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INVESTMENT AND ECONOMIC GROWTH IN NIGERIA: EVIDENCE FROM VECTOR ERROR CORRECTION MODEL

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ABSTRACT

The paper investigates the investment – growth nexus in Nigeria, for the period 1981-2012. Using the Vector Error Correction Model (VECM), the study finds that investment is cointegrated with economic growth in the country; that is, there is a long run relationship between investment and economic growth in Nigeria. The results further show that investment Granger causes economic growth in Nigeria. The paper argues that there is need for the government to invest heavily through appropriate mechanism, strong institutions and macroeconomic policies in order to result to economic progress and sustainable development in the country.

Keywords: Investment, Economic Growth, Long Run, Sustainable Development, Vector Error Correction Model, Granger causes, Nigeria

INTRODUCTION

Investment is a key factor that determines economic progress in both developed and developing economies. Nigeria requires substantial investment in promoting and enhancing economic activities that guarantee better living conditions of the Nigerians. In development economics, the debate on the investment – growth nexus still on going in order for developing countries to cash up with the developed economies.

For any meaningful investment to take place in Nigeria, saving’s habit needs to be encouraged. Savings in Nigerian economy was fluctuating over the study period. Specifically, savings habit in the country fell from 33.7% in 1987 to 6.9% in 1997. It dropped by 59% in 2007 and later rose to 52% in 2012. It is important to investigate this empirically for efficient policy makings and formulations.

Theoretically, Nurkse (1953) argues that the so-called underdeveloped areas, as compared with advanced, are underdeveloped with capital in relation to their population and natural resources. Further, the emphasis was on accumulation of physical capital to the neglect of investment in education, health and skills (human capital) or technical progress. The idea was to divert a part of society’s currently available resources to increase the stock of capital goods so as to make possible an expansion of consumable output in the future.

Nurkse did mention the vicious circle of poverty on the demand side but his solution was a supply-side strategy of balanced growth -- "a more or less synchronised application of capital to a wide range of different industries" -- which he took to be an implication of Rosenstein-Rodan’s theory. His view was that though "capital formation is not entirely a matter of capital supply... this is no doubt the more important part of the problem." To finance the required investment a high savings ratio (or massive foreign borrowing) would be necessary.

In the light of these assertions, it is important to investigate whether the capital accumulation in the country translate to economic progress and sustainable development. However, this study examines whether investment spur economic growth in Nigeria or not and covers the periods 1981 to 2012.

LITERATURE REVIEW

Barro (1991) examines the effect of public investment and public consumption expenditures on cross-country growth rates. After controlling for a number of variables, it was found that public investment has no significant effect on growth rates, whereas the rate of economic growth is negatively related to the share of government consumption expenditure. Canning and Fay (1993) and Easterly and Rebelo (1993) use panel data to investigate the contribution to economic growth of transportation networks. A key finding of the study is a strong relationship between economic growth and public investment in transportation and communication. Devarajan, Swaroop and Zou (1996) present evidence for 43 developing countries, which indicates that the share of total government expenditure (consumption plus investment) has no significant effect on economic growth. However, the authors found an important composition effect for government expenditure: that is, increases in the share of consumption expenditure have a significant positive effect on economic growth, whereas increases in the share of public investment expenditure have a significant negative effect. The negative effect also holds for each of the major components of public investment, including transportation and communication. This leads to the somewhat surprising prescription that governments in developing countries would be better advised to switch public resources from investment goods to current consumption.

Pritchett (1996) suggests another explanation for the Devarajan *et al*. (1996) findings – the “white elephant” hypothesis. He argues that public investment in developing countries is often used for unproductive and inappropriate projects. As a consequence, the share of public investment can be a very poor measure of the actual increase in economically productive public capital. On the one hand, higher public investment raises the national rate of capital accumulation above the level chosen (in a presumed rational fashion) by private sector agents; thus, public capital spending may crowd out private expenditures on capital goods on an ex-ante basis as individuals seek to re-establish an optimal inter-temporal allocation of resources. On the other hand, public capital – particularly infrastructure capital such as highways, water systems, sewers, and airports – is likely to bear a complementary relationship with private capital in the private production technology. Thus, higher public investment may raise the marginal productivity of private capital and thereby “crowd in” private investment.

Public investment has to be a source of endogenous growth. Under the hypothesis of balanced exogenous growth, public spending in the long run does not affect economic growth (King, Plosser, Stock and Watsson, 1991). In an endogenous-growth economy, output follows a stochastic trend, and permanent policy changes have long-term consequences for the growth of output, whereas temporary policy changes have long-term consequences for the level of output (Jones, 1995; Kocherlakota and Yi, 1996; and Evans and Karras, 1994).

In the case of endogenous growth, demand-side effects of increased public spending or crowding-out effects from the way public spending is financed may have long-term effects on output levels. The impact of changes in public investment may vary with the level of public investment. Barro (1991) specifies an endogenous-growth model, which incorporates productive public spending (e.g., public investment financed by lump-sum taxes) into the production function, and he derives a growth-maximizing spending share. The relationship between public spending and growth depends on the current spending level; it is positive (negative) if public spending is below (above) the growth-maximizing share. Therefore, only when public investment is below its growth-maximizing share will additional public investment increase growth. The government spending has to take into account the marginal effects of different types of public spending. The fact that public investment affects output positively does not imply that increases in public investment represent an effective growth strategy.

A balanced growth strategy relies on several prerequisites. Investment in high-speed broadband telecommunication is required for businesses and institutions (e.g., universities, hospitals) to function efficiently and for individuals to communicate. Good quality transportation systems are needed to move people and goods rapidly and safely between towns and cities. Finally, there is a common need for investment in education. There is a role for government in promoting balanced growth. Government as an employer can foster balanced growth through the decentralized provision of public services. Another approach would be to focus on supporting community economic development (CED), including the provision of capital financing.

Bukhari, Ali and Saddaqat (2007) using panel cointegration and causality tests, found that both public and private investment and public consumption have a long-term dynamic impact on economic growth in Korea, Singapore, and Taiwan. The pair-wise analysis of their study shows bidirectional causality between public investment and economic growth, and the homogeneous non-causality hypothesis suggests that non-causality results are completely homogeneous in a small sample of these mentioned countries.

M'Amanja and Morrissey (2008) results reveal two long run relations representing the reduced form growth equation and the behavioural function of private investment. They find that shares of private and public investment, and imports in GDP have strong beneficial effects on per capita income in Kenya. However, aid in the form of net external loans is found to have a significant negative impact on long run growth. Private investment relates to government investment and imports negatively, but positively to foreign aid. The implication for policy was that in order for Kenya to foster and sustain growth, closer attention should be given to factors that promote private investment.

Liu, Park and Zheng (2002) using Granger causality analysis, found evidence that housing investment has a stronger short run effect on economic growth than non-housing investment. They also found that housing investment has a long run effect on economic growth while economic growth has a log run effect on both housing and non-housing investment. They suggested that housing investment is an important factor for the short-term fluctuations of economic growth, with its growth stimulating the economic growth and its slumps leading to downside fluctuations.

Vu (2007) using a cross-country view on the impact of ICT on economic growth for 50 major ICT-spending countries, finds that the key determinants of the variance of ICT contribution to growth across economies include education, institutional quality, openness, and English fluency. Furthermore, ICT investment has a significant impact on economic growth not only as traditional investment, but also as a boost to efficiency in growth: a higher level of ICT capital stock per capita allows an economy to achieve a higher growth rate for given levels of growth in labour and capital inputs.

Jun (2003) analysing China's investment–growth nexus in the context of the high growth experiences in East Asian economies, finds that China has since realized its high growth without giving rise to an increasing proportion of investment to GDP and to arise of ICOR. He further reported that investment efficiency was largely reaped through the rural industrialization and proliferation of small firms in non-state sector.

Chandra and Sandilands (2001) show that no doubt there is a long-term positive relationship between investment (except government investment where the relationship is negative) and GDP in India, but the causality is from the latter to the former and not vice versa. They suggest that in India capital accumulation does not cause growth in the long run; rather growth is the cause of capital accumulation.

Haque (2013) adopting the new neo-classical growth model of Cobb Doglous Production Function utilizing the error correction model (ECM), found that the variables are stationary in first difference and the co-integration tests also confirm the existence of long term relationship between the variables. The findings of the study concluded that there exist a short-run and long-run relationship between public and private investment and economic growth in Bangladesh.

The study revealed that public and private investment impact positively on economic growth in the short and long run process. In addition it confirms that private investment is more effective in the long run than public investment.

According to the traditional view expressed in De Long and Summers (1991 and 1992), fixed investment in non-residential sectors, especially in equipment investment, is the key to economic growth. Blomstrom, Lipsey and Zejan (1996), however, showed that the causal link between growth and investment runs in the opposite direction. They thus suggested that the source of economic growth ought to be found somewhere else outside capital accumulation. Wen (2001) findings do not conform to either of these views about the cause of economic growth. What he have found, surprisingly, is that capital formation in the residential sector Granger-causes economic growth, which in turn Granger-causes capital formation in the business sector. This perhaps explains the slowdown of U.S. economic growth for the 80s and the early 90s, because residential investment as shares of GDP has been falling while non-residential investment as share of GDP has been rising during that period.

In the light of the above literature, there is need to investigate whether investment in the Nigerian economy spur economic growth or not. This will assist for effective policy making in the country.

THEORETICAL FRAMEWORK

This study adopted AK model. An early precursor of the AK model was the Harrod-Domar model[1], which assumes that the aggregate production function has fixed technological coefficients:

$$Y = F(K, L) = \min\{AK, BL\} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \; 1$$

where A and B are the fixed coefficients. Under this technology, producing a unit of output requires 1/A units of capital and 1/B units of labour; if either input falls short of this minimum requirement, there is no way to compensate by substituting the other input.

With a fixed-coefficient technology, there will either be surplus capital or surplus labour in the economy, depending on whether the historically given supply of capital is more or less than (B/A) times the exogenous supply of labour. When $AK < BL$, which is the case that Harrod and Domar emphasize, capital is the limiting factor. Firms will produce the amount

$$Y = AK \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; 2$$

and hire the amount (1/B)Y = (1/B)AK < L of labour.

Now, with a fixed saving rate, we know that the capital stock will grow according to the same equation as in the neoclassical model:

$$\dot{K} = sY - \delta K \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \; 3$$

[1] See Harrod (1939) and Domar (1946).

These last two equations imply

$$\dot{K} = sAK - \delta K \text{ ....4}$$

so that the growth rate of capital will be

$$g = \frac{\dot{K}}{K} = sA - \delta \text{ ....5}$$

Because output is strictly proportional to capital, g will also be the rate of growth of output. It follows immediately that the growth rate of output is increasing in the saving rate s.

The problem with the Harrod-Domar model is that it cannot account for the sustained growth in output per person that has taken place in the world economy since the industrial revolution. To see this point, let n be the rate of population growth. Then the growth rate of output per person is $g - n$. But if this is positive, then so is the growth rate of capital per person K/L, since K also grows at the rate g. Eventually, a point will be reached where capital is no longer the limiting factor in the production function. That is, K/L will eventually exceed the limit B/A above which labour becomes the limiting factor. From then on we will instead have Y = BL, implying that Y will grow at the same rate as L; that is, output per person Y/L will cease to grow.

METHODOLOGY AND MATERIALS

The study is carried out for Nigeria for the period 1981-2012. In this study, we measured economic growth as the log of real Gross Domestic Product, GDP (denoted as Y). Gross domestic investment (K) is measured as a percent of gross capital formation to GDP[2].

It is believed that other variables could have great impact on economic growth and that their omission could bias the direction of causality between investment and economic growth. In view of this, we included two control variables: real interest rate (R) and inflation rate (I) to avoid simultaneous bias (Gujarati, 1995) in our regressions[3].

Real GDP, real interest rate and inflation rate were sourced from Central Bank Statistical Bulletin, 2013 and gross capital formation as percent of GDP was sourced from World Development Indicator, 2013.

Multivariate Co-integration Analysis and Error Correction Modelling

[2] This indicates gross domestic investment in the economy.
[3] Asides, the incorporation of two control variables also helps to make our analysis multivariate as against bivariate. This is important because bivariate causality leads to erroneous causal inferences (see the work of Lutkepohl, 1982; Caporale and Pittis, 1995).

Since the co-integration and error correction methodology in fairly common place and is well documented elsewhere (Banerjee, *et. al*, 1993; Engle and Granger, 1987, Johansen, 1988; Johansen and Juselius, 1990) we provide only a brief overview here. Johansen (1988) multivariate co-integration model is based on the error correction representation given by:

$$\Delta \boldsymbol{X_t} = \boldsymbol{\mu} + \sum_{i=1}^{\rho-1} \boldsymbol{\Gamma_i \Delta X_{t-i}} + \boldsymbol{\Pi X_{t-i}} + \boldsymbol{\varepsilon_t} \ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{6})$$

Where X_t is an (nx1) column vector of ρ variables, μ is an (nx1) vector of constant terms, Γ and Π represent coefficient matrices, Δ is a difference operator, and $\varepsilon_t \sim N(0, \Sigma)$. The coefficient matrix Π is known as the impact matrix, and it contains information about the long-run relationships. Johansen's methodology requires the estimation of the VAR equation 1 and the residuals are then used to compute two likelihood ratio (LR) test statistics that can be used in the determination of the unique co-integrating vectors of X_t. The co-integrating rank can be tested with two statistics: the trace test and the maximal eigenvalue test.

Vector Error Correction Model (VECM)

The error correction version pertaining to the four variables incorporated in our study is stated below:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\delta_0} + \sum_{i=0}^{n} \boldsymbol{\delta_{1i} \Delta Y_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\delta_{2i} \Delta K_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\delta_{3i} \Delta R_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\delta_{4i} \Delta I_{t-i}}$$
$$+ \boldsymbol{\lambda ECM_{t-1}} + \boldsymbol{\varepsilon_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (\mathbf{7})$$

$$\Delta \boldsymbol{K_t} = \boldsymbol{\gamma_0} + \sum_{i=0}^{n} \boldsymbol{\gamma_{1i} \Delta K_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\gamma_{2i} \Delta Y_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\gamma_{3i} \Delta R_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\gamma_{4i} \Delta I_{t-i}}$$
$$+ \boldsymbol{\lambda ECM_{t-1}} + \boldsymbol{\varepsilon_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{8})$$

Where $\boldsymbol{ECM_{t-1}}$ is the error correction term and $\boldsymbol{\varepsilon_t}$ is the mutually uncorrelated white noise residual. The coefficient of the ECM variable contains information about whether the past values of variables affect the current values of the variables under study. The size and statistical significance of the coefficient of the error correction term in each ECM model measures the tendencies of each variable to return to the equilibrium. A significant coefficient implies that past equilibrium errors play a role in determining the current outcomes. The short run dynamics are captured through the individual coefficients of the difference terms (Akinlo and Egbetunde, 2010). Investment (K) does not Granger cause economic growth (Y) if all $\delta_{2i} = 0$, and economic growth (Y) does not Granger cause investment (K) if all $\gamma_{2i} = 0$. These hypotheses can be tested using standard F statistics (Mehra, 1994)[4].

DISCUSSION OF RESULTS

In order to avoid spurious results, we tested the variables for a unit root using an Augmented Dickey-Fullertest, ADF (Dickey-Fuller, 1981) and Phillips-Perron unit root tests as shown in table 1 below.

[4] All the same, as pointed out by Choudry (1995), Granger Causality can still exist as long as λ is significantly different from zero.

Table 1: Uniit Root Tests

Series	Augmented Dickey-Fuller		Phillips-Perron		Order of Integration
	Level	First Difference	Level	First Difference	
Y	-1.791	-7.307***	-1.573	-12.790***	I[1]
K	-1.51	-4.885***	-1.276	-3.629***	I[0]
R	-0.541	-5.835***	-0.410	-7.114***	I[1]
I	1.214	-6.283***	-1.204	-4.305***	I[0]

****, **, * indicate significance level at 1%, 5% and 10% respectively. Figures in parenthesis are t-statistic.*

The results of the stationarity tests at level show that all the variables are non-stationary at level. Having found that the variables are not stationary at level, the next step is to difference the variables once in order to perform stationarity tests on difference variables. The results of the stationarity tests on differenced variables confirmed stationarity.

Having confirmed that all variables included in the causality test are integrated of order one, the next step is to test for the existence of a cointegration relationship among the variable series using the Johansen-Juselius approach described in the methodology. The cointegration test results are reported in Table 2.

Table 2: Cointegration Test

Series: Y K R I				
Hpothesized No. of CE(s)	Max-Eigen Stat.	Trace Stat.	0.05 Critical Value	Prob.**
None *	0.697778	65.18506	47.85613	0.0005
At most 1	0.387752	29.28725	29.79707	0.0572
At most 2	0.246678	14.56873	15.49471	0.0686
At most 3 *	0.183201	6.070859	3.841466	0.0137

****, **, * indicate significance level at 1%, 5% and 10% respectively.*
Figures in parenthesis are t-statistic.

The results indicate the existence of cointegration relationship among the variables. The maximum eigenvalue and trace statistics reject the null hypothesis of no cointegration at 5 percent level.

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According to N’Zue (2006), when cointegration exists, the Engle-Granger Theorem establishes the encompassing power of the ECM over other forms of dynamic specification. Results of the ECMs are presented in Table 3 below. Since the error correction representation can be used to test for Granger causality, we estimated both equations 7 and 8.

Table 3: VECM Results

Growth Model		Investment Model	
ECM(-1)	-0.732***	ECM(-1)	-0.475***
	[-4.522]		[-3.647]
D(Y(-2))	0.606***	D(K(-2))	-0.505***
	[3.073]		[-3.884]
D(K(-1))	-0.481	D(Y(-1))	0.005***
	[-1.390]		[3.233]
D(K(-2))	-0.309	D(Y(-2))	0.001
	[-1.448]		[0.558]
D(K(-3))	-0.226	D(R(-1))	0.017
	[-1.596]		[0.142]
D(R(-1))	-0.220***	D(R(-2))	-0.111
	[-3.127]		[-0.925]
D(R(-2))	-0.344***	D(I(-1))	0.043*
	[-4.110]		[1.930]
D(I(-1))	0.788***	D(I(-2))	-0.010
	[4.570]		[-0.508]
D(I(-2))	0.728***	C	0.092
	[4.590]		[0.236]
D(I(-3))	0.458***	R-squared	0.798
	[3.407]	Adj. R-squared	0.697
C	0.208	F-statistic	7.901
	[0.972]	F-stat {K $\Rightarrow$ Y}	35.07***
R-squared	0.783		
Adj. R-squared	0.566		
F-statistic	3.609		
F-stat {Y $\Rightarrow$ K}	10.98		

****, **, * indicate significance level at 1%, 5% and 10% respectively.*
Figures in parenthesis are t-statistic.
F-stat {Y → K} denotes F-statistics that economic growth Granger causes investment..
F-stat {K → Y} denotes F-statistics that investment Granger causes economic growth..

In general, the results show that the error correction terms in both equations are well defined, that is, their associated coefficients are negative and statistically significant at 1% (see table 3). The coefficient was -0.732 in growth equation and -0.475 in investment equation of the models in Nigeria. This indicates a feedback of approximately 73 percent (for growth equation) of the previous year's disequilibrium and a feedback of approximately 47 percent (for the investment equation) of the previous year's disequilibrium in Nigeria. The strong significance of the coefficient on ECM supports the conclusion of cointegration. This indicates that investment serves as a catalyst to economic growth in Nigeria, and also income is an engine of investment which in turn transforms the level of economic progress in the country. Moreover, if the rate of investment in the country is sustained and enhanced, the country will witness sustainable development which in turn improve standard of living of people that resident in the country.

The short run dynamics are captured by the individual parameters except that of the ECM term. The results (in growth model) show that investment is insignificantly related to economic growth in Nigeria. This could be as a result of factors[5] that are inimical to investment's motivation which further worsening the living standard in the country. The results (in growth model) further reveal that interest rate (lagged by one to two) is negative and significant impacted on economic growth in the economy.[6] Also, inflation (lagged by one to three) has positive and significant effect on economic development in Nigeria. This suggests that moderate inflation boost economic activities in the country.[7]

In the investment model, it was evidenced that economic growth (lagged by one) has a positive and significant effect on investment in Nigeria. This suggests that advancement in economic growth goes along with adequate investment in the country. More importantly, this study suggests that economic growth is one of the key factors that drive and enhance investment activities in Nigeria. It was further revealed in the investment model that inflation rate (lagged by one) has positive and significant influence on investment in the country. This implies that moderate inflation rate encourages investment activities in the country.

As evidenced from the standard F-Statistics[8] reported in Table 3, there is unidirectional causality running from investment to economic growth in Nigeria. The results show that investment Granger causes economic growth in the country. This implies that investment promotes economic growth in Nigeria. This result supported the view of orthodox development economists' proposition on the requirement to attain development in developing countries. Furthermore, Nigerian economy should enhance investment activities through appropriate mechanisms which in turn result to sustainable development in the country.

[5] The factors include interrupted power supply, poor road network facilities, inadequate skilled manpower, among other.

[6] This implies that high interest rate slow down development strategies in the country. This high interest rate discourages economic agents to embark on programmes that may serve as catalyst to development of Nigerian economy.

[7] This view is supported by scholars in development economics. It was postulated by scholars in this field that high inflation pointed to rise in volume of money and investors use the opportunity to invest heavily for the progress of an economy.

[8] This is the results obtained from multivariate VECM Granger Causality/Block Exogeneity Wald Tests.

F-statistic in both models is significant at 5%. This implies the fitness of the growth and investment models that this study estimated. And the adjusted R-squared is not too high which trash out the issue of multicollinearity in the models.

CONCLUDING REMARKS

This paper investigates the impact of investment on economic growth in Nigeria using multivariate Granger causality test within the context of VECM framework. The paper also examines the long run cointegrating relationship among the series.

The results reveal that all the variables are cointegrated i.e. they are related in the long run. We also confirm this cointegration tests through ECM test within the VECM framework, the finding shows that a long run relationship exist between investment and economic growth in the country. This result corroborates the long run relationship among the series. Moreover, the results further reveal that investment Granger causes economic growth in Nigeria. Therefore, government in the country should put more efforts in accumulating capital to further enhance improvement and efficiency of the investment activities which in turn accelerate sustainable economic development in the country. Also the country should adopt policies that will fast track sustainable development through heavy investment, and the government should ensure the provision of adequate facilities that promote and encourage heavy investment. This notion supported the view of Leibenstein (1957) who suggested that the only way of escaping the trap of underdevelopment is to raise per capita income to a level where growth becomes self-sustaining. This was linked with the idea of big push or critical minimum effort in development economics. In general, the evidence from the paper suggests that policy makers in the country should encourage investors (both local and international) through appropriate mix of strong institutions, legal and regulatory policies in order to provide enabling environment for any business to thrive.

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