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# On The Relationship Between Investment And Economic Growth In Nigeria: An Autoregressive Distritibuted Lag Modeling Approach

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**Specialty Section;This article was submitted to Sciences a section of NAPAS.**

***Submitted:*** ***18/12/2023***
***Accepted:*** ***5/4/2024***
***Published:***

***Citation:***
***IKUGHUR, Jonathan Atsua;NWAOSU, Sylvester Chigozie & IKEBUDU, Perpetual Ifeoma (2024).*** On The Relationship Between Investment and Economic Growth in Nigeria: An Autoregressive Distritibuted Lag Modeling Approach
**7(1):9-22.**
***DOI:10.5281/zenodo.7338397***

***Publisher:****cPrint,Nig.Ltd*
***Email:****cprintpublisher@gmail.com*

## Abstract

In this study, the relationship between investment and Real Gross Domestic Product (LRGDP) in Nigeria is investigated using Auto-regressive distributed Lag (ARDL) and associated statistical methodologies in order to fit a model capturing the dynamics in investment and economic growth over the time. Annual data was collected from Nigeria Bureau of Statistics Central Bank of Nigeria and other statistical agency in Nigeria for the period 1981 - 2022. The study revealed a statistically strong and positive relationship between LRGDP and its lag 2, a negative but insignificant relationship between LRGDP and LGFCF at 5% level in the short run. However, there exist a significant positive relationship between current Real Gross Domestic Product (LRGDP) and LGFCF in the long run. This finding gives credence to the expectation that economic growth is influenced by gross capital investment as demonstrated in this study. These findings will enable policymakers, economists, and stakeholders involved in economic planning to tune policies that will create enabling environment for investment to have positive impact on the economy in both short run and long run.

**Keywords:** Economic Growth, Investment, Auto Regressive Distributed Lag, long run, Short run

## Background of The Study

Gross Domestic Product (GDP) is an indicator of a country's economic growth reflecting the total value of all goods and services produced within a specified period. It captures the total value of all goods and services produced within its borders over a specified period.

Investment, on the other hand, represents the expenditure on capital goods and physical assets aimed at enhancing production capacity and generating future economic returns. The interplay between GDP and investment is crucial, as investment contributes to economic growth (Belloumi and Alshehry, 2018).

Gross fixed capital formation (GFCF), as a component of the expenditure on gross domestic product (GDP) is a macroeconomic concept which measures the value of acquisitions of new or existing fixed assets by the business sector, governments and less disposals of fixed assets (Kanu and Nwaimo (2015). According to Ajose and Oyedokun (2018), GFCF can be classified as gross private domestic investment and gross public domestic investment. The gross public investment includes investment by government and/ or public enterprises. Gross domestic investment is equivalent to gross fixed capital formation plus net changes in the level of inventories

There are several issues hindering economic growth in Nigeria beginning from social issues such as urban population, rural stagnation, inequality (Tolu and Abe, 2017); economic decline (Onyekwere, 2016); insecurity (Musa, 2021) that have undermined the levels of investment, created infrastructural deficits, and limited diversification of the economy that have contributed to unemployment and low per capita income and unemployment.

Over the years, Nigeria has experienced fluctuations in investment levels that are influenced by various factors such as government policies, political stability, infrastructure development, security issues and global economic conditions that have caused the government to implemented several initiatives in order to attract both domestic and foreign investment. For instance, Nigeria's GFCF was N18.2 billion in 1981 and from 1982 to 1987 it declined until 1988 when it assumed an increasing trend. The GCFC was N40.1bn in 1990, N141.9bn in 1995, N331.1bn in 2000, N804.4billion in 2005 and N1546.5 billion in 2006. It came up to N2053 billion in 2008, N4207.4 billion in 2011 (CBN, 2011) and N45,338.4b (www.indexmundi.com).in 2020. Although Nigeria's GFCF appears to be increasing over time, it is necessary to determine its impact on the economic growth. This happens when RGDP and GFCF are correctly measured and the relationship between them is evaluated in order to provide indicator to provide guide to policy implementation for sustainable economic development.

Thus, the relationship between GDP and investment is understood, corresponding policies and strategies for promoting economic growth and sustainable development in Nigeria could be achieved. This study is set to investigate the relationship between real gross domestic product (RGDP) and GFCF as proxy to investment, using the autoregressive distributed lag model in order to determine the long run relationship between investment on Nigeria's economic growth, and also establish short run dynamics existing between the variables.

## Literature Review

**S**avings is largely dependent on income generated in a country and to some extent, the will-power of the political leaders to invest for development purposes. Jhingan (2009) noted that less developed countries (LDC's) consume more than half of their produce as a result of industrial backwardness which makes it difficult for such country to save thereby lowering her capital formulation.

For growth and development in any economy, savings, interest rate, population growth, and foreign direct investment are key determinants. Capital formation encompasses investments in physical infrastructure, such as factories, machinery, and transportation networks, as well as investments in human capital through education, skills training, and healthcare. These investments contribute to the accumulation of productive capacity, technological advancements, and improved productivity, ultimately driving economic growth thereby, stimulating employment, enhancement of competitiveness of industries and to promote diversification of the economy. Savings arises when a portion of income is set in order to invest for future productivity (Todaro and Smith, 2006) hence, savings increases as a result of income per capital (Bakare, 2011a) while low level of savings arises as a result of low capital stock. Similarly, Harrod-Domar theory suggests that if a developing country wants to achieve economic growth, the government in that country need to encourage savings as it leads to investment which eventually leads to capital formation (Domar, 1946).

Another school of thoughts is the Financial Intermediation Theory which supposes that mobilization of fund from surplus area to the area of deficit for the purpose of investment. (Abina and Lemea, 2019). By financial intermediation, savings are pulled together by depository institutions and lent out for productive use. Schumpeter (1911) stated that financial intermediaries render services like savings mobilization, project evaluation, risk management and transaction facilitation for economic development while Schumpeter (1912) and Shaw (1973) emphasized as the banking system help in the allocation of savings and reduction in transactional cost which eventually improves productivity, technical change and the rate of economic growth

**Empirical Review**

In order to ascertain the relationship between capital formation and economic development, Jhingan (2006) asserted that capital formation could not only lead to investment in capital equipment which leads to increase in production but also, leads to employment opportunities. Furthermore, capital formation leads to technical progress which helps achieve economies of large-scale production, increased specialization provision of machines-tools and equipment required by the labour force for effective productivity.

Bakare (2011b) used the econometric method of cointegration to ascertain the relationship between capital formation and economic growth. His study showed that capital formation has a direct relationship with economic growth of Nigeria. Similarly, Alfa and Garba (2012) see Investment as the most important part of an open and effective economic system which serves as a major factor that facilitates economic growth and asserted that there is a significant long run positive relationship between domestic investment and economic growth in Nigeria.

Gbenga and Adeleke (2013) examined the causal relationship between savings, gross capital formation and economic growth between the period 1975-2008. Using the VAR causality test among statistical tests, the results showed a strong linkage between Capital formation and growth and gross domestic product and gross fixed capital formation all exhibit bi-directional causality.

Kanu and Ozurumba (2014) examined the impact of capital formation on the economic growth of Nigeria using multiple regressions technique. They showed that in the short run, gross fixed capital formation had no significant impact on economic growth while in the long run; the VAR model estimate indicates that gross fixed capital formation, total exports and the Lagged values of GDP had positive long run relationships with economic growth in Nigeria.

Egbetunde and Fadeyibi (2015) in their study on the relationship between investment and economic growth in Nigeria used the data for the period 1981-2012 and Vector Error Correction Model (VECM) for modeling which showed that investment is cointegrated with economic growth in the country indicating that there is a long run relationship between investment and economic growth in Nigeria.

In Onyinye (2017), the relationship between capital formation and economic growth in Nigeria for the period 1984-2015 was investigated. The study discovered that causality flows both ways, that is a bi-directional causality flows from gross fixed capital formation to gross domestic product (GDP).

However, Ajose and Oyedokun (2018) examined the impact of capital formation on Nigeria economic growth for the period of 1980-2016. The Granger causality test was used to analyze the data with result showing that the causal relationship flowed in one way; from real gross domestic product to gross fixed capital formation and also, a negative non-significant relationship between economic growth and capital formation in Nigeria.

Onwioduokit *et al*. (2019) studied the impact of capital formation on economic growth in Nigeria. The study employed the ARDL regression techniques for the period 1981 -2017. The results revealed that gross fixed capital formation used as a proxy for capital formation was positive in both the long-run and short-run model but had no significant impact, while Abina and Mogbeyiteren (2021) on their study on the impact of capital formulation on economic growth in Nigeria showed that gross fixed capital formation has a negative and significant relationship with gross domestic product.

**Methods**

The data used for this study were obtained from the National Bureau of Statistics Statistical Bulletin 2022 and the Central Bank of Nigeria Statistical Bulletin 2022. The main variable of interest are GDP and Investment. GDP represents the aggregate output of an economy while investment captures the expenditure on capital goods and physical assets and other related variables.

**Stationary Test (Augmented Dicker Fuller) (ADF)**

If the time series are non-stationary, there are several tests in literature that can be used to determine whether a series contain unit root or not. Here, the Augmented Dickey Fuller (ADF) test is used on the data set.

The ADF unit root test's model is given as

$$\Delta y_{t-1} = \mu + \delta y_{t-1} + \sum_{i=1}^{k} \beta_1 \Delta y_{t-1} + u_t \quad (1)$$

Where $\delta = \alpha - 1$, $\alpha$ = coefficient of $y_{t-1}$, $\Delta y_{t-1}$ = First difference of $y_t$.

The hypothesis of ADF is $H_0: \delta = 0$ (The series is non-stationary) vs. $H_1: \delta < 0$ (The series is stationary).

If the null hypothesis is not rejected, the series is non-stationary otherwise the series is stationary.

**Auto-Regressive Distributed Lag (ARDL) Model**

The general form of an autoregressive distributed lag model is given as

$$\varphi(L) y_t = \alpha_0 + \theta(L) x_t + \varepsilon_t \quad (2)$$

Where $\varphi(L)$ is the order of polynomial of order p such that must satisfy the unit roots condition. Thus, for stability, the roots must lie outside the unit circle. $\theta(L)$ is a polynomial of order q.

The Autoregressive Distributed Lag (p,q) is represented as

$$y_t = \alpha_0 + \varphi y_{t-1} + \ldots + \varphi_p y_{t-p} + \theta_0 x_t + \theta_1 x_{t-1} + \ldots + \theta_q x_{t-q} + u_t$$

$$= \alpha + \frac{\theta(L)}{\varphi(L)} x_t + v_t \quad (3)$$

Where $\alpha$ and $v_t$ are respectively, the constant and error term which is the ratio of two finite lag polynomial, $y_t$ is the dependent variable (GDP), $y_{t-1}$ is the Lag 1 of the dependent variable $(GDP_t)$, $x_t$ is the independent variables (GFCF), $x_{t-1}$ is the lag 1 of the independent variable $(GFCF_{t-1})$, p is the optimal lag order associated with the dependent variable in years , $q$ optimal Lag order associated with the independent variable in years and $\varphi$ autoregressive coefficient; and are stationary variables while is the white noise satisfying the assumption thus .

**Co-integration Test (ARDL Bounds Test)**

There is co-integration between two or more variables if there exist a form of equilibrium relationship spanning the long-run. The Bounds test is guided by the assumption of stationary variables at level (ie, I(0)) and the hypothesis for the bounds test is vs. implying that the coefficient of the long-run equation are all equal to zero. If $H_o$ is not rejected, then the short-run model is specified otherwise, the standard ARDL model is specified, that is, if there is no co-integration, the ARDL models is specified and is given as

$$\Delta Ln(GDP) = \alpha_{01} + \sum_{i=1}^{p} a_{1i} \Delta LnGDP_{t-i} + \sum_{i=0}^{q} a_{2i} \Delta LnGFCF_{t-i} + u_t \quad (4)$$

If there is co-integration, the error correction model (ECM) representation is specified as;

$$\Delta Ln(GDP) = \alpha_{01} + \sum_{i=1}^{p} a_{1i} \Delta LnGDP_{t-i} + \sum_{i=0}^{q} a_{2i} \Delta LnGFCF_{t-1} + \lambda ECT_{t-1} + u_t \quad (5)$$

Where $\lambda$ = speed of adjustment parameter with a negative sign showing convergence in the long run else the model is explosive. According to Rajarathinam (2021), while the short run is captured by the individual coefficients on the lagged term, the error correction term, $ECT$ contains information on long run relationship and that, while the significant lagged explanatory variables identifies short run causality, negative and significant ECT signifies long run causality. Here, the long-run causal effect is captured by the significant value of λ, in the ECM and if λ is significant then it shows that there is long-run causality among the variables.

The ECM term is represented by

$$ECT_{t-1} = Ln(GDP) - \alpha_{01} - \sum_{i=1}^{p} a_{1i} LnGDP_{t-i} - \sum_{i=0}^{q} a_{2i} \Delta LnGFCF_{t-1} \quad (6)$$

This model can be consistently estimated using OLS provided that all the predictors are stationary.

**Optimal Lag Length Determination**

For annual data, one or two lags usually suffice for the determination of optimal lag length (Jeffrey, 2012) taking cognizance of the fact that the model must not suffer from non-normality, autocorrelation, and heteroscedasticity. However, optimal lag can best be determined using proper model order selection criteria such as the Akaike Information Criterion (AIC), Schwartz Bayesian Criterion (SBC) or Hannan-Quinn criterion (HQC).

**AIC:** Akaike's Information Criterion (AIC) adjusts the -2 Restricted Log Likelihood by twice the number of parameters in the model. This is give as:

$$AIC = -2L + 2N_p \ .$$

Where $L = -Nln(\sigma^2{}_a) - \frac{SSQ'}{2\sigma^2{}_a} - \frac{2Nln(2\pi)}{2}$ (7)

This provides a measure for selecting and comparing models based on the -2 log likelihood.

**BIC:** The Bayesian information criterion (BIC) is a measure for selecting and comparing models based on the -2 log likelihood. Smaller values indicate better models. The BIC also penalizes over-parametrized models, but more strictly than the AIC because the BIC accounts for the size of the dataset as well as the size of the model.

$$BIC = -2L + ln\,(N)N_p$$

Where N = Total number of observations, L= -2 log likelihood, $\sigma^2{}_a$=variance of residuals, Np= Number of parameters $(N_p = p + q + d + P + Q + D + m)$ and SSQ = residuals sum of squares.

**HQC**: The Hannan-Quinn information criteria (HQC) also measures the goodness of fit of a statistical model. It is given as

$$HQC = -2L + 2N_p log(\log N)/N$$

The smaller values of these indicators, the better is the models.

**Model Diagnostic**

In order to determine the goodness of fit of the model, the Ljung-Box test is used. This diagnostic test identified a good model whose residual is within acceptable limits with all p-values less that 5% level of significance.

**Ljung–Box Test for Residuals**

The Lijung–Box test is a type of statistical test of whether any of a group of autocorrelations of a time series are different from zero. Instead of testing randomness at each distinct lag, it tests the "overall" randomness based on a number of lags, and is therefore a portmanteau test. The hypothesis for Ljung–Box test is defined as: $H_0$: The data are independently distributed (i.e. the correlations in the population from which the sample is taken are 0 versus $H_{A:}$ The data are not independently distributed as they exhibit serial correlation. The test statistic according to Ljung and Box (1978) is:

$$Q = n(n+2)\sum_{k=1}^{h} \frac{\hat{\rho}_k^2}{n-k} \quad (8)$$

where $n$ is the sample size, $\hat{\rho}_k$ is the sample autocorrelation at lag *k*, and *h* is the number of lags being tested. Under $H_0$ the statistic Q asymptotically follows a $\chi^2_{(h)}$. For significance level á, the critical region for rejection of the hypothesis of randomness is $Q > \chi^2_{1-\alpha,h}$ where $\chi^2_{1-\alpha,h}$ is the (1 - $\alpha$)-quantile of the chi-squared distribution with *h* degrees of freedom.

**Post Estimation Tests**

**Autocorrelation test**

One of the assumptions of the classical model is that the disturbance term relating to any observation is not influenced by the disturbance term relating to any other observation; however, if there is such dependence, there exist autocorrelation, Symbolically it is denoted as $(\varepsilon_i, \varepsilon_j) \neq 0 \ \ i \neq j$ .

The Breush-Godfrey test is used to check for the presence of autocorrelation in our disturbance term in this study.

**Heteroscedasticity test**

This assumption of the classical linear regression model requires that the variance of each disturbance term $\varepsilon_i$, conditional on the chosen values of the explanatory variables is a constant number equal to $\sigma^2$, This assumption is known as homoscedasticity or equal variance. Symbolically, $E(\mu_t^2) = \sigma^2 \;\; i = 1,2,\dots,n$.. The Breusch-Pagan-Godfrey test to check for heteroscedasticity is used in this study to test the null hypothesis of homoscedasticity against the alternative hypothesis of heteroskedasticity in the error term.

**Jarque–Bera test for normality**

The Jarque–Bera test is a goodness-of-fit test of whether sample data have the Skewness and kurtosis matching a normal distribution. If it is far from zero, it signals the data do not have a normal distribution. The test statistic JB is defined as:

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}(K-3)^2\right) \qquad (9)$$

where n is the number of observations; S is the sample skewness, K is the sample kurtosis. The JB statistic asymptotically has a chi-squared distribution with two degrees of freedom.

**Parameter Stability Test (CUSUM Graph)**

The check for the stability of the estimated parameters from the auto-regression model in the study is an important post-estimation check. Cumulative Sum (CUSUM) test determines if the coefficients of the regression are respectively changing systematically or changing suddenly. The Hypothesis is $H_0$: Parameters are stable against $H_1$: Parameters are not stable.

**Forecast Evaluation**

The evaluation of forecast from Time series model of this nature can be performed using the following error evaluation techniques for the out samples forecast.

Root Mean Square Error: This is given as

$$\text{MSE} = [\tfrac{1}{n}\textstyle\sum_{t+1}^{t+h}(\widehat{Y_i} - Y_i)^2]^{0.5} \qquad (10)$$

Mean Absolute Error: This is given as

$$\text{MAE} = \tfrac{1}{n}\textstyle\sum_{t+1}^{t+h} |\,\widehat{Y_i} - Y_i| \qquad (11)$$

Mean Absolute Percentage Error: This is given as

$$\text{MAPE} = 100* \tfrac{1}{n}\textstyle\sum_{t+1}^{t+h} |\frac{\widehat{Y_i} - Y_i}{\widehat{Y_i}}| \qquad (12)$$

These estimates are expected to be small or tend to zero for a model that will provide a good fit.

Other criteria include the Theil inequality coefficient given as

$$TI = \frac{MAE}{\sqrt{\sum \widehat{Y_i}^2 / n} * \sqrt{\sum {Y_i}^2 / n}} \qquad (13)$$

Where $0 \le TI \le 1$, as $TI \to 0$ it implies a perfect fit.

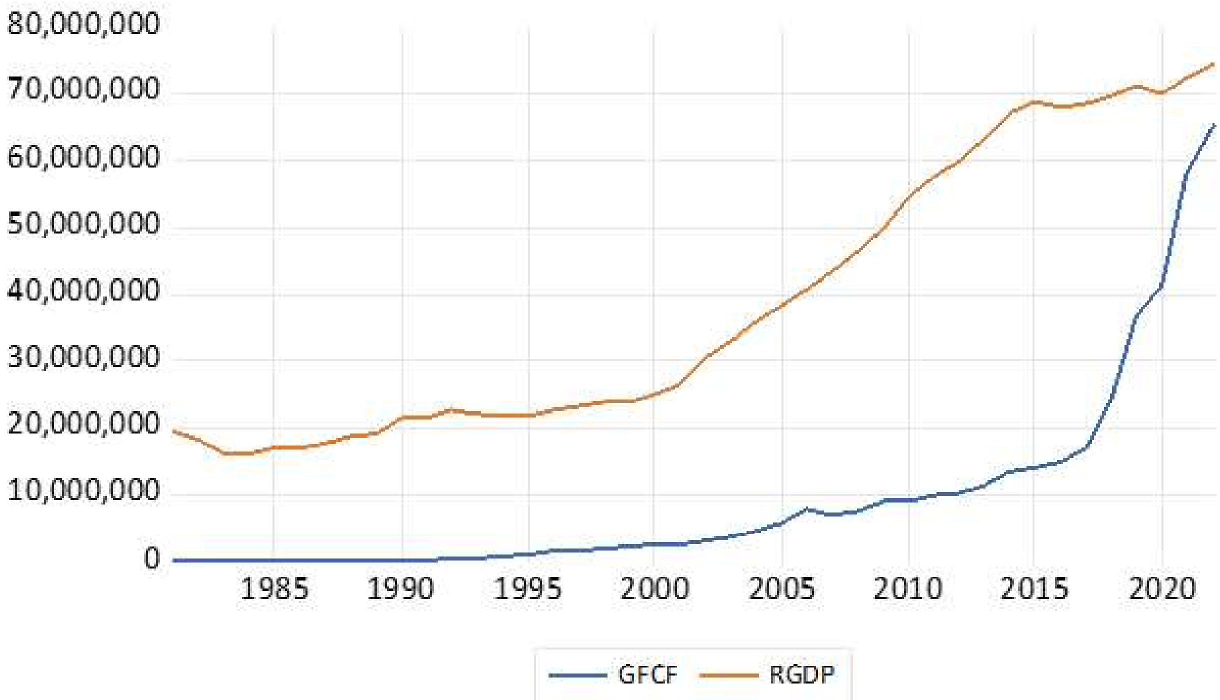
The Bias Proportion shows how far the mean of the forecast is from the mean of the actual series. Generally, if the forecast is good, the bias proportion (BP) should be small.

**Results**

**Graphical Representation**

The graph represents the time plot of the trend of the individual variable with time. There is indication of gradual increase over the time and a sudden sharp increase from 2018 thereabout.

*Figure 1. Graphical Representations of (1981 - 2022)*




**Stationary Test (Augmented Dickey Fuller Test) ADF Test**

The results of the unit root test using the Augmented Dickey Fuller (ADF) procedure at 5% level of significance is shown in Table 2. Both LRGDP and LGFCF were not stationary at level but stationary after first differencing at 5% levels.

**Table 1. Augmented Dickey-Fuller (ADF) Unit Root Test**

| At Level | | | | | At First Difference | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | ADF Statistic | Critical Value (5%) | Prob. | Remark | Variable | ADF Statistic | Critical Value (5%) | Prob. | Remark |
| LRGDP | -0.6806 | -1.519 | 0.8373 | N | LGDP | -2.8906 | -1.526 | 0.0057 | S |
| LGFCF | -1.2223 | -1.525 | 0.6524 | N | LGFCF | -4.1973 | -1.526 | 0.0026 | S |

**N: (Non-stationary) S: (Stationary) ; Source: Author' s computation (2023)**

**Determination of Optimal Lag Length**

In this study, the ARDL(3,7) is specified, as it has the minimum AIC, BIC and HQ value of -5.8410, -5.4570 and -5.4556 respectively as shown in Figure 2 and also in Table 2.

***Figure 2: Akaike information Criteria for Lag Selection.***

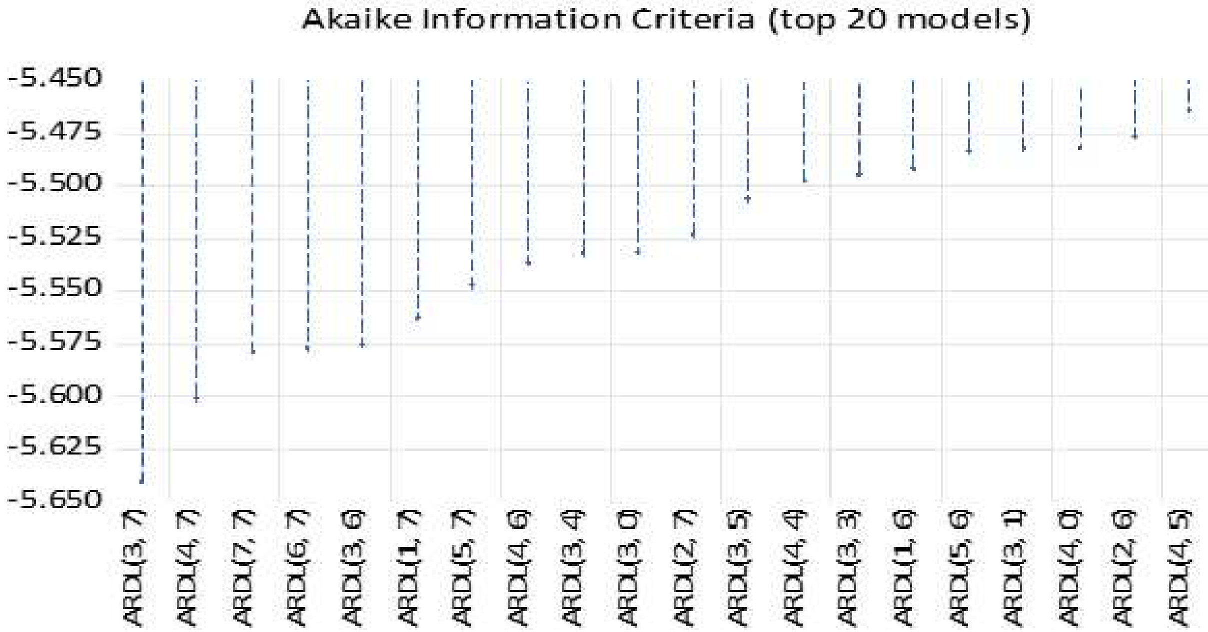



***Table 2: Determination of ARDL Lag Length***

| Model | LogL | AIC* | BIC | HQ | Adj. R-sq | Specification |
|---|---|---|---|---|---|---|
| 1 | 110.718702 | -5.641069 | -5.107806 | -5.456987 | 0.996580 | ARDL(3, 7) |
| 2 | 108.578642 | -5.575922 | -5.087099 | -5.407181 | 0.996296 | ARDL(3, 6) |
| 17 | 107.363840 | -5.563648 | -5.119263 | -5.410246 | 0.996189 | ARDL(1, 7) |
| 4 | 105.821609 | -5.532663 | -5.132717 | -5.394602 | 0.995998 | ARDL(3, 4) |
| 8 | 101.813420 | -5.532195 | -5.310003 | -5.455495 | 0.995639 | ARDL(3, 0) |
| 9 | 107.662821 | -5.523590 | -5.034766 | -5.354848 | 0.996097 | ARDL(2, 7) |
| 3 | 106.368372 | -5.506764 | -5.062379 | -5.353362 | 0.995966 | ARDL(3, 5) |

**Bound Testing**

The ARDL Bound test for co-integration compares the F-statistic value to the upper I(1) and lower I(0) critical bound values as shown in Table 3 in order to determine the existence of co-integration among the variables. If the F-statistic value is greater than the upper critical bound I(1), there is co-integration. However, it is inconclusive if the F-statistic value falls in between the lower I(0) and upper I(1) bound critical value. Here, the F-statistic value is greater than the upper critical bound value for all the levels of significance (1%, 2.5%, 5% and 10%) as such, it is convenient to conclude that there exists unique long-run relationship among the variables.

***Table 3. ARDL Bounds Test for Co-integration***

| F-Bounds Test | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I(0) | I(1) |
| | | | Asymptotic: n=1000 | |
| F-statistic | 6.446641 | 10% | 3.02 | 3.51 |
| k | 1 | 5% | 3.62 | 4.16 |
| | | 2.5% | 4.18 | 4.79 |
| | | 1% | 4.94 | 5.58 |
| Actual Sample Size | 35 | | Finite Sample: n=35 | |
| | | 10% | 3.223 | 3.757 |
| | | 5% | 3.957 | 4.53 |
| | | 1% | 5.763 | 6.48 |

Source: Authors' Computation (2023).

***Table 4. Long run coefficients***

Levels Equation
Case 2: Restricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LGFCF | 0.265469 | 0.017875 | 14.85142 | 0.0000 |
| C | 6.051790 | 0.141345 | 42.81558 | 0.0000 |

EC = LRGDP - (0.2655*LGFCF + 6.0518)

By the result of in Table 4, there exists long run equilibrium relationship between RGDP and GFCF. The coefficient of GFCF is positive and significant indicating that a unit increase in LGFCF will increase economic growth significantly by 0.265 units in the long run.

***Table 5. Short run coefficients***

Conditional Error Correction Regression

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 1.096253 | 0.269973 | 4.060607 | 0.0005 |
| LRGDP(-1)* | -0.181145 | 0.045710 | -3.962937 | 0.0006 |
| LGFCF(-1) | 0.048088 | 0.013087 | 3.674491 | 0.0013 |
| D(LRGDP(-1)) | 0.012743 | 0.163281 | 0.078044 | 0.9385 |
| D(LRGDP(-2)) | 0.312551 | 0.149201 | 2.094827 | 0.0474 |
| D(LGFCF) | -0.006466 | 0.044117 | -0.146559 | 0.8848 |
| D(LGFCF(-1)) | -0.055264 | 0.044848 | -1.232270 | 0.2303 |
| D(LGFCF(-2)) | -0.092697 | 0.046024 | -2.014112 | 0.0558 |
| D(LGFCF(-3)) | -0.065102 | 0.043849 | -1.484698 | 0.1512 |
| D(LGFCF(-4)) | -0.041651 | 0.046614 | -0.893530 | 0.3808 |
| D(LGFCF(-5)) | -0.065268 | 0.044437 | -1.468750 | 0.1554 |
| D(LGFCF(-6)) | -0.079931 | 0.046211 | -1.729699 | 0.0971 |

* p-value incompatible with t-Bounds distribution.

Table 5 shows the estimate of the ARDL model parameters and the goodness of fit measures. The coefficient of the lagged LRGDP variable at lag 1 is positive but insignificant as p>0.05, it is positive and significant at lag 2 as a unit increase in RGDP two periods ago, will increase current LRGDP by 0.31 units at 5% level. However, LGFCF has negative and insignificant effects on the RGDP in the short run. This shows that in the short run, while lags 2 of LRGDP has significant positive effect on LRGDP, GFCF on the other hand has insignificant negative impact in the short run.

***Table 6: Speed of Adjustment***

ECM Regression
Case 2: Restricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LRGDP(-1)) | 0.012743 | 0.149261 | 0.085375 | 0.9327 |
| D(LRGDP(-2)) | 0.312551 | 0.133220 | 2.346120 | 0.0280 |
| D(LGFCF) | -0.006466 | 0.036676 | -0.176292 | 0.8616 |
| D(LGFCF(-1)) | -0.055264 | 0.042304 | -1.306347 | 0.2043 |
| D(LGFCF(-2)) | -0.092697 | 0.042991 | -2.156186 | 0.0418 |
| D(LGFCF(-3)) | -0.065102 | 0.041928 | -1.552714 | 0.1341 |
| D(LGFCF(-4)) | -0.041651 | 0.044653 | -0.932784 | 0.3606 |
| D(LGFCF(-5)) | -0.065268 | 0.042538 | -1.534351 | 0.1386 |
| D(LGFCF(-6)) | -0.079931 | 0.044144 | -1.810685 | 0.0833 |
| CointEq(-1)* | -0.181145 | 0.039509 | -4.584938 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.590084 | Mean dependent var | 0.017961 |
| Adjusted R-squared | 0.442514 | S.D. dependent var | 0.016213 |
| S.E. of regression | 0.012106 | Akaike info criterion | -5.755354 |
| Sum squared resid | 0.003664 | Schwarz criterion | -5.310969 |
| Log likelihood | 110.7187 | Hannan-Quinn criter. | -5.601953 |
| Durbin-Watson stat | 1.921421 | | |

Table 6 shows the error correction model estimates containing the co-integration coefficients otherwise, known as the speed of adjustment which measures the short run adjustment of the deviation of LRGDP from long run equilibrium value. It is required that the co-integration coefficient be negative and significant. Here, the error correction term is negative (-0.181) and significant at 1% level which shows the speed of adjustment approximately 18%, which indicates that it corrects 18% of the error in the previous years.

**Residual Diagnostics**

The Breusch-Godfrey serial correlation LM test results shows the absence of serial correlation in the model as F= 1.264 (p >0.05). as shown on Figure 3. Similarly, the result for the test of normality of the residuals in the model is performed using the Jarques-Bera Test. Here, the probability of the JB statistic is 0.5256 with p>0.05. Table 8 shows that the hypothesis of homoscedastic residuals is not rejected at 5% level as F = 0.4541 with p > 0.05. By this result, it is reasonable to conclude that the residual are normally distributed, homoscedastic and do not contain serial correlation.

*Figure 3: Jarques Bera Test of Normality*

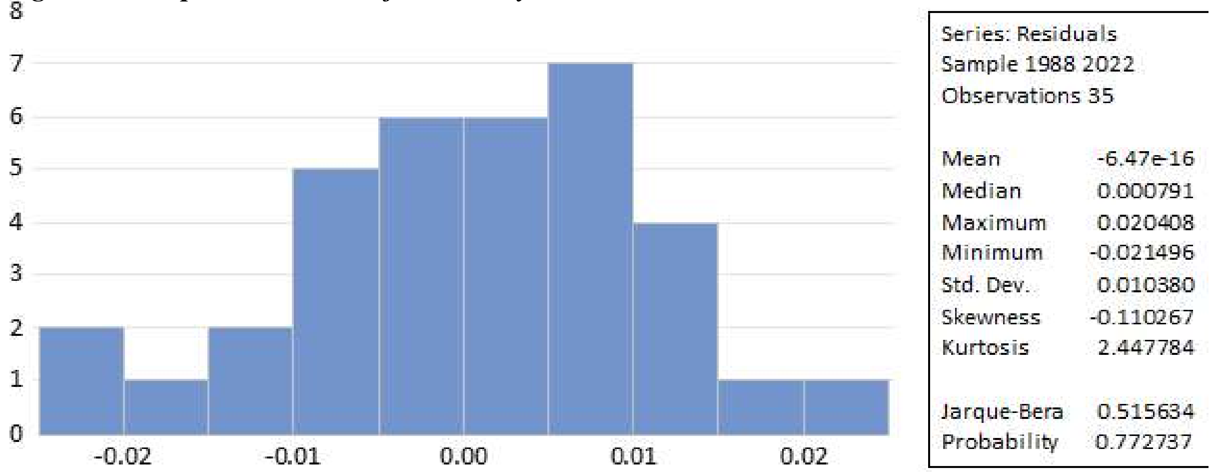



***Table 7. Breusch-Godfrey Serial Correlation LM Test***

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

| | | | |
|---|---|---|---|
| F-statistic | 1.264400 | Prob. F(2,21) | 0.3030 |
| Obs*R-squared | 3.761688 | Prob. Chi-Square(2) | 0.1525 |

Source: Authors' computation (2023) using Eviews 12

***Table 8. Breusch-Pagan-Godfrey Test for Heteroskedasticity***

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

| | | | |
|---|---|---|---|
| F-statistic | 0.454097 | Prob. F(11,23) | 0.9128 |
| Obs*R-squared | 6.244934 | Prob. Chi-Square(11) | 0.8565 |
| Scaled explained SS | 1.952186 | Prob. Chi-Square(11) | 0.9987 |

**Stability Test (CUSUM Graph)**

The result on Figures 4 and 5 indicate that the ARDL (3,7) model is indeed stable as all the points on both the CUSUM and CUSUM squares line plot falls within the stability limits at the 5% significance of significance.

*Figure 4: CUSUM Stability Test*

*Figure 5: CUSUM Squares Stability Test*

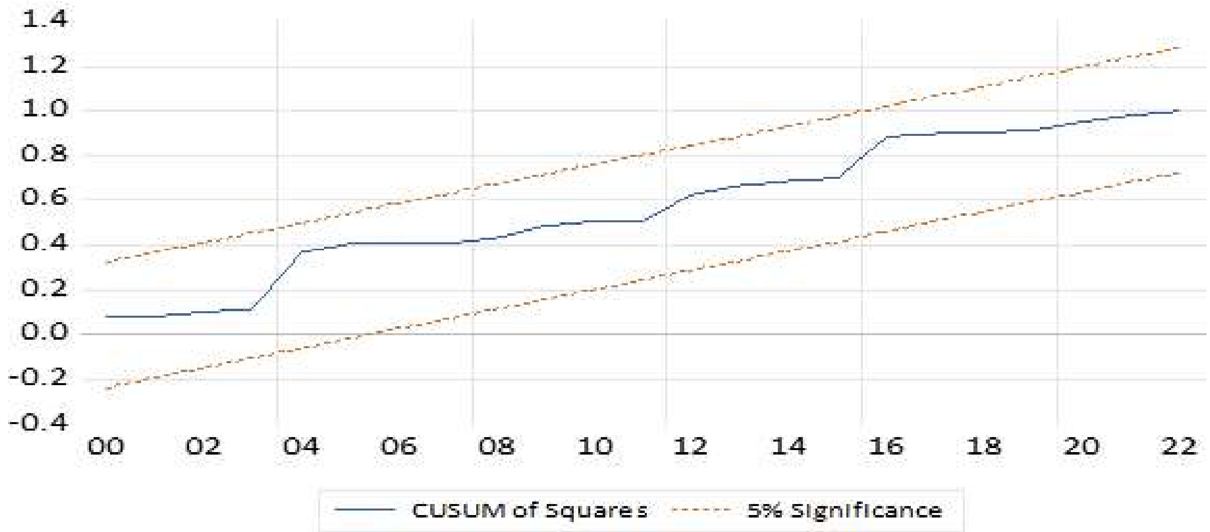
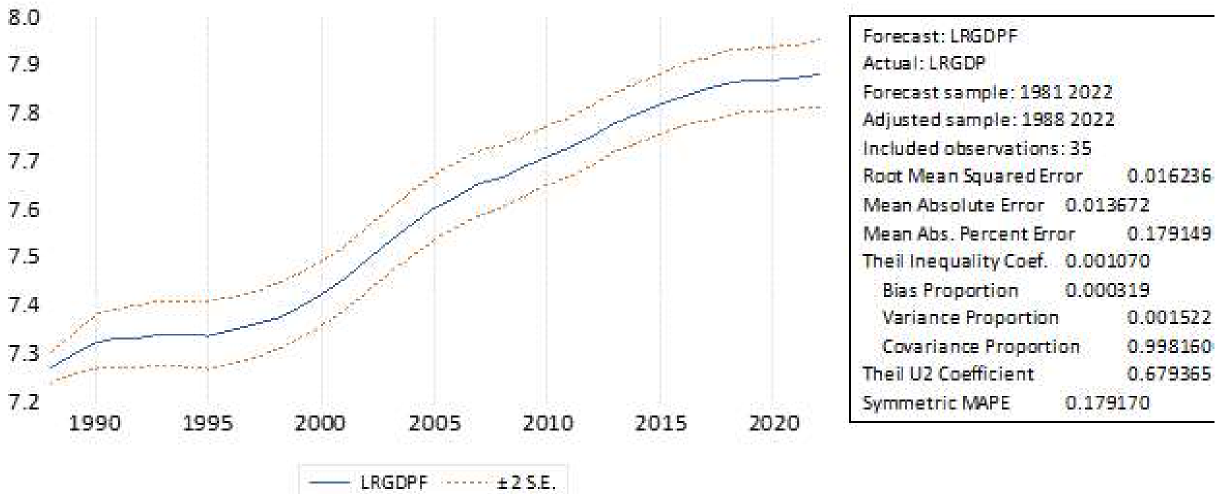



*Figure 6: Forecasts Indicators*




The results on Figure 6 presents the forecast accuracy of the ARDL (3,7) showing the root mean squared error (RMSE) of 0.0162 or 1.6%, Mean Absolute Error (MAE) of 0.0136 or 1.4% and Mean Absolute Percentage Error (MAPE) of 0.179 or approximately 18% with a near zero values of bias proportion and the Theil inequality. This shows that the model provided good forecast.

**Concluding Remarks**

This study aimed to explore the relationship between real gross domestic product (RGDP) and investment (GFCF) in Nigeria using an Autoregressive Distributed Lag (ARDL) modeling approach. The research investigated the short-term and long-term dynamics between these variables using data collected from secondary sources, specifically the Central Bank of Nigeria (CBN) and the National Bureau of Statistics (NBS) Statistical Bulletin, covering a period of 33 years from 1981 to 2022.

The results suggests that the current RGDP (LRGDP) is mainly influenced by its own lagged 2 value (L RGDP(-2)) but negatively affected by lagged values of fixed capital formation (LGFCF) in the short run. The impact of investment however is positive and significant in the long run. The finding of positive impact of GFCF on LRGDP is supported by works of Alfa and Garba (2012), Kanu and Ozurumba (2014) and also Bakare (2011b) among others.

By utilizing the ARDL model, the estimated coefficients showed the existence of significant positive impact of GFCF as proxy to investment on the current level of RGDP in the long run but insignificant negative impact in the short run. The findings in this study provides good insight to approach investment in a more appropriate manner that will significantly contribute to positive economic growth of Nigeria in both short and long run.

## References

Alfa, A.B and Garba, T. (2012). The Relationship between Domestic Investment and Economic Growth in Nigeria . *International Journal of Research in Social Sciences,* 2(3):2249-2496.

Abina A. P. and Lemea G M (2019) Capital market and performance of Nigeria economy. *International Journal of Innovative Finance and Economics Research,*7(2): 51-66.

Abina. A.P and Mogbeyiteren, O.L.B. (2021). Capital Formation and Economic Growth in Nigeria: AnEconometric Analysis**,** *African Journal of Business and Economic Development* 1(12): 57-72

Ajose, K. and Oyedokun. G. E. (2018). Capital formation and economic growth in Nigeria.*Accounting & Taxation Review,*2(2), 131-142.

Bakare A.S. (2011a). The Impact of Capital Formation on the Growth of Nigerian Economy: Causality Approach, *Far East Journal of Psychology and Business,* 13(1), 2-13 www.fareastjournals.com.

Bakare, A.S. (2011b). A theoretical analysis of capital formation and growth in Nigeria. *Far East Journal of Psychology and Business,* 3(2), 11-24.

Central Bank of Nigeria (CBN, 2011). Annual Statistical Bulletins of 1990 - 2020. Central Bank of Nigeria Publication. Abuja.

Belloumi, M and Alshehry, A (2018).. The Impacts of Domestic and Foreign Direct Investments on Economic Growth in Saudi Arabia. *Economies* 18(6):1-17

Domar, E. (1946). Capital Expansion, Rate of Growth and Employment, *Econometrica,* 14(1): 30-40.

Egbetunde, T and Fadeyibi, I.O (2015). Investment and Economic Growth in Nigeria: Evidence from Vector Error Correction Model. *Journal of Sustainable Development in Africa,* 17(3):66-78

Gbenga, W.A. and Adeleke, O. (2013). Savings, gross capital formation and economic growth nexus in Nigeria (1975-2008). *Journal of Economics and Finance.* 2(1): 19-25.

Jeffrey, M.W. (2012). Introduction to Econometrics: A Modern Approach. Fifth Edition

Jhingan, M.L. (2006). *Economic Development,* New Delhi, Vrinda Publications (P) Ltd, P.162 Jhingan, *loc.cit.,* 163.

Jhingan, M.L. (2009). *The Economic Development and Planning*. 39th Edition. Vrinda Publication LTD.

Kanu, S.I. and Ozurumba, B.A. (2014). Capital formation and economic growth in Nigeria. *Global Journal of Human-Social Science,* 4(14),43-58.

Kanu, SI and Nwaimo, C.E. Capital Expenditures and Gross Fixed Capital Formation in Nigeria. *Research Journal of Finance and Accounting*. 6(12):188-197

Ljung, G and Box, G. (1978). On a Measure of Lack of Fit in time Series Models. *Biometrika*, 65:297-303

Mankiw, N.G., Romer, D. and Weil, D. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 2(107), 407- 437.

Musa, Y.E.M (2021). Insecurity in Nigeria: Causes, Consequences and Solutions. 20th Joint Planning Board and National Council on Development Planning Forum held on 3-5 August 2021 in Maiduguri Nigeria.

Onyekwere, B.A. (2016). Economic Growth and Development in Nigeria. *Kuwait Chapter of Arabian Journal on Business and management Review*. 6(3):32-39.

Onyinye, N.G., Idenyi, O.S. and Ifeyinwa, A.C. (2017). Effect of capital formation on economic growth in Nigeria. *Asian Journal of Economics, Business and Accounting,* 5(1): 1-16.

Onwiodiokit, E.A and Otolorin, G.E. (2021). Capital Formation and Economic Growth in Nigeria: An Empirical Re-Examination. *Bullion*, 45(2):58-72

Rajarathinam A and Subha S S (2021). The Interaction Between Area and Production of Food Grain Crops in India : An Empirical Evidence from ADRL Bounds Test Cointegration. Research Squares: 1-17

Schumpeter, J.A. (1911). The theory of economic development. Cambridge, MA: Harvard University Press.

Schumpeter, J. A. (1912). Theorie der wirtschaftlichen, entwicklung. Leipzig: Dunker and humblot, (The theory of economic development, translated by Redivers Opie. Cambridge, MA: Harvard University Press, 1934).

Shaw, E. (1973). Financial deepening in economic development, Oxford University Press, New York.

Todaro, M. P. and Smith, S. C. (2006). Economic development 8th edition. Manila, Philippines: Pearson South Asia Pte. Ltd. pp. 601- 642.

Tolu L and Abe, O. (2017). National Development in Nigeria: Issues and Prospects. African Journal of Political Science, 11(4):1-5.