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Research Paper

Empirical Evaluation of Public-Private Investment Synergies and their Implications for Nigerian Economic Growth

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ABSTRACT
Using annual time series data on real gross domestic product, private investment (measured by gross fixed capital formation), public investment (measured by government capital expenditure), exchange rate, and interest rate spread, this study conducted an empirical assessment of public-private investment synergy and its implications for Nigeria's economic growth. To ascertain whether there is a long-term correlation between governmental and private investment and economic growth in Nigeria across time, the study used the ARDL Bounds Testing methodology. The study's goal is to ascertain how Nigeria's economic growth is impacted by the interaction between governmental and private investment. The outcome showed that the model's variables are co-integrated. The findings also indicated that, both in the short and long term, private and public investment had no statistically significant effects on Nigeria's economic growth during the period under study. Accordingly, the study suggests that the government should create investment policies that will promote the growth of both private and public investment in Nigeria. These policies should include the establishment of business environments that are favorable enough to draw in private investment as well as sound investment that would promote sustainable economic growth in the nation.

KEYWORDS: ARDL, Economic Growth, Public Investment, Private Investment, Nigeria

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I. INTRODUCTION

Nigeria, like the majority of developing countries, yearns for sustainable and swift economic expansion. Investment is one of the most important things that any country can do to get quick and long-lasting economic growth. According to Coen and Eisher (1992), is the process of forming capital, which is getting or making resources Investmentthat can be employed in production. Investment can be made by the government, non-profit organisations, and households. It includes the purchase of both physical and intangible capital as well as human capital. It is a major driver of economic growth and a key part of total demand. Jongwanich and Kohpaiboon (2008) noted that alterations in investment influence aggregate demand and enhance the productive capacity of an economy.

Udeze et al. believed that when the federal, state, and local governments invest in public goods, they build up the nation's capital stock by giving money to basic physical infrastructure (like roads, bridges, rail lines, airports, and water distribution), innovative activity (like basic research), green investments (like clean power sources and weatherization), and education (both primary and advanced, as well as job training). According to Onwuka 2024, government policy has a big impact on Nigeria's investment environment.This leads to higher production and/or better living standards. Individuals also invest in these sectors, albeit at a far lesser extent, partly because the benefits of public investment accrue not only to the investors but also to enterprises. Levine and Renelt (1992) assert that investment in capital goods is the most robust and essential determinant of economic growth. Gross domestic investment boosts economic growth by directly and indirectly expanding physical capital through technology spillovers.

Economic growth, sometimes indicated by GDP, as Balami (2006) observed, pertains to the augmentation of an economy's ability to generate commodities and services essential for enhancing the welfare of its populace. It is an ongoing process that entails augmenting the output of products and services inside the economy. When the pace of growth is substantially higher than the rate of population expansion, it is important since it should lead to better living conditions for people. So, growth happens when the economy's productive capacity and national income both go up over time. This happens when per capita output and total factor productivity both go up. This study conducted an empirical evaluation of the synergy between public and private investment and their implications for sustainable economic growth in Nigeria. Nigeria, as one of the Less Developed Countries (LDCs), confronts fundamental problems in achieving a significant and sustained increase in output while improving the population' standard of living. This will transform their economic, political, and social conditions in a big way. To make this vision a reality, many mechanisms that encourage investment need to be thought upon.

1.1 Question for Research

This research question directed the investigation:

How does the relationship between private and public investment affect Nigeria's economic growth? The overarching aim of this study was to objectively evaluate the synergy between public and private investment and its implications for sustainable economic growth in Nigeria.

1.2 Basic Theories

Keynesian Investment Theory

Keynes (1936) developed his investment theory predicated on 'animal spirits.' He said that even while savings and investments must be the same after the fact, different people usually make the decisions about savings and investments. This means that there is no reason why savings after the fact should equal investments before the fact. Keynes defined an investment function as $I = I0 + i(r)$, where I represents investment, I0 signifies autonomous investment, and i(r) denotes interest rates. Interest rates and investment are related in the other way. The greater the interest rate, the less likely the company is to want to do any given investment project. Keynes said that businesses should prioritize different investment projects based on their internal rate of return (IRR), which is the same as the marginal efficiency of investment. Firms would take on projects with an IRR that was higher than the interest rate. The main critique of this idea was that the order of investments may depend on interest rates.

II. LITERATURE REVIEW

The Neo-Classical Model of GrowthTheory

Robert Solow came up with the Neo-Classical Model of Growth. The model posits that a prolonged rise in capital investment enhances the growth rate only temporarily. This is because the ratio of capital to labor goes up (there is more capital available for each worker to use) but the marginal product of additional units of capital is assumed to decline. The economy eventually moves back to a long-term growth path, with real GDP growing at the same rate as the workforce plus a factor to reflect improving "productivity." When production, capital, and labor all expand at the same rate, the economy is said to be on a "steady-state growth path." This means that output per worker and capital per worker stay the same. Neo-Classical economists assert that elevating an economy's long-term trend rate of growth necessitates an augmentation of the labor supply and an improvement in the productivity of labor and capital. It is stated that the difference in the rate of technical progress explains a lot of the difference in economic growth between industrialized countries. The neo-classical paradigm posits productivity advancements as an exogenous variable, implying that productivity is regarded as independent of capital investment (IMF, 2001).

Empirical Literature

Enya and Ezeali (2021) examined public investment in infrastructure and Nigeria's economic growth. The research utilized econometric analysis with E-View. The stationarity test conducted in the study revealed that all variables were stationary at the first difference, I(1). Consequently, the researchers proceeded to investigate evidence of co-integration among the variables. The results of the co-integration test indicated the presence of two co-integration equations, demonstrating a long-run relationship among the variables. The ECM test was well signed, with a value of -0.019307 and a good adjusted coefficient of determination of 92.78%. The combined statistical probability was 0.00000. The analysis found that public spending on technology, schools, and power all had a good effect on the economy, whereas spending on transportation had a bad effect. The study indicated that public investment was crucial in strengthening the Nigerian economy, particularly during this democratic age.

Garikai & Nicholas (2019) analysed the relative impact of public and private investment on economic growth in Malawi from 1970 to 2014, employing the newly established autoregressive distributed lag model (ARDL) bounds testing methodology. They also noticed how governmental investment can either push private investment out or pull it in. This study, in contrast to most prior research on the topic, which were cross-sectional, investigated the varying effects of public and private investment on economic growth, with an emphasis on Malawi. The primary conclusion of the study was that private investment has a greater impact on economic growth than public investment. After first differences, the variables PCGDP, PINV, PUINV, RIR, and INFLA became stable. The Johansen co-integration test, utilizing trace and maximum Eigenvalue statistics, was employed to determine the long-run equilibrium relationship among the model variables. The over-parameterized and parsimonious ECM was predicted to facilitate short-run dynamic adjustments necessary for achieving a stable long-run equilibrium relationship among the model's variables. The study showed that a stable macro economy and low, predictable inflation rates are very important for private investment to respond strongly to economic incentives.

III. RESEARCH METHOD

The research design for this study is Ex-Post Facto, which means "after the fact" or "retrospectively." This type of research looks at an existing condition or state of affairs and tries to find possible causal factors by looking back in time. The research design establishes a causal relationship between the dependent and independent variable(s). Consequently, the researcher lacks control over the variables being examined, as these variables have been already altered prior to their use in this study. Based on the preceding information, this study will analyze and rely on previously published data.

3.1 Theoretical Framework

This research is based on the Solow-Swan aggregate production function, as utilized in Ghura (1997) and Beddies (1999). To determine the influence of private and public investment on Nigeria's economic growth, the study employed a modified Solow-Swan aggregate production function, incorporating three categories of capital stocks: private capital stock, government physical capital stock, and human capital stock. The production function is expressed as:

$Yt = At(Kt^p)^\propto(Kt^g)^\beta(Zt^p)^y\ Zt = Lt \text{ and } HLt \quad (3.1)$

Y is output; A is technology; Kp and Kg are the private and government physical capital stocks, respectively; and Z is labour (L) that has been adjusted for human capital development. (HLt); and t is a time marker. You can write Equation (3.1) in terms of growth rate like this:

$y = a + \propto K^p + \beta K^g + yK^z \quad (3.2)$

where a lowercase letter for a variable stands for its rate of growth. Equation (3.2), which shows a long-term relationship between economic growth, can be computed as long as there is data on capital stocks. Sadly, underdeveloped economies like Nigeria usually don't have access to this kind of data. Still, equation (3.2) can be turned into an estimable version, equation (3.3), by making some simplifying assumptions about physical capital stocks.

$y = a + \propto PIYt + \beta GIYt + yHLt + \varpi PIYt + \boldsymbol{\varepsilon}t \quad (3.3)$

where

Y = actual output

A = development in technology

KP = private physical capital stock
Kg = the amount of public physical capital
Z = labour force (L) plus human capital development (HL) and
t = the time index.
The parameters ∝, β, and y represent the elasticities of output concerning private, government, labour force, and human capital stocks, respectively.

Tests Before Estimation
Test for Unit Root
The ADF Unit root test is used to find out if the time series data being looked at is stationary. This is to prevent the emergence of spurious regression resulting from a non-stationary series. The augmented Dickey-Fuller (ADF) test statistics will be compared to the crucial values at a 5% significance level. If the (ADF) test statistic is greater than the critical values when the absolute values are taken into account, the data at the tested order will be considered stationary. The tests are performed with or without a deterministic trend (t) for each series. The main version of the (ADF) test is estimated using three models that show a pure random walk, a random walk with drift, and a random walk with drift and trend:

where: .
The null hypothesis is and the alternative hypothesis is. If the ADF test statistic (the t-statistic of the lagged dependent variable) is smaller than the crucial value, we reject the null hypothesis and say that the series is stationary (there is no unit root).

Setting up the model
Based on equation (3.3) above, the model for this investigation is written as:
RGDP = f(PRINV, PUBINV, PRINV*PUBINV, EXCH, INTR) (3.4)
where
RGDP stands for real gross domestic product, which is a way to measure economic growth.
LNPRINV = Private investment (measured by Gross Fixed Capital Formation)
LNPUBINV stands for public investment, which is shown by government capital expenditure.
LNPRINV*LNPUBINV = Interactive Term (for the interaction of private and public investment)
EXCH is the exchange rate.
INTR = the difference between interest rates
β1 - β7 = The values that need to be found for each independent variable.
U = the error term
A priori: $\beta 1 > 0$, $\beta 2 > 0$, $\beta 3 > 0$, $\beta 4 > 0$, and $\beta 5 < 0$.
We transform all the variables in equation (3.4) into logarithmic form, except for the exchange rate and interest rate. This makes them all the same and keeps the growth status. Interest rates and exchange rates are already in rates, thus they don't need to be logged. We can also write Equation (3.4) in econometric form like this:

$$LNRGDP = \beta 0 + \beta 1LNPRINV + \beta 2LNPUBINV + \beta 3LNPRINV*LNPUBINV + \beta 4EXCH + \beta 5INTR + U \quad 3.5$$

to be computed as per the ARDL model outlined in equation (3.6):

$$LNRGDP = \beta_0 + \beta_1 LNPRINV_{t-1} + \beta_2 LNPUBINV_{t-1} + \beta_3 LNPRINV*LNPUBINV_{t-1} + \beta_4 EXCH_{t-1} + \beta_5 INTR_{t-1} + \sum_{i=1}^{k} \delta_{1i} \Delta LnRGDP_{t-1} + \sum_{i=1}^{k} \delta_{2i} \Delta LNPRINV_{t-1} + \sum_{i=1}^{k} \delta_{3i} \Delta LNPUBINV_{t-1} + \sum_{i=1}^{k} \delta_{4i} \Delta LNPRINV*LNPUBINV_{t-1} + \sum_{i=1}^{k} \delta_{5i} \Delta EXCH_{t-1} + \sum_{i=1}^{k} \delta_{6i} \Delta INTR_{t-1} + \delta_{7i} ECM_{t-1} + \varepsilon_t \quad 3.6$$

The Evaluation Method
The Unit Root Test, Co-integration Test, Error Correction Mechanism, and Granger Causality Test.

Test for Unit Roots

To prevent the issue of false correlations in regression analysis, the time-series characteristics of the variables employed are examined using the usual augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests under two distinct assumptions.

Test for Cointegration
Error Correction or else accept. Mechanism (ECM)

We use this test to see if the variables are related in the near term. If the variables are co-integrated, this test can also be used to fix disequilibrium. The coefficient of the error term lag (1), which is the ECM, shows how quickly the dependent variable adjusts to equilibrium in the short run. If it is significant and negative, it means that the error from the previous period (long run) has been fixed and the model has returned to equilibrium. Take away from both sides and add and take away from the RHS:

It illustrates how responds in the short run (SR), to fluctuations in and to divergences from long run (LR) equilibrium. The ECM model demonstrates that the growth rate of y is elucidated by the growth rate of x and historical disequilibrium between these variables.
The higher the value of y,the quicker the adjustment to the new equilibrium, since the error disappears more quickly. The error correction specification says that the variables must be I(1) and co-integrated. Then their initial difference is I(0), and the ECM term is I(0), therefore the error term does not change. Because all stochastic trends will go away, the bogus equation situation will no longer exist.

Tests After the Estimate

Serial Correlation LM Test

The Breusch-Godfrey Serial Correlation LM Test checks to see if the model's residuals are serially correlated. If the Obs*R-squared p-value is less than 0.05, there is a problem with serial correlation. If it is not, there is no concern.

Test for Heteroskedasticity

To find out if the error variance of each observation is the same, a heteroskedasticity test is done. Non-constant variance might lead to biassed outcomes in the estimated model. For this aim, White's general heteroscedasticity test would be used at the 5% level of significance (Gujarati et al. 2012). The Hypothesis is
H0: existence of homoscedasticity
H1: there is heteroscedasticity

If the probability value of Chi-Square is less than 0.05, we reject H0; if it is not, we do not reject it. If n.R2 $>\chi 2$ tab, we reject H0; if it is not, we do not reject it.

Test of Normality

The normality test is done to see if the error term followed a normal distribution. It is conducted under the null hypothesis that the residuals follow a normal distribution. We reject H0 if the computed value of the JB-statistic is higher than the tabular value (chi-square distribution with 2df at 5% level of significance). If the computed value is lower than the tabulated value, we do not reject H0. We reject the null hypothesis if the probability value is less than 0.05; otherwise, we do not reject it.

Hypothesis:
Ho: The error terms follow a normal distribution.

H1: The error terms do not follow a normal distribution.

Test for Multicollinearity
Test for a linear relationship among the variables utilized in the model conducted. This agrees with the Classical Linear Regression Model's (CLRM) idea that there is "no high or perfect multi-collinearity." The main objective of this test is to find out if the variables are very correlated with each other. This test will use the correlation matrix. If the correlation coefficient between two variables is greater than 0.8, then those variables have strong multi-collinearity.

IV. PRESENTATION AND ANALYSIS

Unit Root Test

The Augmented Dickey Fuller (ADF) unit root test is performed at a 5% significance level to ascertain the stationarity of the model variables, specifically whether their mean values and variances remain constant over time, thereby preventing the occurrence of spurious regression. The null hypothesis posits that the series possesses a unit root if the t-statistic is below the critical value at 5%; otherwise, the investigation contradicts this hypothesis.

Table 4.2: Unit Root Test Result

Level			First Difference			
Variables	**ADF Statistic**	**5% Critical Value**	**ADF Statistic**	**5% Critical Value**	**Remarks**	**Rank**
LNRGDP	-0.431234	-2.948404	-4.934456	-2.951125	Stationary	I(1)
LNPRINV	-1.251888	-2.948404	-4.301417	-2.951125	Stationary	I(1)
LNPUBINV	-1.723993	-2.948404	-6.702385	-2.951125	Stationary	I(1)
PRINV_PUBINV	-1.693887	-2.948404	-5.271169	-2.951125	Stationary	I(1)
EXCH	2.239303	-2.948404	-3.908831	-2.951125	Stationary	I(1)
INTR	-0.841000	-2.948404	-6.616034	-2.951125	Stationary	I(1)

Source: Researcher's computation from Eviews

The outcome indicated that all variables; Real Gross Domestic Product (RGDP), Private Investment (LNPRINV) represented by Gross Fixed Capital Formation, Public Investment (LNPUBINV) represented by Government Capital Expenditure, the interaction term between Private and Public Investment (LNPRINV_LNPUBINV), Exchange Rate (EXCH), and Interest Rate Spread (INTR) in the model are integrated of order one, I(1). Consequently, the outcome satisfied the fundamental criteria for ARDL bound testing as delineated by Pesaran et al. (2001), given that none of the model's variables is integrated of order two, I(2). Because of this, the ARDL bounds test framework is used to estimate co-integration and check the error correction model's adequate condition after meeting the stationary conditions.

Co-integration Test - ARDL Bounds Test

The result of ARDL Bounds test performed to test for the presence of co-integration among the variables in the model is presented in table 4.2 below.

Table 4.2 ARDL Bounds Test

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	4.570874	5

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Eviews 9 Regression Output

The estimated F-Statistic for the equation is 4.570874, which is higher than the crucial value of 3.79 at the 5% level of significance. Consequently, the null hypothesis of no co-integration is dismissed. The outcome demonstrated that the variables inside the model are co-integrated, indicating the presence of a long-term relationship among them.

Model Selection Method

Table 4.4. ARDL (4, 4, 0, 0, 2, 0) Regression Model

Dependent Variable: LNRGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRGDP(-1)	0.093527	0.250031	0.374059	0.7133
LNRGDP(-2)	0.223148	0.220981	1.009808	0.3276
LNRGDP(-3)	0.474686	0.211744	2.241787	0.0395
LNRGDP(-4)	-0.267503	0.134692	-1.986028	0.0644
LNPRINV	-0.099062	0.086912	-1.139792	0.2711
LNPRINV(-1)	-0.032342	0.110617	-0.292376	0.7738
LNPRINV(-2)	-0.169072	0.124412	-1.358964	0.1930
LNPRINV(-3)	-0.013179	0.114684	-0.114915	0.9099
LNPRINV(-4)	0.291446	0.094615	3.080327	0.0072
LNPUBINV	-0.353652	0.142183	-2.487307	0.0243
LNPRINV_LNPUBINV	0.039019	0.013210	2.953671	0.0093
EXCH	-0.001985	0.000472	-4.205297	0.0007
EXCH(-1)	-0.000496	0.000999	-0.497055	0.6259
EXCH(-2)	0.002052	0.000758	2.708856	0.0155
INTR	-0.005933	0.008835	-0.671567	0.5114
C	5.592428	1.403633	3.984251	0.0011

R-squared	0.996644	Mean dependent var	10.52367
Adjusted R-squared	0.993497	S.D. dependent var	0.501132
S.E. of regression	0.040412	Akaike info criterion	-3.272546
Sum squared resid	0.026130	Schwarz criterion	-2.539678
Log likelihood	68.36073	Hannan-Quinn criter.	-3.029621
F-statistic	316.7396	Durbin-Watson stat	2.431011
Prob(F-statistic)	0.000000		

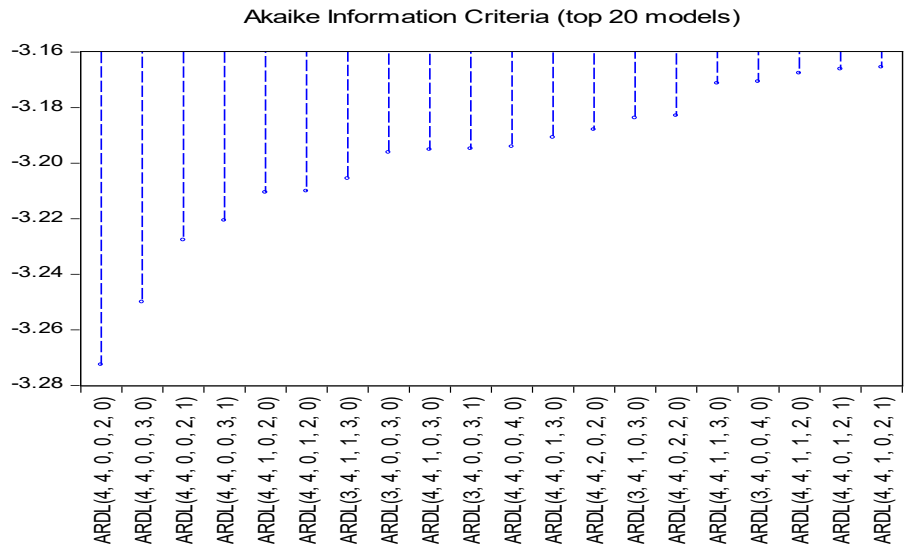
*Note: p-values and any subsequent tests do not account for model selection.

Source: Eviews 9

Optimum Lag Length Selection

The Optimum Lag Length Selection for the dependent and the independent variables in the model was obtained through Akaike Information Criterion (AIC). The result is presented in figure 4.1 below.

Fig 4.1 ARDL Optimum Lag Length Selection



Source: Eviews 9 Regression Output.

The result showed that ARDL(4, 4, 0, 0, 2, 0) regression model was selected using Akaike Information Criterion (AIC) after 20 models generated automatically.

Regression Model

Basic Regression Model

The Basic Regression Model is specified with no interactive term to determine the impact of private and public investment on economic growth in Nigeria.

Table 4.5 Basic Regression Model

Dependent Variable: LNRGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRGDP(-1)	0.314903	0.213359	1.475929	0.1594
LNRGDP(-2)	0.093941	0.239308	0.392552	0.6998
LNRGDP(-3)	0.351082	0.196737	1.784528	0.0933
LNPRINV	-0.079563	0.090522	-0.878932	0.3924
LNPRINV(-1)	-0.053835	0.121040	-0.444770	0.6624
LNPRINV(-2)	-0.226022	0.132119	-1.710741	0.1064
LNPRINV(-3)	0.051127	0.121019	0.422468	0.6783
LNPRINV(-4)	0.210025	0.094595	2.220249	0.0412
LNPUBINV	0.043494	0.046902	0.927349	0.3675
EXCH	-0.001805	0.000491	-3.674471	0.0020
EXCH(-1)	0.000890	0.000927	0.960204	0.3512
EXCH(-2)	0.000877	0.000925	0.947399	0.3575
EXCH(-3)	0.001486	0.000841	1.767199	0.0963
EXCH(-4)	0.000679	0.000619	1.097697	0.2886
INTR	-0.009572	0.009446	-1.013336	0.3260
C	3.122816	0.844571	3.697516	0.0020

R-squared	0.996127	Mean dependent var	10.52367
Adjusted R-squared	0.992495	S.D. dependent var	0.501132
S.E. of regression	0.043413	Akaike info criterion	-3.129270
Sum squared resid	0.030155	Schwarz criterion	-2.396402
Log likelihood	66.06832	Hannan-Quinn criter.	-2.886345
F-statistic	274.3173	Durbin-Watson stat	2.398664
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Source: Eviews 9 Regression Output

Table 4.6ARDL Bounds Test

ARDL Bounds Test

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	4.656726	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52

5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

The ARDL limits test for the fundamental model revealed the presence of co-integration among the model's variables. So, we used the ARDL model to estimate the Basic Regression Model with no Interactive term to find out how private and public investment affect Nigeria's economic growth. The outcome is displayed in table 4.7 below.

The Basic Regression Model without an Interactive term, utilizing the ARDL model shown in Table 4.7, indicated that neither private investment nor public investment exerts a statistically significant influence on economic growth in Nigeria, both in the short and long term during the study period.

Table 4.7 ARDL Cointegrating and Long Run Form of Basic Regression Model with no Interactive term

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRGDP(-1))	-0.445023	0.192307	-2.314125	0.0343
D(LNRGDP(-2))	-0.351082	0.196737	-1.784528	0.0933
D(LNPRINV)	-0.079563	0.090522	-0.878932	0.3924
D(LNPRINV(-1))	0.226022	0.132119	1.710741	0.1064
D(LNPRINV(-2))	-0.051127	0.121019	-0.422468	0.6783
D(LNPRINV(-3))	-0.210025	0.094595	-2.220249	0.0412
D(LNPUBINV)	0.043494	0.046902	0.927349	0.3675
D(EXCH)	-0.001805	0.000491	-3.674471	0.0020
D(EXCH(-1))	-0.000877	0.000925	-0.947399	0.3575
D(EXCH(-2))	-0.001486	0.000841	-1.767199	0.0963
D(EXCH(-3))	-0.000679	0.000619	-1.097697	0.2886
D(INTR)	-0.009572	0.009446	-1.013336	0.3260
CointEq(-1)	-0.240075	0.116999	-2.051939	0.0569

Cointeq = LNRGDP - (-0.4093*LNPRINV + 0.1812*LNPUBINV + 0.0089 *EXCH -0.0399*INTR + 13.0077)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPRINV	-0.409323	0.551574	-0.742100	0.4688
LNPUBINV	0.181170	0.248059	0.730351	0.4757
EXCH	0.008864	0.004720	1.877899	0.0787
INTR	-0.039871	0.053983	-0.738585	0.4709
C	13.007683	3.528925	3.686018	0.0020

R-squared	0.996127	Mean dependent var	10.52367
Adjusted R-squared	0.992495	S.D. dependent var	0.501132
S.E. of regression	0.043413	Akaike info criterion	-3.129270
Sum squared resid	0.030155	Schwarz criterion	-2.396402
Log likelihood	66.06832	Hannan-Quinn criter.	-2.886345
F-statistic	274.3173	Durbin-Watson stat	2.398664
Prob(F-statistic)	0.000000		

Source: Eviews 9 Regression Output

Interactive Regression Model

We used the ARDL model to estimate the Interactive Regression Model shown in table 4.3 below to find out if public investment affects private investment in Nigeria. The short-run Interactive Regression Model estimation demonstrated that the interaction between private investment and public investment had a statistically significant effect on economic growth in Nigeria. The interaction between private investment and public investment is significant; their impact on economic growth in Nigeria is statistically significant as indicated by the t-statistic and probability values of the private investment and public investment interaction term of 2.953671 and 0.0093 in the short run and by the t-statistic and probability values of the private investment and public investment interaction term of 4.197829 and 0.0007 in the long run respectively. In other words, there is proof that private and public investments work together to make things better; when they are combined, they have a bigger effect than when they are separate.

The outcome also indicated an increase in R-squared for the model incorporating the interaction term relative to the model excluding it. The R-squared went up from 99.6% for the model without an interaction term to 99.7% for the model with an interaction term. This suggests that the model with the interaction term helped explain 0.1% more of the fluctuations in Nigeria's economic growth. This shows that the model with interaction is better than the model without interaction term.

The coefficient of the interactive term is 0.039019 in the short run and 0.081947 in the long run. This means that for every unit change in public investment, the effectiveness of private investment goes up by that amount. This means that a one-unit change in the interaction term will cause real gross domestic product (a measure of economic growth) to vary by 3.9% and 8.19% in the short run and long run, respectively. In the basic regression model without an interaction term, the coefficients for private investment and public investment are -0.079563 and 0.043494 in the short run and -0.409323 and 0.181170 in the long run.

The average economic growth, with all model variables held constant, is 11.745301. An interaction term was incorporated into this model based on the hypothesis that the impact of public investment on economic growth varies depending on the performance of private investment.

Table 4.8: ARDL Cointegrating and Long Run Form

Dependent Variable: LNRGDP

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRGDP(-1))	-0.430332	0.187058	-2.300526	0.0352
D(LNRGDP(-2))	-0.207183	0.172456	-1.201368	0.2471
D(LNRGDP(-3))	0.267503	0.134692	1.986028	0.0644
D(LNPRINV)	-0.099062	0.086912	-1.139792	0.2711
D(LNPRINV(-1))	0.169072	0.124412	1.358964	0.1930
D(LNPRINV(-2))	0.013179	0.114684	0.114915	0.9099
D(LNPRINV(-3))	-0.291446	0.094615	-3.080327	0.0072
D(LNPUBINV)	-0.353652	0.142183	-2.487307	0.0243
D(LNPRINV_LNPUBINV)	0.039019	0.013210	2.953671	0.0093
D(EXCH)	-0.001985	0.000472	-4.205297	0.0007
D(EXCH(-1))	-0.002052	0.000758	-2.708856	0.0155
D(INTR)	-0.005933	0.008835	-0.671567	0.5114
CointEq(-1)	-0.476142	0.148499	-3.206354	0.0055

Cointeq = LNRGDP - (-0.0466*LNPRINV -0.7427*LNPUBINV + 0.0819
*LNPRINV_LNPUBINV -0.0009*EXCH -0.0125*INTR + 11.7453)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPRINV	-0.046641	0.188399	-0.247567	0.8076
LNPUBINV	-0.742746	0.179624	-4.135000	0.0008
LNPRINV_LNPUBINV	0.081947	0.019521	4.197829	0.0007
EXCH	-0.000901	0.001102	-0.817552	0.4256
INTR	-0.012461	0.020669	-0.602889	0.5550

C	11.745301	1.389630	8.452106	0.0000

R-squared	0.996644	Mean dependent var	10.52367
Adjusted R-squared	0.993497	S.D. dependent var	0.501132
S.E. of regression	0.040412	Akaike info criterion	-3.272546
Sum squared resid	0.026130	Schwarz criterion	-2.539678
Log likelihood	68.36073	Hannan-Quinn criter.	-3.029621
F-statistic	316.7396	Durbin-Watson stat	2.431011
Prob(F-statistic)	0.000000		

Source: Eviews 9 Regression Output

The outcome also demonstrated an increase in R-squared for the model using the interaction component in contrast to the model excluding it. The R-squared value went up from 99.6% for the model without an interaction term to 99.7% for the model with one. This suggests that the model with the interaction term helped explain 0.1% more of the fluctuations in Nigeria's economic growth. This shows that the model with interaction is better than the model without interaction term. The coefficient of the interactive term is 0.039019 in the short run and 0.081947 in the long run. This means that for every unit change in public investment, the effectiveness of private investment will increase. This means that one unit change in the interaction term will cause real gross domestic product (a measure of economic growth) to vary by 3.9% and 8.19% in the short run and long run, respectively. The coefficients of private investment and public investment in the basic regression model without an interaction term are -0.079563 and 0.043494 in the short run and -0.409323 and 0.181170 in the long run. The average economic growth, with all model variables held constant, is 11.745301. An interaction term was incorporated into this model based on the hypothesis that the impact of public investment on economic growth varies depending on the performance of private investment.

The ARDL Error Correction Regression results in table 4.3 above demonstrate that the coefficient of the short-run dynamic effect of the interaction between private and public investment and the control variables in the model is negative, fractional, and statistically significant, which is what we wanted. The error correction mechanism (ECM) coefficient is -0.476142, with a probability value of 0.0055 and a t-statistic value of -3.206354. So, the ECM is statistically significant, which means that the process of adjusting speeds up by 47%.

The result further suggested that the interest rate (INTR) does not significantly affect economic growth in Nigeria, both in the medium and long term, at a 5% level of significance, as evidenced by its t-statistic and probability values of -0.671567 and 0.5114; and -0.602889 and 0.5550, respectively. It also showed that the exchange rate has a statistically significant effect on Nigeria's economic growth in the short term, as shown by its t-statistic and probability values of -4.205297 and 0.0007. However, it has no effect on Nigeria's economic growth in the long term, as shown by its t-statistic and probability values of -0.817552 and 0.4256.

Table 4.9 Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	5.752084	Prob. F(2,14)	0.0150
Obs*R-squared	14.43424	Prob. Chi-Square(2)	0.0007

Source: Eviews 9 Regression Output

Correction of Heteroskedasticity and Autocorrelation Problem

The serial correlation problem identified in the model is however corrected using Newey-West HAC standard errors and covariance Test. What Newey-West HAC does, in essence, is to correct the standard error and make it robust. The result of the test is presented in table 4.10 below.

Table 4.10 Newey-West HAC standard errors and covariance Test.

Dependent Variable: LNRGDP

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRGDP(-1)	0.093527	0.298802	0.313005	0.7583
LNRGDP(-2)	0.223148	0.158771	1.405478	0.1790

LNRGDP(-3)	0.474686	0.295738	1.605092	0.1280
LNRGDP(-4)	-0.267503	0.133286	-2.006987	0.0620
LNPRINV	-0.099062	0.078759	-1.257783	0.2265
LNPRINV(-1)	-0.032342	0.077488	-0.417381	0.6819
LNPRINV(-2)	-0.169072	0.042369	-3.990430	0.0011
LNPRINV(-3)	-0.013179	0.105037	-0.125468	0.9017
LNPRINV(-4)	0.291446	0.114833	2.537997	0.0219
LNPUBINV	-0.353652	0.165025	-2.143017	0.0478
LNPRINV_LNPUBINV	0.039019	0.015296	2.550968	0.0214
EXCH	-0.001985	0.000354	-5.607567	0.0000
EXCH(-1)	-0.000496	0.000978	-0.507378	0.6188
EXCH(-2)	0.002052	0.000795	2.580182	0.0201
INTR	-0.005933	0.004756	-1.247525	0.2302
C	5.592428	1.513209	3.695741	0.0020

Source: Eviews 9 Regression Output

The table above displays the Newey-West HAC standard errors and covariance Test method that was used to fix the problem of serial correlation in the model. So, the improvements in the standard error showed that the model's serial correlation problem had been fixed.

Heteroskedasticity Test

The outcome of the heteroskedasticity test displayed in table 4.11 below indicates that the residuals are homoskedastic. So, the model doesn't have any serial correlation because the Prob. The Chi-Square value is 0.5029, which is higher than 0.05.

Table 4.11 Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.861843	Prob. F(15,16)	0.6110
Obs*R-squared	14.30067	Prob. Chi-Square(15)	0.5029
Scaled explained SS	2.766588	Prob. Chi-Square(15)	0.9998

Source: Eviews 9 Regression Output

Ramsey RESET Test

The Ramsey RESET Test is a way to evaluate if the model you estimated was set up correctly. It employs the f-statistic. The null hypothesis posits that the model was accurately defined. If the f-statistic's probability value is less than 0.05, you should reject the null hypothesis. If it is not, you should not reject the null hypothesis. The outcome in table 4.12 indicated an f-statistics probability value of 0.9416, beyond 0.05; so, the null hypothesis should not be rejected. So, the estimated model was set up correctly.

Table 4.12 Ramsey RESET Test

Ramsey RESET Test
Omitted Variables: Squares of fitted values

	Value	Df	Probability
t-statistic	0.074559	15	0.9416
F-statistic	0.005559	(1, 15)	0.9416

F-test summary:

	Sum of Sq.	Df	Mean Squares
Test SSR	9.68E-06	1	9.68E-06
Restricted SSR	0.026130	16	0.001633
Unrestricted SSR	0.026120	15	0.001741

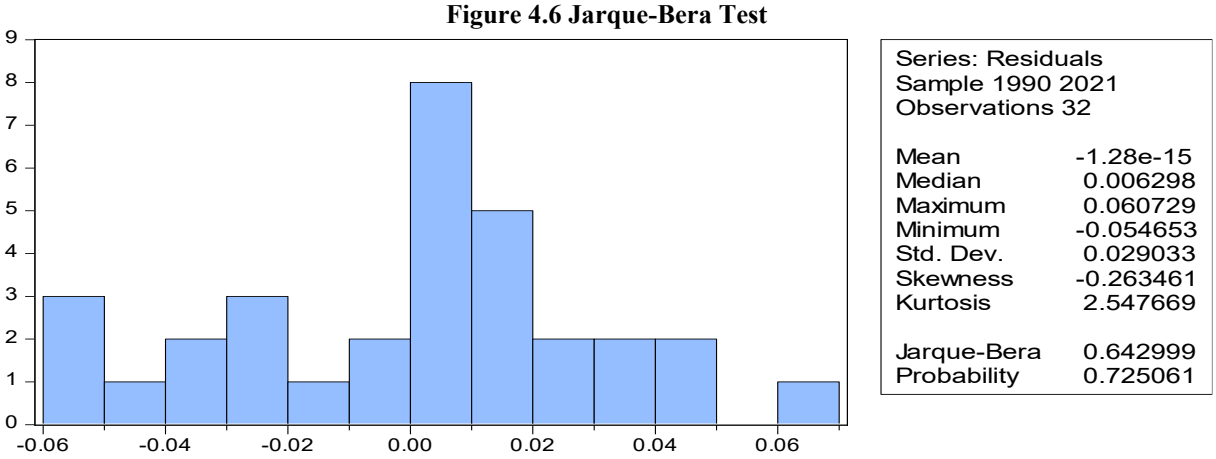
Source: Eviews 9 Regression Output.

Normality Test

The Jarque-Bera Test was conducted to ascertain if the residuals conformed to the normal distribution as stipulated by traditional OLS assumptions. Figure 4.6 shows that the Jarque–Bera probability is 0.725061, which is more than 0.05. This indicates that the residuals adhered to a normal distribution, hence fulfilling the criteria for normal distribution.

Figure 4.6 Jarque-Bera Test

Figure 4.6 Jarque-Bera Test

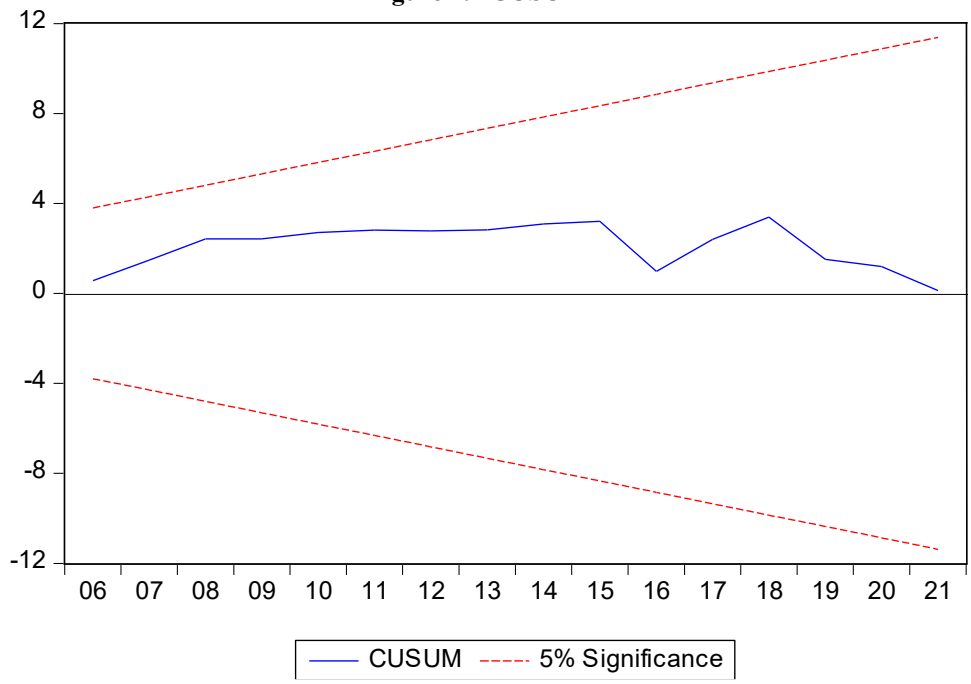


Source: Eviews 9 Regression Output.

Stability Tests (CUSUM) of the Model

The plot of stability tests (CUSUM) of the model is shown in Figure 4.7 below. The CUSUM is shown against the critical boundaries at a 5% level of significance. The outcome demonstrated that the model is stable, as the critical boundaries at 5% were situated between the two 5% lines.

Figure 4.7 CUSUM T



Source: Eviews 9 Regression Output.

Test of Hypotheses

The study examined the notion that the relationship between private and governmental investment does not significantly influence economic growth in Nigeria. The outcome demonstrated that the interplay between private and public investment exerts a statistically significant influence on economic growth in Nigeria, both in the short term and the long term.

V. SUMMARY, CONCLUSION, AND SUGGESTIONS

SUMMARY OF FINDINGS

This study conducted an economic analysis of the interactions between private and public investments on economic growth in Nigeria from 1986 to 2021, utilizing annual time series data on real gross domestic product, private investment (represented by gross fixed capital formation), public investment (represented by government capital expenditure), exchange rate, and interest rate spread. The study utilized ARDL Bounds Testing methodology to ascertain the existence of a long-term relationship between the interactions of private and public investment and economic growth in Nigeria during the specified period. The study examined the hypotheses asserting that the interaction between private and public investment does not significantly influence economic growth in Nigeria. The findings demonstrated that this interaction has a statistically significant effect on economic growth both in the short term and the long term during the period analyzed. The study examined the hypothesis that private and public investment do not significantly influence economic growth in Nigeria, concluding that neither form of investment demonstrates a statistically significant effect on economic growth in both the short and long term during the study period.

CONCLUSION

This study conducted an economic analysis of the interactions between private and public investments on economic growth in Nigeria from 1986 to 2021, utilizing annual time series data on real gross domestic product, private investment (represented by gross fixed capital formation), public investment (indicated by government capital expenditure), exchange rate, and interest rate spread. The research utilised ARDL Bounds Testing approach to ascertain the existence of a long-term relationship between the interactions of private and public investment and economic growth in Nigeria during the specified period. The study aimed to ascertain the effects of the interaction between private and public investment on economic growth in Nigeria, to analyse the influence of both types of investment on economic growth, and to establish the causal relationship between their interaction and economic growth in Nigeria. The study concludes that the interaction between private and public investment has a statistically significant impact on economic growth in Nigeria, both in the short term and the long term during the period examined. Conversely, neither private nor public investment demonstrates a statistically significant effect on economic growth in Nigeria in either timeframe. Furthermore, there is no significant directional causality relationship between the interaction of private and public investment and economic growth in Nigeria during the studied period.

RECOMMENDATIONS

Based on the findings, the study suggests that the government should create investment policies that promote the growth of both private and public investment in Nigeria. These policies should include building the necessary infrastructure at a lower cost and creating a business environment that is not only attractive to private investment but also conducive to sound investment that will lead to long-term economic growth in the country. To encourage private sector investment, the government must solve the problem of a bad investment climate, which includes things like bad infrastructure, a lack of power, bad transit, bad telecom access at business locations, and bad tax administration.

The government needs to create a way to analyze things in order to encourage private investment. In Nigeria, a stable macroeconomic climate and long-term economic growth would be much more likely if the government supported private investment and a competent workforce. The government should also work to stabilize the naira's exchange rate and create conditions that will encourage more domestic investment by adopting macroeconomic policies that will create more investment opportunities in the economy and help it grow.

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