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Effect of Free Cash Flow and Inventory Turnover on Performance of Listed Manufacturing Firms in Nigeria: The Moderating Role of Leverage

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Abstract

The impact of Free Cash Flow Efficiency, Inventory Turnover, and Financial Leverage on firm performance remains fragmented and inconclusive in the existing literature, with limited context-specific insights tailored to the Nigerian manufacturing sector. This study examined the effect of Free Cash Flow Efficiency, Inventory Turnover, and Financial Leverage on the performance of listed manufacturing firms in Nigeria using panel data of 49 companies covering the period 2012 to 2023. Firm performance was proxied by Tobin's Q, while regression analysis was conducted using the robust random-effects model. This study adopts an ex-post facto research design. The findings revealed that Financial Leverage had a positive and statistically significant effect on firm performance proxied by Tobin Q, while Free Cash Flow Efficiency and Inventory Turnover have insignificant effect on Tobin's Q. However, the interaction between Free Cash Flow Efficiency and Financial Leverage was positive and significant, suggesting that Financial Leverage moderates the relationship and enhances the effect of Free Cash Flow Efficiency on firm performance. The study concluded that financial leverage, when prudently managed, plays a strategic role in enhancing Tobin Q, particularly when paired with efficient internal cash flow utilization. Based on these findings, it is recommended that manufacturing firms in Nigeria adopt prudent leverage strategies that complement efficient free cash flow management, as the combined effect significantly enhances market valuation and overall firm performance.

Keywords: Financial Leverage, Free Cash Flow Efficiency, Firm Performance, Manufacturing Firms.

1. Introduction

In today's unpredictable and efficiency-minded corporate environment, Free Cash Flow Efficiency, Inventory Turnover, and Financial Leverage have arisen as essential determinants of firm performance. Efficient free cash flow enhances profitability and firm value by strategically planning each investment and reducing agency costs (Rompotis, 2024). Kargi & Zakariya, (2021) suggests that firms with well-managed free cash flows tend to display stronger financial stability and are less prone to earnings manipulation. Owoyemi and Adesoye (2024); Obeidat, (2021) opined that effective inventory turnover is indicative of sound operational efficiency and has shown a positive impact on return on assets and firm profitability in manufacturing and consumer goods sectors. Inventory management is critical in aligning production with market demand and minimizing holding costs, thereby improving financial outcomes. While moderate leverage can enhance return on equity through tax shields, excessive reliance on debt may hinder profitability due to increased financial risk (Ibrahim et al., 2024; Arhinful & Radmehr, 2023). Overall, a strategic balance among FCFE, inventory efficiency, and leverage fosters sustainable financial performance in competitive industries.

Several empirical literature such as Onyemenam et al., 2023; Uchegbu et al., 2023 confirms a significant relationship between Free Cash Flow Efficiency, Inventory Turnover, Leverage, and firm performance. Free Cash Flow Efficiency, proxied by (Net Cash Flow from Operations – Investing Cash Flow)/Revenue usually influences or affect firm's profitability when judiciously planned and managed, enhancing liquidity and enabling strategic investments. Conversely, excessive or mismanaged free cash flow may encourage earnings manipulation or inefficient resource allocation (Kargi & Zakariya, 2021). Inventory

Turnover—calculated as Total Inventories/Revenue—is a key indicator of operational efficiency. Srour and Azmy (2021); Etale and Sawyerr (2020) confirmed that higher turnover rates are associated with increased return on assets and equity, reflecting better inventory management and responsiveness to demand. Leverage, measured by (Total Liabilities/Total Assets) × 100, also exhibits a mixed yet crucial influence. While moderate leverage may enhance return on equity through tax shields, excessive debt correlates with reduced firm value and financial distress (Wani & Dar, 2015; Dube et al., 2017). The synergy among Free Cash Flow Efficiency, inventory efficiency, and leverage provides firms a robust framework for sustaining competitiveness and driving financial performance, (Dube et al., 2017).

Despite the proliferation of studies examining the influence of Free Cash Flow Efficiency, Inventory Turnover, and Leverage on firm performance, the literature remains fragmented, inconclusive, and under-contextualized, particularly within the Nigerian manufacturing sector. Empirically, past studies present conflicting evidence regarding the role of Free Cash Flow Efficiency in performance outcomes. While Onyemenam, Okwo, and Eze (2023) and Uchegbu, Egbunike, and John-Akamelu (2023) confirm a significant positive effect of operating cash flow on firm performance, other research (Abughniema et al., 2020; Hau, 2017) suggests that excessive free cash flow may encourage inefficient investment and agency-related waste, thus harming firm value. Similarly, findings on inventory turnover are mixed. While Ngbomowa et al. (2023) link efficient inventory management to enhanced financial returns, Ekenyong et al. (2023) observed no significant relationship in the construction sector, highlighting sectoral disparities and measurement inconsistencies.

Methodologically, research across different contexts exhibits notable variations in the definition and measurement of key variables, reflecting weaknesses and inconsistencies in how these constructs are operationalized. These limitations make cross-study comparisons challenging and may affect the generalizability of findings. For instance, Free Cash Flow Efficiency is calculated using varying proxies—some including capital expenditures, others excluding net borrowings—thus leading to conflicting interpretations (Hau, 2017; Cohee et al., 2020). Likewise, leverage is inconsistently measured, with some studies using debt-to-asset ratios and others employing interest coverage ratios, which can yield divergent results depending on the capital structure and industry studied (Ibrahim et al., 2024; Abubakar, 2015).

Scope wise, Nigerian manufacturing firms operate in a macroeconomic environment characterized by exchange rate volatility, inflation, infrastructural deficits, and regulatory inconsistencies, which intensify agency problems and financial distress risks. However, these contextual realities are often omitted in empirical models, limiting the practical relevance and policy applicability of findings. Moreover, while leverage is expected to improve capital access and performance, excessive reliance on debt—as evident in the growing liabilities of firms like Dangote Cement and Lafarge Africa—has proven detrimental, (NGX, 2023 as cited in Ibrahim et al., 2024). This underscores the need to use leverage as a moderator variable in this study.

Specifically, the study aims to assess the effect of Free Cash Flow Efficiency on firm performance of listed manufacturing firms in Nigeria; evaluate the impact of Inventory Turnover on firm performance of listed manufacturing firms in Nigeria; examine the influence of Financial Leverage on firm performance of listed manufacturing firms in Nigeria; and investigate the moderating effect of Financial Leverage on the relationship between Free Cash Flow Efficiency, Inventory Turnover, and firm performance of listed manufacturing firms in Nigeria. Based on these objectives, the study formulates the following null hypotheses: H_{01}: Free Cash Flow Efficiency has no significant effect on the performance of listed

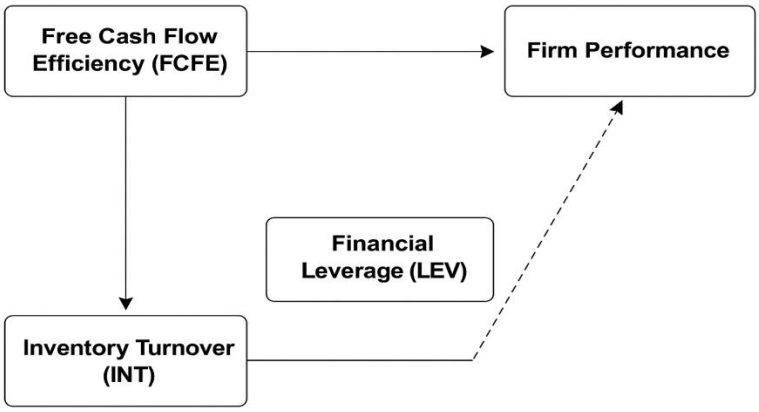
manufacturing firms in Nigeria; H_{02}: Inventory Turnover has no significant effect on firm performance of listed manufacturing firms in Nigeria; H_{03}: Financial Leverage has no significant effect on firm performance of listed manufacturing firms in Nigeria; and H_{04}: Financial Leverage does not significantly moderate the relationship between Free Cash Flow Efficiency, Inventory Turnover, and firm performance of listed manufacturing firms in Nigeria.

2. Literature Review

Conceptual Framework

The conceptual framework illustrates how Free Cash Flow Efficiency (FCFE) and Inventory Turnover (INT) directly influence Firm Performance, while Financial Leverage (LEV) moderates this relationship. It posits that efficient internal financing and inventory management improve performance, but their effects may be strengthened or weakened depending on a firm's leverage level

Figure 1: Conceptual Framework Illustrating the Influence of Independent Variables on Dependent Variable with Moderating Effect



Source: Researcher's Conceptualization (2025).

Free Cash Flow Efficiency and Firm Performance

Several studies have shown that Free Cash Flow Efficiency (FCFE) has a positive and significant effect on firm performance. For instance, Uchegbu et al. (2023) examined the effect of cash flow activities on financial performance among Nigerian manufacturing firms using panel regression analysis and found that higher FCFE led to better return on assets. Similarly, Onyemenam et al. (2023) assessed the pharmaceutical sector and concluded that prudent use of FCF enhances profitability and solvency. Mutende, Mwangi, Njihia and Ochieng (2017) in their study Free Cash Flows, Agency Costs and Performance of Firms Listed at the Nairobi Securities Exchange from 2006 to 2015, using both cross-sectional and longitudinal descriptive survey and the ordinary least square regression technique, revealed that Free cash flow has a positive and significant influence on the performance of firms listed at the Nairobi Securities Exchange. A study by Reuter (2018) on Nordic firms reported that efficient use of FCF was significantly linked to improved performance in firms listed on the Nasdaq Large Cap market. Ali and Ahmad (2018), using data from the Taiwan Stock Exchange, found a direct and positive association between operational efficiency in generating FCF and corporate success. Another study by Hau (2017) in Vietnam employed panel regression models and showed that FCF positively affects firm performance, especially in the manufacturing sector where internal financing dominates. Likewise, Amah (2016) confirmed a strong positive link between free cash flow and financial performance for Nigerian banks listed on the stock exchange. The findings of Mohammed (2018) also supported the

positive role of FCF in predicting financial success, especially where operational activities are well managed. These studies contrast with the present research by focusing mostly on ROA or ROE, whereas this study adopts Tobin's Q**, a** market-based performance metric sensitive to investor expectations.

Contrastingly, other empirical findings report a negative and significant relationship between FCFE and firm performance, often explained through Jensen's (1986) free cash flow hypothesis, which suggests that excess cash might lead to managerial inefficiencies. For instance, Zhou et al. (2012) and Mojtahedzadeh & Nahavandi (2011) found that firms with large free cashflows, but limited investment opportunities showed deteriorating performance due to agency costs. Vinh and Chi (2013), in their Vietnam-based study, demonstrated that firms with low Tobin's Q (no growth opportunities) experienced performance decline when FCF was high. Similarly, Chung et al. (2005) and Bukit & Iskandar (2009) revealed that high free cash flows in low-growth firms encouraged wasteful expenditures and reduced profitability. Nwuba et al. (2020) analyzed non-financial Nigerian companies and found that excess FCF negatively affected growth prospects and firm value. Studies by John et al. (2015) and Hwang et al. (2013) concluded that without adequate governance mechanisms, free cash flows may be misallocated, leading to significant value erosion. Holder et al. (1998) and Hossain et al. (2001) also documented similar outcomes, emphasizing misuse of free cash in firms with weak monitoring structures.

Some studies have presented insignificant effects of Free Cash Flow Efficiency (FCFE) on firm performance, indicating that the relationship may be influenced by contextual or methodological limitations. For instance, Liman and Mohammed (2018) found no significant link between operating cash flow and ROA over a ten-year period among Nigerian firms; however, they observed a significant relationship when ROE was used instead, highlighting the sensitivity of results to performance metrics. Similarly, Sabrin et al. (2016), focusing on small and mid-sized firms, argued that cash flow alone could not sufficiently explain variations in firm value without accounting for industry-specific risk factors. Mohammed (2018) also emphasized that the impact of FCFE was highly dependent on the effectiveness of reinvestment strategies, suggesting that without such managerial controls, the relationship remains ambiguous.

Inventory Turnover and Firm Performance

Empirical studies have consistently linked inventory turnover with improved firm performance, especially in manufacturing contexts. The study by Srour and Azmy (2021) investigated the effect of inventory turnover on Return on Assets (ROA) and Return on Equity (ROE) among listed firms in Egypt. Using regression analysis, they found a statistically significant positive relationship between inventory turnover and both performance measures. The authors concluded that efficient inventory turnover contributes to improved financial efficiency by facilitating better resource utilization and enhancing profitability. Prempeh (2015) studied Ghanaian manufacturing firms and affirmed that efficient raw materials inventory turnover significantly boosts ROA. Similarly, Nawaz et al. (2016), in a study of Pakistani non-financial firms listed on the KSE-100 index, found a positive impact of inventory turnover on ROE, reinforcing the profitability dimension. Lwiki et al. (2013) examined sugar manufacturing firms in Kenya and confirmed a positive link between inventory practices and ROE using survey and correlation methods. Shah and Shin (2007) concluded that higher turnover and lower inventory-to-sales ratios have a direct positive effect on profitability. Panigrahi (2013), in a study of Indian cement companies, also reported a significant relationship between inventory conversion and gross operating profit. Augustine and Agu (2013) emphasized that managing inventory levels efficiently leads to greater organizational effectiveness

On the contrary, some researchers found a significant negative relationship between inventory turnover or inventory conversion periods and firm performance. Elzamly et al. (2019) observed in Malaysian firms

that longer inventory turnover periods negatively impacted ROA, stressing inefficiencies in inventory control systems. Srour and Azmy (2021) also noted that excessive inventory conversion periods are inversely related to profitability metrics like ROA and cash flow from operations. Sitienei and Memba (2015) showed that delays in inventory turnover eroded financial returns among Kenyan firms. Similarly, Sunday and Joseph (2017) identified that prolonged inventory holding negatively affects profitability, but higher turnover supports financial health. Roumiantsev and Netessine (2007) pointed out that inventory turnover negatively influences organizational performance in OECD countries, citing cross-national inefficiencies. Ramachandran and Jankriaman (2009), in a study of Indian companies, found inventory inefficiency to be detrimental to ROA. Dedunu (2018) in Sri Lanka emphasized that delayed inventory conversion reduces market value added and profitability.

Several studies have reported no statistically significant relationship between inventory turnover and firm performance, suggesting conditional dependencies or industry-specific behaviors. Egbunike et al. (2019), using multiple regression on Nigerian manufacturing firms, found that inventory turnover period has a significant negative relationship with net profit margin and operating cash flow to sales ratio. Bawa, Asamoah, and Kissi (2018), studying Ghanaian firms, also observed a negative but insignificant relationship between ROA and inventory turnover. Owolabi and Alu (2012) reported similar findings in Nigeria, noting that inventory conversion period negatively but insignificantly affects return on assets. Oner (2016) documented insignificant relationships in Turkish firms where inventory turnover did not meaningfully impact profitability measures. Folinas and Shen (2014) emphasized that while inventory management influences profitability, inventory turnover specifically showed no significant effect. Vastag and Whybark (2005) also argued that inventory turnover had weak or no direct impact on firm performance globally. Nwaolisa et al. (2019), in a study of consumer goods firms, confirmed insignificant outcomes for inventory turnover on financial outcomes like NPM and operating cash flow. Unlike these studies, the present research adopts Tobin's Q as a market-based measure of firm performance and includes firm size as a control variable to account for differences in scale and operational capacity that may influence valuation outcomes. Financial leverage is introduced as a moderating variable, justified by its theoretical and empirical role in shaping the strength and direction of the relationship between internal financial metrics—such as Free Cash Flow Efficiency—and firm value. This approach allows for a more comprehensive, investor-oriented analysis that captures both direct and conditional effects on performance.

Leverage and Firm Performance

Several studies have documented a positive and significant relationship between financial leverage and firm performance. For instance, Fosu (2013) investigated the effect of leverage on firm performance in South Africa using panel data of 257 firms and found that debt enhances performance by disciplining managers and improving efficiency. Rehman (2013) used correlation analysis on 35 Pakistani sugar firms and confirmed a positive relationship between leverage and both ROA and sales growth. Similarly, Raza (2013) observed a significant positive association between leverage and firm performance among KSE-listed corporations in Pakistan. Olaoye and Omodara (2023), focusing on Nigerian manufacturing firms, also identified a positive effect of long-term debt and total debt ratio on return on equity (ROE) using panel regression models. Akhtar et al. (2012) studied Pakistan's fuel and energy sector and found a direct positive effect of leverage on earnings and ROE, suggesting firms benefit from increased debt in regulated industries. Chandrakumaramanglam and Govindasamy (2010) analyzed Indian cement firms and concluded that leverage boosts EPS and profitability. Barakat (2014), in a Saudi-based study, reported a significant positive link between leverage and ROE using market-based valuation techniques.

A dominant strand of literature reveals a negative and significant relationship between leverage and firm performance. Khan (2012) examined 36 engineering firms in Pakistan and found both total debt to assets and short-term debt to have a significantly negative effect on Tobin's Q using Pooled OLS regression. Ali et al. (2022), analyzing Pakistani firms with panel regression, showed a statistically negative relationship between leverage and both ROA and ROE, suggesting debt burdens outweigh benefits. Alghusin (2015) reported similar results for Jordanian industrial companies, where debt-to-assets negatively influenced ROA. Chinaemerem and Anthony (2012) used OLS regression on Nigerian firms and concluded that debt ratio significantly undermines firm performance, consistent with agency cost theory. Abdul (2012) and Akbarian (2013) also showed negative relationships between capital structure and performance using multivariate regression methods in Pakistan and Iran respectively. Mule and Mukras (2015) found that in Kenya, leverage significantly reduced Tobin's Q and ROA but had no impact on ROE. Eze et al. (2021) observed that high debt exposure leads to reduced profitability in Nigerian manufacturing firms due to rising interest burdens and poor financial structuring.

Chadha and Sharma (2015) examined 422 Indian manufacturing companies and found no significant relationship between leverage and either ROA or Tobin's Q despite controlling for firm size and asset turnover. San and Heng (2011), studying the Malaysian construction sector post-2008 financial crisis, reported that leverage had no significant impact on firm performance due to heavy reliance on long-term financing. Al-Taani (2013) found insignificant results between various debt ratios and performance indicators (ROA, PM) for Jordanian firms, suggesting the impact of capital structure is sector-sensitive. Kuria and Omboi (2015), studying Kenyan investment and banking firms, also revealed that while short-term leverage negatively affected ROA, long-term leverage showed no significant association with either ROA or ROE. Rizqa et al. (2023) applied PLS-SEM on Indonesian firms and found leverage's direct effect on firm value to be insignificant unless mediated by ROE. Abor and Bokpin (2010) used panel analysis on Ghanaian firms and reported no significant effect of leverage on dividend payout, implying weak financial outcomes from capital structure decisions. Leon (2013) revealed that while leverage negatively affected ROE, it did not significantly influence ROA among Sri Lankan manufacturing firms.

Theoretical Framework

One of the most relevant theoretical frameworks for this study is **the** Free Cash Flow Theory**,** developed by Michael Jensen in 1986. The theory posits that managers with excess free cash flow—defined as cash beyond what is needed for profitable investments—may be tempted to use these funds in ways that benefit themselves rather than shareholders, often leading to inefficient investments and reduced firm performance. This theory is highly applicable to this study, which examines the effect of Free Cash Flow Efficiency on firm performance, particularly in the context of financial leverage and inventory turnover as influencing factors. Recent empirical studies have confirmed the continued relevance of this theory: Reuter (2018) found that free cash flow significantly impacts efficiency in Nordic firms listed on the Nasdaq; Nguyen (2018) demonstrated that higher free cash flow positively influenced stock prices among Vietnamese firms, supporting Jensen's argument in high-investment environments; and Ratnadi (2020) linked high FCF to increased earnings management, further confirming the theory's concern about discretionary misuse. Hau (2017) also validated the theory by showing that in sectors with fewer growth opportunities, large free cash flows often led to inefficient or even loss-making projects. These studies underscore the importance of monitoring FCF allocation, which this research aims to address by introducing financial leverage as a moderating factor in its model.

Agency Theory, developed by Jensen and Meckling in 1976, explains the conflicts of interest that arise between principals (shareholders) and agents (managers) in a firm, especially when managers pursue personal goals at the expense of shareholder wealth. The theory posits that such conflicts become

pronounced when firms generate substantial free cash flows, which agents may misuse unless constrained by proper governance mechanisms or external debt disciplines. This theory is highly relevant to the current study, which investigates how Free Cash Flow Efficiency, Inventory Turnover, and Financial Leverage affect firm performance—emphasizing how leverage can act as a disciplinary tool to align managerial actions with shareholder interests. Empirical studies validate this relevance: Omodara et al. (2024) found that increased leverage improved return on equity in Nigerian manufacturing firms by curbing managerial discretion; Onyemenam et al. (2023) observed that efficient cash flow use enhances financial performance, consistent with agency theory's predictions in capital-intensive firms; Uchegbu et al. (2023) also demonstrated that managerial misuse of cash flows negatively affects profitability when not counterbalanced by monitoring tools like debt or asset efficiency metrics. Similarly, Ratnadi (2020) highlighted that excess free cash flow facilitates earnings manipulation, reaffirming agency concerns in emerging markets. These findings support the theoretical basis of the current research by framing financial leverage not only as a financing decision but also as a governance mechanism that moderates the efficiency-performance link.

3. Methodology

This study adopts an ex-post facto research design. The design is suitable as the study examines historical financial data without manipulating any variables. The population consists of 51 listed manufacturing firms in Nigeria, as classified by the Nigerian Exchange Group (NGX); the Census sampling technique was used to select 49 listed Manufacturing companies, based on data availability. The study covers a 12-year period from 2012 to 2023, providing robust longitudinal data. The independent variables include Free Cash Flow Efficiency (FCFE), measured as (Net Cash Flow from Operations – Net Cash Flow from Investing Activities)/Revenue; Inventory Turnover (INT), measured as (Cost of Sales/Average Inventory); and the moderating variable is Financial Leverage (LEV), proxied by (Total Liabilities/Total Assets) × 100. The dependent variable, Firm Performance, is measured by Tobin's Q.

Data for the study was obtained through secondary sources, specifically the annual reports and accounts of the selected listed companies. Reliability was ensured by using audited and standardized financial statements, while validity was achieved through the adoption of widely accepted financial metrics consistent with prior studies. The model is specified as:

$$TOBINQ\_it = \beta_0 + \beta_1 FCFE\_it + \beta_2 INT\_it + \beta_3 LEV\_it + \beta_4 (FCFELEV)\_it + \beta_5 (INTLEV)\_it + \varepsilon\_it \ldots\ldots\ldots\ldots (1)$$

The study applies panel data regression analysis using STATA, justifying its use based on the nature of the dataset, which combines cross-sectional (firms) and time series (years) dimensions. Statistical techniques such as descriptive statistics, Pearson correlation, and diagnostic tests (for example, multicollinearity, heteroskedasticity, serial correlation) were conducted to validate the model. The Breusch-Pagan Lagrange Multiplier Test determined whether pooled OLS or panel models were more appropriate, while the Hausman Test informed the selection between fixed and random effects models. Robust random effect regression was employed where necessary to correct model violations, ensuring credible and generalizable results.

4. Results and Discussion

Descriptive Statistics

In this section, we examine the descriptive statistics for both the independent and dependent variables of interest.

Table 1: Descriptive statistics

Variable	Mean	Median	Maximum	Minimum	Std. Deviation	Observations
Firm Performance (Tobin's Q)	3	1.1	159	0.31	11	524
Free Cash Flow Efficiency (FCFE)	26	0.17	10751	-21	481	513
Inventory Turnover (INT)	4.4	4	23	0.00028	2.8	468
Financial Leverage (LEV)	92	60	2354	12	204	528

Source: Researcher Computation (2025).

The descriptive statistics indicate significant variability across the key financial metrics for Nigerian manufacturing firms. Firm Performance, proxied by Tobin's Q, exhibits an average of 3 with a median of 1.1, suggesting that while some firms achieved exceptionally high market valuations (maximum of 159), many firms are valued closer to their asset replacement cost. The standard deviation of 11 indicates substantial dispersion around the mean, reflecting diverse performance outcomes among the firms studied.

Free Cash Flow Efficiency (FCFE) shows extreme values with an average of 26 and a median of just 0.17, suggesting a highly skewed distribution where a few firms have exceptionally high FCFE values (maximum of 10,751), whereas the majority have much lower efficiency levels. The substantial standard deviation of 481 further emphasizes this extreme variability. Inventory Turnover (INT) has a relatively stable distribution, with a mean of 4.4 and median of 4, indicating consistent operational practices among firms. However, Financial Leverage (LEV) is notably high with an average of 92%, a median of 60%, and a wide dispersion (standard deviation of 204), suggesting significant variability in how these firms structure their financing, with some highly leveraged (up to 2354%) and others more conservatively financed. These findings underscore the heterogeneity in operational and financial management practices across the Nigerian manufacturing sector.

Normality Test

Table 2: Shapiro-Wilk Test Results

Variable	Observations	W Statistic	V	z-value	Prob>z (p-value)
Firm Performance (Tobin's Q)	524	0.18034	287.628	13.638	0.0000
Free Cash Flow Efficiency (FCE)	513	0.02949	334.111	13.986	0.0000
Inventory Turnover (INT)	468	0.87166	40.678	8.881	0.0000
Financial Leverage (LEV)	528	0.21947	275.783	13.542	0.0000

Source: Researcher Computation (2025).

The Shapiro-Wilk test results indicate significant deviations from normality across all examined variables. Specifically, Firm Performance (Tobin's Q) shows a very low W statistic of 0.18034 and a corresponding z-value of 13.638, both statistically significant at a p-value of 0.0000, strongly rejecting the null hypothesis of normality. Similarly, Free Cash Flow Efficiency (FCFE) exhibits an extremely low W statistic of 0.02949 with a z-value of 13.986, also highly significant at a p-value of 0.0000. These findings imply substantial departures from a normal distribution, suggesting that these variables exhibit skewness, kurtosis, or both, potentially due to outliers or extreme values within the dataset.

Inventory Turnover (INT) and Financial Leverage (LEV) likewise demonstrate statistically significant deviations from normality, although with slightly higher W statistics (0.87166 and 0.21947, respectively) compared to the previous variables. The z-values remain highly significant at 8.881 for INT and 13.542 for LEV, each with p-values of 0.0000. These results indicate consistent non-normal distributions across

financial metrics within the Nigerian manufacturing firms studied. Consequently, robust regression methods were to appropriately account for these violations of normality in subsequent analyses.

Correlation Matrix

In examining the association among the variables, we employed the Pearson correlation coefficient (correlation matrix) and the results are presented in the table below.

Table 3: Correlation analysis

Variable	Firm Performance (Tobin's Q)	Free Cash Flow Efficiency (FCFE)	Inventory Turnover (INT)	Financial Leverage (LEV)
Firm Performance (Tobin's Q)	1			
Free Cash Flow Efficiency (FCE)	0.1825	1		
Inventory Turnover (INT)	0.0563	-0.0888	1	
Financial Leverage (LEV)	0.2042	0.9526	-0.0841	1

Source: Researcher Computation (2025).

Tobin's Q displays relatively weak positive correlations with Free Cash Flow Efficiency (0.1825), Inventory Turnover (0.0563), and Financial Leverage (0.2042). The strongest association is with Financial Leverage, suggesting firms with higher leverage slightly tend to achieve better market valuations. FCFE has a very high positive correlation with Financial Leverage (0.9526), indicating that firms managing cash flows efficiently are strongly associated with higher leverage levels. Its correlation with Inventory Turnover is slightly negative (-0.0888), implying a minor inverse relationship between cash flow efficiency and inventory management practices.

Inventory Turnover demonstrates very weak correlations across all other variables, being slightly positive with Tobin's Q (0.0563), but weakly negative with FCFE (-0.0888) and financial leverage (-0.0841). These negligible correlations suggest Inventory Turnover operates relatively independently of the other studied variables. Financial leverage shows a strong positive correlation with Free Cash Flow Efficiency (0.9526), signifying that highly leveraged firms often have better-managed cash flows. Its correlation with Tobin's Q (0.2042) is positive but weaker, while its relationship with Inventory Turnover (-0.0841) remains minimal, highlighting that leverage is primarily associated with financial rather than operational metrics.

Regression Analysis

In testing the hypotheses for this study, robust ordinary least square linear regression was used.

Table 4: Regression Results

Details	Expected Sign	Results	
Constant		0.76 (0.0000)***	
Free Cash Flow Efficiency (FCE)	+	-0.001425 (0.5380)	
Inventory Turnover (INT)	+	-0.02 (0.9150)	
Financial Leverage (LEV)	+	0.01 (0.0000)***	
FCE*LEV	+	0.00 (0.0120)*	
INT*LEV	+	0.00 (0.2820)	
F-value (p-value)		4.90 (0.0002)***	
Breusch-Pagan LM test (p-value)		4.75 (0.0147)*	
Multicollinearity Test (VIF)	< 10	7.54	
Portmanteau test (p-value)	> 0.05	45.00 (0.4720)	
Ramsey RESET test (p-value)	> 0.05	0.09 (0.9659)	
Hausman test (p-value)	> 0.05	0.4656	
Heteroskedasticity test (p-value)	> 0.05	11.96 (0.0005)***	
R-square			0.05
Adjusted R-square			0.04
Observations			464

Source: Researcher Computation (2025).

The regression output reveals several important insights into the determinants of firm performance among Nigerian manufacturing firms. The constant term is positive and statistically significant (0.76; p = 0.0000), indicating a strong baseline firm performance when all explanatory variables are held at zero. Financial Leverage (LEV) is the only main variable that shows a positive and significant effect on firm performance (0.01; p = 0.0000), affirming the value-enhancing role of debt when optimally managed. In contrast, both Free Cash Flow Efficiency (FCE) and Inventory Turnover (INT) have negative and statistically insignificant effects (p = 0.5380 and 0.9150, respectively), suggesting that these metrics alone do not explain variations in market-based firm value. Notably, the interaction term FCE×LEV is statistically significant and positive (p = 0.0120), indicating that financial leverage strengthens the effect of FCE on firm performance. However, the interaction between INT and LEV remains insignificant (p = 0.2820).

Model diagnostics further affirm the statistical validity of the regression. The F-statistic (4.90; p = 0.0002) confirms that the model is jointly significant, meaning that the included variables collectively explain a significant portion of the variation in firm performance. The Breusch-Pagan LM test (p = 0.0147) justifies the use of a random-effects model over pooled OLS. The Hausman test result is not computable due to negative test statistic (0.4656), which typically suggests the absence of systematic difference between fixed and random effects. Additionally, the model passes the Portmanteau test for serial correlation (p = 0.4720) and the Ramsey RESET test for model misspecification (p = 0.9659), indicating no autocorrelation or functional form errors. However, the presence of heteroskedasticity is confirmed (p = 0.0005), suggesting that robust standard errors should be used to improve the reliability of the coefficient estimates.

Despite its statistical soundness, the model demonstrates relatively low explanatory power, with an R-square of 0.05 and an adjusted R-square of 0.04. This means that only 4–5% of the variation in firm performance is explained by the included variables, implying that other external or firm-specific factors may be more influential. The model presents acceptable multicollinearity levels (mean VIF = 7.54), which supports the reliability of the estimated coefficients, including the interaction terms. This enhances

confidence in the findings, particularly the significant role of financial leverage in influencing firm value. The results also affirm that while financial leverage positively impacts performance, inventory turnover plays a limited role in explaining market valuation within the studied context.

H1: Free Cash Flow Efficiency and firm Performance

The first hypothesis of the study states that: H_{01}: Free Cash Flow Efficiency has no significant effect on the performance of listed manufacturing firms in Nigeria. From the regression results, Free Cash Flow Efficiency (FCE) alone exhibits a coefficient of -0.00 with a p-value of 0.5380, which is not statistically significant at the 5% level. However, the interaction term between FCE and Financial Leverage (FCE×LEV) is positive and statistically significant ($\beta = 0.00$; $p = 0.0120$). This result indicates that while FCE on its own does not significantly affect firm performance, its effect becomes significant when moderated by financial leverage. Therefore, the null hypothesis is accepted for the main effect but rejected for the moderating effect, demonstrating that the influence of FCE on firm performance is conditional on the level of leverage employed by the firm.

The finding that FCE does not significantly impact firm performance directly is consistent with studies such as Zhou et al. (2012), Bukit and Iskandar (2009), and Nwuba et al. (2020), which observed that excess or unutilized free cash flow may lead to agency problems, poor investment decisions, or inefficient resource allocations that do not enhance firm value. Similarly, Hwang et al. (2013) and John et al. (2015) reported that, without governance mechanisms, free cash flows may be misused, leading to value erosion. On the other hand, the significant positive moderating effect of leverage supports findings from Uchegbu et al. (2023), Onyemenam et al. (2023), and Amah (2016), who observed that FCE improves firm performance when managed prudently or when constrained by financial obligations such as debt. Additionally, Ali and Ahmad (2018), Reuter (2018), and Hau (2017) also found that efficient cash flow management enhances market value, especially when monitored through financial discipline or regulatory oversight.

The contrasting results between the direct and moderated effects of FCE may be attributed to contextual and methodological differences. In the Nigerian manufacturing context, firms often operate in volatile environments with weak governance and discretionary spending, which explain the insignificant direct effect of FCE on performance. However, when financial leverage is present, it likely imposes discipline and limits managerial discretion, compelling more strategic utilization of free cash flows—thus enhancing firm performance. This aligns with Jensen's (1986) Free Cash Flow Theory and Agency Theory by Jensen and Meckling (1976), which emphasize the role of debt in mitigating agency costs. The differences in findings across the literature can be due to varying institutional frameworks, differences in industry cash flow cycles, and disparities in the effectiveness of financial controls, particularly in emerging markets like Nigeria.

H2: Inventory Turnover and firm Performance

The second hypothesis of the study states that: H_{02}: Inventory Turnover has no significant effect on the performance of listed manufacturing firms in Nigeria. Inventory Turnover (INT) shows a coefficient of -0.02 with a p-value of 0.9150, indicating that it is not statistically significant at the 5% level. Additionally, the interaction term between Inventory Turnover and Financial Leverage (INT×LEV) is also statistically insignificant ($\beta = 0.00$; $p = 0.2820$). These results suggest that Inventory Turnover, whether as a standalone metric or when moderated by leverage, does not significantly influence firm performance as measured by Tobin's Q. Therefore, the null hypothesis is accepted, implying no evidence of a statistically meaningful relationship between inventory turnover and market-based performance for Nigerian manufacturing firms within the scope of this study.

This finding aligns with several empirical studies that have reported a insignificant or negative relationship between inventory turnover and firm performance. For instance, Egbunike et al. (2019), Bawa et al. (2018), and Owolabi and Alu (2012) found no statistically significant link between inventory turnover and profitability among Nigerian and Ghanaian manufacturing firms. Similarly, Oner (2016) and Folinas and Shen (2014) observed that inventory turnover had a weak or non-existent impact on profitability metrics such as ROA or net profit margins. However, the current finding contradicts studies such as Srour and Azmy (2021), Prempeh (2015), and Panigrahi (2013), who found a significant positive relationship between inventory turnover and firm performance across different manufacturing settings. Lwiki et al. (2013) and Shah and Shin (2007**)** also emphasized that higher inventory turnover is linked with increased profitability and operational efficiency.

The observed contradictions can be attributable to industry-specific, contextual, or methodological differences. In Nigeria's manufacturing sector, persistent supply chain disruptions, infrastructural challenges, and overstocking due to demand volatility may weaken the positive effect of inventory turnover on performance. Additionally, Tobin's Q is a market-based measure that reflects investor perception rather than operational metrics like turnover ratios, possibly explaining the weak association. In contrast, studies that reported significant effects have used accounting-based performance metrics (e.g., ROA or ROE) or operated in more stable economic environments. Therefore, the divergence in findings reflect both differences in performance measurement and the operational realities faced by firms across different economies

H3: Financial Leverage and firm Performance

The third hypothesis of the study states that: H_{03}: Financial Leverage has no significant effect on the performance of listed manufacturing firms in Nigeria. The coefficient of Financial Leverage (LEV) is 0.01 with a p-value of 0.0000, indicating a positive and statistically significant effect at the 5% level. This result provides strong evidence to reject the null hypothesis, confirming that Financial Leverage has a significant influence on firm performance measured by Tobin's Q. Hence, it can be concluded that increased leverage, when optimally managed, contributes positively to the market valuation of manufacturing firms in Nigeria.

This finding aligns with a substantial body of literature that supports the positive impact of financial leverage on firm performance. For example, Omodara and Olaoye (2023), Fosu (2013), and Akhtar et al. (2012) demonstrated that leverage enhances return on equity and overall performance through tax advantages and managerial discipline. Similarly, Raza (2013) and Barakat (2014) found that firms using debt strategically achieve better profitability and market positioning. However, this result contradicts the findings of Chinaemerem and Anthony (2012), Ali et al. (2022), and Alghusin (2015), who reported that excessive leverage reduces firm performance due to the burden of financial risk and interest payments. Additionally, Khan (2012) and Eze et al. (2021) emphasized the negative influence of debt on firm value, particularly in less efficient or overleveraged firms.

The variation in findings can be attributed to several factors. In Nigeria, manufacturing firms may benefit from leverage due to access to capital in a credit-constrained environment, where internal financing may be insufficient for expansion. Furthermore, firms that use debt responsibly can leverage it to enhance operations and investor confidence, as reflected in Tobin's Q. In contrast, studies reporting negative effects often highlight environments with high-interest costs, poor debt management, or firms in financial distress. Differences in industry characteristics, economic stability, and the type of performance metric used (market-based vs. accounting-based) also contribute to the inconsistency. Therefore, the positive effect observed in this study likely reflects a context where leverage is utilized as a strategic financial tool under effective governance structures.

Moderating Role of Financial Leverage on the Relationship Between Free Cash Flow Efficiency, Inventory Turnover, and Firm Performance

The fourth hypothesis of the study states that: H_{04}: Financial Leverage does not significantly moderate the relationship between Free Cash Flow Efficiency, Inventory Turnover, and firm performance of listed manufacturing firms in Nigeria. From the regression results, the interaction term between Free Cash Flow Efficiency and Financial Leverage (FCE×LEV) is statistically significant and positive ($\beta = 0.00$; $p = 0.0120$), indicating that leverage significantly moderates the effect of FCE on firm performance. In contrast, the interaction between Inventory Turnover and Financial Leverage (INT×LEV) is not statistically significant ($\beta = 0.00$; $p = 0.2820$). These results lead to the partial rejection of the null hypothesis: Financial Leverage significantly moderates the relationship between FCE and firm performance, but not between INT and firm performance.

The significant moderating effect of leverage on FCE aligns with the findings of Uchegbu et al. (2023), Onyemenam et al. (2023), and Amah (2016), who demonstrated that financial leverage enhances the positive impact of efficient cash flow management on firm value. Their studies support the view that external debt serves as a disciplinary mechanism that ensures optimal use of internally generated cash flows. Similarly, Ali and Ahmad (2018), Reuter (2018), and Hau (2017) provided empirical evidence that when firms are subject to financial constraints such as debt obligations, their utilization of free cash flow becomes more strategic, thereby improving firm performance. Conversely, the result contradicts studies by Zhou et al. (2012), Bukit and Iskandar (2009), and Nwuba et al. (2020), who argue that leverage does not necessarily enhance performance and can even magnify agency costs if not properly managed. Hwang et al. (2013) and John et al. (2015) also observed that financial leverage could intensify inefficiencies where governance structures are weak, resulting in diminished firm value.

The observed findings may be influenced by the corporate and institutional context of Nigerian manufacturing firms. In environments with limited access to equity financing and weaker corporate governance, debt can play a critical role in enforcing managerial discipline and enhancing accountability. This supports the Free Cash Flow Theory by Jensen (1986) and the Agency Theory by Jensen and Meckling (1976), both of which emphasize the value of leverage as a control mechanism over managerial discretion. The absence of a significant moderating effect between Inventory Turnover and leverage may be because inventory management decisions are more operational and less influenced by capital structure. Sector-specific dynamics, such as supply chain inefficiencies and limited automation in Nigerian manufacturing firms, may also reduce the strategic impact of inventory turnover, regardless of financing mix. Hence, the findings reflect how financial discipline interacts more effectively with strategic financial efficiency (FCE) than with routine operational metrics (INT).

5. Conclusion and Recommendations

The findings, based on random-effects regression, reveal that Financial Leverage significantly enhances firm performance, while Free Cashflow Efficiency and Inventory Turnover do not show statistically significant effects. However, the interaction between Free Cash Flow Efficiency and Financial Leverage is significant and positive, confirming that leverage moderates the effect of FCE on firm value. The study thus concludes that firm performance in the Nigerian manufacturing sector is driven more by how financial resources are structured and managed rather than operational efficiency alone. Despite this, the model's low explanatory power suggests that other unobserved factors may play key roles and should be investigated in future research.

Based on the findings, the study recommends that Nigerian manufacturing firms should adopt financial leverage strategically, not only to enhance performance directly but also to amplify the benefits of efficient cash flow management. Improving internal cash flow practices—such as optimizing capital expenditure and strengthening receivables management—can be more impactful when paired with disciplined leverage. Additionally, firms should reconsider their inventory management approaches, integrating modern supply chain technologies to enhance operational efficiency. Finally, policymakers should support the sector through improved access to affordable long-term credit and regulatory frameworks that encourage responsible and performance-driven use of debt.

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