage may encourage investment by lowering the cost of capital through tax shields. However, excessive leverage increases bankruptcy risk and financial constraints, which can hinder new investment. For capital-intensive industries such as steel, where fixed assets and capacity expansion require significant funding, the trade-off between leveraging tax benefits and avoiding distress costs becomes especially critical [33]. Under Pecking Order theory [26], firms with high leverage might reduce investment due to limited internal funds and reluctance to issue equity, especially if external financing is costly or signals negative information. Empirical evidence in emerging markets supports this theory, with firms facing higher borrowing costs and market inefficiencies limiting their financing options [13]. Agency theory [17] suggests that leverage can serve as a disciplinary mechanism. By committing to fixed debt payments, managers face pressure to generate cash flows and avoid wasteful spending, potentially improving investment efficiency. However, leverage can also cause underinvestment problems, where firms forgo positive net present value projects due to debt overhang or risk-shifting behavior, known as asset substitution [24]. This is particularly relevant for steel companies where investments involve high sunk costs and long payback periods.

2. Empirical Evidence on Leverage and Investment

The empirical literature examining the leverage-investment nexus reveals mixed results, reflecting industry-specific conditions, firm characteristics, and country contexts.

2.1. Negative Impact of Leverage on Investment

Several studies report that high leverage constrains investment by raising financial distress costs and limiting internal cash flow availability. For example, [12] documented that financially constrained firms invest less, especially when reliant on external financing. [1] showed in Canadian firms that leverage reduces investment sensitivity to cash flow, indicating credit constraints. Similarly, [33] found that firms with higher debt levels face greater investment restrictions due to increased bankruptcy risk.

In emerging markets, such constraints are more pronounced due to underdeveloped capital markets and asymmetric information. [21] found that Indian firms exhibit a significant negative relationship between leverage and investment, largely due to financial constraints. [27, 6] confirmed this pattern in Indian manufacturing sectors, emphasizing the role of institutional and regulatory factors in amplifying financing frictions.

2.2. Positive or Insignificant Impact of Leverage on Investment

Conversely, some research suggests that leverage may have a positive or neutral effect on investment decisions, primarily when debt imposes managerial discipline or when firms operate in financially developed environments. [17] argued that debt reduces agency costs of free cash flow, motivating managers to invest more prudently. In line with this, [29] observed that well-managed firms with moderate leverage exhibit efficient investment decisions.

Further, [32] examined Chinese firms and found that leverage positively influences investment, particularly for firms with growth opportunities, highlighting market-specific nuances. In the Indian context, [5] noted that large firms with easier access to debt financing invest more despite higher leverage, due to better creditworthiness and capital market access.

2.3. Sectoral and Industry Specific Studies

The steel industry, characterized by capital intensity, cyclical demand, and significant fixed costs, presents a unique setting for leverage-investment analysis. The industry’s reliance on continuous modernization and capacity expansion underscores the importance of understanding how financial leverage influences capital expenditure decisions.

[30] investigated Indian steel firms and found a significant negative correlation between leverage and investment during periods of financial distress, suggesting that heavy debt burdens curtail firms’ ability to invest. Meanwhile, [28] observed that leverage adversely affects capital expenditures in Indian heavy industries due to liquidity constraints. These findings are consistent with global studies indicating that steel firms with high leverage reduce discretionary investments to prioritize debt servicing [18].

At the same time, [10] demonstrated that in certain capital-intensive sectors, debt acts as a signal of financial stability, attracting investments and lowering capital costs. This duality highlights the complexity of leverage effects in industries like steel.

3. Contextual Factors Affecting Leverage-Investment Relationship in Indian Steel Firms

The Indian financial environment, regulatory framework, and market dynamics substantially influence how leverage impacts investment decisions.

Despite improvements post-liberalization, India's capital markets still face inefficiencies such as asymmetric information, limited debt market depth, and regulatory bottlenecks [11]. These factors exacerbate financial constraints for highly leveraged firms, particularly SMEs and sector-specific entities like steel firms. According to [7], these constraints limit firms' ability to finance investment through external debt, intensifying the negative impact of leverage on investment.

Ownership concentration and governance mechanisms also mediate the leverage-investment nexus. Studies by [19] and [9] emphasized that Indian firms with concentrated ownership and effective boards tend to manage leverage more prudently, sustaining investment despite higher debt. The presence of promoter groups in steel firms can influence financing and investment decisions through better access to informal financing and risk-sharing arrangements.

The empirical assessment of leverage's impact on investment has employed diverse methodologies ranging from cross-sectional regressions to dynamic panel data techniques. Panel data analysis, incorporating firm fixed effects and dynamic models (System GMM), is particularly prevalent due to its ability to control for unobserved heterogeneity and endogeneity concerns [2].

[1, 21] have applied these methods to emerging market contexts, enhancing the reliability of findings. The use of investment proxies, such as capital expenditures scaled by total assets or Tobin's Q, alongside leverage measures (debt-to-equity ratio, debt-to-assets ratio), allows nuanced insights into firm behavior.

4. Research Gap

While considerable research has explored the leverage-investment nexus, the sectoral focus on Indian steel firms remains limited, with many studies either aggregating manufacturing industries or focusing on financial institutions. The unique capital structure dynamics, cyclical industry conditions, and evolving regulatory environment necessitate an in-depth, firm-level empirical examination of leverage effects on investment decisions within this sector. Moreover, the mixed empirical evidence calls for updated research incorporating recent financial data and robust econometric techniques. The present study seeks to fill this gap by analyzing select BSE-listed Indian steel companies, providing insights that combine theoretical rigor with practical relevance.

Data and methodology

The methodological framework combines theoretical rigor with robust econometric techniques to ensure reliability and relevance of findings.

1. Study Design

The study adopts a quantitative empirical research design to explore the causal and correlative relationship between financial leverage and investment decisions among Indian steel firms listed on the BSE Ltd. The focus on the steel sector is motivated by its capital-intensive nature and significant contribution to India's industrial growth, making it an ideal context for examining how leverage influences capital allocation decisions. A panel data approach is utilized, enabling the analysis of both cross-sectional (across firms) and time-series (over years) variations. Panel data facilitates controlling for unobserved heterogeneity and improving efficiency in estimations, a critical advantage given the complexity of corporate finance decisions [4].

2. Data and Sample Selection

The data set comprises secondary financial data collected from publicly available sources, including the BSE database, annual reports, CMIE Prowess database, and the Centre for Monitoring Indian Economy. The study period covers ten fiscal years, from 2015 to 2024, which provides an ample timeline to capture variations in leverage and investment behavior through different economic cycles, policy regimes, and market conditions.

The initial universe includes all steel companies listed on the BSE. The sample selection follows purposive sampling with criteria to ensure that the firm must be consistently listed on the BSE for the entire study period, firms must have comprehensive financial statements published annually, firms with extreme outliers or non-standard accounting practices (firms undergoing restructuring or mergers) are excluded to avoid distortions, and the final sample includes 25 steel companies meeting these criteria, representing a broad spectrum of firm sizes and ownership structures within the Indian steel sector.

3. Variables Used

3.1. Dependent Variable: Investment Decision

Investment decision is operationalized as the level of capital expenditure or investment made by firms relative to their asset base. Consistent with prior empirical literature [12] and [21], the primary investment proxy is Capital Expenditure scaled by Total Assets (CAPEX/TA). This ratio captures the intensity of fixed asset investment relative to firm size, facilitating comparability across firms with different asset bases. Alternative investment measures, such as changes in fixed assets or investment growth rates, are used for robustness checks.

3.2. Independent Variable: Financial Leverage

Financial leverage reflects the extent to which firms use debt financing. The debt-to-equity ratio is the financial leverage, widely adopted in capital structure studies [25, 29]. Both short-term and long-term debts are included to capture the total obligation burden.

3.3. Control Variables

To separate the effect of leverage on investment, the analysis controls for firm-specific factors known to influence investment decisions. Firm size (SIZE) is measured by the natural logarithm of total assets. Larger firms have easier access to capital markets and may invest differently [29]. Profitability (ROA) is the net income divided by total assets. More profitable firms generally have higher internal funds for investment ([12]. Growth opportunities (TOBIN'S Q) are defined as the market value of assets divided by the book value of assets. Higher Tobin's Q indicates better investment opportunities [31]. Liquidity (CR) is current assets divided by current liabilities, capturing short-term financial health.

4. Model Specification

The study employs a dynamic panel data regression model to capture the lagged effect of past investment decisions on current investment, accounting for possible persistence. The specification is:

$Inv_{it}=\alpha+\beta_1 leverage_{it}+\beta_2 size_{it}+\beta_3 ROA_{it}+\beta_4 TobinQ_{it}+\beta_5 liquidity_{it}+\gamma_t+\mu_i+\varepsilon_{it}$

Where Inv_{it} is the investment measure for firm i at time t, $leverage_{it}$ represents financial leverage (D/E), $size_{it}$, ROA_{it}, $tobinQ_{it}$, and $liquidity_{it}$ are control variables, γ_t captures year fixed effects, μ_i denotes firm-specific effects, and ε_{it} is the error term. This model enables the investigation of how changes in leverage affect investment decisions while controlling for firm heterogeneity and time trends.

5. Estimation Technique

Given potential endogeneity concerns where leverage may be simultaneously determined with investment, or omitted variables bias may exist, the study uses advanced panel data techniques. The fixed effects (FE) model controls for time-invariant unobserved heterogeneity across firms that might correlate with both leverage and investment [34]. However, FE cannot fully address endogeneity caused by simultaneity or dynamic panel bias. To mitigate endogeneity, the System GMM estimator is employed. This technique uses internal instruments (lagged values of explanatory variables) to address reverse causality and omitted variable bias, particularly suitable for short panels with many firms. System GMM combines equations in levels and first differences to improve efficiency and consistency. The validity of instruments is tested using the Hansen J test, and serial correlation is checked using Arellano-Bond tests for AR (1) and AR (2). The dynamic model estimated via System GMM includes lagged investment as an explanatory variable: $Inv_{it}=\delta_1 inv_{it-1}+\beta_1 leverage_{it}+\ldots+\varepsilon_{it,}$ where Inv_{it-1} capture investment persistence.

Empirical results and analysis

1. Descriptive Statistics

Before running regressions, descriptive statistics and correlation matrices were generated to understand the data distribution and initial relationships.

Table 1: Descriptive Statistics

Variable	Mean	S.D.	Min	Max
Investment (CAPEX/TA)	0.054	0.027	0.008	0.12
Leverage (D/E)	0.81	0.31	0.25	1.62
Firm Size (Log TA)	7.83	0.67	6.50	9.45
Profitability (ROA)	0.055	0.023	-0.04	0.12
Tobin's Q	1.18	0.41	0.59	2.31
Liquidity (CR)	1.42	0.52	0.72	3.18

Table 1 shows that the mean investment ratio of 5.4% suggests moderate capital expenditures relative to total assets in the sector. The average leverage ratio of 0.81 indicates a relatively high reliance on debt, reflecting the capital-intensive nature of steel companies. The firms show moderate profitability and liquidity, which aligns with industry characteristics.

2. Correlation Analysis

Table 2: Correlation Matrix

Variable	Inv	Lev	Size	ROA	TobinQ	CR
Investment (Inv)	1					
Leverage (Lev)	-0.42**	1				
Firm Size (Size)	0.35**	0.12	1			
Profitability (ROA)	0.46**	-0.28*	0.29*	1		
Tobin's Q (TobinQ)	0.52**	-0.31*	0.24*	0.56**	1	
Liquidity (CR)	0.21*	-0.18	0.12	0.35**	0.28*	1

Notes: *p < 0.05; **p < 0.01

Table 2 shows that the negative and significant correlation between leverage and investment (-0.42) suggests a potential crowding-out effect of debt on investment, consistent with theories on financial constraints [12]. Positive correlations of investment with profitability and Tobin's Q confirm that firms with better growth opportunities and earnings invest more.

3. Panel Unit Root Tests

To confirm the stationarity of the variables, panel unit root tests (Levin-Lin-Chu and Im-Pesaran-Shin) were performed.

Table 3: Panel Unit Root Test Results (At Level)

Variable	LLC Statistic	p-Value	IPS Statistic	p-Value	Stationarity
Investment	-4.52	0.00	-2.87	0.00	Stationary
Leverage	-2.37	0.00	-1.73	0.04	Stationary
Profitability	-5.93	0.00	-3.82	0.00	Stationary
Firm Size	-1.92	0.02	-3.40	0.00	Stationary
Growth (Tobin's Q)	-4.01	0.00	-2.21	0.01	Stationary
Liquidity	-3.74	0.00	-2.09	0.01	Stationary

To ensure the validity of panel data regression models, it is essential to examine the stationarity properties of the variables. Non-stationary variables can lead to spurious regression results; hence the Levin, Lin & Chu (LLC) and Im, Pesaran and Shin (IPS) tests are used (shown in table 3). These tests cater to different assumptions about cross-sectional dependence and individual unit heterogeneity. The LLC test, which assumes a common unit root process, indicates that all variables are stationary at level, as the null hypothesis of unit root is rejected at 1% or 5% significance levels. The IPS test, allowing for individual unit root processes, similarly rejects the null for all variables at

conventional significance levels, suggesting stationarity across individual firms in the panel. Results indicate that all variables are stationary at levels or after first differencing, satisfying the prerequisite for panel regression. Since all variables are found to be stationary at level I(0), panel regression models or dynamic models (System GMM) can be applied directly without the need for differencing.

4. Fixed Effects and Random Effects Regression Results

Table 4: Fixed Effects and Random Effects Regression Results

Variables	FE Model	RE Model
Leverage (D/E)	-0.028*** (0.007)	-0.022** (0.009)
Firm Size (Log TA)	0.013* (0.006)	0.015* (0.007)
Profitability (ROA)	0.054*** (0.011)	0.049*** (0.010)
Tobin's Q	0.065*** (0.012)	0.059*** (0.013)
Liquidity (CR)	0.008 (0.006)	0.007 (0.007)
Constant	0.017** (0.007)	0.015* (0.008)
Observations	250	250
R^2	0.51	0.49
F-statistic	18.45***	—
Hausman Test (p)	0.02	—

Note: Standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.10

Table 4 shows that the Hausman test favors the Fixed Effects model, indicating that firm-specific effects correlate with regressors. Leverage has a significant and negative coefficient, implying that increased debt reduces capital expenditure intensity, aligning with the debt overhang hypothesis [24]. Firm size positively influences investment, suggesting larger firms invest more, possibly due to better access to finance [29]. Profitability and Tobin's Q exhibit strong positive impacts, consistent with the pecking order and Q-theory of investment. Liquidity shows an insignificant positive effect, indicating mixed evidence on short-term financial health's role. The models explain approximately 41% of the variance in investment, a respectable fit for firm-level financial models, as supported by [8, 13, 14, 15].

5. Dynamic Panel Data Analysis

To address endogeneity, a dynamic System GMM model was estimated using lagged instruments.

Table 5: System GMM Estimation Results

Variables	Coefficient	S.E.	z-Statistic	p-value
Lagged Investment	0.63***	0.05	12.60	0.000
Leverage (D/E)	-0.015**	0.006	-2.50	0.012
Firm Size (Log TA)	0.009*	0.005	1.80	0.072
Profitability (ROA)	0.040***	0.008	5.00	0.000
Tobin's Q	0.053***	0.010	5.30	0.000
Liquidity (CR)	0.005	0.004	1.25	0.211
Constant	0.012	0.007	1.71	0.087
Hansen J test (p)	0.35			
AR (1) test (p)	0.02			
AR (2) test (p)	0.28			
Number of firms	25			
Number of observations	225			

Note: ***p<0.01, **p<0.05, *p<0.10

Table 5 shows that he significant positive coefficient on lagged investment confirms investment decisions are persistent over time, consistent with adjustment cost models [16]. Leverage remains significantly negative, though smaller in magnitude, after controlling for endogeneity, confirming that high debt levels constrain new investments. This supports [24] debt overhang hypothesis, which posits that debt holders' claims reduce equity holders' incentives to invest. Firm size, profitability, and Tobin's Q remain positive and significant, reinforcing their role in facilitating investments. Liquidity is again insignificant, suggesting short-term cash position is less crucial once other factors are controlled. The Hansen J test's p-value suggests that instruments used are valid and over-identification restrictions are not violated. The AR (1) and AR (2) tests show expected first-order serial correlation but no second-order serial correlation, validating the GMM model assumptions.

The empirical findings strongly suggest that leverage negatively influences firms' investment decisions in the Indian steel sector. This is consistent with financial constraint theories, particularly the debt overhang problem first highlighted by [24], which states that excessive debt discourages equity-financed investments due to the risk of wealth transfer to debt holders. Indian steel companies, being capital intensive, rely heavily on debt, but this reliance appears to create disincentives for new investment, potentially slowing growth and innovation. The positive impact of profitability and Tobin's Q supports the notion that firms with higher retained earnings and better growth opportunities invest more, aligning with pecking order and Q-theory models [12, 31]. Firm size's positive role suggests economies of scale in financing and investment decisions, as larger firms have better access to capital markets [29]. Liquidity's insignificant impact across models may reflect the dominant influence of longer-term financing conditions and investment opportunities over short-term cash holdings in capital-intensive industries.

Conclusion

The present empirical investigation into the influence of financial leverage on firms' investment choices among select BSE-listed Indian steel companies has provided valuable insights into the intricate relationship between capital structure and corporate investment behavior in a capital-intensive and highly leveraged industry. Using a robust panel data methodology over the period 2015 to 2024, the study analyzed how firms' debt levels influence their propensity and ability to invest in productive assets. The findings reveal a significant negative impact of leverage on investment, corroborating the long-standing debt overhang hypothesis posited by [24]. High leverage appears to constrain firms' investment decisions, likely due to the risk of wealth expropriation by debt holders, which diminishes equity holders' incentives to fund new capital expenditures. This phenomenon is particularly pronounced in the steel sector, where firms carry large debt loads to finance asset-heavy operations, but the associated financial rigidity impairs their growth potential. Additionally, the study highlights the positive roles of profitability, firm size, and growth opportunities (proxied by Tobin's Q) in fostering investment activity. These results align with the pecking order, suggesting that firms with stronger internal cash flows and promising market valuations are better positioned to undertake capital expenditures. Liquidity,

however, showed an inconclusive effect, indicating that short-term cash availability may be less critical than long-term financial strategy in this context. The use of advanced dynamic panel data techniques such as System GMM allowed for control of potential endogeneity and persistence in investment behavior, reinforcing the robustness of the conclusions [18, 19, 20].

From a practical standpoint, these results suggest that steel companies should carefully manage their debt levels to avoid excessive financial constraints that hinder necessary investments. The negative influence of leverage on investment highlights the need for balanced capital structures to avoid underinvestment problems. Financial managers should monitor leverage ratios and consider equity or hybrid financing to maintain investment flexibility. The results emphasize the importance of developing debt markets and corporate governance to mitigate debt overhang effects. Policies fostering transparent credit evaluation and facilitating alternative financing could enhance investment levels in the steel sector. Understanding the constraints imposed by leverage can inform investment decisions and risk assessments, particularly in sectors vulnerable to capital structure effects.

Despite its contributions, this study acknowledges limitations, including its focus on listed firms in a single industry, which may limit extrapolation to other sectors or unlisted companies. Future research could explore qualitative factors such as managerial decision-making and governance, as well as macroeconomic influences, to build a more comprehensive understanding of the leverage-investment nexus.

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