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EXAMINING THE MODERATING ROLE OF ASSET TANGIBILITY IN THE LEVERAGE PERFORMANCE RELATIONSHIP OF NIGERIA'S INDUSTRIAL GOODS SECTOR

Agbeyinka Yinka Ibrahim
Department of Accounting Science, Walter Sisulu University, Mthatha, South Africa
Corresponding author: ibrahim.yadeyinka@gmail.com

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ABSTRACT

This study investigates the moderating role of asset tangibility in the relationship between capital structure and firm performance among listed industrial goods firms in Nigeria over the period 2014 to 2023. Drawing on pecking order and trade-off theories, the research evaluates whether varying debt compositions, such as the short-term debt, long-term debt, total debt, and debt-to-equity ratios, affect financial performance (proxied by return on assets) differently depending on the level of tangible assets. Panel data derived from audited financial reports of 10 firms were analyzed using Generalized Least Squares (GLS) random effects estimation. The findings indicate that neither leverage variables nor their interactions with asset tangibility exert statistically significant effects on firm performance. These outcomes suggest that, within Nigeria's industrial goods sector, asset tangibility alone may not enhance the efficiency of debt utilization. The study contributes to capital structure literature by contextualizing firm-specific attributes in emerging markets and underscores the need for more nuanced financial strategies and supportive regulatory frameworks.

INTRODUCTION

The interrelationship between financial leverage and firm performance has long been a subject of academic debate, particularly in developing economies where capital structure decisions are often influenced by volatile macroeconomic conditions and institutional constraints. Financial leverage is a critical strategic decision, as it affects both the risk and return profile of firms. In the Nigerian industrial goods sector, which contributes significantly to manufacturing GDP and national employment, understanding the dynamics of leverage becomes essential for sustainable corporate growth. Yet, the empirical evidence on the leverage–performance nexus remains inconclusive and highly context-specific. In recent years, scholars have emphasized the need to explore contingent variables such as asset tangibility that could moderate this relationship and explain divergent findings across sectors and countries (Akoto et al., 2023; Iqbal & Kume, 2020).

Asset tangibility, defined as the proportion of fixed and tangible assets in a firm's total asset base, plays a dual role in corporate finance. On one hand, tangible

assets serve as collateral that can facilitate external borrowing, especially in credit-constrained environments like Nigeria's. On the other hand, firms with high asset tangibility may exhibit different investment behaviors and risk tolerances, potentially weakening the positive impact of leverage on performance (Chen et al., 2020). As such, the influence of asset tangibility on the leverage–performance nexus may not be linear or uniform but may instead depend on firm-specific characteristics and institutional factors. While prior studies have explored the direct effect of leverage or tangibility on firm performance, there remains a paucity of research that jointly examines their interaction, particularly within the industrial goods sector in sub-Saharan Africa.

From a theoretical standpoint, the pecking order theory and the trade-off theory provide contrasting lenses through which leverage decisions are interpreted. The pecking order theory suggests that firms prioritize internal financing and only resort to debt as a secondary option, implying a potentially negative relationship between leverage and performance if debt reflects internal financing constraints (Myers & Majluf, 1984). In contrast, the trade-off theory posits an optimal capital structure where the marginal benefits of debt (e.g., tax shields) balance its marginal costs (e.g., financial distress), suggesting a potentially positive association between moderate leverage and firm performance (Frank & Goyal, 2009). The moderating role of asset tangibility could, therefore, tip the scale in either direction, warranting empirical investigation in sectors where fixed assets constitute a major part of the capital base.

This study seeks to fill a critical gap in the literature by examining the moderating effect of asset tangibility on the relationship between financial leverage and firm performance within Nigeria's industrial goods sector. The sector comprises firms involved in cement production, building materials, packaging, and industrial chemicals - activities that are capital-intensive and rely heavily on physical infrastructure. Using data sourced from the audited financial statements of ten (10) listed firms between 2014 and 2023, drawn from a population of thirteen (13) sectoral constituents on the Nigerian Exchange Group (NGX), this study presents a robust empirical framework to analyze leverage dynamics. These firms were purposively selected based on data availability and continuous listing during the review period to ensure consistency and reliability of the panel data.

The methodology adopted for this study is the Generalized Least Squares (GLS) random effects regression model, which is well-suited for panel data analysis involving firm-level heterogeneity and time-invariant variables. The GLS estimator accounts for both individual-specific and temporal effects, reducing heteroscedasticity and autocorrelation issues common in corporate finance data. Unlike fixed effects models, the random effects approach assumes that unobserved

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firm-specific effects are uncorrelated with the explanatory variables, a condition verified through the Hausman specification test. The choice of GLS also aligns with recent methodological advancements in panel data econometrics, particularly in studies seeking to uncover interaction effects and structural relationships within corporate datasets (Baltagi, 2021; Gujarati & Porter, 2020).

Overall, this study contributes to the extant literature by going beyond the direct effects of financial leverage to assess how asset structure conditions the leverage - performance link in an emerging market context. By focusing on a strategically important but under-researched sector of the Nigerian economy, the study provides both theoretical and policy insights. It offers evidence to guide corporate managers in making financing decisions that account not only for leverage ratios but also for the composition of the firm's assets. Moreover, the findings have implications for lenders and regulators in terms of credit risk assessment and capital adequacy frameworks. In an era of heightened economic uncertainty and infrastructural bottlenecks, the interplay between balance sheet structure and performance outcomes deserves closer scrutiny.

LITERATURE AND HYPOTHESES

The capital structure discourse is deeply rooted in corporate finance theory, primarily centered around the question of how financing choices influence firm value and performance. Three dominant theories underpin this scholarly inquiry: the *Modigliani-Miller theorem, the trade-off theory, and the pecking order theory*. Each offers contrasting assumptions about firm behavior in the face of capital structure decisions, and each provides a unique lens through which the moderating role of asset tangibility may be analyzed, especially within emerging markets such as Nigeria.

The foundational work of Modigliani and Miller (1958), commonly referred to as the MM theorem, posits that in a world of perfect capital markets, firm value is unaffected by its capital structure. However, this irrelevance proposition is often criticized for its restrictive assumptions, including the absence of taxes, bankruptcy costs, and information asymmetry. Later adaptations of the theory (Modigliani & Miller, 1963) recognized the value-enhancing effects of debt through tax shields, laying the groundwork for the *trade-off theory.* According to this framework, firms optimize their capital structure by balancing the benefits of debt (primarily tax advantages) against its costs (notably bankruptcy risk and agency costs). In this context, asset tangibility becomes salient, as tangible assets can serve as collateral to mitigate the perceived risk of default, thus encouraging more debt financing (Frank & Goyal, 2009).

The *pecking order theory*, introduced by Myers and Majluf (1984), challenges the notion of an optimal capital structure. Instead, it argues that firms follow a financing hierarchy: internal funds are preferred, followed by debt, and equity is

issued only as a last resort. This theory emphasizes the problem of *information asymmetry*, wherein external investors are at a disadvantage compared to internal managers. Asset tangibility may reduce this asymmetry by offering verifiable book values, thereby enhancing a firm's creditworthiness. However, in contexts where tangible assets are already highly leveraged or non-liquid, their role as moderators may become negligible or even counterproductive (de Jong et al., 2011).

An extension of the trade-off theory that considers *agency theory* also sheds light on how asset tangibility interacts with leverage. Jensen and Meckling's (1976) agency framework distinguishes between conflicts of interest among stakeholders, principally between debt holders and shareholders. When firms possess more tangible assets, the risk of asset substitution (where equity holders invest in risky projects at the expense of debt holders) is reduced, which can lower agency costs of debt. Consequently, firms with higher asset tangibility may find it easier to secure loans at favorable terms, potentially reinforcing a positive leverage–performance relationship (Aivazian et al., 2015). However, agency problems may also increase with leverage beyond a certain threshold, causing diminishing or even negative returns on performance.

The *resource-based view (RBV)* provides a strategic perspective, proposing that a firm's resources drive its competitive advantage and performance. From the RBV lens, asset tangibility is not merely a financial metric but a productive resource that determines a firm's operational efficiency and strategic capacity (Barney, 1991). In this sense, tangibility could either amplify or dampen the effect of leverage on performance depending on how efficiently these assets are deployed. If leveraged financing is channeled into underutilized tangible assets, performance gains may be limited. Conversely, if such assets enable productivity or economies of scale, the synergy with leverage can enhance financial outcomes (Habib & Hasan, 2021).

In the context of Nigeria's industrial goods sector, these theories converge to explain the multidimensional role of asset tangibility. The capital-intensive nature of the sector implies a high dependence on fixed assets, which may simultaneously serve as collateral and constrain liquidity. Thus, the extent to which asset tangibility moderates the leverage–performance relationship depends not only on its financial value but also on institutional, operational, and strategic variables. The synthesis of these theoretical perspectives sets the stage for the empirical testing of asset tangibility's moderating role and offers nuanced expectations that go beyond linear causality.

Empirical Review

Empirical investigations into the leverage–performance nexus have yielded diverse findings across different contexts, particularly within emerging economies. In Nigeria's industrial goods sector, studies have highlighted the complex interplay

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between financial leverage, asset tangibility, and firm performance. For instance, Akinleye and Olanipekun (2024) found that while the Interest Coverage Ratio (ICR) did not significantly affect Return on Assets (ROA), the Debt Servicing Ratio (DSR) had a negative and statistically significant impact, indicating that higher debt servicing obligations can erode profitability. Similarly, Adegoyega (2024) reported that environmental auditing positively influences both asset tangibility and financial leverage, suggesting that adherence to environmental standards can enhance a firm's asset base and borrowing capacity.

The role of asset tangibility as a determinant of leverage has been extensively studied. Frank and Goyal (2009) established that firms with higher tangible assets tend to have increased leverage due to the collateral value of these assets. This finding aligns with the trade-off theory, which posits that firms balance the tax benefits of debt against bankruptcy costs. However, in developing countries, Booth et al. (2001) observed that while tangible assets increase long-term debt, they may reduce short-term debt reliance, reflecting the unique financial structures in these economies. In the broader African context, asset tangibility continues to play a significant role in shaping capital structures. Lim et al. (2020) noted that tangible assets not only serve as collateral but also contribute to a firm's cash flow and profitability, thereby influencing leverage decisions. Furthermore, Köksal et al. (2013) emphasized that firms with substantial tangible assets are more likely to secure debt financing, reinforcing the positive relationship between asset tangibility and leverage.

The impact of leverage on firm performance has also been a focal point of empirical research. Njoku and Lee (2024) demonstrated that while high leverage, particularly long-term debt, negatively affects firm value due to increased financial distress risks, the interaction between leverage and dividend payouts can positively moderate this relationship. This suggests that strategic financial policies can mitigate the adverse effects of high leverage. In the Nigerian manufacturing sector, studies have shown that financial leverage can influence systematic risk. Yisau et al. (2024) found that combined leverage positively impacts systematic risk, whereas financial leverage alone has a negative but statistically significant relationship with risk. This indicates that the composition of leverage components can differentially affect a firm's risk profile.

Moreover, the interaction between asset tangibility and leverage has been examined in various studies. Vo (2017) observed that while tangible assets positively influence long-term leverage, they may negatively affect short-term debt, highlighting the nuanced effects of asset composition on different debt maturities. Similarly, Bevan and Danbolt (2002) reported that the impact of tangible assets varies across debt types, emphasizing the need for firms to consider asset structure in their financing decisions.

Hypotheses Development

The interaction between short-term financing and firm performance remains a critical issue in corporate finance literature, particularly within emerging markets. While short-term debt is often associated with lower costs and reduced agency problems, its potential to create refinancing risks and liquidity pressures cannot be overlooked. Studies such as Abor (2005) and Vătavu (2015) show that short-term obligations can enhance performance by enforcing managerial discipline. However, the moderating effect of asset structure may alter this dynamic. Firms with significant fixed assets are more likely to secure short-term loans due to enhanced creditworthiness (Booth et al., 2001; Frank & Goyal, 2009). Moreover, Chen and Chen (2011) argue that tangible assets serve as collateral and buffer risks, which may reduce the adverse effects of short-term financial obligations. In a Nigerian context, Uwuigbe et al. (2016) observed that industrial firms with high asset tangibility maintained efficient operations despite short-term financing burdens, underscoring the potential moderating role of tangible resources.

Conversely, other scholars caution that excessive reliance on short-term debt, regardless of collateral quality, could hinder investment in long-term productive assets and increase financial distress (Salim & Yadav, 2012; Chakraborty, 2010). The ability of asset tangibility to moderate this relationship may depend on its liquidity and adaptability to varying financial conditions. According to Degryse et al. (2012), firms with a rigid asset base may not respond efficiently to short-term pressures, potentially diminishing any mitigating effects. Hence, the role of asset tangibility in modulating the short-term debt–performance relationship is not straightforward and necessitates empirical verification within the industrial goods sector in Nigeria.
H1: Asset tangibility does not significantly moderate the relationship between short-term debt ratio and financial performance of listed industrial goods firms in Nigeria.

Long-term financing instruments, while potentially more stable, also carry significant implications for firm performance. Debt with longer maturities can align better with investment horizons and reduce rollover risks (Titman & Wessels, 1988; Frank & Goyal, 2003). Nevertheless, their associated interest costs and fixed obligations may adversely impact financial outcomes if not optimally structured. The presence of substantial physical assets can play a crucial role in this context. As Harris and Raviv (1991) contend, tangible resources enhance firms' credit profiles, enabling them to secure long-term financing on more favorable terms. In emerging economies, Lemma and Negash (2014) provide evidence that asset tangibility increases access to long-term debt, thereby potentially improving operational efficiency and return metrics.

Tang and Jang (2007) indicate that tangible fixed assets can stabilize firm operations by facilitating lower-cost financing and shielding against default risk. In

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the Nigerian industrial sector, where infrastructure and fixed capital investments are substantial, asset tangibility may improve debt servicing capacity, thereby influencing the effect of long-term leverage on profitability (Oladeji & Ogunlana, 2020). However, it is also possible that heavily asset-backed firms become overleveraged, leading to diminishing returns, as posited by Rajan and Zingales (1995). This conflicting body of evidence highlights the importance of context-specific empirical analysis to clarify the nature of this moderating relationship.

H2: Asset tangibility does not significantly moderate the relationship between long-term debt ratio and financial performance of listed industrial goods firms in Nigeria.

The total level of corporate debt is widely recognized as a critical determinant of firm performance, yet the direction and magnitude of its impact remain debated. High overall leverage can lead to increased financial stress and agency costs, as noted by Jensen (1986) and Myers (2001). At the same time, when efficiently utilized, debt may serve as a disciplining mechanism and provide tax shields that enhance returns (Modigliani & Miller, 1963). The nature of the asset base is a key factor in determining the sustainability of these debt levels. Firms with substantial tangible assets are typically perceived as less risky by lenders and are thus able to carry higher debt burdens without compromising profitability (Booth et al., 2001; Lemma & Negash, 2014). This is especially relevant in capital-intensive industries, where asset tangibility functions as both a buffer and a lever for debt structuring.

Empirical research in emerging economies supports this view. For instance, Chakraborty (2010) and Vo (2017) demonstrated that asset tangibility positively influences both the level and performance outcomes of total leverage. In Nigeria's industrial sector, where asset intensity is high, tangible resources could either mitigate or amplify the effects of total indebtedness depending on asset liquidity and utilization. While asset-backed firms may absorb financial shocks better, overcapitalization in fixed assets might lead to inefficiencies and constrained cash flow, thereby limiting performance improvements (Akinlo, 2011; Ogebe et al., 2013). The exact direction of this moderating effect is thus an empirical question warranting focused investigation.

H3: Asset tangibility does not significantly moderate the relationship between total debt ratio and financial performance of listed industrial goods firms in Nigeria.

The debt-to-equity ratio serves as a comprehensive indicator of a firm's financial structure, reflecting the balance between external financing and shareholders' equity. An optimal ratio can enhance performance by minimizing the weighted average cost of capital (Myers, 2001), but deviations from this balance may either signal financial distress or missed growth opportunities. Asset tangibility plays a pivotal role in determining the cost and availability of both debt and equity financing. Firms with more tangible assets are often better positioned to negotiate

debt financing and avoid excessive equity dilution, especially in markets with underdeveloped financial infrastructure (Frank & Goyal, 2009; Lemma & Negash, 2014). This advantage may reduce the risk associated with high debt-equity structures and positively affect performance.

Literature also suggests that the benefits of asset tangibility in managing equity dilution and debt costs are not uniform. Studies by Chakraborty (2010) and De Jong et al. (2008) argue that beyond a certain point, the over-reliance on debt can erode investor confidence and reduce market value. In Nigeria, where capital markets remain underdeveloped, these risks may be heightened (Uwuigbe et al., 2016). The interaction between firm-level asset characteristics and capital structure, therefore, presents a nuanced context that could significantly influence firm outcomes. As such, empirical testing is required to determine the extent to which asset tangibility moderates this broader leverage-performance relationship.

H4: Asset tangibility does not significantly moderate the relationship between total debt-to-equity ratio and financial performance of listed industrial goods firms in Nigeria.

METHODOLOGY

This study adopts a panel data research design to examine the moderating influence of asset tangibility on the relationship between leverage and firm performance in Nigeria's industrial goods sector. The study utilizes secondary data sourced from the audited financial statements of ten (10) listed industrial goods firms, purposefully selected from a population of thirteen (13) firms on the Nigerian Exchange Group (NGX) over a ten-year period from 2014 to 2023. The firms were selected based on data availability and continuity of listing during the study period, ensuring robust time-series and cross-sectional coverage for panel analysis.

The dataset includes firm-level financial indicators such as return on assets (ROA) as the dependent variable, four different leverage ratios (short-term debt ratio, long-term debt ratio, total debt ratio, and total debt-to-equity ratio) as independent variables, and asset tangibility as a moderating variable. ROA is computed as the ratio of net income to total assets, representing financial performance. Short-term debt ratio and long-term debt ratio respectively represent the proportion of short-term and long-term debt to total assets, reflecting maturity structure of capital. Total debt ratio aggregates all forms of liabilities over total assets, while total debt-to-equity ratio assesses the extent of financial gearing. Asset tangibility, defined as the ratio of tangible fixed assets to total assets, captures the firm's ability to secure debt with collateral.

The Hausman specification test justifies the use of the Generalized Least Squares (GLS) random effects model over fixed effects (Hausman, 1978).

To evaluate the main and moderating effects, the following baseline model is specified:

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$$ROA_{it} = \beta_0 + \beta_1 STDR_{it} + \beta_2 LTDR_{it} + \beta_3 TDRT_{it} + \beta_4 TDER_{it} + \beta_5 ASTG_{it} + \varepsilon_{it} \quad (1)$$

To assess the moderating role of asset tangibility, interaction terms between asset tangibility and each leverage measure are introduced:

$$\begin{aligned} ROA_{it} = {} & \beta_0 + \beta_1 STDR_{it} + \beta_2 LTDR_{it} + \beta_3 TDRT_{it} + \beta_4 TDER_{it} + \beta_5 ASTG_{it} \\ & + \beta_6 (STDR \times ASTG)_{it} + \beta_7 (LTDR \times ASTG)_{it} + \beta_8 (TDRT \times ASTG)_{it} \\ & + \beta_9 (TDER \times ASTG)_{it} \\ & + \varepsilon_{it} \end{aligned} \quad (2)$$

In equations (1) and (2), ROA_{it} represents the financial performance of firm i at time t, and ε_{it} is the error term capturing unobserved heterogeneity.

The relationship between leverage and firm performance is underpinned by competing theories. According to the trade-off theory, a moderate level of debt enhances performance through tax benefits (Kraus & Litzenberger, 1973), suggesting a positive a priori expectation. Conversely, the pecking order theory posits that higher debt levels reflect financing constraints and result in deteriorated performance, especially for less profitable firms (Myers & Majluf, 1984), implying a negative relationship. For asset tangibility, the expectation is that higher tangible assets facilitate borrowing capacity (Titman & Wessels, 1988), thus moderating the risk associated with leverage.

1. Short-term debt may positively or negatively influence performance depending on liquidity and rollover risks.
2. Long-term debt is often linked to long-term capital projects and may have a delayed or negative effect on current profitability.
3. Total debt ratios generally reflect overall indebtedness and are expected to have an inverse relationship with ROA under financial distress conditions (Jensen, 1986).
4. Asset tangibility is expected to cushion leverage risks, moderating the adverse effects of debt on performance, consistent with collateral theory (Berger & Udell, 1990).

The study employs the GLS random effects estimator to address unobserved firm-specific heterogeneity and potential heteroskedasticity across panels. The random effects model assumes that individual-specific effects are uncorrelated with the regressors, a condition confirmed by the Hausman test (p = 0.993), thereby validating the choice of GLS (Baltagi, 2021). The GLS method is particularly suitable for panels with more time periods than cross-sectional units, as it produces efficient and consistent estimators under minimal assumptions of homoskedasticity and serial independence (Greene, 2012). The generic GLS estimator is mathematically expressed as:

$$\mathbf{y} = \mathbf{X\beta} + \boldsymbol{\mu} + \boldsymbol{\epsilon}, \quad \mathrm{Var}(\boldsymbol{\epsilon}) = \sigma_\epsilon^2 \mathbf{I}, \quad \mathrm{Var}(\boldsymbol{\mu}) = \sigma_\mu^2 \mathbf{I} \quad (3)$$

Where **y** is the $N \times 1$ vector of the dependent variable (ROA), **X** is the matrix of explanatory and interaction variables, **β** is the parameter vector, and **μ** and **ϵ** represent firm-specific and idiosyncratic error components, respectively.

Table 1. Definition of Financial Leverage and Moderating Variable

Variable	Measurement	Sign	References	Source
$ROA_{i,t}$	$\frac{EBIT_{i,t}}{Total\ Assets_{i,t}}$	+	Umar & AbdulQudus (2020); Lawal et al. (2022); Obi & Emeka (2023)	Annual Reports of Firms
$STDR_{i,t}$	$\frac{Short\text{-}term\ debt_{i,t}}{Total\ capital_{i,t}}$	±	Ali & Sadaqat (2021); Adebayo & Olayemi (2023); Musa & Sulaimon (2022)	Annual Reports of Firms
$LTDR_{i,t}$	$\frac{Long\text{-}term\ debt_{i,t}}{Total\ capital_{i,t}}$	−	Yahaya & Lamidi (2020); Musa et al. (2024); Nwachukwu & Ibrahim (2021)	Annual Reports of Firms
$TDRT_{i,t}$	$\frac{Total\ debt_{i,t}}{Total\ capital_{i,t}}$	−	Chukwu & Ekezie (2021); Ofori et al. (2023); Etim & Aghedo (2024)	Annual Reports of Firms
$TDER_{i,t}$	$\frac{Total\ debt_{i,t}}{Equity_{i,t}}$	−	Ahmed & Audu (2021); Okwii & Egbunike (2022); Omole & Ajibola (2025)	Annual Reports of Firms
$ASTG_{i,t}$	$\frac{Net\ Fixed\ Assets_{i,t}}{Total\ Assets_{i,t}}$	±	Yusuf & Okafor (2023); Ajayi et al. (2021); Ibrahim & Hassan (2024)	Annual Reports of Firms

Source: Author (2025)

The variance-covariance structure of the GLS estimator corrects for intra-panel correlation, thus offering superior robustness relative to pooled OLS or fixed effects models. Moreover, the inclusion of interaction terms enables the evaluation of moderation effects, an approach increasingly adopted in recent financial performance studies (Nguyen et al., 2020). The study compares baseline and interaction models, examining consistency of coefficient signs and statistical significance. The moderate R-squared values signal that although leverage explains a portion of firm performance, other non-financial and macroeconomic variables could also contribute. Additionally, variance inflation factors and residual normality support the model's statistical reliability. As a further robustness check, the models could be estimated using feasible GLS (FGLS) and fixed effects with cluster-robust standard errors, though the Hausman test indicates no significant endogeneity concern.

RESULTS AND IMPLICATIONS

The descriptive statistics (Table 2) reveal meaningful insights into the central tendencies and dispersions within the dataset. The average return on assets stands at 10.9%, indicating moderate profitability in Nigeria's industrial goods sector. This relatively high mean value suggests a sector that, despite external shocks such as exchange rate volatility and inflationary pressures, maintains modest operating

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efficiency (Onyeche et al., 2023). Short-term debt usage is substantial (mean = 36.0%), significantly exceeding long-term debt (mean = 11.1%). The total debt ratio (mean = 48.5%) and debt-to-equity ratio (mean = 84.6%) reflect an overall high dependence on debt finance. Interestingly, the mean asset tangibility value of 64.4% suggests that these firms possess a strong base of physical, non-current assets, which can influence financing patterns (Bhaduri, 2020).

Table 2. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
$ROA_{i,t}$	0.109	0.169	-0.269	0.793
$STDR_{i,t}$	0.360	0.173	0.033	0.980
$LTDR_{i,t}$	0.111	0.116	0.008	0.622
$TDRT_{i,t}$	0.485	0.339	0.004	1.979
$TDER_{i,t}$	0.846	0.424	0.043	2.156
$ASTG_{i,t}$	0.644	0.141	0.160	0.800

Source: Author (2025)

From the correlation matrix in Table 3, weak linear relationships are observed between the performance variable and leverage indicators. Most notable is the insignificant correlation between performance and long-term debt (-0.192, $p > 0.05$), aligning with literature suggesting that excessive reliance on long-term financing can dampen profitability through interest costs (Olowokure et al., 2021). Furthermore, the positive correlation between short-term debt and total debt-to-equity ($r = 0.706$, $p < 0.01$) suggests that firms utilizing short-term finance tend to rely heavily on external equity, possibly to buffer volatility.

Table 3. Pairwise Correlations (p-values in parentheses)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) $ROA_{i,t}$	1.000					
(2) $STDR_{i,t}$	0.071	1.000				
(3) $LTDR_{i,t}$	-0.192	-0.049	1.000			
(4) $TDRT_{i,t}$	0.015	0.128	0.025	1.000		
(5) $TDER_{i,t}$	-0.032	0.706*	0.390*	0.224*	1.000	
(6) $ASTG_{i,t}$	0.167	-0.014	-0.014	-0.205*	-0.079	1.000

Source: Author (2025)

Table 4 confirms the absence of multicollinearity (all VIFs < 5), enhancing model reliability (Gujarati & Porter, 2010). The Shapiro-Wilk and Shapiro-Francia statistics indicate non-normality in the distribution of all variables; however, the use of Generalized Least Squares (GLS) helps to mitigate heteroskedasticity and panel-specific issues. Table 5 justifies the choice of a random effects model, as indicated

by the insignificance of the Hausman test (p = 0.993), which favors GLS over fixed effects for efficiency without bias.

Table 4. Normality and Multicollinearity Tests

Variable	W	V	z	Prob>z	VIF	1/VIF
$ROA_{i,t}$	0.902	8.077	4.634	0.000		
$STDR_{i,t}$	0.825	14.482	5.930	0.000	3.280	0.305
$LTDR_{i,t}$	0.716	23.480	7.002	0.000	2.680	0.373
$TDRT_{i,t}$	0.852	12.248	5.558	0.000	1.590	0.631
$TDER_{i,t}$	0.906	7.791	4.554	0.000	1.110	0.905
$ASTG_{i,t}$	0.851	12.341	5.575	0.000	1.050	0.953

Source: Author (2025)

In the baseline model (Table 6), none of the debt structure variables exhibit statistically significant effects on firm performance. While long-term debt shows a negative coefficient (–0.220), it remains statistically insignificant (p = 0.267), indicating that the cost burden of long-term obligations may not be a dominant determinant of profitability. Conversely, short-term debt presents a negative but negligible effect, reinforcing findings by Olayinka (2022), who emphasized the transitory nature of short-term borrowing in emerging markets. Asset tangibility, though positive (0.004), is statistically insignificant, hinting that merely holding physical assets is insufficient for influencing returns without strategic financial leverage.

Table 5. Hausman Specification Test

Statistic	Value
Chi-square	0.471
P-value	0.993

Source: Author (2025)

The interaction model (Table 7) introduces asset tangibility as a moderator, yet the interaction terms remain largely insignificant. For instance, the interaction between short-term debt and asset tangibility (–2.605, p = 0.230) indicates a potential but statistically weak adverse effect. The moderating effects of asset tangibility on long-term debt and debt-to-equity also fail to reach significance, aligning with existing studies that found similar non-linear or muted interactions in capital-intensive sectors (Nguyen & Nguyen, 2023). While the inclusion of interaction terms increases the overall R-squared from 3.7% to 10.2%, this marginal improvement lacks robust explanatory power, pointing to the presence of omitted or nonlinear factors.

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Table 6. Random Effects Estimation (Baseline Model)

Variable	Parameter	Sign	Coef.	St.Err.	t-value	p-value
$STDR_{i,t}$	β_1	±	-0.022	0.103	-0.220	0.827
$LTDR_{i,t}$	β_2	−	-0.220	0.199	-1.110	0.267
$TDRT_{i,t}$	β_3	−	0.000	0.038	-0.010	0.991
$TDER_{i,t}$	β_4	−	0.033	0.097	0.340	0.735
$ASTG_{i,t}$	β_5	±	0.004	0.109	0.040	0.970
Constant	β_0	+	0.111	0.053	2.080	0.038
Model Summary:						
Overall r-squared			0.037			
Chi-square			6.363			
R-squared within			0.048			
Prob > chi2			0.272			
R-squared between			0.197			

Source: Author (2025)

Table 7. Random Effects Estimation (With Moderator Interaction)

Variable	Parameter	Sign	Coef.	St.Err.	t-value	p-value
$STDR_{i,t}$	β_1	±	1.785	1.446	1.230	0.217
$LTDR_{i,t}$	β_2	−	0.159	0.980	0.160	0.871
$TDRT_{i,t}$	β_3	−	-0.136	0.211	-0.640	0.521
$TDER_{i,t}$	β_4	−	-0.436	0.523	-0.830	0.404
$ASTG_{i,t}$	β_5	±	0.413	0.377	1.100	0.273
$STDRASTG_{i,t}$	β_6	∓	-2.605	2.171	-1.200	0.230
$LTDRASTG_{i,t}$	β_7	∓	-0.550	1.487	-0.370	0.711
$TDRTASTG_{i,t}$	β_8	±	0.278	0.361	0.770	0.440
$TDERASTG_{i,t}$	β_9	±	0.669	0.785	0.850	0.394
Constant	β_0	±	-0.186	0.236	-0.790	0.429
Model						
Overall r-squared			0.102			
Chi-square			10.171			
R-squared between			0.312			
R-squared within			0.008			
Prob > chi2			0.337			

Source: Author (2025)

Hypotheses Evaluation

The evaluation of the four hypotheses indicates limited support for significant moderation effects. The results from Table 7 suggest that asset tangibility

does not significantly alter the impact of short-term debt on firm performance, thus supporting the null hypothesis (H1). Despite theoretical assertions from the pecking order theory that tangible assets can enhance debt capacity (Myers & Majluf, 1984), the empirical insignificance here implies that the cost and risk associated with short-term financing outweigh any asset-based advantages (Al-Najjar & Belghitar, 2022). Regarding H2, the interaction between long-term debt and asset tangibility is not significant (-0.550, p = 0.711). The negative direction is consistent with the trade-off theory, which postulates that firms with substantial tangible assets may rely excessively on secured long-term borrowing, thereby depressing performance through interest burden (Zeitun et al., 2021). However, the lack of significance aligns with prior research by Agyemang and Castellini (2021), who found that in African markets, macroeconomic instability often undermines the potential benefits of long-term financing.

The test of H3 also supports the null, as the interaction term for total debt and asset tangibility (0.278, p = 0.440) is statistically insignificant. While some studies suggest a positive role of tangible assets in mitigating debt-induced risks (Chen et al., 2020), this result suggests that asset-heavy firms in Nigeria may lack the operational flexibility to convert physical resources into performance-enhancing leverage. Finally, H4 remains unconfirmed, with the asset tangibility interaction term for total debt-to-equity also failing to attain statistical significance (0.669, p = 0.394). This implies that even though tangible assets may signal lower default risk, their influence on equity-based capital structuring and returns is not straightforward. These findings resonate with recent studies by Yartey and Adjasi (2020) that caution against overreliance on tangible collateral as a moderating financial tool in Sub-Saharan Africa's volatile environments.

Policy Implications

First, the findings suggest that Nigeria's industrial goods firms should critically reassess the effectiveness of physical asset accumulation as a means to support debt financing. Tangible assets, while valuable for operational stability, may not automatically translate into financial flexibility or enhanced performance, particularly under high-interest regimes (Okafor et al., 2023). Second, policymakers should prioritize financial market reforms that deepen access to long-term debt at competitive rates. The negligible effect of long-term leverage on performance indicates that current debt instruments may be poorly structured or overpriced, limiting their productivity-enhancing potential (Egbunike & Okerekeoti, 2021). Third, the apparent ineffectiveness of asset tangibility in moderating debt effects underscores the importance of intangible capital, such as R&D investment, brand strength, and managerial capability, in driving profitability. Policies should

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therefore incentivize broader asset diversification beyond physical infrastructure (Kanu & Ozurumba, 2022).

Fourth, regulatory frameworks must enhance transparency in capital structure disclosures to allow investors and analysts to better assess the risk-return dynamics associated with different leverage strategies. Given the sector's reliance on short-term funding, disclosure regimes should emphasize rollover risks and liquidity constraints (Asongu et al., 2022). Finally, capacity-building initiatives are essential to equip corporate finance managers with tools to navigate complex interactions between capital structure and asset composition. Strategic debt management training can improve the optimal use of tangible resources in financial planning (Adegbite & Nakajima, 2021).

CONCLUSION

This study examined the moderating role of asset tangibility in the relationship between capital structure and firm performance among listed industrial goods firms in Nigeria. Employing a panel data approach with Generalized Least Squares (GLS) random effects estimation on a sample of 10 firms, the analysis assessed how various leverage components - short-term debt, long-term debt, total debt, and debt-to-equity - interact with asset tangibility to affect return on assets, a proxy for firm performance. The findings revealed that none of the individual leverage variables nor their interaction terms with asset tangibility significantly influenced firm performance, though the directions of the coefficients were largely consistent with theoretical expectations under pecking order and trade-off frameworks.

These results underscore the complexity of financial decision-making in capital-intensive sectors within emerging markets. The lack of significant moderating effects suggests that asset tangibility alone may not suffice as a contingency factor in optimizing leverage-performance outcomes. This is particularly relevant in Nigeria's industrial goods sector, where macroeconomic instability, regulatory uncertainty, and underdeveloped capital markets may dilute the benefits of traditional capital structure strategies (Al-Najjar & Belghitar, 2022; Egbunike & Okerekeoti, 2021). Moreover, the persistence of non-significant results highlights the potential role of omitted variables such as managerial efficiency, firm-specific risk profiles, or industry-level shocks that are not adequately captured in the current model specification.

This study is not without limitations. First, the relatively small sample size (10 firms) may constrain the generalizability of the findings. Although the sample was selected to ensure representativeness within the sector, a broader dataset covering multiple sectors or a longer time span could yield more robust insights. Second, the study focused solely on ROA as a performance metric, which, while informative, may not fully capture market-based outcomes such as stock returns or

enterprise value (Zeitun et al., 2021). Additionally, the reliance on secondary data from published financial reports may introduce measurement biases, especially in an environment where corporate disclosures vary in quality and consistency.

Given these limitations, several recommendations emerge. At the firm level, finance managers should adopt a more holistic approach to capital structure decisions by integrating both tangible and intangible asset considerations, including intellectual capital, innovation capacity, and governance structures. Regulatory bodies, such as the Nigerian Securities and Exchange Commission, should intensify efforts to enhance financial transparency and encourage diversification in funding sources, especially for asset-heavy industries. Furthermore, policy interventions that reduce the cost of long-term borrowing, such as government-backed credit guarantees or subsidized industrial bonds, may help firms unlock the productivity potential of their physical asset base.

Future research could extend this study by incorporating additional moderating variables such as ownership structure, institutional quality, or environmental factors, particularly in light of emerging sustainability frameworks. Applying dynamic panel techniques such as system Generalized Method of Moments (GMM) may also better account for endogeneity and firm-specific inertia. Lastly, comparative studies across African or BRICS economies could offer valuable insights into the institutional and macroeconomic contingencies shaping the capital structure–performance nexus in transitional economies.

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