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External Debt And Financial Performance In Nigeria Economic Growth

Jimoh Tajudeen Shola & Odukoya Olusoji Olumide (Ph.D.)

Department of Accounting, Finance and Taxation,
Caleb University Imota, Lagos

ABSTRACT
This study focuses on examining the effect of external debt and financial performance on the economic growth of Nigeria. The study employs the expost facto research design and makes use of secondary data from 1999 to 2023. The multiple regression model was used to analyze the effect of external debt and financial performance on the economic growth of Nigeria. The result of the analysis reveals that external debt has a positive non-significant influence on economic growth in Nigeria. While financial performance has a positive nonsignificant influence on economic growth. This study also shows that economic capacity has a negative non-significant influence on economic growth in Nigeria. Finally, the study reveals that capital formation has a significant inverse influence on economic growth in Nigeria. It is concluded from the study that that external debt and financial performance does not have a significant influence on economic growth in Nigeria. Finally, it is recommended that controls should be strictly placed to ensure that external debts subscribed to are judiciously used for the purpose in which they were gotten.
Keywords: Capital formation, Change in GDP, Economic capacity, External debt rate, financial performance

1. INTRODUCTION

External debt is a part of the economic tools used to fund activities in the economy that will lead to economic growth. In the world today, the developed countries are also recipient of debt financing to drive economic activities within their economies.

However, in the cases of developed economies, a high tax revenue in proportion of debt financing indicates that the government possesses robust institutional mechanism for revenue collection, reducing the need for excessive borrowing to meet public expenditure demands (Ebenezer et al., 2025). While developing countries show a record of low tax revenue to debt funding which is a source of concern as it is a signal non-sustainable financing as the revenue to service the debt is low and might not be able to meet up with the obligation. In addition, developing countries are marred with the existence of corruption which is also responsible for the low level of utilization efficiency of public debt (Todaro & Smith, 2020).

Furthermore, countries such as Nigeria are also faced with the challenges of foreign exchange volatility due to the fall in the value of their currency with makes is more expensive to service such debt and leading to a drop in funds available for the government to use in funding activities. Nigeria cost of debt service in recent years rose sharply due to the fall in the value of the country's currency (Naira) (Onifade et al., 2020).

On the other hand, the level of economic growth among countries in the world was reduced with the occurrence of the COVID19 virus outbreak in the year 2020. In Nigeria, COVID19 led to a decline in the gross domestic product with speculations that the economy had fallen into depression (World Bank 2025). However, for any economy to be classified as depressed, it should have experienced a negative growth

rate of more than once consecutively. Even though Nigeria has been declared not to be depressed, the economic growth rate is at a low rate which is an indicator of the level of economic activities. Proponents have explained that government activities such as public expenditure stimulate the economic level of activity. It is important to note that government expenditure is a direct function of the total income generated, and the public debt sourced (Yusau & Okwechime, 2025).

Unlike the private sector where financial performance can be easily determined, the public sector is not easily measured by financial performance but by service delivery. Scholars have linked the variety in performance measurement of the public sector to the rising need for debt funding (Krugman, 1988). Also, it appears that debt financing have a varying influence on the economic activities of the country.

Hence, the need to examine how these factors influence economic development is important given the significance of economic development on the welfare of the citizens. Therefore, this study is focused on examining the effect of external debt and financial performance on the economic development in Nigeria.

Objective of the Study

The main objective of this study is to examine the effect of external debt and the financial performance on the economic growth of Nigeria. To achieve this, the following specific objectives were met which are to:

i. Determine the effect of external debt on the economic growth in Nigeria.
ii. Assess the effect of financial performance on the economic growth in Nigeria.
iii. Evaluate the effect of economic capacity on economic growth in Nigeria.
iv. Examine how capital formation influences economic growth in Nigeria.

Research Hypotheses

The following research hypotheses which are stated in their null form are tested in this study:

$H_0$1: External debt does not have a significant effect on the economic growth of Nigeria.
$H_0$2: Financial performance does not have a significant effect on the economic growth of Nigeria.
$H_0$3: Economic capacity does not have a significant effect on the economic growth of Nigeria.
$H_0$4: Capital formation does not have a significant effect on the economic growth of Nigeria.

2. LITERATURE REVIEW

Economic Development

Economic development is a broad concept that cuts across the standard of living, income, health, education and generally, the quality of life of individuals in an economy. Economic development is more encompassing compared to economic growth which is focused on the production output which is referred to as the gross domestic product (GDP) from an economy. Economic development goes beyond the production output to include the structural adjustments, poverty reduction and the equitable allocation of wealth (Todaro & Smith, 2020).

Economic development can be described as the sustained level of improvement in the economic quality and well-being of life of a group of individuals in an economy which is achieved by the creation of economic opportunities and putting machineries in place to support growth in income levels and viz a viz, the tax base. This suggests that economic development goes beyond the national output level or the accumulation of capital, but it also involves the wellbeing and capabilities of individuals (Amartya Sen, 1999).

From the description of economic development, it cuts across three dimensions which are the income and output growth dimension which has gross domestic product (GDP) and the gross national income (GNI) as the indicators. In addition, the social indicators dimension which has human development index (HDI), literacy rate, life expectancy, access to clean water and infant mortality. Finally, economic development involves structural transformation which is described as movement in the economy from primary to secondary commercial activities. For instance, agriculture to manufacturing, services among others.

North (1990) identified the quality of human capital, physical infrastructure, institutional and governance and innovation and technology, trade and investment as factors that enhances the possibility of economic development.

In addition, certain factors have been identified which inhibits the level of economic development in any economy. Such factors include but not limited to inequality and exclusion of marginalized group might not benefit from economic prosperity and might also hamper that of other groups thereby slowing down the overall level of economic development.

External Debt

External debt can be described as the total accruals a country owe other countries or external bodies which are not found within the geographical boundary or control of the indebted country. In summary, external debt in public finance can be described as foreign debt. They exist in the form of loans, credit facilities from other governments or international bodies, bonds among others. It is important to note that external debt is a key component of public finance. A fundamental feature of external debt is that the principal and interest amount are usually settled in foreign currency. External debt can be public or private.

External debt is important as it provides succor to the government to carry out its program in the period of deficit budgeting. it is function of deficit budgeting which arises from when a government plans to incur expenditure which is higher than the revenue it generates. This implies that debt financing will be used to bridge the deficit (Ajayi & Khan, 2000). In addition, trade deficits will also lead to debt financing as this is peculiar with countries that are highly import dependent as there is no commensurate value to give in exchange for goods imported therefore, this creates pressure on their currency and lead to payment more than receipt thereby creating a shortfall that needs to be addressed.

Financial Performance

Financial performance can be described as the level to which financial objectives are being achieved by any entity. It is used to determine the performance of the entity. However, the financial performance of the public sectors is not clearly cutout which makes it cumbersome to effectively measure and follow. Unlike, entities in the private sector, those in the public sector are not primarily set-up to pursue wealth but to enhance the economic well-being of their citizens. This objective is subjective and unlike the traditional financial performance metrics which include profitability, liquidity, activity or efficiency ratios, solvency and market valuation (Pandey, 2015).

Financial performance is generally influenced by a range of measures which include but not limited to cost control by ensuring prudency in incurring public debt, operational efficiency which ensures that wastages are curbed, innovation which improves efficiency and thereby cutting down cost of wastages and the style of management or leadership can actually influence cost management as a flamboyant management or leadership might lead an increase in cost and a conservative leadership might promote cost cutting measures.

Furthermore, the macroeconomic environment can influence the financial performance of both the private sector and the government (public sector). For instance, the attitude of taxpayer will determine the amount of tax revenue that can be possibly generated. Furthermore, during period of high inflation and interest rate, businesses are under pressure and as such, the profit levels are reduced, and the money government can raise is also reduced (Oduro & Kwaku, 2012).

Theoretical Review

Debt Overhang Theory

Debt overhang theory is credited to Paul Krugman in the year 1988. However, earlier trace and formation of the theory is traced to Jeffrey Sachs and Jonathan Eaton. Although Krugman in 1988 developed the strengthened the postulation of the theory with the focus on debt with special focus on developing countries in the 1980's.

The theory reveals that when a country's debt level is more than its capacity to pay back, future income and investment benefits will be more to the advantage of the creditors of the country than debtors (Krugman, 1988). This therefore demotivates debtors from providing debt finance and investors from channeling investment into the economy.

As they are disadvantaged because future economic benefits are naturally expected to flow in favor of the settlement of creditors. Hence, high debt levels create a challenge for the future generation of investment and debt financing. The theory is built on certain assumptions which include a high debt to gross domestic product (GDP) ratio for the postulation to hold. It is also assumed that investors and policy makers act rationally and predict outcomes before taking decisions. The theory is also built on the assumption that debt pardon is not readily available and as such, countries that are in debt will need to repay their debt soon. Furthermore, it is assumed that there is limited access to the capital market to raise additional funds because of their past debts. Additionally, debt repayment is a function of future output (Eaton & Gersovitz, 1981).

The theory is however being criticized as it is relative in the application as countries that are transparent still have access to debt finance and investors' confidence despite their high debt to gross domestic ratio, examples of countries that fall into such category include but not limited to United States of America, Germany among others. Furthermore, various governments employ varying techniques to manage their debt. Hence, irrespective of the level of debt, they can better still attract debt financing and investment into their economies. The theory is also critiqued for not taking into consideration all relevant factors that contribute to fiscal policy management. Examples of such structures that have a direct or indirect influence on fiscal policies include political structures, institutional mechanisms among others. Finally, the theory can be described as a conditioner to investors and debt financiers to give funds to the detriment of the economy.

Ricardian Equivalence Theory

The origin of the Ricardian theory is first traced to the classical economist, David Ricardo in the early 19th century which is why the theory is coined after his name. However, significant contribution to the development of the Ricardian equivalence theory is credited to Robert J. Barro's paper in 1974 which is titled as "Are government bonds net wealth?"

It is explained from the theory that government deficit budgeting does not affect the overall demand level in any economy. This means that when debt levels increase, it is anticipated that tax level will be increased which is the main source of government revenue and taxpayers will increase savings to meet up with future tax liabilities and thereby leaving their savings level unchanged.

The theory is framed on certain assumptions which include the rationality of consumers in incurring spendings. Consumers spending is influenced not just on their current income but in consideration of future considerations. In addition, the theory assumes that both the government and private individuals have access to the loan at the same interest rate which indicates a perfect capital market. This is also built on the premise that funds or liquidity are always available due to easy access to the capital market.

Furthermore, the theory is premised on infinite existence of individuals such that all tax liabilities will eventually be settled. It is also assumed from the theory that taxes are not existent in distortionary form but rather exist in such that the efficiency of the tax management system influences the economy to operate efficiently. Finally, it is assumed that government spending is not determined on government revenue and debt but rather, they are varied to maintain the level of spending.

The theory postulation is basically to underscore that regardless of government spending, or fiscal activities, consumers response is not severely impacted. Hence, the government fiscal activities cannot significantly influence the state of the economy

Public Choice Theory

The origin of public choice theory is traced to the year 1962 and is basically credited to have been advanced by James M. Buchanan and Gordon Tullock in a seminal paper titled "the calculus of consent: Logical foundations of constitutional democracy" (Buchanan & Tullock, 1962).

The theory attempts to describe the behavior of parties involved in the political process. The theory explains that actors pursue their own selfish interests. As politicians seek to garner as much possible votes as possible while bureaucrats attempt to increase the size and relevance of their units while voters are influenced based on the interest group that influences them. The theory shows that political decisions are framed by competition and negotiations rather than rationality.

Empirical Review

Related studies have been conducted on the theme of this study and some of them are examined to give insight into the level of work done. For instance, Yusau and Okwechime (2025) utilized a Vector Error Correction Model (VECM) to study the relationship between budget implementation and economic growth in Nigeria from 1990 to 2023. The study found a significant long-run relationship, with capital expenditure positively influencing GDP, while recurrent expenditure had a mixed effect. They emphasize the need for improved fiscal discipline and prioritization of capital investments.

Ngcobo et al. (2025) applied a Bayesian approach to study the impact of public debt on economic growth in newly democratized countries. They found that escalating public debt negatively affects economic growth, emphasizing the importance of fiscal discipline and effective taxation policies.

Ebenezer et al. (2025) explored the impact of fiscal policy on SMEs in Nigeria. The study found that fiscal policies significantly affect SME performance, suggesting that supportive fiscal measures can enhance SME growth and contribute to economic development.

Al Mamun (2025) used a Markov Switching VAR approach to study fiscal policy effectiveness during the COVID-19 crisis. The study found that targeted fiscal interventions, such as subsidies and increased government spending, effectively mitigated the adverse effects of the crisis on household savings and consumption.

Amade and Oyigebe (2024) employed an ARDL model to analyze Nigeria's fiscal deficit from 1983 to 2023. Their findings indicate that budget deficits significantly impact economic growth. They recommend transparency in fiscal operations and directing deficits toward productivity-enhancing investments like infrastructure and FDI.

3. RESEARCH METHODS

This study shows how the data will be collected in this study and processed to get full information that will shapes the outcome of this study. This chapter is broken down to show the population of the study, the sampling technique and sample size, the source of data, the validity and reliability of the research instruments, sources of data, method of data analysis, model specification among others.

4. DATA PRESENTATION AND ANALAYSES

This study shows the result of analysis carried out in this study. It reveals the result of the descriptive, diagnostic and inferential analysis carried out on the secondary data collected for the purpose of this study. The latter part of this study shows the discussion of findings which situates the result of the analysis from the position of related literature carried out in the time past

Result of the Descriptive Analysis

	External Debt	Financial Performance	Economic Capacity (X-M)	Capital Formation	Economic Growth
Mean	₦' billion 3,612.17	₦' billion - 509.29	3,968.36	8,575.32	20.08
Std. Deviation	6,933.54	1,672.63	5,404.24	1,681.12	14.47
Minimum	8.82	- 6,850.70	- 5,513.80	5,668.87	4.47
Maximum	38,219.85	1,076.10	15,795.20	12,893.80	75.27
N	42	42	42	42	42

The result of the descriptive analysis as shown above reveals that external debt is at an average of N3.6 billion for the period under review (1982-2024). The result also shows that the financial performance of the Federal government of Nigeria is a deficit of N509.29 million which shows that over the period over consideration, deficits were more reoccurring. The economic capacity, which is considered as the net difference between exports and imports, is averaged at N3.9 billion. Capital formation is averaged at N8.5

billion and the economic growth rate is averaged at 20.8% between 1982 to 2024. The result also reveals that external debt for the period ranged from N8.8 million to N38.2 billion. The result also shows that financial performance ranges between -N6.9 billion to N1 billion. Economic capacity on the other hand ranged from N5.5 billion to N15.8 billion. The result also reveals that capital formation N5.7 billion to N12.9 billion. Finally, economic growth is ranged between 4% and 75% approximately between the period under review

Estimation Techniques	**Regression Result**			
Dependent Variable: CGD	**Coeff.**	**Std. Err**	**T-Stat**	**Prob**
Constant	46.52	12.54	3.74	0.001
EDR	0.34	0	0.81	0.422
FPE	0.28	0	0.65	0.522
ECA	-.01	0	-0.53	0.596
CFN	-0.36	0	-2.07	0.046
Adjusted R^2	0.08			
F-Stat	$F_{(4, 42)} = 1.9$ (0.129)			

Source: Researcher's Analysis (2025)

The result from the table can be used to express the study model as shown below:

$CGD = a + \beta_1 EDR_i + \beta_2 FPE_i + \beta_3 ECA_i + \beta_4 CFN_i + \mathcal{E}_i$

Where:

CGD= 46.53 +0.34 (x) +0.28 (x) – 0.1 (x) – 0.36 (x)

The model means that economic debt which is represented with a positive integer shows that the higher the level of economic debt is incurred, the greater the level of economic growth to be experienced. The financial performance integer is also positive and follows the same direction with economic debt, showing that when surplus financing is practiced, economic growth level is sustained. However, the integers for economic capacity and capital formation reveal that the higher they increase lower economic growth. This shows that they move in the opposite direction and suggests that economic growth is stirred by the government.

The result also captures the point that proxies used in this study to explain and predict economic growth only explains 8% of what happens in economic growth. It further shows that 92% of influence in economic growth is experienced from variables outside the focus of this study.

DISCUSSION OF RESULTS

Based on the result from this study, the research questions from this study are answered and discussed in the veil of existing literature.

Research Question One: What is the effect of external debt on the economic growth in Nigeria?

From the result of the analysis in this study, external debt has a positive non-significant influence on economic growth in Nigeria. This is in contrast with the position of Keweloh (2023) who opined that external debt would have a significant influence on the economic growth level. Ngcobo et al. (2025) on the other hand discovered that escalating public debt negatively affects economic growth, emphasizing the importance of fiscal discipline and effective taxation policies.

The variation in results might be due to the varying prevailing economic factors in the different countries even though Ngcobo et al (2025) looked at democratic countries, which also characterizes Nigeria, differences exist even among the various democratic countries. Keweloh (2023) on the other hand carried out highly theoretical research by reviewing various models to arrive at the propositions from the study

Research Question Two: How does the financial performance of affect the economic growth in Nigeria?

The results of the analysis show that financial performance has a positive non-significant influence on economic growth. This is in tandem with Ozili (2024) position that shows that positive budgeting

translates to economic growth. This means that surplus leads to economic growth. Yusau and Okwechime (2025) however share a divergent view as they pointed out that a significant long-run relationship, with capital expenditure positively influencing GDP, while recurrent expenditure had a mixed effect. They emphasize the need for improved fiscal discipline and prioritization of capital investments. The argument is that government objective is not to make profit but rather welfare by providing public goods. Although, this study shows that the financial viability of the government can influence the level of economic growth. This is possible as a viable public sector is more attractive for the purpose of assessing public loans and which means more spending to stimulate the economy and invariably will lead to economic growth. This is amplified by the position of Ebenezer et al (2025) who showed how government spending can influence SMEs to boost their activities such that they grow in operations, and the resultant effect is felt on the economy.

Research Question Three: To what extent does economic capacity influence the economic growth in Nigeria?

The result from this study shows that economic capacity has a negative non-significant influence on economic growth in Nigeria. This means that the higher the level of economic activities the more the depletion of the economic welfare. However, this is not significant. This agrees with Effiong et al. (2024) who pointed out the non-significant inverse relationship between manufacturing activities and economic growth. This also points to the direction that the private sector activities alone cannot influence the level of economic growth. This study is also in contrast with Ali et al. (2024) who revealed that increases and decreases in government position have different impacts on economic growth. This position, unlike the result from this study, shows that the position of government does influence the level of economic growth in the country.

This is in tandem with the public choice theory that shows how various economic agents pursue their various selfish purposes.

Research Question Four: What is the effect of capital formation on the level of economic growth in Nigeria?

The result from this study shows that capital formation has a significant inverse influence on economic growth in Nigeria. The study agrees with Ali et al (2024) who opined that fiscal activities do have a significant influence on economic growth. However, this study shows that the direction of influence is being inverse. This means that the net-off export and import saved within the economy within the period diminishes the level of economic growth. This can mean that the exports level is not high compared to the imports and suggests that more is needed to increase exports.

5. CONCLUSION AND RECOMMENDATION

The focus of this study is to examine the effect of external debt and the financial performance on the economic growth of Nigeria. The outcome from this study shows external debt has a positive non-significant influence on economic growth in Nigeria. While financial performance has a positive non-significant influence on economic growth. This study also shows that economic capacity has a negative non-significant influence on economic growth in Nigeria. Finally, the study reveals that capital formation has a significant inverse influence on economic growth in Nigeria.

External debts are necessary to meet shortfall internal resources and stimulate the economy. However, it must be properly utilized to avoid serious consequences. Borrowing is not the most important issue but the use to which the fund is deployed. This should be the most important thing agitating the mind of any good accountant and Economist whenever external debt is contemplated. It should be approached with caution, ensuring optimal utilization and higher return than the interest (cost of fund).

It is therefore concluded from this study that external debt and financial performance does not have a significant influence on economic growth in Nigeria

RECOMMENDATION

Based on the findings from this study, the following recommendations are given:

1. Controls should be strictly placed to ensure that external debts subscribed to are judiciously used for the purpose in which they were gotten
2. Government revenue and government expenditure should be managed such that government revenue is more than government expenditure as this steers the economy towards growth even though it might not be significant as per the outcome from this study.
3. Promote Transparency and Accountability: Strengthen anti-corruption agencies like EFCC and ICPC to monitor and audit the use of loan funds
4. Government policies and activities need to be geared up to enhance activities that increases the level of export and invariably the level of economic growth in Nigeria.
5. Establish real-time monitoring mechanisms for debt-financed projects to ensure they stay on track

Contribution to Knowledge and Future research

Theoretical Contribution

The outcome from this study goes further to re-validate the Ricardian experience theory and public choice as being valid even in contemporary time.

Empirical Contribution

The outcome from this study shows practical evidence as data gotten were tested and serves as a prove in predicting the relationship between external debt, financial performance and economic performance in Nigeria.

Methodological Contribution

The variables used in this study can serve as a reference point to future researchers and guide them in carrying out future research.

REFERENCES

Al Mamun, A. (2025). Assessing fiscal policy effectiveness on household savings in Hungary, Slovenia and the Czech republic: A Markov switching VAR approach. *arXiv Preprint*. From https://arxiv.org/abs/2503.15584

Ali, A. M., Mohamed, J., & Mohamed, M. O. (2024). Asymmetric modeling of the fiscal policy economic growth nexus in Somalia: Evidence from a Nonlinear ARDL approach. *Cogent Economics & Finance, 12*(1).

Amade, P., & Oyiege, A. (2024). *Budget deficit and economic growth in Nigeria (1983-2023): An ARDL approach.* Higher Education Press.

Amartya, S. (1999). *Development as freedom.* Oxford: Oxford University Press.

Blanchard, O., & Perotti, R. (2024). The role of fiscal policy: A survey of revent empirical findings. *Open Economies Review, 35*(1). From https://link.springer.com/article/10.1007/s11079-024-09759-4

Buchanan, J. M., & Tulloack, G. (1962). *The calculus of consent: Logical foundations of consitutional democracy.* Michigan: University of Michigan Press.

Downs, A. (1957). *An economic theory of democracy.* New York: Harper and Row.

Eaton, J., & Gersovitz, M. (1981). Debt with potential repudiation: Theoretical and empirical analysis. *Review of Economics Studies, 48*(2), 289-309.

Ebenezer, A. M., Efemena, E. O., & Enitan, O. O. (2025). Fiscal policy and small and medium scale enterprises performance in Nigeria. *Journal of Economics and Management, 10*(1), 33-45.

Effiong, C. E., Umeh, F. O., & Udo, A. I. (2024). Fiscal policy, interest rate and the manufacturing sector performance in Nigeria: Evidence from ARDL approach. *MPRA Paper No.120679*, 1-20.

Krugman, P. (1988). Financing vs forgiving a debt overhang. *Journal of Development Economics, 29*(3), 253-268.

Mueller, D. C. (2003). *Public choice III.* Cambridge: Cambridge Univeristy Press.

Ngcobo, M., Zungu, L. T., & Nkomo, N. Y. (2025). The dynamic effect of public debt on economic growth in newly democratised countries: A Bayesian approach. *International Journal of Development Issues*. From https://www.emerald.com/insight/content/doi/10.1108/ijdi-07-2023-0188/full/html

Onifade, S. T., Cevik, S., & Bekun, F. V. (2020). An empirical restrospect of the impacts of government expenditures on economic growth: New evidence from Nigeria. *Journal of Economic Structures, 9*(1), 50-65.

Ozili, P. K. (2024). Impact of financial stability on economic growth in Nigeria. *MPRA Paper No. 120776*. From https://mpra.ub.uni-muenchen.de/120776

Riblier, C. (2023). The fiscal cost of public debt and government spending shocks. *arXiv* . From https://arxiv.org/abs/2309.07371

Tendengun, I., Kapingura, F. M., & Tsegaye, A. (2022). Fiscal policy and economic growth in South Africa. *Economies, 10*(9), 1-14.

Todaro, M. P., & Smith, S. C. (2020). *Economic development* (13th ed.). Pearson.

UNDP. (2025, May 29). *UNDP*. From UNDP: https://hdr.undp.org

World Bank. (2025, May 29). *World Bank*. From World Bank: https://databank.worldbank.org/source/world-development-indicators

Yusau, M., & Okwechime, I. (2025). Assessing the impact of budget implementation on economic growth in Nigeria. *International Journal of Research and Innovation in Social Science, 9*(3), 5-15

Zhou, Y., Liu, H., & Zhang, L. (2024). How do financial variables impact public debt growth in China? Evidence from a Markov regime-switching model. *ArXiv Preprint*. From https://arxiv.org/abs/2407.02183