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CORPORATE TAX OPTIMIZATION EFFECT ON COST OF DEBT CAPITAL: EVIDENCE OF LISTED AGRICULTURAL FIRMS IN NIGERIA

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Abstract

This study examined the effect of corporate tax optimization on cost of debt capital among listed agricultural firms in Nigeria from 2015–2024, guided by the Trade-Off Theory. It focused on four key tax optimization variables: statutory tax gap, cash flow tax efficiency, capital intensity tax, and debt tax shield, using an ex post facto design and panel data from four selected firms. The Driscoll–Kray fixed-effects model was applied to ensure robust results in the presence of heteroscedasticity, autocorrelation, and cross-sectional dependence. The findings revealed that statutory tax gap and cash flow tax efficiency both have significant negative effects on cost of debt capital, indicating that firms benefiting from tax incentives and strong cash flow management enjoy lower borrowing costs due to improved liquidity and perceived creditworthiness. In contrast, debt tax shield has a significant positive effect, suggesting that excessive reliance on debt increases perceived financial risk and raises borrowing costs despite tax advantages. Capital intensity tax was found to have no significant effect, implying that asset structure does not strongly influence debt pricing in the Nigerian agricultural sector, likely due to asset illiquidity and sector-specific risks. Based on these results, the study recommends that firms and policymakers prioritize effective tax optimization strategies such as expanding statutory tax benefits and improving cash flow efficiency to reduce debt costs. However, it cautions against overreliance on debt-based tax shields and capital intensity adjustments as strategies for lowering borrowing costs, emphasizing balanced financing structures aligned with lender risk perceptions.

Keywords: Corporate Tax Optimization, Statutory Tax Gap, Heteroscedasticity, Tax Advantages, Tax Incentives, Debt-Based Tax.

Introduction

Corporate tax optimization has become an important aspect of corporate finance as firms seek to reduce tax liabilities, maximize shareholder value, and improve financial performance within legal boundaries (Hanlon & Heitzman, 2010; Innekeputri & Aribowo, 2024). Tax optimization strategies such as statutory tax gap management, cash flow tax efficiency, capital intensity tax planning, and debt tax shelters are often used to improve after-tax cash flows and liquidity. However, while these strategies may enhance short-term financial outcomes, they may also increase financial opacity and information asymmetry, thereby affect creditors' perception of risk and ultimately influence the cost of debt capital (Balakrishnan, Blouin, & Guay, 2019; Guedrib & Hamdi, 2025). Creditors increasingly view aggressive tax planning as a signal of earnings manipulation, regulatory exposure, and weak transparency, leading to higher borrowing costs and stricter lending conditions.

The statutory tax gap, which reflects the difference between statutory and effective tax rates, is commonly associated with tax aggressiveness because it reveals the extent to which firms exploit loopholes and tax incentives to reduce liabilities. Similarly, cash flow tax efficiency allows firms to defer tax payments and temporarily improve liquidity, though lenders may interpret excessive deferrals as a sign of unsustainable earnings quality. Capital intensity tax strategies, which rely on depreciation allowances and investment incentives, can improve tax savings and provide collateral value for lenders, but excessive dependence on such deductions may conceal underlying cash flow weaknesses. Debt tax shelters, rooted in the trade-off theory of capital structure, also reduce taxable income through interest deductibility; however, excessive debt usage for tax purposes may increase financial distress risk and attract creditor concern (OECD, 2015).

Globally, regulatory initiatives such as the OECD Base Erosion and Profit Shifting (BEPS) framework and evolving IFRS disclosure requirements have intensified scrutiny on firms' tax behavior and financial transparency. Studies suggest that aggressive tax planning can either be interpreted as financial sophistication or as governance and opacity risk, depending on institutional context and investor perception (Hanlon, Maydew, & Saavedra, 2017; Himme & Fischer, 2014). A notable example is Apple Inc., which faced criticism after the European

Commission revealed that the company used complex Irish tax structures to significantly reduce its effective tax rate. Such controversies heightened regulatory scrutiny and investor skepticism, with potential implications for financing costs.

In Nigeria, fiscal reforms and tax incentives aimed at stimulating sectors such as agriculture have increased the relevance of tax optimization strategies. Government initiatives, including tax holidays, VAT exemptions, and subsidized credit schemes, were introduced to support agricultural productivity and investment (Central Bank of Nigeria, 2021). Despite these efforts, many listed agricultural firms still face high borrowing costs, weak tax compliance, and financial opacity, which reduce creditor confidence and increase debt financing costs (Adebayo & Yusuf, 2022; Egbunike & Okoye, 2021). Recent reforms, including the Finance Act and proposed reductions in corporate income tax rates, have further increased the need to understand how tax optimization affects firms' cost of debt capital.

Although prior studies have examined tax optimization and firm performance, most empirical evidence comes from countries outside Africa, particularly Indonesia and other Southeast Asian economies. Nigerian studies remain limited and have largely focused on financial performance rather than the relationship between tax optimization and debt financing costs. More importantly, little attention has been given to the agricultural sector despite its strategic importance and persistent financing challenges. Therefore, there remains a significant gap in understanding how tax optimization practices influence the cost of debt capital among listed agricultural firms in Nigeria, particularly within the context of ongoing fiscal reforms and increasing lender sensitivity to corporate transparency and tax behavior.

Objective of the Study

The main objective of this study is to evaluate the effect of tax optimization on cost of debt capital of listed agricultural firms in Nigeria. Specifically, the study was set out:

1. Evaluate the effect of statutory tax gap on cost of debt capital of listed agricultural firms in Nigeria.

2. Examine the effect of cash flow tax efficiency on cost of debt capital of listed agricultural firms in Nigeria.
3. Investigate the effect of capital intensity on cost of debt capital of listed agricultural firms in Nigeria.
4. Identify how debt tax shield effect cost of debt capital of listed agricultural firms in Nigeria.

Research Hypotheses

In line with the specific objectives of this study, the following null hypotheses have been proposed to be tested. The hypotheses are stated as:

1. Statutory tax gap has no significant impact on cost of debt capital of listed agricultural firms in Nigeria.
2. Cash flow tax efficiency has no significant impact on cost of debt capital of listed agricultural firms in Nigeria.
3. Capital intensity has no significant impact on cost of debt capital of listed agricultural firms in Nigeria.
4. Debt tax shield has no significant impact on cost of debt capital of listed agricultural firms in Nigeria

Literature Review

Conceptual Review

Cost of Debt Capital

Understanding the cost of debt capital is crucial as it represents the interest rate a company must pay on its borrowed funds. It plays a crucial role in a company's financing activities. When a company borrows money through loan, bonds, or other debt instruments, it incurs cost of debt. Therefore, cost of debt represents the cost that the company incurs for borrowing money from lenders or bondholders (Dirman, 2020; Boubakri, & Ghouma, 2010). Similarly, Santosuosso, (2014), note that interest rate, company's creditworthiness, and terms of the borrowing arrangement all impact the cost of debt. When determining the expenses associated with running business activities, debt capital cost plays a crucial role in the weighted average cost of capital (WACC), impacting the overall value of the company (Brealey, Myers & Allen, 2011).

There are two ways to perceive the cost of debt capital: before-tax and after-tax. The company pays the before-tax cost of debt as interest on the debt. However, the after-tax cost is lower due to the tax-deductible nature of interest payments, (Modigliani & Miller, 1958) which can minimize the company's overall tax liability. When compared to equity capital, debt capital is typically cheaper, because lenders face less risk due to the contractual obligation of debt repayment, which consequently lowers the cost (Brigham & Ehrhardt, 2013). However, if a company is considered risky, the cost of its debt capital is expected to increase due to the heightened risk of default. In such cases, lenders may demand higher interest rates to offset the potential risk (Ross, Westerfield & Jaffe, 2010). Several other elements, including the current interest rates, company-specific risk, the maturity of the debt, and the company's existing debt-to-equity ratio, can influence the cost of debt capital (Crabbe & Fabozzi, 2012).

Nevertheless, Modigliani-Miller theorem, posit that in perfect conditions (no taxes, bankruptcy costs, or information asymmetry), the debt's cost is considered insignificant to the company's worth. Notably, these circumstances are seldom met, highlighting the significance of debt cost in assessing the company's worth (Modigliani & Miller, 1963). Interestingly, a high cost of debt capital can serve a disciplinary purpose, deterring managers from investing in projects with a negative net present value (NPV), thus alleviating agency costs (Jensen & Meckling, 1976).

According to the pecking order theory, companies usually favour internal financing and resort to debt only when internal resources are insufficient, thus emphasizing the significance of the cost of debt capital (Myers & Majluf, 1984). Debt capital expenses are essential in capital budgeting choices, serving as the discount rate for cash flows linked to particular investment ventures (Brealey, Myers & Allen, 2011). In this regard, Franco Modigliani & Merton Miller, (1958) document that maximizing a company's value involves identifying the most efficient capital structure to reduce debt capital costs. Accurately calculating and wisely managing the cost of debt capital, particularly through the application of optimal debt weighting within a firm's capital structure, can provide a competitive advantage by enabling more effective investment and financing decisions (Damodaran, 2016).

Debt weighting, which refers to the percentage of debt in a company's capital structure or investment portfolio, is a critical element in this process, as it significantly influences a firm's financial risk, overall cost of capital, and the risk return profile of its investment portfolio (Brealey, Myers, Allen & Mohanty, 2018). Companies strategically decide on their debt weighting based on their operational

needs, financial objectives, and market conditions. For instance, a higher debt level may enable a company to undertake substantial investments for growth, albeit with increased financial risk (Modigliani & Miller, 1958). Investors and analysts pay close attention to a company's debt weighting, often measured by financial ratios such as the debt-to-equity ratio, to assess its financial health and risk profile (Zhang, Altman & Yen 2010). Higher debt levels can lead to higher financial risk due to the obligatory nature of debt repayments, which can put pressure on a company's cash flows (Jensen & Meckling, 1976).

Debt weighting is a critical factor in calculating a company's Weighted Average Cost of Capital (WACC). Companies strive to optimize their capital structure the mix of debt and equity – in a way that minimizes their WACC and maximizes firm value (Modigliani & Miller, 1958). Within an investment portfolio, debt instruments such as bonds and debentures form a significant part of the asset mix. The proportion of these instruments, i.e., the debt weighting, influences the portfolio's risk and return profile. Bonds, for instance, are considered lower risk than equities but also typically offer lower returns (Elton, Gruber, Blake, & Shachar, 2013). In portfolio management, the Capital Asset Pricing Model (CAPM) and Modern Portfolio Theory (MPT) are often used to determine optimal asset weights, including debt weighting, to achieve a desired balance of risk and return (Sharpe, 1964; Markowitz, 1952). Transaction costs are also a key consideration in deciding on debt weighting, both in corporate finance and investment management, as these costs can significantly affect net returns (Perold, 1988). Overall, changes in interest rates can impact the value of debt securities in a portfolio (Campbell, Lo, & MacKinlay, 1997), highlighting the importance of monitoring and adjusting debt weights in response to market conditions.

Corporate Tax Optimization

Corporate tax optimization refers to a deliberate and lawful approach by corporate entities to minimize its tax liabilities through strategic planning and utilization of available tax provisions, incentives, and regulatory frameworks. This concept is distinct from tax evasion, as it operates within the legal boundaries set by tax authorities (Fellegi, 2013). Corporate tax optimization encompasses various tactics such as statutory tax gap options, debt tax shelters, cash flow tax, and capital intensity adjustments (Taylor & Richardson, 2013), all aimed at enhancing a firm's financial efficiency and shareholder value. In the views of Neuman, 2014; Garbarino, (2011) corporate tax optimization strategy is often characterized by the strategic minimization of tax liabilities within legal frameworks. Tax optimization strategies are designed to align corporate tax liabilities with an entity's overall financial objectives while maintaining compliance with national and international tax regulations (Avi-Yonah, 2017; Sosnowski, 2023). The literature delineates tax optimization as a proactive approach to managing tax obligations through deliberate corporate structuring, the leveraging of permissible tax deductions, and transfer pricing mechanisms, especially relevant in multinational corporations (Cooper & Nguyen, 2020).

The process involves selective adherence to statutory allowances and strategic planning to benefit from jurisdictional tax incentives, resulting in an optimized tax burden without engaging in illicit tax evasion (Khaoula & Ali, 2012). Notably, digital advancements have recently enabled firms to adopt sophisticated, real-time tax planning techniques, enhancing their adaptability to fluctuating fiscal policies and regulatory environments (Kononenko et al., 2022). As such, corporate tax optimization represents a legal, yet strategic, financial maneuvering tool, with implications for competitive advantage, public perception, and regulatory scrutiny (Elamer et al., 2024). Specifically, Isallah, (2024) note that the conceptual framework of corporate tax optimization strategy is grounded in the principle that strategic tax planning can lead to improved financial performance without breaching legal obligations. Therefore, by leveraging tax laws and incentives, companies can optimize its tax positions, thereby freeing up resources for reinvestment and growth. In Nigeria, the Federal Inland Revenue Service (FIRS) plays a pivotal role in shaping the corporate tax landscape. Through initiatives like the introduction of thin capitalization rules in 2020, which limit deductible interest expenses to 30% of a company's earnings before interest and tax depreciation and amortization (EBITDA), the goal of the FIRS is to curb excessive debt financing used for tax avoidance. Additionally, the Chartered Institute of Taxation of Nigeria (CITN) contributes to the development of corporate tax practices by providing professional guidelines and advocating for tax reforms that align with global best practices.

Theoretical Review

The Trade-Off Theory, developed by Kraus and Litzenberger and later expanded by other scholars, explains how firms balance the benefits and costs of debt financing in determining an optimal capital structure. The theory argues that debt can enhance firm value through tax advantages such as interest tax shields, but excessive debt increases financial distress and bankruptcy risks. Thus, firms seek equilibrium where the marginal benefits of debt equal its marginal costs.

The theory assumes imperfect capital markets where financing decisions are influenced by taxes, transaction costs, and information asymmetry. Managers are expected to make rational financing decisions that minimize the weighted average cost of capital (WACC) and maximize shareholder value. In this context, tax optimization strategies such as debt tax shields, statutory tax gaps, and asset depreciation become important tools for reducing financing costs. The relevance of the Trade-Off Theory to this study lies in its ability to explain how tax-related financing strategies influence the cost of debt among listed agricultural firms in Nigeria. Given the sector's exposure to tax incentives and financing constraints, the theory provides a suitable framework for examining how firms balance tax benefits and borrowing risks in managing debt capital.

Empirical Review

Gbulum, Kwaghfan, Luper, and Tersoo (2025) examined the effect of corporate performance on tax planning, with the central objective of evaluating how firms' financial outcomes influence their tax planning strategies. The data for the study were derived from the Nigerian Exchange Group, covering the period between 2017 and 2022. The research focused on companies in the consumer goods sector. The study adopted *ex-post facto* research design and employed purposive sampling to select 18 listed firms from a population of 21, resulting in 108 firm-year observations. Data were sourced from annual financial reports and analyzed using the random effect regression technique within a multiple linear regression framework. The findings revealed that both return on assets and return on equity had a significant positive impact on tax planning, whereas net profit margin had a positive statistically insignificant relationship with tax planning.

Tanzila and Hotang (2025) investigated the effect of institutional ownership, leverage, company size, and tax planning on cost of debt. The data for the study was sourced from the Indonesia Stock Exchange. The time frame covered in the study spanned from 2017 to 2023. The research focused specifically on the financial sector. Employing a positivist quantitative research design, the study utilized a probability sampling technique with cluster sampling to select a sample of 46 companies from a population of 106, generating 322 firm-year observations. The analysis of data was carried out using the fixed effect model. The findings revealed that leverage and tax planning had a statistically significant effect on cost of debt, while institutional ownership and company size did not exhibit any significant influence.

Richardson et al. (2015) examined the relationship between corporate tax planning and the cost of debt financing. The study found that firms with wider differences between statutory and effective tax rates, achieved through legitimate tax planning strategies, tend to experience lower borrowing costs. The researchers argued that lenders perceive tax savings as indicators of improved financial strength, liquidity, and repayment capacity. The study concluded that effective tax management enhances firm value and reduces creditor risk perception, thereby lowering the cost of debt capital.

Hasan et al. (2014) investigated how cash flow strength and tax payment capacity influence debt financing costs. Using firm-level financial data, the study revealed that firms with strong operational cash flows relative to tax obligations generally enjoy lower debt costs. The findings showed that creditors interpret strong cash flow tax efficiency as evidence of sound liquidity management and reduced default risk. The study emphasized that firms capable of meeting tax obligations through internal cash flows are more financially stable and attractive to lenders.

Lim (2011) explored the relationship between debt tax shields and borrowing costs. The study found that although debt financing provides tax benefits through interest deductibility, excessive dependence on debt can increase the cost of borrowing. The researcher explained that beyond a certain leverage threshold, creditors begin to associate high debt levels with increased financial distress and default risk, thereby demanding higher interest rates. The study concluded that the

benefits of debt tax shields may diminish when firms become excessively leveraged.

Koralun-Bereźnicka (2013) examined the effect of asset intensity on financing costs among asset-heavy firms. The findings indicated that high levels of tangible assets do not necessarily reduce the cost of debt, especially in industries characterized by operational uncertainty and market risk. The study argued that lenders may place greater importance on cash flow stability and business risk rather than collateral value when pricing debt. The researcher concluded that asset intensity alone is not always a significant determinant of borrowing costs.

Methodology

Ex post facto research design was adopted. Secondary method of data collection was used. The population of this study consists of 5 agricultural firms listed on the floor of the Nigerian Exchange Group (NGX) as of December 31st, 2024 out of which 4 was selected as sample size using purposive sampling techniques.

Model Specification

$$CODC_{it} = \beta o + \beta_1 STAXGAP_{it} + \beta_2 CFTAX_{it} + \beta_3 CINTAX_{it} + \beta_4 DTAX_{it} + \beta_5 FINLEV_{it} + \mu_{it}$$

Where:

CODC	=	Cost of Debt Capital
STAXGAP	=	Statutory Tax Gap
CFTAX	=	Cash Flow Tax Efficiency
CINTAX	=	Capital Intensity Tax
DTAX	=	Debt Tax Shelter
FINLEV	=	Financial Leverage
β_0	=	Constant
β_1- β_5	=	Slope Coefficient
μ	=	Stochastic disturbance
i	=	i^{th} company
t	=	period

Thus, the apriori expectation, based on the literature reviewed and related theories, is stated as follows; $\beta_1 X_{1it} < 0$, $\beta_2 X_{2it} < 0$, $\beta_3 X_{3it} < 0$, $\beta_4 X_{4it} < 0$, $\beta_5 X_{4it} > 0$.

Operationalization of Variables

Table 1 Variable Measurement & Source

Variables	Measurement	Source
CODC (Dependent Variable)	Computed as total interest / total debt	Satt, Bendriouch, & Nechbaoui (2020)
STAXGAP (Independent Variable)	Statutory Tax Rate − (Tax Expense ÷ Pre-tax Accounting Profit)	Lestari, Dewi, Wahyuni, and Windiyani, (2023).
CITAX (Independent Variable)	Capital intensive tax optimization strategy is computed as the ratio of total assets to total sales revenue	Dyreng, Hanlon, Maydew and Thornock, (2017).
DTAX (Independent Variable)	Debt tax shelter is computed in % as finance cost divided by total asset	Lubis, Suryani, & Anggraeni, (2018
CFTAX (Independent Variable)	Computed in % as income tax paid in cash flow statement divided by cash flow from operations.	Auerbach, Devereux, Keen and Vella, (2017).
FINLEV (Independent Variable)	Computed in % as total debt divided by total asset	Chen, (2020).

Source: Authors' Compilation (2025)

Descriptive Statistics Analysis

In the descriptive statistics, each variable is examined based on its mean, standard deviation, maximum, minimum p1 and p9 values which have been presented in Table 2.

Table 2 Descriptive Statistics Result

	Obs	Mean	Std_Dev	Min	Max	p1	p99	Skew	Kurt
CODC	40	6.869	8.248	.35	45.81	.35	45.81	3.043	13.816
STAXGAP	40	6.295	24.471	-101.96	30	-101.96	30	-2.187	10.562
CFTAX	40	7.485	51.67	-162.6	270.78	-162.6	270.78	2.501	20.836
CINTAX	40	1.17	.847	.391	4.612	.391	4.612	2.713	10.761
DTAX	40	3.636	3.368	.11	13.75	.11	13.75	1.239	3.903
FINLEV	40	57.106	24.435	17.79	116.45	17.79	116.45	345	2.61

Source: Author's Computation (2026)

The descriptive statistics reveal substantial variation in cost of debt capital (CODC), tax optimization indicators, and financial structure among listed agricultural firms in Nigeria between 2015 and 2024. Cost of debt capital recorded an average of 6.87% with significant dispersion (SD = 8.25%), indicating differing borrowing costs across firms due to variations in credit risk, leverage, and macroeconomic conditions. The wide range of values further reflects the influence of interest rate volatility and firm-specific financing conditions, consistent with findings by Onaolapo and Kajola (2019).

The statutory tax gap (STAXGAP) showed high volatility, with a mean of 6.30% and a large standard deviation of 24.47%, suggesting inconsistent tax positions across firms due to tax incentives, loss carryforwards, and varying tax administration practices (Akintoye et al., 2019). Similarly, cash flow tax efficiency (CFTAX) exhibited extreme fluctuations, reflecting mismatches between tax obligations and operating cash flows caused by the seasonal and cyclical nature of agricultural operations in Nigeria.

Capital intensity tax strategy (CINTAX) recorded a relatively low mean with moderate variation, indicating that most firms maintained similar asset-to-sales structures, although some firms operated with very high fixed asset bases that provided capital allowance benefits. Debt tax shield (DTAX) values suggest that firms moderately benefited from interest deductibility, though the extent varied according to financing structures. Financial leverage (FINLEV) averaged 57.11%, with some firms being heavily debt-dependent, exposing them to higher financial distress risk during revenue downturns, consistent with Chukwuma et al. (2023).

Overall, the results highlight considerable heterogeneity in borrowing costs, tax planning practices, and leverage among Nigerian agricultural firms, reflecting firm-specific strategies, seasonal industry characteristics, and broader macroeconomic conditions.

Test for Normality of Data

This study employs Skewness and Kurtosis test for normality of data and document the results as shown in the table 3.

Table 3: Skewness and kurtosis Tests for Normality

		----- Joint test -----			
Variable	Obs	Pr(skewness)	Pr(kurtosis)	Adj chi2(2)	Prob>chi2
CODC	40	0.0000	0.0000	34.98	0.0000
STAXGAP	40	0.0000	0.0000	26.43	0.0000
CFTAX	40	0.0000	0.0000	35.20	0.0000
CINTAX	40	0.0000	0.0000	30.34	0.0000
DTAX	40	0.0020	0.1307	9.80	0.0074
FINLEV	40	0.3200	0.8222	1.09	0.5792

Source: Author's Computation (2026

The skewness and kurtosis normality test results show that most variables for listed agricultural firms in Nigeria between 2015 and 2024 significantly deviated from normal distribution. Cost of debt capital (CODC) recorded a significant adjusted chi-square statistic (34.98, p = 0.0000), indicating non-normality due to extreme borrowing cost variations arising from interest rate volatility and firm-specific credit risks (Brooks & Wichmann, 2019). Similarly, statutory tax gap (STAXGAP) and cash flow tax efficiency (CFTAX) also showed strong departures from normality, reflecting irregular income patterns, tax compliance differences, seasonality, and fluctuating cash flows within the agricultural sector (Gujarati & Porter, 2020).

Capital intensity tax (CINTAX) was equally non-normal, suggesting uneven asset-to-sales structures across firms, particularly between large mechanized firms and smaller labor-intensive operations. Debt tax shield (DTAX) also deviated from normality, although with a lower chi-square statistic, indicating moderate irregularities in financing cost structures.

In contrast, financial leverage (FINLEV) was approximately normally distributed, as its probability value (0.5792) showed no statistical evidence against normality. This suggests relatively similar debt financing patterns among agricultural firms due to common sector-wide financing practices.

Overall, the results confirm significant non-normality in most variables, implying the presence of skewness, outliers, and heterogeneity in the dataset. This justifies the use of robust estimation techniques and non-parametric approaches in subsequent regression analyses to ensure reliable and unbiased results (Brooks & Wichmann, 2019; Gujarati & Porter, 2020).

Correlation Analysis

The Kendall tau correlation analysis presented in table 4.3, reveals several statistically significant associations among the variables under consideration for listed agricultural firms in Nigeria with a time frame falling through 2015 and 2024.

Table 4: Correlation Analysis Result

Key
tau_a
tau_b
score
Number of obs
Sig. level

	CODC	STAXGAP	CFTAX	DTAX	CINTAX	FINLEV
CODC	0.9987					
	1.0000					
	779.0000					
	40					
STAXGAP	0.2795*	0.9731				
	0.2835*	1.0000				
	218.0000	759.0000				
	40	40				
	0.0112					
CFTAX	-0.2756*	-0.2385*	0.9000			
	-0.2907*	-0.2548*	1.0000			
	-215.0000	-186.0000	702.0000			
	40	40	40			
	0.0111	0.0276				
DTAX	0.7718*	0.2359*	-0.2859*	0.9987		
	0.7728*	0.2393*	-0.3016*	1.0000		
	602.0000	184.0000	-223.0000	779.0000		
	40	40	40	40		
	0.0000	0.0325	0.0084			
CINTAX	0.1526	0.3192*	-0.2179*	0.0577	1.0000	
	0.1527	0.3236*	-0.2297*	0.0577	1.0000	
	119.0000	249.0000	-170.0000	45.0000	780.0000	
	40	40	40	40	40	
	0.1692	0.0038	0.0449	0.6082		
FINLEV	0.1346	0.0269	-0.2897*	0.3628*	-0.0667	1.0000
	0.1347	0.0273	-0.3054*	0.3631*	-0.0667	1.0000
	105.0000	21.0000	-226.0000	283.0000	-52.0000	780.0000
	40	40	40	40	40	40
	0.2256	0.8152	0.0076	0.0010	0.5524	

Source: Author's Computation (2026)

The correlation results reveal significant relationships among cost of debt capital (CODC), tax optimization variables, and financial leverage among listed agricultural firms in Nigeria. Cost of debt capital shows a significant positive association with statutory tax gap (STAXGAP) ($\tau_b = 0.2835$), indicating that firms with higher borrowing costs tend to exhibit larger differences between statutory and effective tax rates. CODC is also strongly and positively associated with debt tax shield (DTAX) ($\tau_b = 0.7728$), suggesting that firms with higher interest-related tax benefits also face higher borrowing costs, although the coefficient remains below the multicollinearity threshold of 0.80 (Gujarati & Porter, 2020).

Conversely, CODC has a significant negative relationship with cash flow tax efficiency (CFTAX) ($\tau_b = -0.2907$), implying that firms with higher borrowing costs are less efficient in meeting tax obligations from operating cash flows. Statutory tax gap further shows positive associations with capital intensity tax (CINTAX) and debt tax shield, indicating that asset-heavy firms enjoy greater tax planning opportunities through capital allowances and debt financing. However, STAXGAP is negatively related to CFTAX, suggesting that firms with larger tax gaps often experience weaker cash-based tax efficiency.

Debt tax shield also exhibits a negative association with cash flow tax efficiency and a positive association with financial leverage, implying that highly leveraged firms benefit more from interest tax deductions but face reduced cash flow flexibility for tax payments. Similarly, financial leverage is negatively associated with cash flow tax efficiency, reflecting the pressure of debt obligations on operating cash flows. Meanwhile, capital intensity tax and financial leverage show only a weak and insignificant relationship, suggesting that asset intensity does not necessarily determine gearing patterns in the agricultural sector.

Overall, the findings indicate meaningful interrelationships among tax planning variables, borrowing costs, and leverage structures, while the absence of correlation coefficients above 0.80 confirms that multicollinearity is not a major concern, supporting the suitability of the variables for further econometric analysis (Wooldridge, 2020).

Regression Analyses

The effect of the independent variables on the dependent variable was assessed using fixed and random effects panel estimators, with Hausman test identifying the most preferred model. The preferred model was diagnosed for residual normality, serial correlation, and cross-sectional dependence, which guided the choice of estimator for hypothesis testing. Multicollinearity is absent, and the results are shown in Table 5.

Table 4.4 **Cost of Debt Capital Regression Analysis Result**

	FIXED EFFECT MODEL	RANDOM EFFECT MODEL	DRISCROLL-KRAAY SE MODEL
STAXGAP	-0.099 **(0.009)	-0.013 (0.707)	-0.099 **(0.003)
CFTAX	-0.014 (0.267)	-0.019 (0.219)	-0.014 **(0.041)
DTAX	2.083 ***(0.000)	2.176 ***(0.000)	2.083 ***(0.000)
CINTAX	-1.342 (0.106)	-0.381 (0.681)	-1.342 (0.232)
FINLEV	-0.274 ***(0.000)	-0.155 ***(0.000)	-0.274 **(0.008)
_CONS	17.232 ***(0.000)	8.458 (0.000)	17.232 **(0.040)
R_ SQUARED	0.8103	0.7418	
FISHER_STAT/WALD CHI^2	26.49 (0.0000)	94.67 (0.0000)	47983.17 ***(0.0000)
M Wald Test for Groupwise Heteroskedasticity = 0.0000 ***	B&P LM test RE = 1.0000	Wooldridge Test for Autocorrelation: Prob = 0.0451**	
Mean VIF = 1.25 Pool ability Test = 0.0011 **	Hausman Test Chi^2 = 13.59, Probability = (0.0035) **	Frees' Test of Cross-Sectional Independence: = 0.407 Alpha = 0.3429	

Source: Author's Computation (2025)

The fixed-effects model shows a strong explanatory power within entities, with a Within R-squared of 0.8103, indicating that approximately 81.03% of the variation in the cost of debt capital across time for the same agricultural firms is explained by the independent variables. The F-statistic of 26.49 with a Prob > F value of 0.0000 confirms that, jointly, the independent variables are significantly associated with the dependent variable in the fixed-effects framework. In the random-effects model, the Between R-squared is 0.7480, meaning that 74.80% of the variation in the cost of debt capital between firms is explained by the model, and the Wald chi-squared statistic of 94.67 with a Prob > chi2 of 0.0000 confirms joint statistical significance in this framework. At the bottom of the fixed-effects results, the F-test for all u_i = 0 reports a Prob > F of 0.0011, indicating the presence of significant firm-specific effects. However, the Breusch and Pagan Lagrangian multiplier test for random effects yields a chibar2 (01) value of 0.00 with a Prob > chibar2 of 1.0000, suggesting no significant difference between the random-effects model and pooled OLS; thus, the data is pool table from the random-effects perspective.

The Hausman specification test returns a $chi^2(3)$ statistic of 13.59 with a Prob > chi^2 of 0.0035, leading to the rejection of the null hypothesis that the random-effect estimator is consistent. This result statistically justifies the preference for fixed-effect model over the random-effect model for the dataset under consideration.

The diagnostic test for multicollinearity shows that all variables have variance inflation factor (VIF) values well below the threshold of 10, with a mean VIF of 1.25, indicating that multicollinearity is not a concern in this model. The tolerance values are all above 0.1, further supporting the absence of problematic collinearity among the independent variables. The condition number of 7.6100 is far below the commonly cited threshold of 30, reinforcing the conclusion that the data is free from severe multicollinearity. Consequently, the estimated coefficients are unlikely to be distorted by inflated standard errors due to collinearity, ensuring stability in the regression estimates.

The Modified Wald test for groupwise heteroskedasticity yields a chi2(4) statistic of 32.99 with a Prob > chi2 of 0.0000, indicating strong evidence of heteroskedasticity across the panels. The Wooldridge test for autocorrelation in panel data produces a Prob > F of 0.0451, which is below the 5% significance level, confirming the presence of first-order autocorrelation. The Frees' test statistic of 0.407 exceeds the 5% critical value of 0.3429, signifying cross-sectional dependence among the panels. Given the joint presence of heteroskedasticity, autocorrelation, and cross-sectional dependence, the application of regression with Driscoll–Kraay standard errors is justified, as it provides robust standard errors that are consistent in the presence of all three violations, ensuring reliable hypothesis testing in this study's fixed-effects framework.

Test of Research Hypotheses

Ho_1: Statutory tax gap has no significant impact on cost of debt capital among listed agricultural firms in Nigeria.

As revealed in Table 4.4, the Driscoll–Kraay fixed-effects regression analysis shows that statutory tax gap (STAXGAP, coef. = –0.099, p = 0.003) significantly and negatively affects cost of debt capital (CODC) among listed agricultural firms in Nigeria. This finding implies that, on average, a one-unit increase in statutory tax gap is associated with approximately 0.0988 unit decrease in the cost of debt capital during the study period, suggesting that greater divergence between statutory and effective tax rates, often reflecting tax optimization strategies, may signal improved after-tax profitability and lower perceived default risk to lenders, thereby reducing borrowing costs. This outcome aligns with the earlier empirical evidence of Richardson et al. (2015), who reported that effective tax management leading to a wider statutory–effective tax gap is linked to reduced debt financing costs in firms, as lenders may interpret tax savings as enhancing debt service capacity. In line with this evidence, rejection of the null hypothesis which state that statutory tax gap has no significant effect on cost of debt capital among listed agricultural firms in Nigeria is rejected.

Ho_2: Cash flow tax efficiency has no significant impact on cost of debt capital among listed agricultural firms in Nigeria.

As presented in Table 4.4, the Driscoll–Kraay fixed-effects regression analysis shows that cash flow tax efficiency (CFTAX, coef. = –0.014, p = 0.041) negatively affects cost of debt capital (CODC) of listed agricultural firms in Nigeria. This outcome implies that, on average, a one-unit increase in cash flow tax efficiency reduces cost of debt capital with about a 0.0141 unit, suggesting that listed agricultural firms in Nigeria who are able to meet tax obligations more effectively from operating cash flows are perceived by lenders as

less risky, thereby attracting lower borrowing costs. This finding is consistent with earlier evidence of Hasan et al. (2014), who documented that firms with strong tax payment capacity relative to cash flows signal financial discipline and reduced default probability, leading to favorable debt pricing. In line with this reasoning, the result supports rejecting the null hypothesis, which posits that cash flow tax efficiency has no significant effect on cost of debt capital among listed agricultural firms in Nigeria.

Ho_3: Capital intensity tax has no significant impact on cost of debt capital among listed agricultural firms in Nigeria.

In this study, capital intensity tax (CINTAX, coef. = –1.342, p = 0.232) in the Driscoll–Kraay fixed-effects regression model shows an insignificant effect on cost of debt capital (CODC) of listed agricultural firms in Nigeria. This indicates that, holding other factors constant, the ratio of total assets to sales revenue does not have a statistically significant impact on cost of debt capital for the sampled firms. This finding is similar to the results obtained by Koralun-Bereźnicka (2013), who reported that higher capital intensity, while potentially improving operational stability, does not necessarily influence lenders' pricing of debt when other financial risk factors dominate credit decisions. Consequently, this outcome supports the null hypothesis that capital intensity tax has no significant effect on cost of debt capital of listed agricultural firms in Nigeria.

Ho_4: Debt tax shield has no significant impact on cost of debt capital among listed agricultural firms in Nigeria.

As presented in Table 4.4, the Driscoll–Kraay fixed-effects regression model reveals that debt tax shield (DTAX, coef. = 2.0827, p = 0.000) exerts a statistically significant positive effect on cost of debt capital (CODC) of listed agricultural firms in Nigeria. This outcome implies that, on average, a one-unit increase in the proportion of finance costs to total assets leads to about a 2.0827 unit rise in the cost of debt capital during the study period, suggesting that while interest expenses provide tax-deductible benefits, higher levels of such expenses may simultaneously signal increased financial risk to lenders, prompting them to impose higher borrowing costs. This finding is consistent with the evidence of Lim (2011), who reported that excessive reliance on debt, despite its tax shield advantages, can increase creditors required returns due to heightened perceptions of default risk, ultimately raising debt servicing costs. In light of this, the study rejects the null hypothesis, which states that debt tax shield has no significant effect on cost of debt capital of listed agricultural firms in Nigeria.

Discussion of Findings

The findings of this study show that statutory tax gap (STAXGAP) has a statistically significant negative effect on the cost of debt capital among listed agricultural firms in Nigeria. This supports the Trade-Off Theory, which explains that firms benefit from tax-saving strategies that improve financial stability and reduce borrowing risk. A wider statutory tax gap, resulting from legal tax incentives such as capital allowances, VAT exemptions, and investment deductions, improves post-tax earnings and strengthens firms' debt servicing ability. This finding is consistent with Richardson et al. (2015), who found that firms with greater differences between statutory and effective tax rates through legitimate tax planning often enjoy lower debt costs because lenders perceive them as financially stable.

Similarly, cash flow tax efficiency (CFTAX) was found to have a statistically significant negative effect on cost of debt capital, highlighting the importance of liquidity management in debt pricing. This supports the Pecking Order Theory, which emphasizes the preference for internal financing over external borrowing. Agricultural firms that can meet tax obligations effectively through operational cash flows demonstrate financial discipline and stable liquidity, thereby reducing lender concerns about repayment risk. This result aligns with the findings of Hasan et al. (2014), who reported that firms with stronger operational cash flow relative to tax obligations tend to enjoy lower debt financing costs.

Conversely, debt tax shield (DTAX) exhibits a statistically significant positive effect on cost of debt capital, contrary to the traditional expectation of the Trade-Off Theory that debt tax benefits reduce borrowing costs. This outcome is better explained by the Agency Cost Theory, which suggests that excessive debt raises concerns about financial distress and over-leverage, thereby increasing lender risk perception. In the Nigerian agricultural sector, where firms often depend on short-term and high-cost borrowing, the risks associated with excessive leverage may outweigh the tax advantages of debt financing. This finding is consistent with Lim (2011), who argued that beyond a certain point, the benefits of debt tax

shields are offset by increased default risk, leading to higher borrowing costs.

The study also reveals that capital intensity tax (CINTAX) has no statistically significant effect on cost of debt capital. Although high capital intensity may theoretically reduce debt costs through collateral value, agricultural assets such as machinery, farmland improvements, and storage facilities are often illiquid and exposed to environmental risks. Consequently, lenders may focus more on firms' cash flow stability and creditworthiness rather than asset intensity when pricing loans. This finding agrees with Koralun-Bereźnicka (2013), who noted that asset-heavy firms may not necessarily enjoy lower financing costs in industries characterized by high operational risk.

Overall, the findings suggest that tax optimization strategies influence cost of debt capital differently depending on the method adopted. Strategies that improve fiscal efficiency and liquidity, such as STAXGAP and CFTAX, reduce borrowing costs, while excessive reliance on debt-related tax shields (DTAX) may increase borrowing costs due to higher perceived financial risk. These results highlight the need for Nigerian agricultural firms to balance tax efficiency with prudent debt management in order to maintain favorable access to debt capital.

Conclusion

In contemporary corporate finance, the strategic application of tax optimization mechanisms has emerged as a decisive factor in shaping firms' financing outcomes, particularly the cost of debt capital, as creditors increasingly integrate tax behavior into risk assessment frameworks (Innekeputri & Aribowo, 2024; Zhen, 2025). Within the Nigerian agricultural sector, this study examined statutory tax gap, cash flow tax efficiency, debt tax shield, and capital intensity tax as core proxies for tax planning, reflecting diverse approaches through which firms manage tax liabilities while navigating credit market perceptions. While statutory tax gap and cash flow tax efficiency capture fiscal efficiency and liquidity management in meeting tax obligations, and debt tax shield embodies the trade-off between tax-deductible interest and perceived financial risk, capital intensity tax occupies a distinct position as it reflects asset-to-sales structure and the extent to which capital-intensive operations leverage allowances, depreciation schedules, and investment-related deductions to optimize tax exposure. Remarkably, the statistical insignificance effect of capital intensity tax in the context of cost of debt capital stresses the reality that, despite its theoretical potential to enhance credit terms through collateral value, asset-heavy agricultural firms in Nigeria may not secure debt pricing advantages if their capital base does not translate into predictable cash flows or mitigate sector-specific risks. Thus, the study's conclusion reinforces that in transitional economies like Nigeria, tax optimization strategies are interpreted by lenders in different ways, one of such ways is that not all theoretically advantageous measures, such as high capital intensity tax, materialize into tangible financing benefits, reflecting the importance of context-specific risk evaluation by credit providers.

Recommendation

Based on the empirical evidences presented in this study so far, this study carefully recommends that:

1. Policymakers, regulators, and financial institutions should strengthen tax optimization frameworks in Nigeria's agricultural sector by providing incentives, tax reliefs, and simplified compliance systems. This will help agricultural firms retain more income, improve liquidity, reduce borrowing costs, and encourage long-term investment and productivity growth.
2. Stakeholders should promote better cash flow tax efficiency through flexible tax payment structures, working capital support, and training on cash flow management. This will improve firms' liquidity, creditworthiness, and access to cheaper and sustainable debt financing.
3. Financial managers, policymakers, and lenders should ensure that debt tax shields are properly managed by balancing debt with equity and internal financing. This will allow firms to enjoy tax benefits from debt without increasing financial risk or borrowing costs, while maintaining healthy cash flows and stronger credit profiles.
4. Since capital intensity tax has no significant effect on the cost of debt capital, stakeholders should not rely on changes in asset-to-sales structures as a strategy for reducing borrowing costs. Instead, capital intensity tax should only be considered as part of general operational efficiency evaluation rather than debt pricing decisions.

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