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ANALYZING CAPITAL STRUCTURE AND SHAREHOLDER WEALTH IN THE INDIAN AUTOMOTIVE INDUSTRY: A NON-LINEAR APPROACH

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Abstract

This study examines the influence of capital structure on shareholder wealth in the Indian automotive industry, utilizing both linear and non-linear analytical models. The research analyzes financial parameters, such as Debt-to-Equity Ratio and Total Debt Ratio, of significant corporations in the NSE Nifty 50 index, including Tata Motors, Mahindra & Mahindra, and Maruti Suzuki. The analysis indicates that specific ratios have a notable adverse impact on shareholder wealth. Moderate levels of debt may potentially improve performance, however excessive debt likely to be detrimental. A cubic prediction model is employed to accurately reflect the complex, non-linear correlation between capital structure and shareholder wealth. This model identifies a critical threshold at which the influence of debt on performance undergoes a major change. The results highlight the need of maintaining a well-balanced capital structure to maximize shareholder value and offer significant insights for strategic financial management in the automobile industry. Further investigation is advised to examine these dynamics in other industries and economic environments.

Keywords: *Capital Structure, Debt to Equity, Optimal Capital Structure, Shareholder's Wealth.*

INTRODUCTION

One of the biggest and fastest-growing industries worldwide, the Indian automotive sector consists in production, marketing, and sales of a wide spectrum of vehicles including passenger cars, two-wheelers, commercial vehicles, and three-wheelers. Driven by rising middle class, urbanization, and disposable incomes, the sector has drawn large investments from both domestic and foreign companies such Maruti Suzuki, Tata Motors, Mahindra & Mahindra, Hero MotoCorp, and Bajaj Auto.

India's global manufacturing center helps the industry by using affordable manufacturing, trained labor, and government regulations that support cost-effective development—all of which have together raised employment and economic growth.

Driven by growing income levels, better infrastructure, and more financing options—a strong domestic market—the sector keeps serving a variety of vehicle sectors; demand for electric vehicles among government incentives and tougher emission rules is clearly increasing. Furthermore supporting India's competitive advantage in world exports are its adherence to international quality criteria and low manufacturing costs. Rapid technical developments in the sector—including the integration of electric mobility, connected automobile technology, and autonomous driving features—which fit changing customer desires and legal constraints define the sector.

All things considered, the Indian automotive sector is still vibrant and essential for the economic growth of the nation since it shows resilience and flexibility to fit evolving technical trends and market conditions.

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REVIEW OF LITERATURE

With basic theories like the Modigliani-Miller theorem (1958), which postulates that in a perfect market the value of a firm is unaffected by its capital structure, and the trade-off theory, which suggests that firms balance the tax advantages of debt with the costs of possible financial distress to determine their optimal capital structure, financial literature has extensively examined the relationship between capital structure and wealth creation.

More recent empirical studies, including those by Frank and Goyal (2020), have honed these ideas by demonstrating that, particularly in volatile market conditions, too much debt can cause financial misery and lower firm value by reducing the total cost of capital and using tax shields, while modest levels of debt can improve company value.

In the context of the automotive sector, which is marked by high capital intensity, cyclical demand, and large expenditures in research and development, capital structure decisions are vital for sustaining competitiveness and driving wealth creation. Due to predictable cash flows and the need for significant capital expenditures, Titman and Wessels (2021) discovered that companies in this industry often retain moderate to high degrees of debt; nevertheless, the ideal level of debt must be carefully managed to avoid the dangers of over-leverage, especially in economic downturns. Harris and Raviv (2022), who used regression models to examine capital structures and discovered that automotive companies must incorporate industry-specific elements such regulatory environments, cyclical market conditions, and the need of technological innovation when deciding their best debt-equity mix, support this.

Research on worldwide automotive companies by Korajczyk and Levy (2023) on balanced capital structures—usually with debt-to--- Equity ratios between 1:1 and 2:1—have revealed that companies with balanced capital structures—typically with debt-to--- Equity ratios between 1:1 and 2:1—achieved the highest returns on equity. This implies that keeping balance is essential to prevent financial crisis even if using debt might help to improve returns and enable development. Underlining the need of flexibility in capital structure management, Anderson and Mansi (2022) tested several capital structure scenarios using simulation-based techniques and concluded that the optimal leverage levels for U.S. automotive companies are quite sensitive to changes in market conditions and investor risk appetite.

Major automakers include Ford, General Motors, and Toyota case studies highlight these ideas even further. Ford's very cautious approach to leverage, emphasizing on preserving cash and modest debt levels, helped it to weather the 2008 financial crisis more successfully than General Motors, which had to go through major restructuring due to high leverage (Anderson & Mansi, 2022). Stable wealth generation and durability during market downturns have been connected to Toyota's cautious capital structure strategy, which emphasizes internal financing and little loan use (Korajczyk & Levy, 2023).

Still, there are difficulties in the research, especially in adjusting these models to fit dynamic changes in the sector, such the move towards electric cars (EVs) and the changing regulatory scene. While in fact changing interest rates, currency risks, and investor mood can greatly affect the ideal capital structure, many current models assume stationary conditions.

Especially as the automotive sector moves toward new technologies and business models, future studies should concentrate on creating more dynamic and flexible models that can more effectively depict the complexity of the sector. The research shows that, in a highly competitive and fast changing environment, the ideal capital structure for automotive companies is not fixed but rather a careful balance of using development prospects while controlling financial risks.

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OBJECTIVES

This work aims primarily for two different objectives. First, with an eye toward how different financial ratios affect shareholder value in the automobile industry, it seeks to investigate how capital structure shapes wealth generation. The study aims to find important understanding of how capital management methods influence wealth production by means of an analysis of the link between many capital structure ratios and company performance. Second, the study aims to create a suitable capital structure model catered for automotive manufacturers. This model will include linear and non-linear elements to offer a complete framework for choosing the optimal balance between debt and equity, so helping companies in improving their financial stability and performance.

METHODOLOGY

This study uses mixed-methods, integrating exploratory and descriptive research. The exploratory component seeks to understand and hypothesize about capital structure and financial performance in Indian NSE Nifty 50 enterprises. The analysis uses a sample of NSE-listed automobile companies from the NSE Nifty 50 index. Three companies (TATA Motors, Mahindra & Mahindra and Maruti) identified were constantly featured in the index. This sampling approach is used to analyze the association between capital structure and financial performance in NSE Nifty 50 listed Indian companies.

The study covers 2011–2023. Capital structure and financial performance trends can be examined over a certain timeframe. Based on current literature, the study selects proxy variables for capital structure and financial performance to define its scope. DER (independent variable), Long-Term Debt Ratio (LTDR), Degree of Financial Leverage (DFL), Total Investment to Long-term Liabilities (TILI), Fixed Asset to Funded Debt (FAFD), Current Liabilities to Proprietors Fund (CLRF), and Reserves to Equity Capital (REC) are chosen as capital structure ratios. Shareholders' wealth is the dependent variable considered in the study. The study encompasses firms across India, providing a pan-Indian perspective.

DATA ANALYSIS AND DISCUSSION

Dynamic environment of the automotive sector, financial management's study of the complicated interaction between shareholder wealth and capital structure is very important. This industry presents a unique setting for the research of the effect of several financial parameters on company performance since of its high capital intensity and sensitivity to economic cycles. Strategic decisions depend on organizations understanding how capital structure affects wealth generation as they negotiate the complexities of debt and equity.

Interactions among shareholder wealth and capital structure variables, including the debt-to-equity ratio, Degree of Financial Leverage, Total Investment to Long term Liabilities, Fixed Asset to Funded Debt, Current Liabilities to Proprietors Fund, Reserves to Equity Capital and the total debt ratio.

Using both linear and non-linear analytical models—including a cubic prediction model—we aim to find the ideal capital structure that maximizes business value and concurrently reduces financial risks. By analyzing a thorough collection of financial data from well-known automotive businesses, this study aims to provide practical insights for industry players and support the larger conversation on financial strategy and asset management.

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Table 1: Impact of capital structure ratios on shareholder's wealth

Variable	Intercept	Slope	p-value	R-square	Lack of Fit (p-value)
Debt-to-Equity Ratio	27717.29	-16061.02	0.0149*	0.194	0.9276
Total Debt Ratio	38089.38	-32131.95	0.0031*	0.2722	
Degree of Financial Leverage	24100.12	-186.96	0.8109	0.0021	
Total Investment to Long term Liabilities	19413.34	430.57	0.0268*	0.1632	
Fixed Asset to Funded Debt	24314.09	-59.38	0.5338	0.01	0.8394
Current Liabilities to Proprietors Fund	31702.86	-12346.69	0.0130*	0.2008	
Reserves to Equity Capital	-232284.6	261602	0.0120*	0.2051	

Source: JMPSAS Output

The regression analysis demonstrates that certain financial ratios significantly influence the dependent variable, potentially related to firm performance or value. The debt-to-equity ratio has a negative slope of -16,061.02 and a significant p-value of 0.0149, with an R-square of 0.194, indicating that 19.4% of the variance in the dependent variable is explained by this ratio. This suggests that higher debt relative to equity tends to decrease the dependent variable, pointing to possible financial distress. Similarly, the total debt ratio has a negative slope of -32,131.95 with a p-value of 0.0031 and a higher R-square of 0.2722, showing that 27.22% of the variance is explained by this ratio, reinforcing that increased leverage adversely affects the dependent variable.

On the positive side, the total investment to long-term liabilities ratio has a slope of 430.57 and a p-value of 0.0268, with an R-square of 0.1632, suggesting that 16.32% of the variance is explained, and that greater investment relative to long-term liabilities positively impacts the dependent variable. The reserves to equity capital ratio exhibits a strong positive slope of 261,602 with a significant p-value of 0.0120 and an R-square of 0.2051, indicating that 20.51% of the variance is accounted for by this ratio, highlighting the positive impact of higher reserves relative to equity on the dependent variable.

In contrast, the degree of financial leverage has a negligible slope of -186.96 and a non-significant p-value of 0.8109, with an extremely low R-square of 0.0021, showing that this ratio does not meaningfully explain the variance. The fixed asset to funded debt ratio also shows a weak influence with a slope of -59.38, a p-value of 0.5338, and an R-square of 0.01, indicating a minimal explanatory power and a lack of significant impact on the dependent variable. These findings suggest that while some financial ratios are significant predictors of the dependent variable, others contribute little explanatory power, highlighting the complexity of the financial dynamics at play.

Table 2: Optimal capital structure fit for automobile sector

Parameter	Estimate	Std Error	Wald ChiSquare	Prob > ChiSquare
Intercept	32306.32	2537.89	162.04	<.0001*
Slope	-139241.90	44146.09	9.95	0.0016*
Quadratic	360780.27	143634.09	6.31	0.0120*
Cubic	-262533.90	119786.59	4.80	0.0284*

Source: JMPSAS Output

The cubic prediction model for the automobile industry, with "Total Shareholder's Fund" as the dependent variable and "Debt Equity Ratio" as the independent variable, reveals a complex relationship characterized by linear, quadratic, and cubic components. The intercept of 32,306.32 represents the estimated value of the Total Shareholder's Fund when the Debt Equity Ratio is zero, though this interpretation is theoretical since negative ratios are not practical. The slope coefficient of -139,241.90 indicates a decrease in Total Shareholder's Fund for each unit increase in Debt Equity

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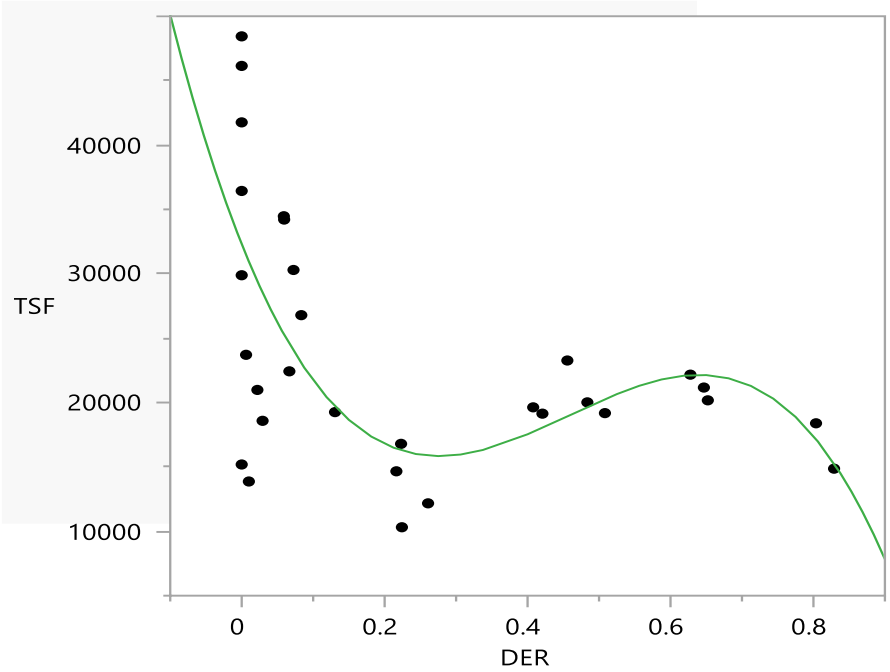
Ratio, suggesting that higher debt reduces shareholder wealth. The positive quadratic term coefficient of 360,780.27 signifies an upward curvature in the relationship, while the negative cubic term coefficient of -262,533.90 introduces further complexity with a downward curvature, reflecting a more intricate non-linear pattern. The precision of these estimates is indicated by their standard errors, and the significance of all parameters is supported by Wald Chi-Square tests with p-values below 0.05, underscoring the cubic model's robustness in explaining the variations in Total Shareholder's Fund. This model effectively captures both linear and non-linear effects, offering a comprehensive understanding of how the Debt Equity Ratio influences shareholder wealth in the industry.



Source: JMPSAS Output

Figure 1: Plot showing cubic curve fit for TSF and DER

The scatter plot illustrates a non-linear relationship between the Debt-to-Equity Ratio (DER) and the Total Sum of the Function (TSF), likely representing firm performance in the automobile industry. Initially, at low DER levels, TSF is high but decreases sharply as DER rises from 0 to around 0.2, indicating that increased debt relative to equity initially harms performance. Between DER values of approximately 0.2 and 0.6, TSF stabilizes and even slightly increases, suggesting that the negative effects of rising DER are mitigated within this range. However, at DER levels above 0.6, TSF begins to decline again, reflecting that very high debt levels negatively impact performance due to increased financial risk. Overall, there appears to be an optimal DER range, roughly between 0.2 and 0.6, where firm performance is relatively stable or slightly improves, balancing the benefits and risks of debt.

Cubic Model: $\boldsymbol{TSF = A + B(DER) + C(DER)^2 + D(DER)^3}$

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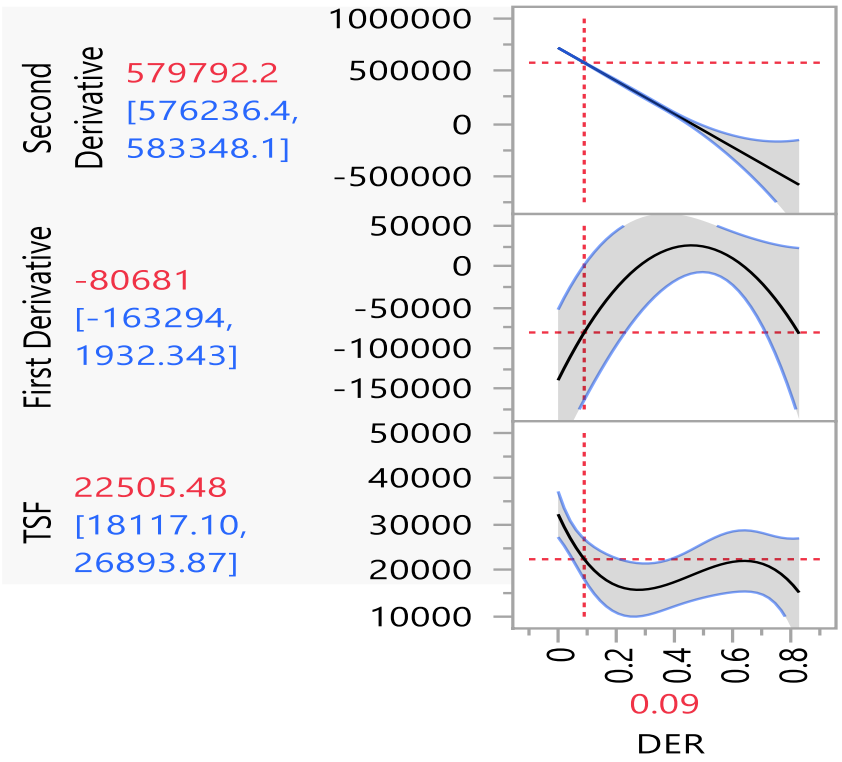

Source: JMPSAS Output

Figure 2: Prediction Profiler for cubic model for automobile industry

The prediction profiler for the cubic model illustrates how the Debt-to-Equity Ratio (DER) impacts firm performance in the automobile industry through its total, first, and second derivatives. The second derivative, consistently positive at 579,792.2, indicates that the curve is concave up, suggesting an accelerating effect of DER on the dependent variable. The first derivative, with a negative value of -80,681, shows that while the rate of change initially decreases with increasing DER, it eventually crosses zero, signaling a non-linear relationship with an inflection point where the effect direction changes. The overall trend, as shown by the Total Sum of the Function (TSF) at 22,505.48, reveals that while DER initially boosts performance, it peaks and then declines as DER increases further, highlighting that moderate levels of DER might be optimal. A critical point at DER = 0.09 marks a significant shift in the response pattern of the dependent variable, suggesting a threshold that could guide optimal capital structure decisions.

CONCLUSION

This analysis investigates the impact of capital structure ratios on shareholder wealth and examines the optimal capital structure for firms in the automobile industry. The regression results highlight that specific financial ratios significantly influence shareholder wealth, with the Debt-to-Equity Ratio (DER) and Total Debt Ratio both demonstrating notable negative relationships with the dependent variable (Jensen & Meckling, 1976; Frank & Goyal, 2009). Conversely, the Total Investment to Long-Term Liabilities Ratio and the Reserves to Equity Capital Ratio show positive impacts, indicating that higher investment and reserves relative to equity contribute positively to shareholder wealth (Graham & Harvey, 2001).

The cubic model further elucidates the non-linear relationship between DER and Total Shareholder's Fund (TSF). The model's parameters reveal a complex interaction, with the slope, quadratic, and cubic

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terms collectively explaining the variation in TSF. Notably, the prediction profiler underscores that while moderate DER levels can enhance performance, excessive debt leads to diminished shareholder value. The critical point identified at DER = 0.09 suggests a pivotal threshold where the effects of DER on performance transition significantly (Modigliani & Miller, 1958; Chen & Huang, 2010).

These findings underscore the importance of maintaining a balanced capital structure to optimize shareholder wealth. The non-linear dynamics highlighted by the cubic model and the significance of specific financial ratios provide valuable insights for strategic financial management in the automobile sector. Future research could further explore the implications of these results across different industries and under varying economic conditions to validate and extend these conclusions (Brealey, Myers, & Allen, 2019; Myers, 1984).

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