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Cointegration and Causality Inferences on Domestic Savings, Investment and Economic Growth in Nigeria

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ABSTRACT

Economic theories speculate that savings generate investment which in turn creates employment opportunities that give birth to demand, prices, profit and more production expansion. This expansion if properly utilized will lead to economic growth of a country. This paper attempts to investigate the causal relationship between domestic savings, domestic investment and economic growth in Nigeria. The study uses annual time series data from 1970-2015. Augmented Dickey-Fuller unit root test, Johansen cointegration, fully modified least squares; Vector error correction model (VECM) and Granger causality test based on Toda-Yamamoto procedure were employed in this study. The results shows that all variables are integrated of order one and hence cointegrated. The study finds domestic investment as having positive and significant impact on economic growth in Nigeria in the long-run. The economic impacts of domestic saving and investment on economic growth in the short-run are found to be low, permanent and long lasting. The VECM model has identified a sizeable speed of adjustment by 68.78% for correcting disequilibrium annually for achieving long term equilibrium steady state position. The Granger causality test result shows statistical evidence of bidirectional causality between domestic investment and economic growth and bidirectional causality between domestic savings and domestic investment in the short-run. However, there is no short-run Granger causality between domestic savings and economic growth. The study recommends that promoting investment for higher economic growth is a better policy strategy for Nigeria. Enhancing investment growth through savings is also a policy option suitable for short-run to long-run as evidenced by this study.

Keywords: *Savings, Investment, Economic Growth, Unit Root, Error Correction Model, Granger Causality, Nigeria.*

1. Introduction

In econometric theory *economic growth* refers to growth of potential output such as production at full employment which is caused by growth in aggregate demand or observed output. According to Tadaro (1977) economic growth is simply the increase overtime of an economy's capacity to produce those goods and services needed to improve the well-being of the citizens. It is the steady process by which the productive capacity of the economy is increased overtime to bring about rising levels of national income.

Dornbusch and Fischer (1994) stated that, economic growth focuses on the expansion of productive capacity over time. The expansion of productive capacity requires an increase in natural resource, human resource, capital and technology. Thus economic growth is due to growth in inputs, such as labour, capital and technological improvement.

Economic growth is measured by the increase in the amount of goods and services produced in a country. A growing economy produces more goods and services in each successive time period. Thus, growth occurs when an economy's productive capacity increases which, in turn, is used to produce more goods and services. Savings according to McKinnon (1973) is defined as that portion of income after tax, which is not spent on consumption goods. It can also be seen as that part of income, which is not devoted to the purchase of household items and firm. Investment on the other hand can be defined as the expenditure of funds leading to the creation of net additions to the stock of physical capital; it is done almost exclusively by firms. The major factor that determines investment is interest rate and this is influenced by savings. An investor will be favoured when the marginal efficiency of capital is high. Marginal efficiency is defined as the expected rate of returns from additional unit of capital asset. It also refers to the expected rate of profit per year on real investment of the most efficient type. However, there will be no investment of profit expectation which is not very bright; this is the reason why investment falls to a low level during a depression despite all the encouragement to stimulate private investment (Revel, 1975).

When savings increase, investment is very essential for the economic development of an economy. With increase investment, employment is bound to increase which will in turn increase demand, prices, profit and more production expansion. This expansion if properly utilized will lead to economic growth of a country (Shaw, 1973). Investment comes as a result of capital accumulation, which in turn depends upon savings (Ndulu, 1990). Savings by profit earners and their conversion into investment was the main determinant of economic growth of Great Britain in the 19th century.

In other to promote economic growth in Nigeria, government must encourage saving, stimulate investment and production in the country. Investment contributes to economic growth in aggregate wealth. But for investment to increase there must be a corresponding increase in the amount of saving. Therefore, savings perform a major function of providing national capacity for investment and production, which affects the potential for economic growth. A serious constraint to sustainable economic growth is caused from the low rate of saving. When saving rate is higher, it leads to less consumption, but results in larger amount of capital investment and higher level of economic growth (Rasmidatta and Lin, 2011).

According to the theory of marginal propensity to save, saving expand as income increases, from this perspective it can be easily understood that when there is growth in an economy, the amount of saving also increases. Looking at the controversial perception about the relationship between saving and economic growth, it can easily be seen that once aggregate saving increases perhaps from rising in income, it might enhance investment opportunities and generate economic growth for the country.

The figure below provides insight into domestic savings, investment and growth profile in Nigeria.

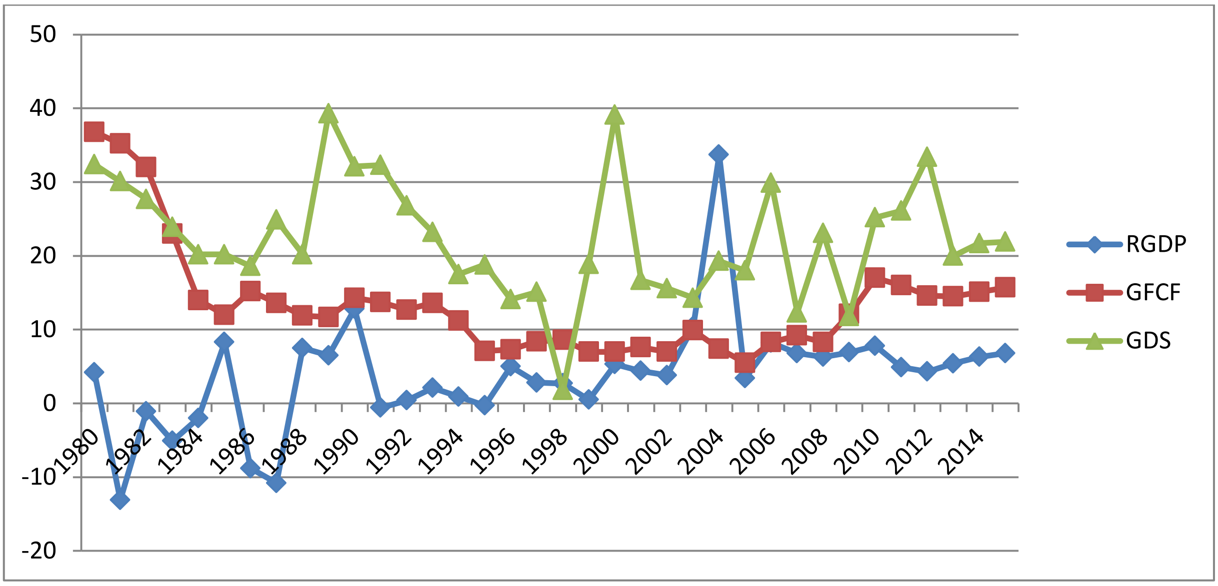

Figure 1: Savings, Investment and Growth Profile in Nigeria from 1980-2015

Figure 1 provides a trend analysis of the savings, investment and growth rates in Nigeria for the period 1980 to 2015. From 1980 to 2002 the growth rate for Nigeria was very low alternating between low positive values to negative indicating a contraction in the growth rate, although there was a significant improvement in 2004.The rates of gross domestic saving and Gross fixed capital formation are generally higher than growth especially in the early 1980's. While the rate of saving increases, the rate of investment declines especially between 1995 and 2008. Generally, savings rate, investment rate and GDP growth rate are very low in Nigeria with fluctuating trends.

There are mixed findings on the relationship between economic growth and savings, Carroll and Weill (1994) empirically found that economic growth Granger causes savings, but savings does not Granger cause economic growth. Similar conclusions were reached by independent researchers such as Sinha and Sinha (1998), Agrawal (2001), Anoruo and Ahmad (2001), Baharumshahl et al. (2003), Verma (2007), Odhiambo (2009), Agrawal et al. (2010) and Andrei and Huidumac-Petrescu (2013) among others. On the contrary Aghion and Howitt (2005), Greenidge and Miller (2010), Jangili (2011), Budha (2012), Tang and Ch'ng (2012), Tang and Lean (2013) and Tang and Tan (2014) among many other researchers empirically found one-way causality from savings to economic growth. Few studies such as Tang and Chua (2012) and Gulmez and Yardımcıoglu (2013) found two-way causality between economic growth and savings. On the relationship between domestic investment and economic growth Ahmad and Hamdani (2003) found that domestic investment had positive and significant impact on economic growth, while Adams (2009), Sooreea-Bheemul and Sooreea (2013) found that economic growth had positive and significant impact on domestic investment. On the other hand Mohamed et al. (2013) and Chowdhary and Kushwaha (2013) found that there was bidirectional causality between economic growth and domestic investment. Looking at these empirical findings one would conclude that there exist mixed findings between the relationship between domestic investment and economic growth. Bayar (2014) examined the effects of domestic savings and foreign direct investment inflows on the economic growth in emerging Asian economies for the period 1982-2012. He employed Pedroni, Kao and Johansen-Fisher panel co-integration tests and vector error correction model. He found that gross domestic savings, gross domestic investment and foreign direct investment inflows had positive and significant impact on economic growth in the long run.

In Nigeria, Uma et al. (2014) examined the influence of investment and saving in Nigeria economy using time series data from 1980-2012. They found that savings and domestic investment have long run positive and significant impact on the Nigerian economy while FDI has negative and insignificant impact on the economy. Kanu and Ozurumba (2014) conducted a study on the impact of capital formation on the economic growth in Nigeria using multiple regressions technique. They found that in the short run, gross fixed capital formation had no significant impact on economic growth; while in the long run; the VAR model estimated indicate that gross fixed capital formation, total exports and the lagged values of GDP had positive long run relationships with economic growth in Nigeria. Adelakun (2015) examined the relationship between savings, investment and economic growth in Nigeria. His study made use of time series data spanning for twenty-nine years using error correction model. The result shows a positive relationship between savings, investment and economic growth in Nigeria. From the foregone, it is glaring to know that while different techniques were employed by independent researchers across different economies to investigate the relationship between domestic savings, investment and economic growth, all agreed that domestic savings and investment are among the key factors promoting economic growth all over the world including Nigeria. This study therefore, contributes, confirms and extends the existing literature by conducting an econometric analysis to investigate the causal relationship between domestic savings, investment and economic growth in Nigeria using more sophisticated statistical tools and more recent data.

2. Materials and Methods

2.1 Source of Data

The data used in this work are annual time series data covering the fiscal year 1980 to 2015. Real gross domestic product (RGDP) is used as proxy for economic growth. Gross domestic savings (GDS) is used as proxy for savings, which is obtained by subtracting final consumption expenditure from gross domestic product. Investment is represented by the gross fixed capital formation (GFCF) in the national accounts. The secondary data on these variables are obtained from World Bank website.

2.2 Unit Root Test

The purpose of conducting unit root test is to check whether the macroeconomic variables of interest are integrated of the same order before proceeding to the estimation procedure of cointegration test (Engle and Granger, 1987). In this study we employ the popular Augmented Dickey-Fuller unit root test. The ADF test regressions with drift are given as:

$$\Delta RGDP_t = \alpha_0 + \alpha_1 RGDP_{t-1} + \sum_{j=1}^{k} a_j \Delta RGDP_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta RGDS_t = \beta_0 + \beta_1 RGDS_{t-1} + \sum_{j=1}^{k} b_j \Delta RGDS_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta RGFCF_t = \varphi_0 + \varphi_1 RGFCF_{t-1} + \sum_{j=1}^{k} c_j \Delta RGCFF_{t-1} + \varepsilon_t \quad (3)$$

Where Δ is the first difference operator, ε_t is the random error term which is iid. k is the number of lagged differences. The ADF equations test the following pairs of hypotheses:

$H_0: \alpha_1 = \beta_1 = \varphi_1 = 1$ (the series contains a unit root) against

$H_1: \alpha_1 \neq \beta_1 \neq \varphi_1 < 1$ (the series is stationary)

2.3 Johansen Cointegration Test

Two or more non-stationary series, I(1), are said to be cointegrated if their linear combination gives a stationary series, I(0). Johansen (1991, 1995) developed a methodology for testing for cointegration as follows:

Let $\boldsymbol{Y_t} = (y_{1t}, y_{2t}, \dots, y_{nt})'$ denote an $(n \times 1)$ vector of non-stationary I(1) time series variables. The basic Vector Autoregressive Model of order p, denoted VAR(p) is defined as

$$\boldsymbol{Y}_t = \boldsymbol{\alpha} + \boldsymbol{\phi}_1 \boldsymbol{Y}_{t-1} + \boldsymbol{\phi}_2 \boldsymbol{Y}_{t-2} + \cdots + \boldsymbol{\phi}_p \boldsymbol{Y}_{t-p} + \boldsymbol{B X_t} + \varepsilon_t, t = 1, 2, \dots, T \quad (4)$$

where $\boldsymbol{\alpha}$**:** is an $(n \times 1)$ vector of intercept; $\boldsymbol{\phi}_i\ (i = 1, 2, \dots, p)$: is $(n \times n)$ coefficient matrices; $\boldsymbol{X}_t$ = d-vector of deterministic variables; ε_t: is an $(n \times 1)$ vector of unobservable error term with zero mean (white noise). We may rewrite this VAR as:

$$\Delta \boldsymbol{Y}_t = \boldsymbol{\Pi} \boldsymbol{Y}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \boldsymbol{Y}_{t-i} + \boldsymbol{B} \boldsymbol{X}_t + \varepsilon_t \quad (5)$$

Where,

$$\boldsymbol{\Pi} = \sum_{i=1}^{p} \boldsymbol{\phi}_i - \boldsymbol{I} \,;\; \Gamma_i = - \sum_{j=i+1}^{p} \boldsymbol{\phi}_j \qquad (6)$$

Granger's representation theorem asserts that if the coefficient matrix $\boldsymbol{\Pi}$ has reduced rank $r < k$, then there exist $k \times r$ matrices α and β each with rank r such that $\boldsymbol{\Pi} = \alpha\beta'$ and $\beta' \boldsymbol{Y}_t$ is I(0). r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. Johansen cointegration test computes two statistics: trace statistic and maximum eigenvalue statistic. We only employ both the trace test and maximum eigenvalue test statistics in this study. The trace statistic for the null hypothesis of r cointegrating relations is computed as:

$$LR_{tr}(r|k) = -T \sum_{i=r+1}^{k} \log(1 - \lambda_i)$$

The maximum eigenvalue test statistic is computed as:

$$LR_{max}(r|r+1) = -T log(1 - \lambda_{r+1}) = LR_{tr}(r|k) - LR_{tr}(r+1|k) \qquad (8)$$

where λ_i is the i-th largest eigenvalue of the $\boldsymbol{\Pi}$ matrix in (3.6), $r = 0, 1, 2, \dots, k-1$.

In testing for cointegration, we summarize the five deterministic trend cases considered by Johansen (1995):

(1) The level data $\boldsymbol{Y}_t$ have no deterministic trends and the cointegrating equations do not have intercepts:

$$H_2(r): \boldsymbol{\Pi} \boldsymbol{Y}_{t-1} + B\boldsymbol{X}_t = \alpha\beta' \boldsymbol{Y}_{t-1} \quad (9)$$

(2) The level data have no deterministic trends and the cointegrating equations have intercepts:

$$H_1^*(r): \boldsymbol{\Pi} \boldsymbol{Y}_{t-1} + B\boldsymbol{X}_t = \alpha(\beta' \boldsymbol{Y}_{t-1} + \rho_0) \ (10)$$

(3) The level data $\boldsymbol{Y}_t$ have linear trends but the cointegrating equations have only intercepts:

$$H_1(r): \boldsymbol{\Pi} Y_{t-1} + B\boldsymbol{X}_t = \alpha(\beta' \boldsymbol{Y}_{t-1} + \rho_0) + \alpha_\perp \gamma_0 \ (11)$$

(4) The level data $\boldsymbol{Y}_t$ and the cointegrating equations have linear trends:

$$H^*(r): \boldsymbol{\Pi Y}_{t-1} + B\boldsymbol{X}_t = \alpha(\beta' \boldsymbol{Y}_{t-1} + \rho_0 + \rho_1 t) + \alpha_\perp \gamma_0 \quad (12)$$

(5) The level data $\boldsymbol{Y}_t$ have quadratic trends and the cointegrating equations have linear trends:

$$H(r): \boldsymbol{\Pi Y}_{t-1} + B\boldsymbol{X}_t = \alpha(\beta' \boldsymbol{Y}_{t-1} + \rho_0 + \rho_1 t) + \alpha_\perp (\gamma_0 + \gamma_1 t) \quad (13)$$

When the study variables are cointegrated, it is statistically reasonable to estimate a vector error correction model (VECM). To do this, it is also reasonable to estimate cointegrating multiple regression model whose errors are obtained and use in estimating the VECM. The model specification for the cointegrating multiple regression is presented in the following subsection.

2.4 Cointegrating Regression Model Specification

To investigate the impact of real gross domestic savings and investment on real economic growth in Nigeria, we employ a multiple cointegrating regression model using fully modified ordinary least squares (FMOLS). The model is specified as follows:

$$RGDP = f[RGDS, RGFCF] \quad (14)$$

Real GDP is a function of real gross domestic savings and real gross fixed capital formation (investment). Our linear growth model then becomes

$$RGDP_t = \beta_0 + \beta_1 RGDS_t + \beta_2 RGFCF_t + \varepsilon_t \quad (15)$$

where $RGDP_t$ represents real GDP at time t used as proxy for economic growth, $RGDS_t$ represents real Gross Domestic Savings used as proxy for savings, $RGFCF_t$ represents real Gross Fixed Capital Formation used as proxy for investment, ε_t is the error term assumed to be normally and independently distributed with zero mean and constant variance, which captures all other explanatory variables that influence economic growth but are not included in the model. β_0 is the intercept of the regression model which represents the predictive value of the dependent variable when all the independent variables are kept constant. β_1, β_2 are the partial elasticity of real GDP growth with respect to $RGDS_t$ and $RGFCF_t$respectively.

The study expects the slope coefficient of RGDS to be positive $(\beta_1 > 0)$ and the coefficient of RGFCF to be positive $(\beta_2 > 0)$ for them to have positive impacts on economic growth.

2.5 The Vector Error Correction Model (VECM)

The error correction model which integrates the short-run dynamics in the long-run growth function is given by:

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{p} \beta_{2i} \Delta RGDP_{t-1} + \sum_{i=1}^{p} \gamma_{3i} \Delta RGDS_{t-1} + \sum_{i=0}^{p} \delta_{4i} \Delta RGFCF_{t-1} + \lambda_5 EC_{t-1} + \varepsilon_{2t} \quad (16)$$

where EC_{t-1} is the error correction term (the residuals that are obtained from the estimated cointegrating model of equation (10)). It provides the feedback and speed of adjustment which indicates how much of the disequilibrium that is being corrected in the system. For a stable long-run relationship to exists among the study variables, the error correction term must be negative and highly statistically significant (Bannerjee *et al.,* 1998). The symbol Δ represents the first-differenced form of the variables in the model. The coefficient of the various explanatory variables, $\beta_{2i}, \gamma_{3i}, \delta_{4i}$ are the impact multipliers which measure the immediate impact that a change in the explanatory variable has on a change in the dependent variable. λ represents the speed of adjustment parameter. The value of λ must lie in the range $-1 \leq \lambda \leq 0$ and must be statistically significant.

2.6 Granger Causality Test Based on Modified Wald Test Procedure

In order to test for Granger causality among the study variables, Toda & Yamamoto test procedure is employed (Toda and Yamamoto, 1995). Toda and Yamamoto procedure uses a Modified Wald (MWALD) test for restrictions on the parameters of the VAR (k) model. The model is specified as follows:

$$A_t = \alpha_1 + \sum_{i=1}^{k+d} \beta_{1i} A_{t-i} + \sum_{t-i}^{k+d} \beta_{2i} B_{t-i} + \varepsilon_{at} \quad (17)$$

$$B_t = \alpha_2 + \sum_{i=1}^{k+d} \varphi_{1i} A_{t-i} + \sum_{t-i}^{k+d} \varphi_{2i} B_{t-i} + \varepsilon_{bt} \quad (18)$$

where k is the optimal lag order; d is the maximal order of integration of the series in the system; ε_{at} and ε_{bt} are error terms which are assumed to be white noise. The usual Wald test is then applied to the first k coefficient matrices using the standard χ^2-statistics. The test checks the following pairs of hypotheses: A_t "Granger causes" B_t if $\beta_{2i} \neq 0$ in equation (17) against B_t "Granger causes" A_t if $\varphi_{1i} \neq 0$ in equation (18)

3. Results and Discussion

3.1 ADF Unit Root Result

Determining the order of integration of study variables is crucial in Johansen cointegration analysis. This is because Johansen cointegration technique can only be applied to variables that are integrated of the same order. For this purpose, this study has employed the popular

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Augmented Dickey-Fuller (ADF) unit root test both in level and first difference of the variables. Statistical results of the ADF test are presented in Table 1.

Table 1: ADF Unit Root Test Result

Variable	Option	Test statistic	P-value	Critical values		
				1%	5%	10%
$rgdp$	Intercept only	-2.1487	0.0942	-3.6329	-2.9484	-2.6129
	Intercept & trend	-2.6811	0.2500	-4.2436	-3.5442	-3.2047
$\Delta rgdp$	Intercept only	-3.0825	0.0031*	-3.6537	-2.9571	-2.6174
	Intercept & trend	-5.2740	0.0008*	-4.2627	-3.5529	-3.2096
$rgds$	Intercept only	-2.5160	0.0819	-3.6329	-2.9484	-2.6129
	Intercept & trend	-2.5175	0.0951	-4.2436	-3.5442	-3.2047
$\Delta rgds$	Intercept only	-5.0782	0.0002*	-3.6463	-2.9540	-2.6158
	Intercept & trend	-8.8457	0.0000*	-4.2529	-3.5485	-3.2071
$rgfcf$	Intercept only	-2.1942	0.1054	-3.6329	-2.9484	-2.6129
	Intercept & trend	-2.1102	0.1141	-4.2529	-3.5485	-3.2071
$\Delta rgfcf$	Intercept only	-6.6100	0.0000*	-3.6463	-2.9540	-2.6158
	Intercept & trend	-6.5255	0.0000*	-4.2627	-3.5530	-3.2096

Note: * denotes the significant of the ADF test statistic at 1% significance level. Δ denotes the first difference of the variable.

The result of Table 1 shows that gross domestic product, gross domestic savings and gross fixed capital formation are all non-stationary in levels for both cases with intercept only and with intercept and linear trend.

But these variables are stationary in the first differences. This is because the ADF test statistics are all less than their corresponding critical values at the conventional test sizes. Thus, we conclude that all variables are integrated of the same order, I(1).

Therefore, Johansen cointegration approach can be applied on these study variables conveniently.

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3.2 Johansen Cointegration Test Results

Since all study variables are integrated of the same order, we apply both Johansen cointegration trace test and maximum eigenvalue test. The results are reported in Table 2 and Table 3.

Table 2: Johansen Cointegration Rank Trace Test

Hypothesized No. of CE(s)	H_0	H_1	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	$r = 0$	$r \geq 1$	0.564927	46.88256	29.79707	0.0002
At most 1	$r \leq 1$	$r \geq 2$	0.284002	19.41863	15.49471	0.1521
At most 2 *	$r \leq 2$	$r = 3$	0.224591	8.394049	3.841466	0.0038

Note: Trace test indicates 2 cointegrating equations at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values.

Table 3: Johansen Cointegration Rank Maximum Eigenvalue Test

Hypothesized No. of CE(s)	H_0	H_1	Eigenvalue	Max. Eigen Statistic	0.05 Critical Value	Prob.**
None *	$r = 0$	$r = 1$	0.564927	27.46393	21.13162	0.0056
At most 1	$r \leq 1$	$r = 2$	0.284002	11.02458	14.26460	0.1530
At most 2 *	$r \leq 2$	$r = 3$	0.224591	8.394049	3.841466	0.0038

Note: Maximum Eigenvalue test indicates 2 cointegrating equations at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values.

From the results of Table 2 and Table 3, we reject the statistical hypotheses of no cointegration at $r = 0$ and $r \leq 2$ for both trace test and maximum eigenvalue test. The trace test and maximum eigenvalue test both indicate two cointegrating equations at the 0.05 significance levels. These results confirm the existence of a stable long run or equilibrium relationship among gross domestic product, gross domestic savings and gross fixed capital formation. This means that the variables under study share a common stochastic drift. This also means that the variables will not wander away from each other in the long run and are bound to vary in sympathy with each other.

3.3 Estimation of Long-Run Coefficients

To investigate the impacts of domestic savings and investment on economic growth in Nigeria, we estimate cointegrating regression equation using fully modified ordinary least squares. The result is presented in Table 4.

Table 4: FMOLS Parameter Estimates of Cointegrating Equation

Dependent Variable: RGDP				
Variable	Coefficient	Std. Error	t-Statistic	P-value
RGDS	0.091438	0.163595	0.558929	0.5801
RGFCF	0.456361	0.198971	2.293606	0.0285
C	8.175015	3.828412	2.135354	0.0405
R-squared				0.744934
Adjusted R^2				0.591492
Durbin Watson				1.993522

The model equation describing the long-run relationship between real GDP, real GDS and real GFCF from the estimates of Table 4 is presented below:

$$\mathrm{RGDP}_t = 8.175015 + 0.091438\mathrm{RGDS}_t + 0.456361\mathrm{RGFCF}_t \qquad (14)$$

From equation (14) it is observed that the intercept is positively related to gross domestic product and statistically significant. This means that real GDP is predicted to be 8.18 percent when the independent variables are held constant. The slope coefficients of real gross domestic savings and real gross fixed capital formation both have expected positive signs as suggested by economic theory. The slope coefficient of real gross domestic savings, although not statistically significant, has the expected positive sign indicating its positive relationship with real GDP. This shows that for every 1 percent increase in RGDS, real GDP is predicted to increase by 9.14% in the long-run. This low impact of domestic savings on economic growth may be due to the fact that investment is influenced by foreign inflows such as foreign direct investment and positive net current transfer in balance of payments.

The slope coefficient of the GFCF is positively related to real GDP and statistically significant. The slope coefficient of real GFCF is 0.4564 which is very low and indicates low long-run

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investment multiplier. This implies that real GDP will only increase by 45.64% if investment is increased by 100%. This suggests the existence of many leakages in Nigeria economy that hinders the working of investment multiplier.

The coefficient of determination (R^2) of the estimated model shows that about 74.49% of the variability in real GDP has been explained by real gross domestic savings and real gross fixed capital formation leaving 25.51% unexplained variations to error or factors not included in this model. The Durbin Watson statistic value of 1.9935 which is greater than R^2 and R^2 indicates that our model is non-spurious. This also shows the absence of positive serial correlation in the model. This study has identified investment as having positive impact on economic growth in Nigeria. While the finding of this result agrees with the findings of Hamdani (2003), Kanu & Ozurumba (2014), Uma *et at*. (2014) and Adelakun (2015), it disagrees with the findings of Adams (2009) and Sooreea-Bheemul and Sooreea (2013).

3.4 The Vector Error Correction Model

Since the study variables are cointegrated, they are indeed in a state of equilibrium. We thus use the residuals obtained from the cointegrating regression equation in Table 5 to estimate the error correction model (VECM) which adjusts the speed of disequilibrium in the system. The result is presented in Table 5.

Table 5: Parameter Estimates of Error Correction Model

Dependent Variable: ΔRGDP					
Variable	Coefficient	Std. Error	t-statistic		P-value
C	0.056934	1.249159	0.045578		0.9640
ΔRGDP (-1)	-0.845805	0.184406	-4.586645		0.0001
ΔRGFCF (-1)	-0.949556	0.428141	-2.217858		0.0194
ΔRGDS (-1)	-0.735528	0.126933	5.794616		0.0000
EC (-1)	-0.687777	0.065744	-10.46144		0.0000
R-squared	0.846774	F-statistic	5.854952		
Adjusted R^2	0.670467	Prob (F-statistic)	0.001399	DW Stat.	2.120733

The slope coefficients of ΔRGDP(-1), ΔRGFCF(-1) and ΔRGDS(-1) are called short-run equilibrium coefficients while the slope coefficient of EC(-1) is the long-run equilibrium coefficient known as the error correction coefficient. Theory expects the coefficient of EC(-1) to be negative and significant.

The short-run equilibrium coefficients tell us the rates at which the previous period's disequilibrium in the system is being corrected. In our ECM model the system corrects its previous period's disequilibrium at the speed of 84.58% between economic growth and economic growth lag one year, 94.96% between economic growth and investment lag one year and 73.55% between economic growth and saving lag one year. The higher percentage values show how fast the previous period's disequilibria between economic growth and other explanatory variables in the system are being corrected. The slope coefficients of ΔRGDP(-1), ΔRGFCF(-1) and ΔRGDS(-1) are all statistically significant at lag one year indicating that the impacts of domestic saving and investment on economic growth are permanent and long lasting.

The one lagged period error correction model is represented by EC(-1). This guides the independent variables in the system to restore back to equilibrium when it is negative and statistically significant. In our model the EC(-1) coefficient is -0.687777. This value is negative and statistically significant as desired indicating that the system corrects its previous period's disequilibrium at a speed of 68.78% yearly. This means that the ECM model has identified a sizeable speed of adjustment by 68.78% for correcting disequilibrium annually for achieving long term equilibrium steady state position.

3.5 Granger Causality Test Result based on Modified Wald Test Approach

To conduct Granger causality test based on Toda-Yamamoto (modified Wald test) procedure, we estimate two equations in VAR model. We now use these equations to conduct VAR lag order selection test using different information criteria. The result is presented in Table 6.

Table 6: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-302.3831	NA	37929.44	19.0535	19.5977*	19.2366
1	-289.3186	20.5864*	30127.07*	18.8072*	19.7595	19.1276*
2	-281.6193	10.7324	33905.21	18.8860	20.2465	19.3438

Note: * denotes lag length selected by the criteria

The various information criteria in Table 6 suggest that we should specify a maximum lag length of 1 for each variable in the model.

To test for stability of the estimated VAR model, we conduct serial correlation LM test of residuals of the estimated VAR model, the result is presented in Table 7.

Table 7: VAR Residual Serial Correlation LM Tests

Lags	LM-Stat	P-value
1	8.151868	0.5189
2	6.927617	0.6447
3	12.27155	0.1984
4	6.411279	0.6982
5	9.518504	0.3909
6	16.11932	0.0644
7	3.375999	0.9475
8	9.102050	0.4279
9	9.098733	0.4282
10	4.268641	0.8929
11	6.127358	0.7271
12	6.349819	0.7045

The null Hypothesis of no serial correlation in the residuals of the estimated VAR model up to lag order 12 is accepted since the p-values are not statistically significant at 5% level. This means that our estimated VAR model has satisfied the stability condition and can use to conduct Granger causality test based on Toda-Yamamoto procedure. The result of Granger causality test is presented in Table 8.

Table 8: Granger Causality Test Based on Toda-Yamamoto Procedure

Variable	**Modified Wald Test**		
	RGDP	RGDS	RGFCF
RGDP	---	1.1498 [0.5628]	7.1950 [0.0115]*

RGDS	0.3938 [0.8213]	---	8.1293 [0.0159]*
RGFCF	6.2763 [0.0286]*	9.8747[0.0052]*	---

The result of Table 8 shows statistical evidence of bidirectional short-run causality between domestic investment and economic growth. This means that gross fixed capital formation (domestic investment) Granger causes gross domestic product (economic growth) and economic growth in turn Granger causes domestic investment. But there is no short-run Granger causality between domestic savings and economic growth. The Granger causality test result also shows two-way causality between domestic savings and domestic investment in the short-run. This means that savings Granger causes investment and investment in turn Granger causes savings. This result is in conformity with Budha (2012) but contradicts the findings of Tang and Chua (2012), Chowdhary and Kushwaha (2013), Mohamed *et al*. (2013) and Gulmez and Yardimcioglu (2013) who found bilateral causality between domestic savings and economic growth.

4. Conclusion

This paper is has attempted to investigate the causal relationship between domestic savings, domestic investment and economic growth in Nigeria. The study uses annual time series data from 1970-2015 and employed Augmented Dickey-Fuller unit root test to examine the unit root and stationarity properties of the series, Johansen cointegration to investigate the long-run relationship among study variables, fully modified least squares to determine the impact of savings and investment on economic growth; Error correction model to determine the speed of adjustment for disequilibrium and Granger causality test based on Toda-Yamamoto procedure to find the direction of causality among study variables.

The unit root test result of the study shows that all the study variables are integrated of order one; the Johansen cointegration found the existence of long-run relationship among the study variables. The study finds domestic investment as having positive and significant impact on economic growth in Nigeria in the long-run. The economic impacts of domestic savings and investment on economic growth in the short-run are found to low, permanent and long lasting. The ECM model has identified a sizeable speed of adjustment by 68.78% for correcting disequilibrium annually for achieving long term equilibrium steady state position. The Granger causality test result shows statistical evidence of bidirectional causality between domestic investment and economic growth. Similarly, the study found

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bidirectional causality between domestic savings and investment in the short-run. However, there was no short-run Granger causality between domestic savings and economic growth.

Although gross domestic savings have no long-run effect on economic growth in Nigeria, it should be promoted and encouraged for its desirable level effects in the short-run. Since domestic investment and economic growth have bidirectional relationship both in the short-run and long-run, promoting investment for higher economic growth is a better policy strategy for Nigeria. Enhancing investment growth through domestic savings is also a policy option suitable for short-run to long-run as evidenced by this study.

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