

# The Interactive Term of Debt Servicing and Oil Revenue on Capital Formation in Nigeria

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**Abstract:** Excessive debt servicing can strain government budgets, diverting resources away from critical investments and capital formation. Therefore, this study investigates how the concurrent level of debt servicing affects the relationship between oil revenue and capital formation in Nigeria. The study employs fully-modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) estimation techniques and utilizes time series data covering a period from 1981 to 2022. Results indicate a cointegration relationship among the variables in the model, and the findings reveal that debt servicing negatively and significantly moderates the positive effect of oil revenue on capital formation in Nigeria. Based on these findings, the study recommends that policymakers should carefully manage debt servicing obligations. This may involve exploring strategies to reduce the cost of servicing or optimizing debt repayment schedules to minimize the impact on the country's overall debt burden. Similarly, since the findings suggest that oil revenue has a positive impact on capital formation, policymakers should devise strategies to efficiently manage and diversify the use of oil revenues to enhance overall capital formation.

**Keywords:** capital formation; debt servicing; economic growth; gross domestic saving; oil revenue

## 1. Introduction

Capital formation is a cornerstone of a nation's economic development, and crucial for fostering sustained growth. It entails the accumulation of both physical and financial assets, thereby facilitating heightened production and productivity [1]. The significance of this process becomes apparent when a country is grappling with problems associated with debt accumulation and servicing [2]. The issue arises when excessive debt servicing burdens government budgets, redirecting resources away from essential investments. In such a scenario, the very foundation for robust economic development is compromised, posing challenges to the nation's overall growth path [3].

In Nigeria, the accumulation and servicing of excessive debt is creating a strain on government budgets, diverting resources from crucial sectors such as infrastructure, education, healthcare, and capital formation. The country witnessed a consistent growth in external debt, reaching a substantial amount of US\$41.11 billion by 2004 (Debt Service Management Office [4]).

Consequently, Nigeria encountered challenges in meeting its debt obligations. To tackle this issue, the Paris Club, consisting of 15 creditor nations, initiated a debt relief program in 2005 for heavily indebted countries, including Nigeria. At that time, Nigeria's debt to the Paris Club stood at US\$28 billion, constituting a significant

portion (85.8%) of its overall debt burden [5]. Through this initiative an upfront payment of US\$6 billion in debt arrears, a substantial portion of Nigeria's debt, totaling US \$16.6 billion, was forgiven. Additionally, the remaining debt of US\$8.2 billion qualified for a buyback arrangement, resulting in significant savings of US\$2 billion. This strategic approach effectively reduced Nigeria's external debt burden to US\$3.7 billion, equivalent to 2.1% of its GDP, by 2006 [6].

However, recent data indicates that Nigeria's external debt has experienced further upsurge, standing at US \$42.50 billion as at December ending 2023. These figures reflect a continued upward trend, raising concerns about the sustainability of debt service obligations and introducing a high degree of uncertainty in managing the country's debt [7]. External debt accumulation and servicing in Nigeria might affect various macroeconomic factors that are anticipated to contribute positively to capital formation. In essence, the emphasis is on oil revenue, a crucial aspect of the nation's income. The debt servicing could potentially reduce the anticipated positive influence of oil revenue on capital formation in the country. The allocation of resources to service debt may disrupt the intended beneficial effects of oil revenue on the accumulation of capital.

Analyzing the relationship between debt servicing, oil revenue, and capital formation in Nigeria is crucial for economic management. This study provides insights into debt dynamics and offers policymakers tools to optimize resource allocation and manage risks effectively. Understanding how oil revenue fluctuations impact debt servicing and capital formation can help Nigeria develop more targeted policies for sustainable development and financial stability. Incorporating these insights into development strategies can improve fiscal planning, boost investor confidence, and attract domestic and foreign investment. By aligning debt management with long-term development objectives, Nigeria can enhance inclusive growth, reduce poverty, and build a foundation for lasting economic prosperity.

Therefore, the objective of this study is to empirically examine how the concurrent level of debt servicing affects the relationship between oil revenue and capital formation in Nigeria. After this introduction, the second section deals with the review of related literature. The third section presents the methodology of the study. The fourth part present and discusses the empirical results. The last section summarizes the main findings, conclusion and provides policy recommendations.

## 2. Literature Review

The Harrod-Domar model developed in the mid-20th century represents a theoretical framework that was first designed to elucidate the relationship among saving, economic growth, and capital accumulation within an economy. It postulates that the rate of economic growth is directly tied to the level of savings and the capital stock. In essence, the model contends that an increase in savings can lead to a rise in capital accumulation, consequently fostering economic growth. The Harrod-Domar model thus provides insights into the dynamics that connect savings, capital formation, and the overall expansion of an economy [8].

Guided by Harrod-Domar model, numerous researchers have examined the relationship among savings, capital formation, economic growth and other macroeconomic variables. For instance, Yang and Shafiq investigated the relationship among capital formation, economic growth, foreign direct investment (FDI), inflation, money supply, and trade openness in twenty emerging Asian countries spanning a period from 2007 to 2018 [9]. The study utilized a fixed-effect model with robust standard errors to assess the impact of predictors on the economic growth of these Asian countries. The findings indicated a positive relationship between economic growth and predictors such as FDI, capital formation, money supply, and trade openness, while inflation exhibited a negative association with the economic growth of the Asian countries.

Similarly, Aslan and Altinoz employed the panel vector autoregression (PVAR) approach to investigate the interconnection among natural resources; gross capital formation, globalization, and economic growth in developing countries across Europe, Asia, Africa, and the Americas during the period 1980–2018 [10]. Findings across continents indicate bidirectional causality between globalization and economic growth. Additionally, bidirectional causality is observed between capital formation and growth in Europe and Asia, as well as between natural resources and growth in Asia and America. Moreover, unidirectional causality is identified from GDP to natural resources in Europe, from capital formation to GDP in Africa and America, and from GDP to natural

resources in Europe, with a reverse direction from natural resources to GDP in America.

In a country specific study, Ali investigated the effect of gross fixed capital formation on the economic growth of Pakistan, utilizing annual time series data spanning from 1981 to 2014 [11]. The study employed the Johansen Co-integration and Vector Error Correction Model (VECM). The findings indicated that all variables in the model were statistically significant, displaying the expected signs and establishing a long-run relationship with economic growth. Similarly, Bal, et al. investigated the influence of capital formation on economic growth in India during the period from 1970 to 2012 [12]. The authors employed the ARDL estimation technique and found that capital formation, trade openness, exchange rate, and total factor productivity had positive effects on economic growth in India.

In a specific Nigerian context, Akinola and Omolade conducted a study from 1975 to 2008, investigating the relationship among gross domestic savings (GDS), gross capital formation (GCF), and economic growth (GDP) [13]. Using the vector error correction model (VECM), their results revealed that GDP had a strong positive and statistically significant impact on both GDS and GCF, surpassing the effects of GDS and GCF on GDP. The causality test confirmed bidirectional causality among all the variables. Similarly, Udude et al. [14], employing the VECM estimation technique, explored the impact of oil exports on gross capital formation in Nigeria from 1980 to 2015. Their findings indicated that: oil exports had an inversely significant impact on gross capital formation in Nigeria in both the long run and short run; real gross domestic product impacted gross capital formation in Nigeria in the long run; and a causal relationship existed between the dependent variable and explanatory variables in Nigeria. The study concluded that oil exports did not contribute to the growth in gross capital formation in Nigeria.

Lucky and Uzah examined the determinants of capital formation in Nigeria [15]. The model considered Gross Fixed Capital Formation (GFCG/GDP) as a function of Broad Money Supply (M2/GDP), Credit to the Private Sector (CPS/GDP), Gross National Savings (GNS/GDP), Commercial Banks Lending Rate, Exchange Rate (EXR), Inflation Rate (INFR), External Debt (EXTD/GDP), Public Expenditure (PEX/GDP), Government Revenue (GR/GDP), Terms of Trade (TT/GDP), and Operating Surplus (OPS/GDP). The results indicated that M2/GDP, GNS/GDP, EXR, EXTD/GDP, and TT/GDP had negative and insignificant effects on capital formation, while CPS/GDP, LR, INFR, PEX/GDP, GR/GDP, and OPS/GDP had positive and insignificant effects on capital formation in Nigeria. Similarly, Abdullahi et al. assessed the effect of external debt on capital formation in Nigeria, using time series data from 1980 to 2013 and employing the Autoregressive Distributed Lag (ARDL) modelling [2]. The result shows that external debt has negative effect on capital formation in Nigeria.

In the same vein, Ozuzu and Ewubare employed the autoregressive distributed lag (ARDL) approach to investigate the impact of export earnings on capital formation in Nigeria spanning from 1980 to 2018 [16]. The study included various components of export earnings, such as oil export earnings, agriculture export earnings; solid minerals export earnings, and services exports earnings. Capital formation was assessed using indicators like gross capital formation, foreign reserve build-up, and foreign direct investment. The results from the Bound Test Cointegration indicated a long-run relationship between gross capital formation and the explanatory variables in the model. However, the study found that oil export earnings had a negative effect on capital formation in the long run, while agriculture export and solid mineral export earnings had positive effects on capital formation both in the short and long run.

The gap observed in the literature so far appeared in the fact that, while numerous studies have investigated the impact of different macroeconomic factors on capital accumulation in Nigeria, they have largely overlooked the moderating role of debt servicing in the relationship between oil revenue and capital formation. As a result, this study aims to fill this research gap by investigating how the impact of oil revenue on capital formation is influenced by the level of debt servicing in Nigeria.

### 3. Methodology

This section discusses the methodological approaches employed in order to achieve the objective of this study. It covers model specification, data sources, and estimation techniques.

### 3.1. Model Specification and Data Source

Following Abdullahi et al. [2], the functional form of the model is as specified in Equation (1):

$$GCF_t = f(GDS_t, GDP_t, OIL_t, DEBT_t, OIL * DEBT_t) \quad (1)$$

The variables in Equation (1) are; GCF (gross capital formation in current US\$), GDS (gross domestic savings in current US\$), GDP (gross domestic product in current US\$), OIL (oil revenue in ₦ Billion), DEBT (total debt service on external debt in current US\$), and OIL\*DEBT (interaction of oil revenue and total debt service). The data for these variables span from 1981 to 2022 and were collected from the World Development Indicators, a World Bank database [17], and the statistical Bulletins of the Central Bank of Nigeria [18]. The natural logarithm of Equation (1) is taken to derive the baseline econometric model of the study, as presented in Equation (2).

$$\ln GCF_t = \alpha_0 + \alpha_1 \ln GDS_t + \alpha_2 \ln GDP_t + \alpha_3 \ln OIL_t + \alpha_4 \ln DEBT_t + \alpha_5 \ln OIL * \ln DEBT_t + \varepsilon_t \quad (2)$$

In Equation (2), "ln" represents the natural logarithm of the variables;  $\alpha_0$  denotes the intercept or constant term;  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_4$ ,  $\alpha_5$  are the parameters or coefficients that signify the magnitude and direction of the impact each variable has on gross capital formation (GCF); and  $\varepsilon_t$  is the error term, representing the unobserved factors affecting gross capital formation (GCF) that are not explained by the included independent variables.

### 3.2. Estimation Techniques

The estimation techniques employed in this study encompasses three steps. The first step involves conducting unit root tests to establish the stationarity property of the series, utilizing the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. In the second step, the study tests the existence of a cointegration (long-run) relationship among the variables, employing the Johansen cointegration test [19]. This method is frequently applied in previous studies and is preferred over other cointegration tests due to its ability to simultaneously estimate multiple cointegrating vectors. The third step involves estimating the coefficients of Model (2) using both fully-modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) to enhance the robustness of the results.

Pedroni initially developed the FMOLS estimation technique, a residual-based test that provides efficient results for cointegrated variables [20]. Additionally, FMOLS is considered a reliable estimate, especially when dealing with small sample sizes, and it helps alleviate issues related to endogeneity and serial correlation among the variables [21]. Similarly, Stock and Watson developed the DOLS estimation technique to handle endogeneity (correlation between the independent variables and the error term) and serial correlation (correlation between error terms across time), issues often encountered in time series data [22]. FMOLS and DOLS are both valuable techniques for analyzing time series data with non-stationarity and endogeneity issues. FMOLS is particularly useful for estimating long-run relationships, while DOLS is more focused on dynamic models and efficient estimation of cointegrating vectors.

## 4. Results and Discussion

This section presents and discusses the empirical findings of the study. It includes the results of unit root tests that assess the stationarity status of the series, cointegration tests exploring long-run relationships among the variables, and the results of the estimated coefficients in the model.

### 4.1. Results of Unit Root Tests

Table 1 displays the outcomes of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The results reveal that all the variables exhibit unit roots at their levels, indicating non-stationarity. However, upon implementing first-order differencing, these variables attain stationarity [I(1)]. As a result, the null hypothesis proposing the non-stationarity of the variables was rejected.

**Table 1.** Results of ADF and PP Unit Root Tests.

Variables	Level		First Difference		Status
	ADF	PP	ADF	PP	
lnGCF	-0.980	-1.389	-3.850***	-3.696***	I(1)
lnGDS	-1.413	-1.586	-6.053***	-6.050***	I(1)
lnGDP	0.044	-0.330	-4.466***	-4.466***	I(1)
lnOIL	-1.695	-1.812	-6.267***	-6.267***	I(1)
lnDEBT	-2.791	-2.730	-6.341***	-11.172***	I(1)
LnOIL*lnDEBT	-2.160	-2.082	-6.802***	-10.153***	I(1)

Note: The Schwarz Information Criterion (SIC) was utilized to select the optimal lag length in the ADF test, and \*\*\* indicates statistical significance at the 1% level.

Based on the results of the conducted unit root tests, it is reasonable to conclude that the variables are integrated of the same order [I(1)]. This rationale justifies the utilization of the Johansen (1988) cointegration test to determine the existence of a cointegration relationship among the variables in the model.

*4.2. Results of Cointegration Test*

The results of the Johansen cointegration test, as presented in Table 2, reveal both the Trace statistic and Max-Eigen statistic, indicating a cointegration relationship among the series in the model. Specifically, the Trace test suggests 6 cointegrating equations at the 5% level of significance, and the Max-Eigen test indicates 1 cointegrating equation at the 5% level of significance. Consequently, the null hypothesis of no cointegration is rejected in favor of the alternative, establishing a cointegration (long-run) relationship among the variables in the model.

**Table 2.** Results of Johansen Cointegration Test.

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.
None *	0.770	144.703	95.754	0.000
At most 1 *	0.490	85.876	69.819	0.002
At most 2 *	0.444	58.950	47.856	0.003
At most 3 *	0.354	35.480	29.797	0.010
At most 4 *	0.257	18.023	15.495	0.020
At most 5 *	0.142	6.142	3.841	0.013
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.
None *	0.770	58.827	40.078	0.000
At most 1	0.490	26.926	33.877	0.267
At most 2	0.444	23.470	27.584	0.154
At most 3	0.354	17.457	21.132	0.152
At most 4	0.257	11.881	14.265	0.115
At most 5 *	0.142	6.142	3.841	0.013

Note: Schwarz Information Criterion (SIC) was used to select optimal lag length (1), and\* denotes rejection of the null hypothesis of no cointegration at the 5% significance level.

With the cointegration (long-run) relationship among the variables confirmed, the subsequent step involves estimating the long-run coefficients for the model. This estimation is carried out using Dynamic Ordinary Least Squares (DOLS), with Fully Modified OLS (FMOLS) serving as a robustness check.

#### 4.3. Results of Estimated Coefficients

Consistent results are observed across FMOLS and DOLS, as presented in Table 3. Both methods produce comparable coefficient estimates and significance levels, indicating robust findings. The results reveal that both gross domestic savings (lnGDS) and economic growth (lnGDP) exhibit positive and statistically significant coefficients. This implies that higher capital formation is associated with increased gross domestic savings and economic growth. Enhanced savings offer resources for investment in productive capacity, while economic growth typically creates favorable conditions for capital formation.

**Table 3.** Results of Estimated Coefficients.

Regressors	FMOLS		DOLS	
	Coefficient	t-Statistic	Coefficient	t-Statistic
lnGDS	0.593***	6.479	0.592***	5.343
lnGDP	0.373***	4.648	0.363***	3.592
lnOIL	0.130***	4.906	0.118***	3.449
lnDEBT	-0.322*	-1.941	-0.308	-1.487
lnOIL*lnDEBT	-0.059***	-2.872	-0.058**	-2.267
C	0.383**	2.210	0.360	1.681
R <sup>2</sup>	0.967		0.977	

Note: Schwarz Information Criterion (SIC) was used to select the lags and leads of one (1); \*\*\*, \*\* and \* indicate statistical significance at 1%, 5% and 10% respectively.

The results further indicate that oil revenue (lnOIL) exerts a positive and statistically significant impact on capital formation. More precisely, a 1% increase in oil revenue, on average, leads to a 0.12% to 0.13% rise in capital formation, while keeping other variables constant (*ceteris paribus*). This implies that as oil revenue increase, there is, a subsequent boost in capital formation. Essentially, the positive and statistically significant relationship suggests that the availability and increase in oil revenue contribute positively to the overall capital formation in Nigeria. This result aligns with the findings of Oluwatobi et al. which also found that oil and tax revenue have significant impact on capital formation and economic growth in Nigeria [3]. The consistency in results between the current study and Oluwatobi et al. reinforces the importance of oil revenue as a key factor influencing capital formation dynamics and economic development in the Nigerian context [3].

However, debt servicing (lnDEBT) was found to have a negative and statistically significant effect on capital formation in Nigeria. More precisely, the coefficient of 0.322 signifies that a 1% increase in debt servicing is associated with a 0.322% decrease in capital accumulation in Nigeria. This implies that when all other factors are held constant, a higher level of debt servicing contributes to a corresponding decrease in the capital accumulation in Nigeria. High debt servicing obligations can constrain government budgets and divert resources away from investments. This finding suggests a tendency for the decrease of capital formation over time as debt servicing obligations increase. This result aligns with the findings of previous researches; namely Abdullahi et al. and Adamu et al. [2,23]. These earlier studies also discovered a similar trend, where an increase in debt servicing was associated with a decrease in capital accumulation in the context of Nigeria.

Moreover, the findings also reveal that the interaction of oil revenue and debt servicing (lnOIL\*lnDEBT) has a negative and statistically significant effect on capital formation in Nigeria. This suggests that the relationship between oil revenue and capital formation is moderated by the level of debt servicing. In other words, the impact of oil revenue on capital formation is influenced by the concurrent level of debt servicing. The

negative coefficient indicates that the combined effect of oil revenue and debt servicing leads to a reduction in capital formation. This implies that, as the country grapples with higher levels of debt servicing, the positive impact of oil revenue on capital formation diminishes or becomes counteracted.

The R-squared ( $R^2$ ) values (0.967 for FMOLS and 0.977 for DOLS) indicate the goodness of fit of the model. They represent the proportion of the variance in the dependent variable (capital formation) that is explained by the independent variables included in the model. In this case, an  $R^2$  of 0.967 and 0.977 suggests that approximately 96.7% to 97.7% of the variability in capital formation is accounted for by the model, indicating strong explanatory power.

## 5. Conclusion and Policy Implications

This study utilizes the fully-modified OLS (FMOLS) and dynamic ordinary least squares (DOLS) estimation techniques to investigate the moderating role of debt servicing on the relationship between oil revenue and capital formation in Nigeria. Specifically, the study examines how the effect of oil revenue on capital formation is affected by the concurrent level of debt servicing in Nigeria, using time series data spanning from 1981 to 2022. Having confirmed the same order of integration for all series, the study identified a cointegration relationship among the variables in the model, indicating a long-run equilibrium. Within this long-run relationship, the study found that debt servicing negatively and significantly moderates the positive impact of oil revenue on capital formation in Nigeria.

Based on the findings of this study, several recommendations can be made to guide policy and decision-making in Nigeria regarding debt accumulation. First, given the negative and significant long-run effect of debt servicing on capital formation, it is crucial for policymakers to carefully manage debt servicing obligations. This may involve exploring strategies to reduce the cost of servicing or optimizing debt repayment schedules to minimize the impact on the country's overall debt burden. Secondly, the positive impact of GDP growth on capital formation underscores the importance of fostering sustained economic growth. Policymakers should prioritize economic policies that promote GDP growth, which can help mitigate the need for debt accumulation. Thirdly, the positive effect of gross domestic savings on capital formation highlights the significance of encouraging domestic savings and investment. Implementing policies that incentivize savings and channel them into productive sectors of the economy can reduce reliance on debt financing. Finally, since the findings suggest that oil revenue has an impact on capital formation, policymakers should devise strategies to efficiently manage and diversify the use of oil revenues to enhance overall capital formation, and governments must craft fiscal strategies mindful of oil revenue fluctuations. High oil revenues may lead to increased borrowing, assuming debt can be serviced with oil income, but this is risky due to volatile oil prices. Policymakers should adopt prudent fiscal policies considering oil revenue variability, possibly diversifying revenue sources or creating stabilization funds. A nuanced understanding of this interplay is crucial for sustainable fiscal policies promoting economic stability and growth.

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### Data Availability Statement

Not applicable.

## Conflicts of Interest

The author declares no conflict of interest.

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