

Debt as a Double-Edged Sword: Amplifier of Gains and Losses Among Listed Oil and Gas Firms in Nigeria

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<https://doi.org/10.56201/ijssmr.vol.12no9.2026.pg669.685>

Abstract:

This study examined how firm debt, proxied by debt-to-equity ratio and debt-to-asset ratio, influences the financial performance, measured by return on capital employed (ROCE), of listed oil and gas firms in Nigeria, with a focus on its dual role in amplifying gains and losses. The study adopted an ex-post facto research design and analyzed data from seven oil and gas firms listed on the Nigerian Exchange Group as of 2024. Secondary data were collected from the annual reports of the sampled firms for the period 2015 to 2024. Hypotheses were tested using panel Generalized Least Squares regression to address heteroskedasticity and cross-sectional dependence. The findings reveal that debt-to-equity ratio has a positive and significant effect on ROCE ($\beta = 0.058$, $p = 0.000$), indicating that higher leverage relative to equity enhances financial performance. Equally, it was found that debt-to-asset ratio has a negative and significant effect on ROCE ($\beta = -0.124$, $p = 0.0485$), suggesting that excessive reliance on debt relative to total assets reduces financial performance. Thus, boards and financial controllers should closely monitor the debt-to-asset ratio (DAR), aiming to keep it below 1.0, as higher values were empirically shown to reduce ROCE due to increased financial distress costs.

Keywords: Firm Debt, Debt-To-Equity Ratio, Debt-To-Asset Ratio, Return on Capital Employed

1. Introduction

The oil and gas industry are a critical component of Nigeria's economy, contributing significantly to government revenue, foreign exchange earnings, and employment generation. Over the years, the sector has attracted substantial investments due to its potential for high returns, but it is also characterized by high capital intensity, operational risks, and fluctuating global oil prices (Okologume et al., 2026; Adamu et al., 2025). Firms operating in this sector require large sums of capital to fund exploration, production, and distribution activities. While internally generated funds can provide some financing, most companies rely on external sources such as bank loans, bonds, and other forms of debt to sustain operations and pursue growth opportunities (Eseimieghan & Onuorah, 2025; Agbachi et al., 2025). Financing decisions, particularly the choice between debt and equity, can profoundly influence the financial stability and profitability of these firms (Aderibigbe et al., 2025; Ahmed et al., 2025). Companies with optimal financing structures are better positioned to exploit growth opportunities, manage operational risks, and maintain investor confidence. Conversely, firms that over-rely on debt or fail to balance their capital structure may face financial distress, increased costs of capital, or

even insolvency (Ikwuo et al., 2025; Oketah et al., 2024). In the Nigerian context, listed oil and gas companies face additional pressures from regulatory requirements, market competition, and economic volatility, making financing decisions especially crucial.

Debt continues to play a significant role in today's business environment, providing firms with the ability to finance large-scale projects, expand operations, and invest in technological advancements without immediately diluting ownership (Adamu et al., 2025; Agbachi et al., 2025). For many companies, debt is not only a source of funds but also a tool to optimize their capital structure and reduce the cost of capital. Interest payments on debt are tax-deductible, which can enhance profitability if managed carefully (Eseimieghan & Onuorah, 2025). In addition, leveraging debt allows firms to take advantage of opportunities that may otherwise be inaccessible due to limited equity resources (Okologume et al., 2026; Ahmed et al., 2025). However, the use of debt also introduces obligations that must be met regardless of a firm's performance. Companies with high debt levels are more exposed to financial risks, particularly in industries like oil and gas where cash flows can be unpredictable due to market fluctuations (Ikwuo et al., 2025; Oketah et al., 2024). The relevance of debt has been highlighted by several studies, which show that firms that carefully balance debt and equity can achieve higher returns on investment and improved shareholder value (Aderibigbe et al., 2025; Agbachi et al., 2025). At the same time, firms that fail to manage debt effectively may experience reduced profitability, higher financial distress, and lower market confidence (Ehiedu et al., 2022; Abubakar, 2020). The strategic use of debt therefore requires a careful assessment of expected returns, market conditions, and the firm's capacity to meet financial obligations. In today's dynamic business environment, the ability to navigate these trade-offs is critical for long-term sustainability and competitiveness (Abosede, 2020). In the Nigerian oil and gas sector, debt functions as a double-edged sword, amplifying both gains and losses depending on how it is employed (Eseimieghan & Onuorah, 2025; Okologume et al., 2026). When used optimally, debt can enhance firm performance by financing profitable investments, enabling growth, and improving returns to shareholders (Aderibigbe et al., 2025). Debt can also provide the means to take advantage of favorable market conditions, such as rising oil prices, thereby amplifying gains (Ahmed et al., 2025). On the other hand, excessive debt or poorly managed borrowing can have severe negative consequences. High debt levels increase financial obligations in the form of interest payments, which can strain cash flows, especially during periods of declining oil prices or operational disruptions (Ikwuo et al., 2025; Abosede, 2020). In such cases, debt magnifies losses, reduces profitability, and may even threaten a firm's survival (Oketah et al., 2024; Ehiedu et al., 2022). The dual effect of debt highlights the importance of balancing risk and reward, particularly in a sector that is sensitive to both domestic and global economic conditions. Many listed oil and gas firms in Nigeria rely heavily on debt without sufficient consideration of their capacity to service it or the volatility of the industry. Studies have shown that long-term borrowing often reduces shareholder value, while short-term debt may be underutilized or mismanaged (Ikwuo et al., 2025; Okologume et al., 2026). There are cases where debt levels are high, interest obligations strain cash flows, and financial performance fluctuates in response to oil price shocks and operational disruptions (Abosede, 2020; Oketah et al., 2024). These patterns indicate that debt is sometimes used in ways that amplify losses rather than support growth, creating uncertainty and instability for firms and investors alike.

Excessive or poorly managed debt increases the likelihood of financial instability, reduces profitability, and can lead to insolvency in extreme cases. Firms that fail to align borrowing with revenue-generating capacity may experience declining returns on assets and equity, weakening their market position and eroding investor confidence (Abubakar, 2020; Eseimieghan & Onuorah, 2025). The inconsistent impact of debt on performance also limits the ability of oil and gas companies to plan for long-term growth, invest in new opportunities, and maintain a stable financial structure. This makes it necessary to examine how debt can both

enhance and threaten firm performance, particularly in a sector that is highly capital-intensive and sensitive to external economic conditions.

A review of the existing empirical literature on debt and financial performance in Nigerian oil and gas firms reveals a strong focus on ex-post facto designs and secondary data analysis, yet there are notable methodological limitations that this study addresses. Okologume et al. (2026), Adamu et al. (2025), Agbachi et al. (2025), Ahmed et al. (2025), Ikwuo et al. (2025), Eseimieghan and Onuorah (2025), Aderibigbe et al. (2025), Oketah et al. (2024), Ehiedu et al. (2022), Abubakar (2020), and Abosede (2020) all relied primarily on ordinary least squares or standard panel regression techniques without explicitly addressing potential econometric issues such as heteroskedasticity and cross-sectional dependence, which are common in financial panel data of listed firms. While some studies applied panel data methods, they did not consistently use robust estimators like Generalized Least Squares or apply White cross-section standard errors and Cross-section Seemingly Unrelated Regression adjustments to correct for these problems. Additionally, most prior research measured debt using a variety of proxies, but few studies explicitly examined the combined effects of debt-to-equity and debt-to-asset ratios on return on capital employed, while controlling for firm size. These methodological choices limit the reliability and generalizability of findings, as potential biases from variance inequality and cross-sectional correlation could affect the estimated relationships between debt and financial performance. Consequently, there is a need for a more rigorous panel estimation approach that incorporates robust standard errors and controls for cross-sectional dependence, providing more precise and unbiased results. This study addresses this gap by employing panel Generalized Least Squares regression with appropriate corrections, ensuring a more accurate assessment of how debt influences firm performance as a double-edged sword in the Nigerian oil and gas sector. The main objective of this study is to examine how debt (proxied by debt to equity ratio and debt to asset ratio) influences the financial performance (proxied by return on capital employed) of listed oil and gas firms in Nigeria, considering its dual role in amplifying both gains and losses. This study makes three key contributions to the literature on debt and firm performance in the Nigerian oil and gas sector. First, it advances existing knowledge by jointly examining the effects of debt-to-equity ratio (DER) and debt-to-asset ratio (DAR) on financial performance, using return on capital employed (ROCE) as a comprehensive performance measure, thereby providing a more integrated assessment of leverage dynamics than prior studies that considered these proxies in isolation. Second, the study adopts a more rigorous econometric approach by employing panel Generalized Least Squares (GLS) with robust corrections for heteroskedasticity and cross-sectional dependence, addressing key methodological limitations in earlier works and enhancing the reliability of the findings. Third, the study offers practical insights by clarifying how debt can function as a double-edged sword, thereby informing managerial decisions on optimal capital structure and guiding policymakers and investors in promoting financial stability within a highly volatile and capital-intensive sector.

2.0 Literature Review

2.1 Synthesis of Existing Empirical Studies on the Relationship Between Debt and Firm Performance

Empirical studies on the effect of debt on the performance of Nigerian oil and gas firms demonstrate that financing decisions are closely linked to firm outcomes, though the nature of this relationship varies across contexts and debt measures. Okologume et al. (2026) found that short-term debt positively influences financial performance, while long-term debt does not produce a significant effect, highlighting that the type and maturity of debt can determine its impact on operational efficiency. Similarly, Eseimieghan and Onuorah (2025) reported that

debt-to-equity ratio and debt ratio positively affect firm performance, whereas capitalization ratios may reduce profitability, suggesting that careful calibration of debt and equity can enhance returns while mitigating financial distress. These findings collectively highlight that not all debt is equally beneficial and that firms must align their financing strategies with their capacity to generate returns (Okoye, 2026).

Other studies, however, reveal that debt can also have adverse effects on firm value. Adamu et al. (2025) observed that both short-term and long-term debt negatively influence market capitalization, though total debt showed a positive effect, indicating that the overall structure of borrowing matters more than individual components. Aderibigbe et al. (2025) found that higher debt-to-equity ratios can negatively affect return on equity and Tobin's Q, while total debt-to-asset ratios were largely insignificant. Ikwuo et al. (2025) also highlighted that long-term debt increases can reduce shareholder value, signaling that excessive reliance on debt, particularly over longer terms, may amplify financial risks and diminish returns. These studies collectively suggest that while debt can provide growth opportunities, it may simultaneously threaten firm value if not carefully managed. Further evidence points to mixed outcomes depending on specific financial ratios and operational conditions. Agbachi et al. (2025) reported that total debt-to-asset ratios positively and significantly influenced net assets, while total debt-to-equity and long-term debt-to-asset ratios negatively affected performance, with some effects being significant. Ahmed et al. (2025) found that despite heavy reliance on short-term debt, capital structure did not significantly improve operational performance, suggesting that debt alone may not guarantee efficiency or profitability. Oketah et al. (2024) also showed that debt ratio negatively affects returns on assets, whereas debt-to-equity and interest coverage ratios had either insignificant or marginal positive effects. These studies illustrate that the financial impact of debt is context-specific, influenced by industry conditions, firm size, and operational efficiency, and that over-leveraging can dampen performance. Finally, longitudinal analyses reinforce the notion that debt operates as a double-edged sword for Nigerian oil and gas firms. Ehiedu et al. (2022) found that short-term debt positively affects returns, but long-term and total debt had no significant impact, while Abubakar (2020) noted that total debt-to-equity negatively influenced ROE. Abosede (2020) similarly reported that long-term debt can significantly reduce financial performance, highlighting the risks of over-borrowing. Collectively, these findings indicate that debt has the potential to amplify both gains and losses depending on how it is structured and managed. The evidence suggests that while strategic borrowing can enhance profitability and shareholder returns, excessive or poorly timed debt can increase financial vulnerability (Xiao & Yao, 2022), emphasizing the need for careful debt management among listed oil and gas firms in Nigeria.

2.2 Theoretical Framework and Development of Research Hypothesis

The study is anchored on Trade-Off Theory of capital structure which was first introduced by Kraus and Litzenberger in 1973 (Brendea, 2011). The theory emerged as an extension of earlier capital structure studies, including the Modigliani-Miller propositions, to address the practical considerations of real-world firms. The theory recognized that while debt financing offers benefits such as tax shields, it also carries potential costs, including financial distress and bankruptcy (Michalkova et al., 2021). The theory was developed to explain why firms do not rely entirely on debt or equity but instead choose a mix that balances the advantages and disadvantages of borrowing. By providing a framework to understand the relationship between financing decisions and firm performance, the Trade-Off Theory has become one of the foundational models for analyzing corporate debt behavior.

The main postulations of the Trade-Off Theory suggest that firms determine their optimal capital structure by weighing the benefits of debt against its costs (Abdeljawad et al., 2013; Ghazouani, 2013). One advantage of using debt is that interest payments are tax-deductible,

which lowers the total cost of capital and can improve a company's profitability. On the cost side, higher debt levels increase the likelihood of financial distress, reduce managerial flexibility, and can lead to bankruptcy if obligations cannot be met. According to the theory, firms will increase debt financing up to the point where the marginal benefit of the last unit of debt equals the marginal cost of potential financial distress (Abel, 2018). This creates an equilibrium level of debt that maximizes firm value and shareholder wealth while minimizing the risks associated with excessive leverage.

The relevance of the Trade-Off Theory to this study lies in its explanation of the dual impact of debt on firm performance. In the context of listed oil and gas firms in Nigeria, debt can act as a double-edged sword by amplifying both gains and losses. Properly structured debt can provide the financial resources needed for exploration, production, and expansion, enhancing returns to shareholders. Conversely, excessive or poorly managed debt can increase financial obligations and risk, reducing profitability and threatening firm stability. By applying the Trade-Off Theory, this study can assess how different levels and types of debt, measured through debt-to-equity and debt-to-asset ratios, influence the financial performance of these firms, as proxied by return on capital employed. The theory provides a clear lens through which the relationship between debt and performance can be analyzed, highlighting the balance firms must strike between leveraging opportunities and managing risks. Based on the research objective, the following two alternate hypotheses were formulated as follows:

Hypothesis 1 (H₁): Debt, measured by debt-to-equity ratio, has a significant effect on the financial performance (return on capital employed) of listed oil and gas firms in Nigeria.

Hypothesis 2 (H₂): Debt, measured by debt-to-asset ratio, has a significant effect on the financial performance (return on capital employed) of listed oil and gas firms in Nigeria.

3.0 Methodology

This study adopted an ex-post facto research design. The design was deemed appropriate because it allows for the investigation of existing data on financing decisions and financial performance without manipulating variables (Anaike et al., 2026; John-Akamelu et al., 2025). Ex-post facto designs are commonly used in corporate finance research where historical financial data are analyzed to determine the relationship between independent and dependent variables over time (Ikwuo et al., 2025; Muomaife et al., 2026; Nworie et al., 2024). In this study, debt, measured by debt-to-equity ratio (DER) and debt-to-asset ratio (DAR), serves as the independent variable, while financial performance, proxied by return on capital employed (ROCE), is the dependent variable. The ex-post facto approach enables the analysis of how past debt decisions influence current financial performance, providing a reliable method for understanding the dual effect of debt as both an amplifier of gains and losses among listed oil and gas firms in Nigeria.

The population for this study comprised all oil and gas firms listed on the Nigerian Exchange Group (NGX) as of December 31, 2024. According to NGX records, there were eight oil and gas marketing firms listed in Nigeria at that time, including Conoil Plc, Eterna Plc, Japaul Gold & Ventures Plc, MRS Oil Nigeria Plc, Oando Plc, Seplat Energy Plc, TotalEnergies Marketing Nigeria Plc, and Aradel Holdings Plc. These firms represent the entire sector of listed oil and gas companies in Nigeria, making the population appropriate for analyzing debt structure and performance outcomes over a sustained period.

For the sample size and sampling technique, the study employed purposive sampling. This method was chosen because it allows for the deliberate selection of firms that meet specific criteria relevant to the study's objectives. Out of the eight listed firms, seven were selected based on the requirement that a firm must have been listed prior to the 2017 financial year.

Aradel Holdings Plc was excluded because it was listed in October 2024 and did not have sufficient historical data for the analysis period. The final sample, therefore, included Conoil Plc, Eterna Plc, Japaul Gold & Ventures Plc, MRS Oil Nigeria Plc, Oando Plc, Seplat Energy Plc, and TotalEnergies Marketing Nigeria Plc. The purposive selection ensures that the firms analyzed have adequate financial history to observe the effects of debt on financial performance. The method of data collection involved extracting secondary data from the annual reports of the selected firms for the period 2015 to 2024. Financial statements, including balance sheets, income statements, and notes to the accounts, provided the data necessary to calculate debt ratios and financial performance measures. Debt was measured using the debt-to-equity ratio and debt-to-asset ratio, while firm performance was proxied by return on capital employed. Additionally, firm size, represented by the natural logarithm of total assets (FSZ), was included as a control variable to account for the impact of scale on performance. The use of secondary data ensures accuracy and consistency, as these financial statements are audited and verified by regulatory authorities. To analyze the data and test the hypotheses, the study employed panel estimated Generalized Least Squares (GLS) regression. The choice of panel GLS was informed by the need to address potential econometric issues such as heteroskedasticity and cross-sectional dependence, which are common in financial panel data. Heteroskedasticity was addressed using White cross-section standard errors and covariance, while cross-section dependence was corrected using Cross-section Seemingly Unrelated Regression (SUR). This approach provides robust estimates that are not biased by differences in variance across firms or correlations between cross-sectional units.

The model specification for the study is expressed as follows:

$$ROCE_{it} = \beta_0 + \beta_1 DER_{it} + \beta_2 DAR_{it} + \beta_3 FSZ_{it} + \varepsilon_{it}$$

Where:

$ROCE_{it}$ = Return on Capital Employed of firm i at time t

DER_{it} = Debt-to-Equity Ratio of firm i at time t

DAR_{it} = Debt-to-Asset Ratio of firm i at time t

FSZ_{it} = Firm Size of firm i at time t , measured as the natural logarithm of total assets

β_0 = Constant term

$\beta_1, \beta_2, \beta_3$ = Coefficients of the independent and control variables

ε_{it} = Error term capturing unexplained variation

The inclusion of firm size as a control variable allows the model to account for the influence of scale on financial performance, ensuring that the effect of debt ratios is properly isolated. The model enables the testing of the dual role of debt in amplifying both gains and losses in financial performance, while controlling for variations in firm scale that may independently affect ROCE. Data analysis involved descriptive statistics, correlation analysis, and the panel GLS regression to test the formulated hypotheses. Diagnostic tests for multicollinearity, heteroskedasticity, and cross-sectional dependence were conducted to ensure the robustness of the results. Findings from the analysis provide empirical evidence on how debt ratios influence financial performance in Nigerian oil and gas firms, highlighting both the potential benefits and risks associated with different debt structures.

4.0 Data Analysis

4.1 Descriptive Analysis and Model Diagnostics

Table 4.1 Descriptive Statistics

	ROCE	DER	DAR	FSZ
<i>Mean</i>	0.160798	1.609193	0.872596	8.042686
<i>Median</i>	0.124998	1.686835	0.729980	7.842672
<i>Maximum</i>	2.737083	15.44258	3.270473	9.992167

<i>Minimum</i>	-3.223058	-21.35047	0.366379	6.943113
<i>Std. Dev.</i>	0.642815	4.427542	0.511656	0.591644
<i>Skewness</i>	-0.760677	-1.195472	2.392741	0.868806
<i>Kurtosis</i>	16.58349	13.81005	9.434289	3.718218
<i>Jarque-Bera</i>	544.9083	357.5069	187.5443	10.31081
<i>Probability</i>	0.000000	0.000000	0.000000	0.005768
<i>Sum</i>	11.25584	112.6435	61.08170	562.9880
<i>Sum Sq. Dev.</i>	28.51160	1352.616	18.06365	24.15294
<i>Observations</i>	70	70	70	70

Source: Eviews 10 Output (2025)

The mean value of ROCE in Table 4.1 is 0.161, indicating that, on average, the sampled firms generated a return on capital employed of about 16 percent over the study period. The maximum and minimum values of 2.737 and -3.223, respectively, show a wide variation in performance, suggesting that while some firms achieved very high returns, others experienced negative returns during the period under review. The standard deviation of 0.643 reflects considerable dispersion around the mean, confirming that firm performance varied significantly across the sample. The negative skewness of -0.761 indicates that the distribution of ROCE is slightly skewed to the left, meaning that extreme low values are more pronounced than extreme high values. The kurtosis of 16.583, far above 3, shows that the distribution is highly peaked with heavy tails, implying the presence of outliers. The Jarque-Bera probability is 0.000, which is below the 0.05 threshold, confirming that ROCE is not normally distributed despite the central limit theorem mitigating some concerns given the 70 observations.

Debt-to-equity ratio (DER) has a mean of 1.609, indicating that on average, firms rely more on debt than equity to finance their operations. The wide range, with a maximum of 15.443 and a minimum of -21.350, shows significant differences in leverage strategies. The negative debt-to-equity ratio (DER) indicates that some firms have negative shareholders' equity, which typically arises when accumulated losses exceed shareholders' funds. This suggests financial distress or insolvency risk, as liabilities surpass assets, making debt levels appear negative relative to equity. The standard deviation of 4.428 further confirms high variability in capital structure among the sampled firms. The negative skewness of -1.195 suggests a longer tail on the left side, implying that extreme low or negative values occur more frequently than extremely high values. Kurtosis of 13.810 indicates a leptokurtic distribution with heavy tails, pointing to the presence of outliers in leverage ratios. The Jarque-Bera probability of 0.000 confirms non-normality at $p < 0.05$, meaning statistical techniques that account for non-normal distributions, like panel GLS, are appropriate for hypothesis testing.

Debt-to-asset ratio (DAR) shows a mean of 0.873, indicating that debt constitutes roughly 87 percent of total assets on average, reflecting high leverage in these firms. The maximum of 3.270 and minimum of 0.366 indicate considerable variation across firms in how assets are financed. The standard deviation of 0.512 points to moderate dispersion around the mean. The skewness of 2.393 shows a strong rightward skew, meaning most firms cluster below the mean with a few firms holding exceptionally high debt-to-asset ratios. Kurtosis of 9.434 reflects a distribution with heavy tails and outliers. The Jarque-Bera probability of 0.000 is below 0.05, confirming that DAR is not normally distributed, reinforcing the need for robust estimation methods in the analysis.

For FSZ, Table 4.1 shows a mean of 8.043, suggesting that the sampled firms are relatively large in terms of total assets, measured in natural logarithm form. The maximum and minimum values of 9.992 and 6.943 indicate that while some firms are substantially larger, others are comparatively smaller, yet the variation is moderate. The standard deviation of 0.592 suggests

that most firms are fairly close to the average size, reflecting limited variability. The positive skewness of 0.869 indicates a slight rightward tilt in the distribution, meaning a few very large firms pull the average upward. Kurtosis is 3.718, which is slightly higher than 3, suggesting a moderately peaked distribution with a few extreme observations. The Jarque-Bera probability of 0.0058 is below 0.05, indicating that FSZ does not follow a normal distribution, though the sample size of 70 observations allows for reasonable inference under the central limit theorem.

Table 4.2 Multicollinearity Test

Variance Inflation Factors

Date: 12/11/25 Time: 14:38

Sample: 1 70

Included observations: 70

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
DER	0.000287	1.247823	1.100363
DAR	0.021619	4.369084	1.105913
FSZ	0.014698	189.4703	1.005311
C	0.993903	197.0264	NA

Source: Eviews 10 Output (2025)

Table 4.2 presents the Variance Inflation Factors (VIF) for the independent variables DER, DAR, and FSZ, which measure the degree of multicollinearity in the model. Multicollinearity occurs when two or more explanatory variables are highly correlated, which can distort regression estimates and make it difficult to determine the individual effect of each variable. The VIF values reported (1.100 for DER, 1.106 for DAR, and 1.005 for FSZ) are all well below the commonly accepted threshold of 10. This indicates that there is no significant multicollinearity among the predictors, suggesting that each variable provides unique information and the regression coefficients are reliable. The result ensures that the model can accurately estimate the influence of debt ratios and firm size on financial performance.

Table 4.3 Test of Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.345005	Prob. F(2,64)	0.7095
Obs*R-squared	0.746649	Prob. Chi-Square(2)	0.6884

Source: Eviews 10 Output (2025)

Table 4.3 shows the Breusch-Godfrey Serial Correlation LM test, which assesses whether residuals from the regression are correlated over time. Serial correlation violates the assumption of independence in regression models and can lead to biased standard errors and incorrect inference. The F-statistic of 0.345 with a corresponding probability of 0.7095, which is greater than 0.05, indicates that the null hypothesis of no serial correlation cannot be rejected. This means that the residuals are independent across time, confirming that the model does not suffer from serial correlation and that the estimated coefficients are consistent.

Table 4.4 Heteroskedasticity Test

Panel Cross-section Heteroskedasticity LR Test

Null hypothesis: Residuals are homoskedastic

Equation: UNTITLED

Specification: ROCE DER DAR FSZ C

	Value	df	Probability
Likelihood ratio	117.2777	7	0.0000

Source: Eviews 10 Output (2025)

Table 4.4 reports the Panel Cross-section Heteroskedasticity Likelihood Ratio test, which checks whether the variance of the residuals is constant across observations. Heteroskedasticity violates a key assumption of ordinary regression and can make standard errors unreliable, affecting hypothesis testing. The likelihood ratio value of 117.278 with a probability of 0.000 indicates that the null hypothesis of homoskedastic residuals is rejected at $p < 0.05$. This confirms that heteroskedasticity is present in the model. The presence of unequal residual variances justifies the use of robust estimation techniques, such as panel Generalized Least Squares, to ensure accurate coefficient estimates and valid statistical inference.

Table 4.5 Cross-Section Dependence Test

Residual Cross-Section Dependence Test

Null hypothesis: No cross-section dependence (correlation) in residuals

Equation: Untitled

Periods included: 10

Cross-sections included: 7

Total panel observations: 70

Note: non-zero cross-section means detected in data

Cross-section means were removed during computation of correlations

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	37.92938	21	0.0131
Pesaran scaled LM	2.612260		0.0090

Source: Eviews 10 Output (2025)

Table 4.5 presents the residual Cross-Section Dependence test, which examines whether residuals are correlated across firms in the panel. Cross-sectional dependence can arise when shocks affecting one firm also influence others, violating the assumption of independent errors and potentially biasing the results. The Breusch-Pagan LM statistic of 37.929 with a probability of 0.0131, and the Pesaran scaled LM of 2.612 with a probability of 0.0090, both fall below 0.05, indicating significant cross-sectional dependence. This result implies that residuals are correlated across the sampled firms, reinforcing the need to use panel estimation methods that correct for such dependence, like GLS with cross-section SUR adjustments, to produce consistent and reliable regression results.

4.2 Test of Hypotheses

Hypothesis 1 (H₁): Debt, measured by debt-to-equity ratio, has a significant effect on the financial performance (return on capital employed) of listed oil and gas firms in Nigeria.

Hypothesis 2 (H₂): Debt, measured by debt-to-asset ratio, has a significant effect on the financial performance (return on capital employed) of listed oil and gas firms in Nigeria.

Table 4.6 Test of Hypotheses

Dependent Variable: ROCE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DER	0.057677	0.007356	7.840994	0.0000
DAR	-0.123732	0.061547	-2.010367	0.0485
FSZ	0.071217	0.013667	5.210740	0.0000
C	-0.402202	0.108430	-3.709320	0.0004
Weighted Statistics				
R-squared	0.674706	Mean dependent var		1.807105
Adjusted R-squared	0.659920	S.D. dependent var		2.136055
S.E. of regression	1.026774	Sum squared resid		69.58142
F-statistic	45.63120	Durbin-Watson stat		1.665566
Prob(F-statistic)	0.000000			

Source: Eviews 10 Output (2025)

Table 4.6 presents the panel EGLS regression results for the effect of debt on financial performance measured by return on capital employed (ROCE). The model's Adjusted R-squared of 0.660 indicates that about 66 percent of the variation in ROCE is explained by the independent variables: debt-to-equity ratio (DER), debt-to-asset ratio (DAR), and firm size (FSZ). This shows a strong model fit for explaining financial performance in the sampled oil and gas firms. The F-statistic probability of 0.000 confirms that the model is statistically significant at the 5% level, indicating that collectively the predictors have a meaningful effect on ROCE. The Durbin-Watson statistic of 1.666, being close to 2, suggests minimal autocorrelation in the residuals, supporting the reliability of the coefficient estimates. The constant term (C) is -0.402 with a p-value of 0.0004, which is significant at 5%, implying that when DER, DAR, and FSZ are zero, ROCE would start at a negative value of approximately -0.402. This baseline highlights that without financing and firm size influences, the sampled firms would generate losses on capital employed.

The firm size coefficient (FSZ) is 0.071 with a p-value of 0.000, indicating a positive and statistically significant effect at the 5% level. This means that larger firms, measured by the natural logarithm of total assets, tend to achieve higher ROCE. The marginal effect shows that as firm size increases by one unit, ROCE rises by 0.071, suggesting that size provides operational and financial advantages, such as economies of scale and better access to capital markets, which support performance. Including FSZ as a control variable strengthens the validity of the debt effect estimates by accounting for structural differences across firms.

Hypothesis 1 (DER effect on ROCE)

The coefficient for debt-to-equity ratio (DER) is 0.058 with a p-value of 0.000, which is

statistically significant at the 5% level. This indicates that a one-unit increase in DER leads to an increase of 0.058 in ROCE, holding other variables constant. In practical terms, a higher reliance on debt relative to equity appears to amplify gains in financial performance among the listed oil and gas firms. The positive direction of the effect suggests that when firms strategically employ debt financing, they can enhance returns on capital employed, likely due to tax benefits and the ability to leverage growth opportunities. Therefore, the first hypothesis (H_1) is supported, confirming that debt measured by debt-to-equity ratio has a significant positive effect on financial performance in this context.

Hypothesis 2 (DAR effect on ROCE)

The coefficient for debt-to-asset ratio (DAR) is -0.124 with a p-value of 0.0485, which is also statistically significant at the 5% level. This implies that a one-unit increase in DAR results in a decrease of 0.124 in ROCE, *ceteris paribus*. This negative effect indicates that when a larger portion of assets is financed through debt, financial performance tends to decline, reflecting the risk of over-leverage. The marginal effect suggests that excessive debt relative to total assets can amplify losses by increasing interest obligations and financial distress during periods of unstable revenue, particularly in the oil and gas sector, where cash flows can be volatile. Hence, the second hypothesis (H_2) is supported, showing that debt measured by debt-to-asset ratio significantly reduces financial performance.

4.2.1 Test of Robustness

The robustness test re-estimated the model using Robust Least Squares with return on assets (ROA) as an alternative measure of financial performance, in order to account for the possible influence of outliers and distributional issues.

Table 4.7 Robustness Test

Dependent Variable: ROA

Method: Robust Least Squares

Date: 03/21/26 Time: 08:35

Sample: 2015 2024

Included observations: 70

Method: M-estimation

M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)

Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
DER	0.006613	0.001357	4.871722	0.0000
DAR	-0.110616	0.011746	-9.417572	0.0000
C	0.088358	0.012477	7.081382	0.0000
Robust Statistics				
R-squared	0.161702	Adjusted R-squared	0.136678	
Rw-squared	0.615496	Adjust Rw-squared	0.615496	
Akaike info criterion	132.4982	Schwarz criterion	141.8077	
Deviance	0.306976	Scale	0.048770	

Rn-squared statistic	154.1396	Prob(Rn-squared stat.)	0.000000
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Source: Eviews 10 Output (2026)

The results in Table 4.7 show that the debt-to-equity ratio (DER) has a positive and statistically significant effect on ROA ($\beta = 0.006613$, $p = 0.0000$), indicating that an increase in leverage relative to equity is associated with improved asset-based performance. This suggests that, even under a more conservative estimation technique, firms are able to utilize equity-backed debt efficiently to generate returns. Conversely, the debt-to-asset ratio (DAR) exhibits a negative and statistically significant effect on ROA ($\beta = -0.110616$, $p = 0.0000$), implying that a higher proportion of debt in total assets adversely affects firm performance. This finding reinforces the argument that excessive reliance on debt financing increases financial risk and burden, thereby reducing the efficiency with which assets are employed to generate profits. The negative impact remains consistent with the baseline results, further confirming the detrimental effect of over-leverage. In all, the robustness results validate the main findings of the study, as both the direction and significance of the key variables remain unchanged despite the use of a different estimation technique and performance proxy. Although the adjusted R-squared value (0.136678) indicates a lower explanatory power under the robust model, the statistically significant Rn-squared statistic confirms the overall model fit. This consistency strengthens confidence in the conclusion that debt plays a dual role in influencing financial performance in the Nigerian oil and gas sector, enhancing returns when optimally utilized while diminishing performance when excessively accumulated.

4.3 Discussion of Findings

Positive and Significant Effect of Debt-to-Equity Ratio (DER) on ROCE

The finding that the Debt-to-Equity Ratio (DER) has a positive and significant effect on Return on Capital Employed (ROCE) ($\beta = 0.058$, $p = 0.000$) suggests that higher leverage relative to equity enhances financial performance in the Nigerian oil and gas sector. This result aligns with the concept that using debt effectively can amplify returns to equity holders, particularly when capital is invested in high-return projects. Debt financing allows firms to expand without diluting ownership, thus providing shareholders with higher returns if managed properly. The positive and significant effect of debt-to-equity ratio (DER) on ROCE suggests that firms benefit from the tax shield advantage of debt financing, where interest payments are tax-deductible and thereby enhance overall profitability. Okologume et al. (2026) found a similar positive impact of short-term debt on financial performance in Nigerian oil and gas firms, indicating that judicious use of leverage enhances performance. Additionally, Eseimieghan and Onuorah (2025) found that maintaining an optimal debt-equity mix positively influences firm profitability, emphasizing that strategic debt use can drive operational success. Furthermore, Aderibigbe et al. (2025) suggested that firms that utilize debt to leverage their capital base can enhance value creation, particularly when debt-to-equity ratios are kept within a manageable range. However, it is crucial to note that while this positive relationship is apparent, the benefits of leverage depend on the company's capacity to generate returns that exceed the cost of debt (Adamu et al., 2025). In this context, the Nigerian oil and gas sector, with its volatility and high operational risks, highlights the need for firms to carefully structure their debt to avoid excessive financial distress.

Negative and Significant Effect of Debt-to-Asset Ratio (DAR) on ROCE

The finding that the Debt-to-Asset Ratio (DAR) has a negative and significant effect on ROCE ($\beta = -0.124$, $p = 0.0485$) indicates that excessive reliance on debt relative to total assets reduces

financial performance. This result suggests that when companies take on too much debt relative to their assets, the cost of servicing that debt can become burdensome, particularly during periods of low revenue or operational disruption, a characteristic feature of the oil and gas industry. The negative and significant effect of debt-to-asset ratio (DAR) on ROCE indicates that excessive reliance on debt increases financial distress costs, such as higher interest burdens and risk of default, which ultimately reduce firm performance. Ikwuo et al. (2025) similarly found that excessive long-term debt reduces shareholder value, highlighting the risk of over-leveraging in the Nigerian oil and gas context, where external shocks like oil price volatility can significantly impact cash flows. Agbachi et al. (2025) also found that while total debt-to-asset ratios had a positive impact on net assets, excessive debt was associated with a deterioration in financial performance, confirming that too much debt compared to assets can strain a company's ability to generate positive returns on equity. Moreover, studies by Abosede (2020) and Abubakar (2020) emphasize the risks associated with high debt levels in Nigerian oil and gas firms. Specifically, Abosede noted that long-term debt negatively affected return on capital employed (ROCE), supporting the view that excessive debt relative to assets limits a firm's ability to maximize returns. In line with these findings, Oketah et al. (2024) observed that while certain forms of debt can contribute positively to financial performance, a higher debt ratio generally imposes significant pressures on profitability. In the case of Nigerian oil and gas companies, the overall financial stability of these firms becomes increasingly vulnerable as they over-leverage their asset base, which is likely to diminish returns on capital employed.

5.0 Conclusion and Recommendation

The results of this study highlight the complex role of debt in shaping the financial performance of listed oil and gas firms in Nigeria, emphasizing how leverage can simultaneously amplify gains and losses. The positive effect of debt-to-equity ratio on returns on capital employed highlights the potential benefits of using borrowed funds strategically, as it allows firms to take advantage of growth opportunities, finance expansion, and leverage tax benefits, thereby improving profitability. At the same time, the negative effect of debt-to-asset ratio demonstrates the risks associated with over-reliance on debt, particularly when a large proportion of a firm's assets are financed through borrowing, which can increase financial obligations, strain cash flows, and heighten vulnerability during periods of market volatility. Together, these outcomes reflect the dual nature of debt as both a source of financial strength and a potential strain on firm resources, illustrating the importance of balancing financing sources to manage risk effectively. The findings also suggest that firm size interacts with financing decisions, as larger firms appear better positioned to absorb debt-related pressures and sustain performance, indicating that operational scale can provide resilience in managing leverage. In all, the results shed light on the delicate balance that managers must maintain when structuring capital, highlighting that debt can be a powerful tool for enhancing returns if carefully monitored but can also magnify losses if left unchecked. This understanding contributes to the broader discourse on corporate finance by demonstrating how debt ratios influence profitability in a context marked by market fluctuations, regulatory demands, and high capital intensity, providing evidence that financial strategies must account for both potential gains and risks to sustain long-term firm performance.

The researchers recommended that:

1. Managers should strategically maintain a debt-to-equity ratio (DER) in a range that supports growth while preserving financial stability—based on the study's findings, a DER that does not exceed the industry median of approximately 1.6 can optimize returns on capital employed and

maximize tax shield benefits without creating excessive risk. Borrowing decisions should prioritize financing profitable projects and investments, ensuring that leverage enhances performance rather than contributing to financial strain.

2. Boards and financial controllers should closely monitor the debt-to-asset ratio (DAR), aiming to keep it below 1.0, as higher values were empirically shown to reduce ROCE due to increased financial distress costs. Firms should adopt rigorous cash flow management and risk assessment procedures before acquiring debt, and differentiate between short-term operational loans and long-term investment financing to balance liquidity needs with sustainable leverage.

5.1 Contribution to Knowledge

This study contributes to the literature by addressing key methodological limitations in previous research on debt and financial performance in Nigerian oil and gas firms. Unlike earlier studies by Okologume et al. (2026), Adamu et al. (2025), Agbachi et al. (2025), Ahmed et al. (2025), Ikwuo et al. (2025), Eseimieghan and Onuorah (2025), Aderibigbe et al. (2025), Oketah et al. (2024), Ehiedu et al. (2022), Abubakar (2020), and Abosede (2020), this study employs panel Generalized Least Squares regression with White cross-section standard errors and Cross-section Seemingly Unrelated Regression adjustments to control for heteroskedasticity and cross-sectional dependence, improving the reliability and robustness of the results. It also examines the combined effects of debt-to-equity and debt-to-asset ratios on return on capital employed while controlling for firm size, providing a more comprehensive assessment of how debt affects financial performance. By using a rigorous estimation technique and focusing on these specific debt measures, the study offers more precise and unbiased evidence on the dual role of debt as an amplifier of both gains and losses, thereby enhancing understanding of optimal debt management in listed Nigerian oil and gas firms.

5.2 Limitations of the Study and Suggestion for Further Studies

This study is limited in several ways that should be considered when interpreting the results. The analysis only includes seven oil and gas firms listed on the Nigerian Exchange Group, which may not fully represent the entire industry or account for smaller or unlisted firms. The data relied entirely on secondary sources, such as annual reports, which may contain reporting errors or omissions. The study focuses on two measures of debt, debt-to-equity and debt-to-asset ratios, and one measure of financial performance, return on capital employed, which may not capture all aspects of financial health. Additionally, external factors such as changes in government policy, global oil prices, and economic conditions were not directly controlled for, which could influence the relationship between debt and performance. Only firm size was used as a control variable, thereby overlooking other important firm-specific and macroeconomic factors that may influence financial performance. This omission may limit the comprehensiveness of the analysis, as variables such as liquidity, asset tangibility, growth opportunities, and inflation could also play significant roles. These limitations suggest the findings should be interpreted with caution.

Future studies could expand the scope to include more firms across different sectors of the Nigerian oil and gas industry, including smaller and unlisted companies, to provide a broader understanding of debt and performance. Researchers could also use additional financial performance measures, such as return on assets, return on equity, and Tobin's Q, to examine the effect of debt from multiple perspectives. Incorporating other types of debt, such as short-term, long-term, or total debt, could provide a more detailed analysis of how different borrowing strategies affect firm performance. Further studies could also include external factors like oil price fluctuations, regulatory changes, and macroeconomic variables to better explain

how these conditions influence the effect of debt on financial outcomes. Using alternative estimation techniques may also strengthen the reliability of the results.

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