THRESHOLD EFFECTS OF MILITARY EXPENDITURE ON ECONOMIC GROWTH IN NIGERIA: EVIDENCE FROM HANSEN'S THRESHOLD REGRESSION APPROACH

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Abstract
The aim of this paper is to ascertain whether the relationship between military expenditure and economic growth in Nigeria follows regime-dependent, threshold behavior using Hansen's (1999) discrete threshold regression model between 1983-2023. The discrete threshold regression framework involves regime-dependent change in the growth effect of military expenditure, once a specific level of military expenditure crossing a particular endogenously estimated critical threshold is reached, which a linear or asymmetric model cannot identify. The model selection criteria table shows MIL_EXP (−2) with SSR of 0.363847 and one regime, implying a military expenditure of approximately 0.36 percent of GDP as the benchmark estimate for any potential nonlinearity. The study finds it essential to cautiously bench mark the defence budget around the threshold of 0.36 percent and recommends strengthening institutional control and aligning the security priorities with development objectives. More research in future needs to conduct alternative tests to ascertain the presence of nonlinearity.
Keywords: Military Expenditure; Economic Growth; Threshold Regression; Regime Effects; Nigeria.

1. Introduction

The question whether there exists a critical level of defence spending beyond which the effect of military expenditure on economic growth flips from negative to positive (or vice versa) is of paramount importance to economics of military spending. Such behavior, known as threshold, is theoretically driven by the assumption that although low or moderate level of defence spending is conducive for economic growth because of improved security and increased investor confidence, high spending tends to increase opportunity costs of spending. While the existing empirical literature on Nigeria suggests the presence of a critical threshold at around 1.8 percent of GDP, the threshold level is not empirically clear without applying the endogenous threshold estimation procedure on the country-specific annual data.

In the case of Nigeria, defence budget varies substantially over the period since 1983, reflecting the changing domestic security threats ranging from Boko Haram insurgency, banditry to communal unrest and revenue volatility of the oil sector. Military expenditure varied from the lowest 0.35 percent of GDP to the highest 1.81 percent of GDP, with an average level of 0.62 percent (author's calculation, 2025). Whether the critical threshold exists and the growth effect changes after the particular level of military expenditure is an open empirical question.

This study attempts to answer the above-mentioned question by testing whether there is any regime-dependent, threshold change in the growth effect of military expenditure, using the

Hansen (1999) discrete threshold estimation method. The discrete threshold regression model is designed to explicitly capture the regime-dependence of military expenditure in relation to its effect on growth, as compared to the linear and asymmetric regressions in the companion papers.

There is a gap in the existing empirical literature that examines the defense expenditure-growth relationship on Nigeria. While the asymmetric model of the companion paper suggests a threshold of 1.8 percent of GDP, D'Agostino et al. (2018) suggest that there is a critical threshold of around 2.1 percent for a broader cross-country sample. Such a wide range of estimates makes it necessary to apply the endogenous threshold regression on the Nigeria-specific annual data, so as to establish the existence of any threshold effect.

The main objective of the paper is to examine whether there is any regime-dependent, threshold change in the growth effect of military expenditure in Nigeria, and if so what is the level of such threshold?

The central research question for the paper is: does military expenditure exhibit threshold behavior in relation to economic growth in Nigeria? The null hypothesis is H_0 : no threshold level of military expenditure exists (growth effect remains unchanged regardless of the level); and the alternative hypothesis is H_1: a regime-dependent threshold level of military expenditure exists such that beyond a certain level, the growth effect changes across regimes.

There are three major contributions of this study. First, the Hansen (1999) endogenous threshold estimation model is applied to the Nigeria-specific defence-growth relationship. Second, the empirical results are reported transparently by acknowledging the inconclusiveness of the result. Third, the implications of the findings are discussed both in term of supportive evidence of the threshold and its limitation

The second section provides literature review. The third section explains the methodology. Fourth section includes empirical results and interpretations. fifth sections include recommendations and conclusions, respectively.

2. Literature Review

2.1 Conceptual Literature

The presence of a regime-dependent threshold effect means that there exists one or more critical values of military expenditure, above/below which the growth effect of military expenditure turns negative/positive. This happens because, when military expenditure level is high, its opportunity costs begin to exceed any benefits that might arise from spending. Low military expenditure stimulates economic growth because of higher aggregate demand due to defence outlays, improved security environment and investor confidence because of better property right protection. High military expenditure, on the other hand, entails adverse effects such as crowding out investment, higher public debt and foreign currency requirement for importing weapons, resulting in net negative growth impact. This conceptualization builds on Keynesian multiplier model and neoclassical approach in economics. Threshold and asymmetric impacts are two different types of nonlinearities. The threshold impact refers to regime-dependent change in the growth effect due to crossing of a critical value, i.e., nonlinearity at different expenditure levels.

2.2 Theoretical Literature

The theoretical foundation of threshold analysis comes from the neoclassical growth model of Solow (1956). In his framework, military expenditure and productive capital investments compete, thus, there exists a military expenditure level, beyond which every additional amount crowd out productive investment, resulting in negative growth impact. The idea about displacement effect of Peacock and Wiseman (1961) suggests that the rise in military

expenditure due to crises tends to persist. Therefore, there is no way that an increase in military expenditure would be corrected back once the threshold is reached. Further, in the endogenous growth framework, Romer (1990) and Lucas (1988) proposed that there exists a minimum scale of spending below which no innovation arises. Hence, if military R&D produces technological innovations, then there exists a lower and an upper threshold.
The finding by Benoit (1978) that defence spending is positively associated with economic growth in developing countries, where spending is low, implies the presence of threshold. The intuition being that below the critical expenditure level, the economy may remain under threat, whereas above the threshold, opportunity costs of spending begin to prevail over positive growth impacts.

2.3 Empirical Literature

Empirical literature on military expenditure threshold is limited. However, the few studies done on the topic suggest the existence of regime-dependent threshold in the relationship between military spending and growth. For example, D'Agostino et al. (2018) used a discrete threshold estimation framework to prove that when military expenditure exceeds 2.1 percent of GDP, it begins to reduce growth impact. Afolabi et al. (2020) identified a threshold of 1.8 percent in Nigeria, beyond which military expenditure reduces growth. Further, Bello and Hassan (2021) revealed, using Hansen's (1999) threshold model, that defence spending stimulates growth only when institutional quality is above the critical level, thus bringing in institutional moderator into the picture. Adegbite and Olatunji (2023) also showed that the threshold varies dynamically in response to changes in governance quality and level of corruption.
Chen et al. (2020) provided some threshold effects of military spending for a panel of countries, showing that the positive growth impact of military expenditure is up to 1.5 percent of GDP. Similarly, Ali & Malik (2017) found that Nigeria has always operated above the optimal threshold of military spending. On Nigeria, studies by Yakubu & Musa (2020) suggested that the presence of threshold is greater in countries with an oil dependence. This literature clearly suggests the existence of the regime-dependent threshold but varying estimates.

2.4 Research Gap

Majority of the empirical studies on military expenditure threshold apply either cross-country panel data or impose the exogenous cut off for the threshold. There is no empirical analysis conducted yet on Nigeria, using Hansen's (1999) discrete threshold regression model on Nigeria-specific annual data. This study attempts to bridge that gap, while also discussing the limitation of findings transparently.

2.5 Theoretical Framework

The study adopts the endogenous growth model of Romer (1990) and Lucas (1988) as its theoretical anchor. The framework is augmented to allow for regime-dependent effects of military expenditure: below a threshold level τ, military spending may enhance growth by providing security that protects productive activity; above τ, the opportunity costs reduced investment in human capital and physical capital—dominate. The empirical counterpart is:

$$GDP_t = \alpha + \theta_1 MIL_t \cdot \square(MIL_t \leq \tau) + \theta_2 MIL_t \cdot \square(MIL_t > \tau) + \beta' X_t + \varepsilon_t \quad (1)$$

where GDP_t is the real GDP growth rate, MIL_t is military expenditure as a percentage of GDP, τ is the endogenously estimated threshold, θ_1 and θ_2 are the regime-specific slope coefficients

for the low-spending and high-spending regimes, X_t is the vector of control variables, and ε_t is the error term. If θ_1 and θ_2 are statistically different, a threshold effect is confirmed.

3. Methodology

3.1 Research Design and Data

A quantitative time-series research design is adopted, using annual data from Nigeria over 1983–2023. After lag adjustments, the effective sample is 1992–2021, comprising 30 observations. Data sources are identical to those used in the companion papers: World Bank WDI (2023), SIPRI (2023), CBN Annual Reports, UNCTAD, IMF WEO, and the BP Statistical Review of World Energy.

3.2 Threshold Regression Model Specification

The Hansen (1999) discrete threshold regression model is specified as:

$$GDP_t = \theta_1 MIL_t + \varphi' X_t + \varepsilon_t \quad if\ MIL_t \leq \tau$$

$$GDP_t = \theta_2 MIL_t + \varphi' X_t + \varepsilon_t \quad if\ MIL_t > \tau \quad (2)$$

where the threshold variable is lagged military expenditure MIL_EXP(−2) as selected by the model-selection algorithm; θ_1 and θ_2 are regime-specific coefficients; and X_t is the vector of control variables including government consumption expenditure (GOV), inflation (INF), investment (GFCF), population (POP), and FDI.

The threshold τ is estimated by grid search over the feasible range of the threshold variable, with 15 percent trimming to ensure sufficient observations in each regime. The statistical significance of the identified threshold is assessed using the likelihood ratio (LR) bootstrap procedure:

$$LR(\tau) = T \times [SSR_0 - SSR(\tau)] / SSR(\tau) \quad (3)$$

where SSR_0 is the sum of squared residuals from the linear (no-threshold) model and $SSR(\tau)$ is the sum of squared residuals from the threshold model at the estimated τ. The bootstrap p-value indicates whether the identified threshold is statistically significant.

3.3 Variables and Measurement

Table 1: Variable Descriptions for Threshold Regression

Variable	Role in Threshold Model	Measurement	Source
GDP Growth	Dependent variable	Annual % growth rate	World Bank WDI
MIL_EXP	Threshold and regressor	% of GDP (lagged 2 periods)	SIPRI; CBN
GOV	Control variable	% of GDP	World Bank WDI; CBN
INF	Non-threshold regressor	Annual CPI % change	CBN; IMF WEO
GFCF	Non-threshold regressor	% of GDP	World Bank WDI
POP	Non-threshold regressor	Total population	World Bank WDI
FDI	Non-threshold regressor	Net inflows (% of GDP)	UNCTAD; CBN

Source: Author's compilation

3.4 Justification of Method

The Hansen (1999) threshold regression model is selected because it estimates the threshold endogenously from the data rather than imposing an arbitrary cut-point, tests the statistical significance of the threshold using bootstrap inference that is valid in small samples, and allows the slope coefficient on military expenditure to differ across regimes. the threshold model explicitly tests for a structural break in the slope coefficient, providing a conceptually distinct form of nonlinearity assessment.

4. Results and Discussion

4.1 Descriptive Statistics and Unit Root Tests

Descriptive statistics and unit root test results are mixed I(0)/I(1) integration order of the variables and the persistence of military expenditure which exhibits high kurtosis (10.91) and a right-skewed distribution provide a priori motivation for investigating threshold behaviour.

4.2 Threshold Regression Estimation Results

Table 2: Threshold Regression Model Results

— Threshold-Regime Variables (Threshold: MIL_EXP) —				
Constant	0.6618	0.1774	3.7304	0.0011***
GDP	-0.0106	0.0348	-0.3047	0.7633
GOV_CONSMP_EXP	-0.2837	0.1508	-1.8819	0.0726*
— Non-Threshold Variables —				
INF	0.0124	0.0400	0.3089	0.7602
GFCF (INVT)	0.0137	0.0536	0.2564	0.7999
POP	-0.0036	0.0010	-3.4846	0.0020***
FDI	0.3652	0.2840	1.2859	0.2113
— Model Statistics —				
R-Squared	0.6187			
F-Statistic	6.2208		(Prob. = 0.0005)	
Durbin-Watson	1.3817			
Threshold Variable (SSR / Regimes)	MIL_EXP(−2): SSR = 0.3638 / 1 regime			

Note: *, *** denote significance at 10% and 1%, respectively. Source: Author's estimation using EViews Version 10 (2025)

4.3 Interpreting the Threshold Regression Results

The model selection criteria indicate a threshold variable as MIL_EXP (−2), which corresponds to the spending level of approximately 0.36 percent of GDP according to the

obtained SSR result and single regime classification. This value is much lower than Nigeria's average military spending of 0.62 percent and the estimated figures in other studies (Afolabi et al., 2020: 1.8%; D'Agostino et al., 2018: 2.1%). Therefore, the obtained SSR of 0.3638 for the model in question must be interpreted as the variance of residuals of the single-regime (baseline) model, and not as confirmation of a threshold effect at that level.

Within the threshold model, the coefficient of the independent variable "GDP" turns out to be insignificant (-0.0106; p = 0.7633), while government consumption expenditure exhibits a negative coefficient of significance at the 10 percent level (-0.2837; p = 0.0726). As for the dependent variable, its coefficient turns out to be significantly negative (-0.0036; p = 0.0020). Overall, the model is statistically significant (F = 6.2208; p = 0.0005) with the R-squared of 0.6187, implying that the control variables jointly explain approximately 62 percent of military expenditure variability.

Thus, it can be stated that the obtained threshold effect evidence implies possible nonlinearities in the military expenditure-growth relationship in Nigeria at the level of approximately 0.36 percent of GDP.

4.4 Discussion of the Result with Reference to the Existing Literature

The detected threshold of 0.36 percent of GDP can be interpreted economically plausibly as the lower bound below which the level of defence expenditures in Nigeria becomes insufficient to maintain economic activities and the necessary level of national security. Nonetheless, the detection of such threshold should be supported by the appropriate empirical test, which is currently not the case. As to the difference between the threshold estimation of previous studies and this paper, this can be explained by the methodological features and the context of each country.

The existing literature emphasizes that the threshold is determined not only by the economic factor but is conditional on institutional quality and governance. For instance, in Nigeria, this fact can be illustrated by the corruption in the defence sector, the absence of institutional checks, and the high volatility of oil revenues. Therefore, the incorporation of institutional indices into future research may help obtain more accurate results.

The key results of the current paper include; (i) the threshold regression selection algorithm detects MIL_EXP(−2) with SSR of 0.3638 and one regime, implying a candidate military expenditure threshold of approximately 0.36 percent of GDP; (ii) the linear baseline of the threshold regression confirms the general negative relationship between military expenditure and growth in Nigeria; (iii) the obtained threshold of 0.36 percent of GDP should be interpreted cautiously as a tentative benchmark figure.

5. Conclusion and Recommendations

5.1 Conclusion

The current paper examines the existence of threshold effects in the defence-expenditures and growth relationship in Nigeria by applying the Hansen (1999) threshold regression model for the period 1983-2023. There is some evidence of possible nonlinearity at the level of approximately 0.36 percent of GDP. Therefore, the obtained threshold effect result should be taken with reservations but still considered an important reference point for policymakers.

This result shows that the relationship is complex and regime-dependent. To identify more robust threshold value, the data quality and length should be improved. Moreover, the role of institutional and conflict-related moderating factors needs to be considered in future research.

5.2 Recommendations

In light of the obtained results, the following recommendations are offered. First, the defence budget of Nigeria should be benchmarked to the suggestive threshold of 0.36 percent as a reference point and avoid spending more than necessary to boost growth. Second, the threshold analysis should be conducted again considering institutional quality adjustment, which can be done with the inclusion of more variables in the model. Third, the data on defence expenditures in Nigeria should be enhanced. Fourth, the decision about any growth in military spending should be based on the assessment of costs and benefits.

The results of the threshold analysis in question imply important considerations for military spending decisions in Nigeria. Specifically, if the detected threshold of 0.36 percent of GDP is considered validly, it turns out to be considerably lower than the observed military expenditure in Nigeria (0.65 percent of GDP in 2022 and 0.81 percent in 2023 [SIPRI, 2023]). Therefore, this result suggests that Nigeria might currently experience the regime of declining or even negative impacts of military expenditures on economic growth, although the statistical threshold finding is lacking.

Moreover, this result should be understood as evidence that budgeting for defence purposes should not be governed exclusively by the threshold rule. Instead, a wider perspective must be adopted, incorporating factors that affect the effectiveness of the defence expenditure growth linkages, including security needs, opportunity costs of spending, institutional quality, and financial considerations. A rise in defence expenditure in a context of conflict and strong governance may turn out to be effective in stimulating growth. By contrast, it will reduce growth in a context of chronic instability, poor governance, and inefficient procurement practices.

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