Capital Structure Dynamics and Speed of Adjustment: Sectoral Heterogeneity in Indian Manufacturing Firms

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Abstract: *This paper examines capital-structure dynamics and the speed of adjustment (SoA) towards target leverage across industrial sectors in India. Using a panel dataset of 549 listed firms from ten industries from 2011 to 2021, long-term debt ratio (LTDR) is modelled in a dynamic partial-adjustment framework estimated with sector-wise panel GMM that includes macro-financial conditions (GDP growth, interest rates and stock-market returns) and firm-specific characteristics (tangibility, profitability, growth opportunities, firm size and liquidity) as controls. The results reveal marked heterogeneity in adjustment behaviour: estimated SoA ranges from about 4% per year in Pharmaceutical products to over 40% in Chemicals and Chemical Products, with several other industries showing intermediate speeds. Profitability consistently exerts a negative effect on leverage, supporting pecking-order arguments. In contrast, GDP growth and liquidity generally reduce leverage. Furthermore, firm size and asset growth are associated with higher target debt ratios. Macroeconomic variables, particularly interest rates, matter most for capital-intensive sectors, underscoring the role of external financing conditions in leverage rebalancing. Overall, Indian manufacturing firms move slowly towards their target capital structures, suggesting that adjustment costs and institutional barriers are significant. The observed sectoral heterogeneity indicate the need for industry-specific financial policies that lower barriers to leverage adjustment in slower-adjusting sectors while maintaining conservative debt levels in sectors where adjustment is relatively rapid.*

Keywords: Capital structure, Manufacturing firms, Sectoral heterogeneity, Speed of adjustment, GMM

INTRODUCTION

The decision pertaining to the choice of capital structure is fundamental in corporate finance because it shapes the firm's risk, value, and its ability to support future expansion. when the inherent benefits from rebalancing exceed the associated transaction, information, and distress costs (Flannery & Rangan, 2006; Huang & Ritter, 2009). Present empirical research for advanced economies has documented moderate 'speeds of adjustment' (SoA) and shows that deviations from target leverage are persistent but not permanent (Fama & French, 2002). However, little is known about how quickly firms in different Indian manufacturing industries converge to their desired targets, and how this process is, in turn, influenced by macroeconomic conditions and firm-specific characteristics.

Prevailing studies on Indian firms typically estimate an average SoA for listed firms, with limited emphasis on systematic cross-industry heterogeneity and the joint role of firm-specific and macroeconomic drivers (Ghose & Kabra, 2019; Mukherjee & Mahakud, 2010). Yet, manufacturing industries differ considerably in terms of capital intensity, asset tangibility, demand volatility, and access to external finance, implying that leverage adjustment is likely to be heterogeneous across sectors. Understanding this heterogeneity is crucial for assessing Industry-specific financial stability and for designing policy interventions that recognise uneven leverage adjustment frictions.

This paper aims to address the following research question: To what extent is cross-industry heterogeneity present in the speed at which Indian manufacturing firms try and adjust their leverage toward target levels, given firm-specific and macro-financial conditions? To answer this question, the study uses panel data for 549 listed firms from ten manufacturing industries over 2011–2021 and estimates sector-wise dynamic partial-adjustment models of the long-term debt ratio within a panel GMM framework that incorporates GDP growth, interest rates and stock-market returns alongside standard firm-level controls such as tangibility, profitability, growth opportunities, firm size, and liquidity.

Sectoral estimates show substantial heterogeneity in adjustment behaviour, with annual SoA ranging from very slow convergence in some capital-intensive industries to much faster rebalancing in others. Profitability tends to reduce leverage, consistent with pecking-order behaviour, while firm size and the proxy growth opportunity are generally associated with higher target debt. Macroeconomic conditions, particularly interest rates, have a stronger impact on capital-intensive sectors. By documenting and

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interpreting these sector-specific adjustment patterns, the paper contributes new evidence on capital-structure dynamics in an important emerging economy and provides a basis for more finely targeted financial and industrial policies.

REVIEW OF LITERATURE

Dynamic capital structure studies refine the 'Trade-Off' and 'Pecking-Order' theories by acknowledging that adjustment costs lead firms to adjust only gradually toward their target leverage levels. Using US data, Fama & French (2002) show that profitable firms rely less on debt and more on internal funds, motivating partial-adjustment models in which leverage drifts around a target. Within this framework, Flannery & Rangan (2006) report a moderate annual speed of adjustment toward target leverage and show that firm size, profitability, and market-to-book ratios are systematic determinants of target leverage, while Huang & Ritter (2009) show that estimated adjustment speeds and the apparent support for different capital structure theories depend strongly on how leverage and its dynamics are measured.

Subsequent research has generalised these insights across diverse institutional environments and has focused on identifying the determinants of the speed of adjustment. Studies for the UK, Switzerland and the eurozone (Getzmann et al., 2015; Ozkan, 2001)confirm the existence of target leverage but show that adjustment speeds differ according to risk, growth opportunities, and macroeconomic conditions. Elsas & Florysiak (2011) document heterogeneous SoA across firms, with faster adjustment when the costs of deviating from the target are high. In emerging markets, Yang et al. (2015) finds a gradual adjustment among Chinese firms, and Mbulawa et al. (2020) reports that firms in Zimbabwe and Pakistan maintain optimal leverage but adjust more quickly when macroeconomic conditions are unstable, or deviations from target are large.

A related body of literature examines the extent to which institutional structures and policy environments influence corporate leverage dynamics. Öztekin & Flannery (2012) show that stronger legal and financial institutions are associated with faster SoA across countries, while Haron et al. (2013) find that Malaysian firms under-adjust toward targets and that firm-level characteristics and macroeconomic variables jointly influence adjustment behaviour. Bajaj et al. (2021)has integrated economic policy uncertainty into the partial-adjustment framework for Indian firms and found that higher uncertainty is associated with higher leverage but slower adjustment, highlighting the role of policy regimes in amplifying adjustment costs.

Indian evidence on dynamic capital structure has grown rapidly over the past couple of years, but remains relatively limited for companies in the manufacturing sector.Mukherjee & Mahakud (2010)show that Indian firms pursue an optimal target leverage, with profitability, size and historical market-to-book ratios influencing both target debt and the pace of adjustment. Ghose & Kabra (2019) confirm the relevance of target-adjustment behaviour and reveal asymmetries in SoA between high- and low-profitability firms. More recent studies have introduced governance, institutional and sectoral dimensions in the mix. Gulzar & Haque (2022) find that non-debt tax shields and governance characteristics, such as board size and independence, raise adjustment speeds in Indian manufacturing, whereas firm size and tangibility slow down the adjustment process.Hegde et al. (2023)demonstrate that both financial flexibility and sectoral characteristics are associated with heterogeneous SoA across Indian manufacturing. Panda et al. (2022) have linked leverage and flexibility to monetary-policy conditions, suggesting that macroeconomic structures interact with firm-level frictions in shaping adjustment. Taken together, the literature suggests the existence of target leverage, moderate yet far-from-instantaneous adjustment, and heterogeneity in SoA across firms, countries, and institutional regimes, while leaving open questions about sector-specific dynamics and how firm characteristics, macro-financial conditions, and policy uncertainty interact in emerging-market manufacturing.

METHODOLOGY

Research design and approach: The study adopts a quantitative, longitudinal research design based on firm–year panel data for listed Indian manufacturing firms. Capital-structure dynamics are analyzed within a dynamic partial-adjustment framework that explicitly models the speed at which most firms move toward a predetermined target leverage ratio. A panel econometric framework controls for unobserved firm heterogeneity, uses both time-series and cross-sectional variation, and mitigates endogeneity from lagged leverage and other financial variables (Flannery & Rangan, 2006).

Data, population, and sample selection: The study uses secondary data for 549 non-financial manufacturing companies listed on the Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). Firm-level observations span ten financial years from 2011–2012 to 2020–2021, resulting in a balanced panel. The population comprises manufacturing firms classified under ten industrial sectors, and the number of sample firms in each industry is reported in Table 1. Firms in the banking, financial services, and insurance sectors are excluded because of their highly regulated capital structures. Firm-level accounting and market data are drawn from a CMIE Prowess IQ, while macroeconomic data were taken from the CMIE Economic Outlook database.

Table 1: Industrial sectors selected

Sectors	Number of Companies
Basic Iron and Steel	50
Transport Equipment	58
Textiles	67
Chemicals and Chemical Products	103
Machinery and Equipment	34
Pharmaceuticals	61
Other Non-Metallic Mineral Products	38
Electrical Equipment	46
Food Products	36
Rubber & Plastic Products	56
Total	549

Variables and measurement: Capital structure is proxied by the 'long-term debt ratio' (LTDR), defined as long-term

debt divided by total assets (Table 2). This measure focuses on the part of leverage most relevant for long-term financing and adjustment frictions. The target leverage ratio is assumed to depend on a set of firm-specific and macroeconomic determinants that form part of the core capital structure literature. Firm-level explanatory variables include tangibility, profitability, growth opportunities, firm size, and liquidity. Macroeconomic variables are introduced as macroeconomic controls: GDP growth, stock market conditions, interest rates, and net capital flows.

Table 2: Dependent variable

Dependent variable	Formula
Long-term debt ratio (LTDR)	Long-term debt/ Total Assets

Table 3: List of Independent Variables

Variable	Formula
Growth in GDP (GDPR)	Gross domestic product at constant market prices (Base year 2011-12)
Stock market conditions (SMC)	NIFTY 50 Index Returns
Interest Rate (INTR)	Weighted Average Base Rate of Scheduled Commercial Banks
Capital Flows (CF)	Net foreign direct investment+ Net portfolio investment
Tangibility (TANG)	net fixed assets/ total assets
Profitability (PROF)	EBIT / Total Assets
Growth opportunity (GROWTH)	Percentage variation in all assets
Firm size (SIZE)	Sales, which is adjusted for inflation
Liquidity (LIQ)	cash and bank accounts/ Total assets

The Partial-adjustment model and the Speed of Adjustment

The dynamic behaviour of firms' capital structure is modelled using a standard partial-adjustment model in which each firm has an unobserved target leverage ratio and adjusts gradually towards it (Flannery & Rangan, 2006). The target leverage for firm *i* in year *t* is specified as a linear function of lagged LTDR and firm-specific and macroeconomic controls:

$$LEV*_{i,t} = \beta' X_{i,t-1} \quad (1)$$

Where $LEV*_{i,t}$ denotes the target long-term debt ratio, $X_{i,t-1}$ is a vector of lagged explanatory variables, and â is a coefficient vector.

Due to adjustment costs and financial frictions, actual leverage does not immediately converge to the target. Instead, firms close only a fraction (λ) of the gap between actual and target leverage in each time frame. This partial-adjustment process is written as:

$$LEV_{i,t} - LEV_{i,t-1} = \lambda(LEV*_{i,t} - LEV_{i,t-1}) + \mu_{i,t} \quad (2)$$

Where $LEV_{i,t}$ is the observed long-term debt ratio, $0 \leq \lambda \geq 1$ is the speed-of-adjustment (SoA) parameter, and $\mu_{i,t}$ is an idiosyncratic error term.

Substituting the target equation (1) into the adjustment equation (2) yields the following dynamic leverage equation:

$$LEV_{i,t} = (1-\lambda)LEV_{i,t-1} + \lambda\beta' X_{i,t-1} + \mu_{i,t} \quad (3)$$

Equation (3) shows that current leverage is a weighted average of last period's leverage and the target implied by firm-specific and macroeconomic conditions, with λ governing the speed of convergence.

To estimate the model in a panel-data setting with unobserved firm-specific heterogeneity, equation (3) is rewritten as:

$$LEV_{i,t} = \rho LEV_{i,t-1} + \gamma' X_{i,t-1} + \mu_{i,t} + \tau_t + \epsilon_{i,t} \quad (4)$$

Where, $\rho = 1 - \lambda, \gamma = \lambda\beta$, $\mu_{i,t}$ captures time-invariant firm effects, $\epsilon_{i,t}$ captures common time effects, and is an idiosyncratic error term. In this parametrisation, the speed of adjustment is recovered as $\lambda = 1 - \rho$. Values of λ close to zero indicate very slow adjustment towards target leverage, whereas values closer to one indicate rapid convergence within a single period.

Estimation strategy and diagnostic checks: The dynamic panel model is estimated separately for each of the ten industrial sectors, using the 'Generalised Method of Moments' (GMM) estimators for dynamic panels (Arellano & Bond, 1991; Blundell & Bond, 1998). This approach addresses the issue of endogeneity of lagged leverage and other potentially endogenous regressors by using internal instruments, while controlling for unobserved firm effects and time dummies. To avoid instrument proliferation, the instrument matrix is collapsed, and the lag depth is restricted. Robust two-step standard errors, adjusted for small-sample bias, are clustered by firm to allow for correlation over time within each firm.

Several specification tests are used to assess the validity of the GMM estimations. The Arellano–Bond tests for first and second order serial correlation in the differenced residuals are examined to check that there is no residual AR (2) pattern that would invalidate lagged instruments. The Sargan/Hansen tests of over-identifying restrictions are used to assess the joint validity of the chosen instruments.

RESULTS

This section presents the sector-wise GMM estimates of the dynamic partial-adjustment model for long-term leverage. We report the 'Speed of Adjustment' across industries and assess how firm-specific characteristics and macroeconomic conditions jointly shape capital-structure dynamics in Indian manufacturing.

Table 4: Sectoral results of the generalized method of moments (GMM) analysis

	Basic Iron and Steel	Electrical Equipment	Pharmaceuticals
L. LDTR	0.9265768***	0.7760872***	0.6452959***
GDPR	-0.0026249**	-0.0032812**	-0.0000257
INTR	0.1408467**	0.1966158***	0.0659874
SMC	-0.0002201	-0.0002212	0.0002668***
CF	-9.34E-06	0.0000682	0.0000454
TANG	0.021094	0.0164463	0.0360867
PROF	-0.2626483***	-0.1952366***	-0.0922587
GROWTH	0.0009473**	0.0011494***	0.0004024
LIQ	0.0616368	-0.0010437	-0.0759431***
SIZE	0.0021571	0.0004762	0.0005817
Constant	-0.2872026	-0.3956086	-0.0948085
Wald Chi2	1073.92	614.31	1690.46
No of groups	50	46	61
No of Instruments	23	33	14
AR(2) statistic (p-value)	0.22(0.829)	-0.74(0.457)	-1.66(0.096)
Hansen test statistic (p-value)	11.76(0.465)	20.79(0.534)	2.76(0.430)
Mean VIF	1.39	1.44	1.42

	Rubber &Plastic Products	Transport Equipment	Food Products
L.LTDR	0.7636017***	0.6334146***	0.7772435***
GDPR	-.0017176**	-0.0028952**	-0.0040899**
INTR	0.0752236	0.1669155***	0.1919237
SMC	-.0002216***	-0.000255	-0.0003717
CF	0.000034	0.0000307	-0.000174
TANG	0.0439962	0.0903698***	0.0344515
PROF	-.1935745***	-0.1123024***	-0.1660205***
GROWTH	.0012114***	0.0001433	0.0005949***
LIQ	0.0475063	-0.1114992***	-0.0089473
SIZE	.0062721***	0.0035111**	0.0071097**
Constant	-0.1498507	-0.3334954	-0.3984165
Wald chi2	476.72	390.29	277.75
No of groups	56	58	36
No of Instruments	32	26	18
AR(2) statistic (p-value)	0.20(0.840)	-0.72(0.473)	-0.20(0.845)
Hansen test statistic (p-value)	22.72(0.359)	11.91(0.686)	7.95(0.337)
Mean VIF	1.41	1.45	1.43

	Textiles	Chemicals and Chemical Products
L.LTDR	0.8231483***	0.8325356***
GDPR	-0.0011537	-0.0013176
INTR	0.0827756	0.1086108**
SMC	7.78E-06	-0.0002129
CF	0.0000275	0.0000418
TANG	0.1110259	-0.0494657
PROF	-0.173483***	-0.1656091***
GROWTH	0.001028***	0.0004453**
LIQ	0.1587456	0.0117617
SIZE	0.0001386	0.012262
Constant	-0.1906395	-0.2257381
Wald chi2	893.33	669.54
No of groups	67	103
No of Instruments	43	43
AR(2) statistic (p-value)	-0.99(0.322)	-0.70(0.483)
Hansen test statistic (p-value)	35.92(0.290)	35.79(0.295)
Mean VIF	1.42	1.42

	Machinery and Equipment	Other Non-Metallic Minerals
L.LTDR	0.61041***	0.4444519***
GDPR	-0.0037075***	-0.0063835***
INTR	0.2123692**	0.365114***
SMC	-0.0001139	-0.000358
CF	-0.0000181	-0.0001767
TANG	0.0122175	0.2634433***
PROF	-0.2899138***	-0.1959849**
GROWTH	0.0012527***	0.000838
LIQ	-0.0914798**	-0.1236104
SIZE	0.0133056***	0.0123445
Constant	-0.4316268	-0.8100939
Wald chi2	1051.2	142.31
No of groups	34	38
No of Instruments	13	15
AR(2) statistic (p-value)	0.39(0.696)	-1.44(0.151)
Hansen test statistic (p-value)	0.73(0.696)	4.88(0.300)
Mean VIF	1.44	1.46

Note that in the above result tables,values in the parentheses are z-statistics; *** p < 0.01; ** p < 0.05; p-values reported for AR (2) and Hansen tests are at a 5% level of significance.

Table 5: Results of the sector-wise analysis of the firms' Speed of Adjustment

Industrial Sectors	ϱ	λ (1-ϱ)
Basic Iron and Steel	0.778211	0.221789
Transport Equipment	0.833883	0.166117
Textiles	0.875096	0.124904
Rubber & Plastic Products	0.768306	0.231694
Chemicals and Chemical Products	0.578391	0.42161
Machinery and Equipment	0.736942	0.263058
Pharmaceuticals	0.960206	0.039795
Other Non-Metallic Minerals	0.797805	0.202196
Electrical Equipment	0.778228	0.221772
Food Products	0.668928	0.331072

DISCUSSION

The sectoral analysis of the Speed of Adjustment toward an optimal leverage offers valuable insights into how Indian manufacturing firms realign their capital structures under varying financial, institutional, and operational constraints across different sectors. Empirical evidence reveals heterogeneous adjustment speeds, which strongly supports the dynamic trade-off theory that suggests that firms adjust gradually toward a target leverage due to inherent adjustment costs (Elsas & Florysiak, 2011; Flannery & Rangan, 2006). Sectoral disparities are also found to arise from differences in asset tangibility, profitability, financial flexibility, and exposure to macroeconomic risks, reflecting structural asymmetries in adjustment dynamics (Panda et al., 2022).

Cross-Sectoral Variation in Adjustment Dynamics

The findings validate the non-homogeneity of adjustment speeds across different industrial sectors. The Chemicals and Chemical products sector reveals the fastest adjustment speed, reflecting relatively low adjustment costs and steadier cash flows. In contrast, textiles and Pharmaceutical industries display comparatively slower adjustment speeds, consistent with elevated sunk costs, cyclical demand, and restricted access to capital markets(Haron et al., 2013). This heterogeneity highlights industry-specific trade-offs between capital-structure adjustment costs and financial flexibility (Byoun, 2008; Mbulawa et al., 2020).

The current Indian evidence aligns with global findings that industries with higher tangible assets and relatively stable cash flows, such as food processing and the manufacture of chemicals, exhibit a much higher Speed of adjustment due to reduced bankruptcy risks and higher debt capacity (Ozkan, 2001). Conversely, high-growth sectors like textiles and construction, with unstable revenue streams, adjust much slower as uncertainty increases tolerance for deviations (Bajaj et al., 2021; Huang & Ritter, 2009).

Empirical Positioning within the International Literature

International studies document Speed of Adjustments ranging from 7–18% in the U.S. (Fama & French, 2002) to 25–45% in Europe (Getzmann et al., 2015), with Asian markets particularly in China (Yang et al., 2015) and Malaysia (Haron et al., 2013), showing faster adjustment rates of 40–57%. The present results place the Indian estimates (20–40%) within this mid-range, indicating a comparatively moderate speed of convergence, typical

of emerging markets, which are characterized by credit market imperfections and institutional constraints (Ghose & Kabra, 2019; Öztekin & Flannery, 2012).

The present findings in the Indian sectoral context resonate with Mukherjee & Mahakud (2010), who reported a national average Speed of Adjustment of almost 33%, suggesting Indian firms take around three years to reach the designated target leverage. Subsequent sectoral studies (Gulzar & Haque, 2022; Hegde et al., 2023)confirm moderate to fast adjustment speeds in capital-intensive sectors like the manufacture of chemicals and the manufacture of food and food products, validating the Dynamic Trade of Theory's assumption of partial yet significant convergence.

Determinants Influencing Sectoral Speed of Adjustment

Across the different industrial sectors, 'profitability' was found as a consistent positive determinant of Speed of Adjustment, implying that firms with larger retained earnings encounter fewer financing constraints and adjust their capital structure more rapidly (Ghose & Kabra, 2019). Larger firms ('firm size') adjust more quickly by reducing asymmetric information and securing more favorable credit terms (Flannery & Rangan, 2006; Gulzar & Haque, 2022). 'Tangibility' and 'non-debt tax shields (NDTS)' are found to exhibit mixed effects: while tangible assets enhance debt carrying capacity, high NDTS substitute debt tax shields, reducing adjustment urgency (Haron et al., 2013).

India's corporate capital-structure speed of adjustment can be viewed through the lens of economic policy uncertainty. When the economic policy uncertainty rises, companies tend to slow down their balance-sheet adjustments, as managers tend to become more risk-averse and lenders tighten their grip on the flow of credit (Bajaj et al., 2021). In line with this system, higher macroeconomic instability is often associated with longer adjustment time frames, as seen in transition and emerging economies.

CONCLUSION

This study aimed to investigate how quickly Indian manufacturing firms across industrial sectors in India realign their long-term leverage towards optimal levels, after controlling for firm-specific characteristics and macroeconomic conditions. The sector-wise GMM estimates indicate that adjustment is far from frictionless; in the 'Pharmaceutical products' sector, firms close only about 4 per cent of the gap to target leverage each year, whereas in the 'Chemicals and Chemical products' sector, the annual convergence rate is roughly 42 per cent, with the remaining sectors clustered between about 12 and 33 per cent. The profitability of the firm systematically reduces its leverage, which is consistent with the pecking-order theory. Meanwhile, firm size and growth potential are associated with higher target debt ratios. Macroeconomic conditions, particularly interest rates, have a stronger impact on capital-intensive industries, underscoring the importance of external financing conditions for adjusting capital structures.

Overall, these results position Indian manufacturing firms in the middle of the international range of leverage-adjustment estimates, reinforcing prior work that finds only gradual convergence to target capital structures (Flannery & Rangan, 2006; Mukherjee & Mahakud, 2010). They also add to recent Indian evidence by demonstrating that adjustment frictions and reactions to macroeconomic shocks are highly sector-specific, rather than common across the different industrial sectors (Ghose & Kabra, 2019). From a policy standpoint, the results indicate a need for sector-specific financial and industrial policies, with a focus on easing financing and institutional constraints in slow-adjusting industries and preserving sound leverage positions in faster-adjusting sectors. Future research could extend this analysis by incorporating explicit corporate governance indicators and measures of policy uncertainty, as well as exploring possible nonlinearities or asymmetries in the adjustment process, thereby offering a more comprehensive picture of capital structure dynamics in emerging markets.

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