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An Application of Vector Autoregressive Model on Investments and Savings in Nigeria

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Abstract
The saving- investment relationship and its implication for economic growth across borders has been sharplydebated in the literature since the pioneering work of Feldstein and Horioka (1980). In this paper, the debate is extended to the Nigerian economy in Africa using the Vector Autoregressive (VAR) approach and causality tests on the Savings and Investment data obtained from the Central Bank of Nigeria (CBN).The effects of stochastic shocks to investment on savings and to savings on investment are explored and it was observed that savings granger causes investment and investment granger causes savings. Thus, policies should be concentrated towards enhancing the level of investment to bolster savings in the Nation.
Keywords: Domestic saving, domestic investment, equilibrium, unit roots, cointegration, causality.

1.0 INTRODUCTION

Economic growth and development to a great extent are determined by the rate of growth in domestic savings, investments and output of goods and services which includes real GDP per capital, human development amongst others. The wide divergence between the deposit and lending rates (interest rate spread) was an obstacle to economic growth and development of the Nigerian economy ,(CBN, 2001).Increase in domestic savings for instance; offer investors opportunities to have access to investment funds through financial intermediaries.

Saving and investment are discovered to be highly correlated following the work done by Feldstein and Horioka (1980).The authors stressed further that the correlation between national savings and domestic investment can be used as a measure of international capital mobility, as the rate of return is the most relevant factor to investors if capital is perfectly mobile, domestic saving will not, necessarily be related to domestic investment. Feldstein and Horioka(1980) findings and interpretation of the high correlation coefficients between saving and investment as evidence of imperfect capital mobility across national boundaries conflict with conventional wisdom of international capital mobility, which argues that in the absence of financial controls, capital should flow between countries in search of a higher rate of return. Feldstein and Horioka (1980) generated a large body of research that supports the original empirical finding. These include Feldstein (1983), Feldstein and Bacchetta (1989), Baxter and Crucini (1993). In general, these studies contend that capital is not internationally mobile. Therefore, increases in domestic saving, other things equal, will flow into domestic investment.

African economies are plagued with inefficient state enterprises, inadequate and deficient infrastructure, pervasive and burdensome trade restrictions, highly restrictive financial sector and trade regulations, poor corporate governance, political instability, and heavy external debt problems. It is therefore; natural to expect the macroeconomic forces and dynamics generating the relationship between savings and investment in these countries to be quite different from those found in the Organization of Economic Corporation and Developing (OECD) group of countries and other developing regions of the world.

In this paper, the savings-investment correlation is re-examined using data for Nigeria. According to the economic theory, the increase in investment gives rise to more production and higher income. On the other hand, Zeller et al (1997) explained that access to savings has positive correlation with production, investment and consumption. Savings is one of the key relevant macroeconomic variables in any economy (Akperan&Akomaye, 2006) and the impact of savings on economic growth cannot be overemphasized. According to Lipsey& Chrystal (1999), savings are needed to finance investment and all things being equal, countries with high rates of national savings tend to have high investment rates and high growth rates of real gross domestic product (GDP). Though the following are barriers to savings in Nigeria (Onunugbo&Nwosu, 2006), High incidence of poverty and low nominal disposal income; under developed capital markets, unfavourable economic environment characterized by high unemployment and inflation.

However, Nwachukwu and Odigie (2009) suggested that government policies aimed at improving fiscal balance has the potential of bringing about substantial increase in the National saving rate in Nigeria. From the foregoing, savings has long been thought to be a crucial source of economic growth through investment (Michael, 2007). Increase in savings increases the rate of investment.

Foreign private investment is a significant component of foreign private capital flow that provides much needed finance to increase the use of existing capacity to stimulate new investment in developing countries (Salami, 2006). Ekpo (1997) &Iyoha (1998) identified certain factors that affect investment. They are macroeconomic instability, inflation, exchange rate, credibility, government expenditure as well as institutional and political factors. Also, higher interest rate triggers lower investment (Valentino, 2001). It was also discovered that exchange rate is the most important variable that affects private foreign investment in Nigeria among variables such as interest rates, inflation rates and gross domestic products. This was supported by Uremadu (2008) that foreign exchange rate leads to capital formulation in Nigeria.

Furthermore, Salami recommended that exchange rate should be more market responsive, inflation rates should be pursued to single digits and there should be more generous incentives for foreign direct investment in Nigeria.

The debate over the correlation between savings and investment has been initiated by the work of Feldstein & Horioka (1980). The relationship between savings and investment remains one of the great contested areas in macroeconomics. At the heart of the debate lies the question of 'causation' and whether it is "savings that causes investment" or it is "investment that causes savings".

In spite of the availability of the established theory relating savings, investment and economic growth, there is an on-going debate as to how precisely savings and investment affect economic performance of a country and vice versa. The debate started with the pioneering work by Feldstein and Horoika (1980). According to them if capital is perfectly mobile, investors care only about the rate of return on their investments and do not worry about in which country they are investing, implying domestic saving need not be equal to domestic investment under perfect international capital mobility. Regressing domestic investment ratio on domestic saving ratio for cross-sectional samples of 16 OECD countries over the period 1960-1974, they found that the estimated regression coefficients, i.e. the "saving-retention coefficients", were all close to one, indicating that most of the incremental saving remain in the country of origin. Miller (1988) opines that if there exist co-integration between savings and investment, the capital is at least somewhat immobile internationally, while the lack of co-integration suggests perfect capital mobility. Therefore, Understanding the causal relationship between savings and investment has become relevant for its policy implications. If the saving causes investment, then promoting domestic savings should be a high priority to boost investment and economic growth. Alternatively, if causality runs from investment to saving, saving-promoting policies are likely to be unsuccessful and may involve economic inefficiencies. Policy emphasis should be shifted away from saving and concentrated in removing the impediments to investment. Most of the existing studies on saving- investment relationships are cross section and cross country studies and do not use long period data. The difficulty with such studies is the homogeneity assumption across the countries, which is unrealistic due to variations in social, economic and institutional conditions. Therefore, country specific studies are needed to throw more light on the causality issue of savings and investment and the related policy issues.

Investment is the process of adding to capital (Arene and Okpukpara, 2006).Lack of capital has been implicated as the major sustenance of the vicious circle of poverty. This is due to its negative effect on production capacity. In developing countries, national income is low; hence savings and investment are low. Low investment translates to low capital stock, low productivity and low output as well as low income.

In terms of agricultural productivity, Arene and Okpukpara (2006) hold that massive application of capital to land in form of land reclamation and critical productive inputs improve its productivity. In Keynesian terminology, real investment refers to addition to capital (as a factor of production) which leads to increase in the levels of production and income (Jhingan, 2003). Thus, real investment includes new plant and equipment, construction of public works like dams, road, building, net foreign investment, inventories, and stocks and shares in new companies.

According to Jhingan (2003), investment could be induced or autonomous. Induced investment is profit or income motivated. On the other hand, autonomous investment is independent of the level of income. In reality, there are three major determinants of investment. These are the cost of capital asset, expected rate of return and the market rate of interest. These factors are embedded in Keynes' concept of marginal efficiency of capital (MEC). MEC expresses the highest rate of return from an additional unit of a capital asset or fund over its cost or opportunity cost.

From the foregoing, it is clear that the general drive behind any type of investment is return in one form or the other. It is in this light that this study views foreign investment in Nigeria. A rational foreign investor will be interested in a sector that has the highest MEC. Whatever the motive of the foreign investor is, the recipient economy could have its own interest which could be at variance with that of the investor. In an economy where agriculture, despite its neglect by the government, holds the key to sustenance, the preferred sector should be agriculture.

Investment transcends national boundaries in line with economic theory that capital will move from countries where it is abundant to countries where it is scarce. This pattern, according to Oyeranti (2003), will be informed by returns on new investment opportunities, which are considered where capital is limited, especially in developing countries. As suggested by Summers (2000), the resultant capital relocation is expected to boost investment and bring about enormous social and economic benefits to the recipient country.

Foreign direct investment, a major component of international capital flows, refers to investment by multinational companies with headquarters in developed countries. This investment ranges from transfer of funds to whole package of physical capital, techniques of production, managerial and marketing expertise, products, advertising and business practices for the maximization of global profits. The Organization for Economic Cooperation and Development (OECD) conceptualized FDI as net financing by an entity in a developed country with the objective of retaining a lasting interest in an entity resident in a developing country (Oyeranti, 2003). The implications of this definition are:

1. FDI flows from developed country to developing countries; and
2. The investor has a significant influence on the management of the enterprise.

2.0 THE CAUSAL RELATIONSHIP BETWEEN SAVINGS AND INVESTMENT

The causal relationship between savings and investment has been widely debated in the empirical literature following the pioneering work of Feldstein and Horioka (1980). Recently, Sanjib and Joice (2012) explored the relationship between savings and investment in three diverse economies. They found a co integrated relationship between savings and investment in these countries. Similarly, Onafowara et al. (2011) studied the relationship between savings and investment in eight advanced economies of the European Union and found statistically significant evidence of co-integration for six countries. Contrary to these findings, Esso and Keho (2010) have found mixed evidence for the causality between savings and investment for West African Economic and Monetary Union(UEMOA) countries. The absence of causality between savings and investment has been attributed to capital mobility.

Afzal (2007) provides additional evidence on savings and investment relationship in developing countries using conventional and time-series econometrics techniques. He finds no long-run relationship between savings and investment in seven countries of the sample, which implies increased degree of capital mobility and weakening of savings and investment relationship. The results reveal that there is bidirectional causality between savings and investment in South Africa, while there is unidirectional causality from savings to investment in Pakistan and Sri Lanka. And there is no causality in India, Philippines, Malaysia, and Iran. Concluding on this he says the divergence might be due to country-specific policies and economic conditions, and the strong correlation between savings and investment does not rule out capital mobility across these countries. Mishra, et al, (2010) have identified a number of factors that have emerged empirically to explain the savings and investment correlation in both developed and developing countries such as capital mobility, current account targeting, inter-temporal budget constraint and economic liberalization. Cyrille (2010), studying causality for 15 Sub Saharan African countries, concluded that the coefficient of saving and investment relation is low and correlation between inflows and outflows of capital is insignificant, and have no effect on saving- investment relation in these countries.

3.0 RESEARCH METHODOLOGY

3.1 VECTOR AUTOREGRESSIVE (VAR) MODELS

The VAR model is a multi-equation system where all the variables are treated as endogenous. There is thus one equation for each variable as dependent variable. Each equation has lagged values of all the included variables as dependent variables, including the dependent variable itself. Since there are no contemporaneous variables included as explanatory, right-hand side variables, the model is a reduced form. Thus all the equations have the same form since they share the same right-hand side variables.

Say, we have two variables: GDP, *y,* and the money supply, *m*, the VAR model will be:

$$y_t = a_1 y_{t-1} + \ldots + a_k y_{t-k} + a_{k+1} m_{t-1} + \ldots a_{k+1+n} m_{t-n} + e_t^y$$

$$m_t = b_1 y_{t-1} + \ldots + b_k y_{t-k} + b_{k+1} m_{t-1} + \ldots b_{k+1+n} m_{t-n} + e_t^y$$

The two endogenous variables *y* and *m* are also the explanatory variables in lagged form. How many lags to put in is an empirical matter, which is decided at the estimation stage.

3.2 STRUCTURAL VARs

When the VAR first was presented, it was argued that an advantage was that it does not need any prior assumptions needed for a structural model. For a structural model to be estimated certain restrictions are needed about which variables are allowed to affect each other. It is not possible to estimate a simultaneous model where all variables are considered endogenous. Econometricians say that the model is not identified if there are not enough exogenous variables. To estimate a VAR the researcher does not need to impose any conditions beforehand. The attractive feature of letting the data speak for themselves comes at a price, however, since only forecasting is possible. VARs have come to be used as a forecasting tool and they have often turned out to be as successful as large-scale structural models.

The need for structural analysis and policy evaluation in combination with the success of VARs as forecasting tools have led to the construction of structural models which have a VAR as a reduced form. Typically these models are smaller, i.e. contain variables and fewer equations than the large-scale Keynesian type simultaneous equation models. The compactness of structural VARs has two attractive features: they are easy to estimate and they are easier to interpret than large simultaneous models.

Here we will look at the simplest case: a two-variable/two equation system. We use the concrete example of the interaction between money, *m*, and GDP, *y*, corresponding to the two-equation example above. This particular application issue has in fact motivated much of the discussion of structural VARs though it is not the only application.

We will show three different structural VARs that all give rise to the same VAR, which has the same variables and the same coefficients. The two structural models are derived using different timing assumptions about the interaction between money and GDP. Timing assumptions are not the only assumptions used for the formulation of a structural VAR, but the most common as they are the easiest to implement. The structural form postulates how the interaction occurs within the period. The structural form may be either simultaneous, i.e. there is mutual interaction within the period, or the model is recursive: one variable affects the others within the period, with interaction back from the others occur in subsequent periods. We present recursive models based on judgments on timing patterns between the GDP and money.

Thus, assume that the true model is such that one variable affects the other within the period, but not the other way round, that is, the model is recursive. With two variables, it is then possible to construct two structural models from a given reduced from VAR. A third structural VAR is obtained by assuming that there is no interaction at all within the period

Treating the money supply as an endogenous variable implies that it reacts to GDP. The reason for modeling the money supply as endogenous is that monetary policy is not made out of the blue. Policy makers react to the state of the economy in order to stabilize the economy. The policy is systematic in some way. Economists say that policy is made according to a policy rule. Sometimes a rule is more or less explicitly declared by the central bank, but even if it is not, the central bank's behaviour may be described as following a rule. This means that policy actions are not truly exogenous, but that policy instruments are endogenous variables. Thus there is mutual interaction between the policy instrument, here the money supply, and the economy: The policy action affects the economy, and the policy maker reacts to the state of the economy through the policy rule. Hence both money and GDP are endogenous variables.

The reduced form with GDP and the money supply shows the results of this interaction but does not show how it occurs, since the within-period interaction is netted out. We need a structural form for this. Since there is no unique structural form compatible with a certain reduced from, we need to assume something specific about the within-period interaction. We will look at three possibilities.

Structural m-Y-VAR 1: m-policy reacts with a lag, y immediately reacts to changes in m

The structural model contains two equations: one describing how the money supply is set, and the other how GDP reacts to the money supply.

We begin with the money supply rule. Monetary policy making is a time-consuming process. The economists working at the central bank have to wait for data collected by statistical agencies, which then have to be analyzed. Thereafter, the policy makers have to make a decision. This implies that the policy action depends on information about the economy some time back. We formalize this by writing the current money supply as a function of last period's GDP. If we use quarterly data, it means that the central bank uses information from the last quarter in setting the money supply. We also allow the money supply to depend on itself last period, perhaps because the central bank adjusts the money supply slowly in response to GDP. We also allow for a random component of the money supply. Even if the central bank wishes to set the money supply only with respect to past values of GDP and money supply, it may not be able to fully control the money supply. We thus add an error, which we interpret as a "control error". The policy rule is:

$$m_t = \beta_1 Y_{t-1} + \beta_2 m_{t-1} + \varepsilon_t^m .$$

This is a structural equation: it describes the behavior of an economic agent, the central bank. Note that it has the same form as the reduced form. Only now, we are able to interpret the equation structurally because we made an assumption of how the central bank acts. We denote the structural error with the greek e to distinguish it from the reduced form error *e*.

Having restricted the money supply process, we can afford a general specification for the GDP equation. Thus assume that GDP reacts immediately to money supply changes. To add dynamics, we allow GDP to react both to itself lagged (gradual infinite adjustment) and to lagged money supplies (finite reaction). This means that the dynamic response will be very flexible, that is, the impulse response function with respect to a change in the money supply may have a variety of shapes. Let all the other influences on GDP be collected in the error term, which thus are not explicitly modeled. The GDP equation is then:

$$Y_t = \alpha_1 m_t + \alpha_2 Y_{t-1} + \varepsilon_t^Y .$$

Now investigating the relationship between the reduced form VAR and this particular structural form, repeat the structural form:

$$Y_t = \alpha_1 m_t + \alpha_2 Y_{t-1} + \varepsilon_t^Y$$

$$m_t = \beta_1 Y_{t-1} + \beta_2 m_{t-1} + \varepsilon_t^m$$

To determine if it is possible to construct the structural form coefficients from the reduced form, repeat the reduced form:

$$y_t = a_1 y_{t-1} + a_2 m_{t-1} + e_t^y$$

$$m_t = b_1 y_{t-1} + b_2 m_{t-1} + e_t^m$$

Suppose this is the VAR model we have estimated. Thus the *a* and *b* coefficients are known and the *e*'s are known for every period. We now show how to calculate the structural form coefficients and errors. First, we note that the structural monetary policy equation has the same form as the reduced form. Thus the structural coefficients are identical to the reduced form coefficients:

$$b_1 = \beta_1,\ b_2 = \beta_2 .$$

The estimated errors are also identical $e_t^m = \varepsilon_t^m$, that is, we can identify them as the control errors, or mistakes, the central bank makes.

To find the structural form coefficients for the output equation, we need to first derive the theoretical reduced from the hypothesized structural from. Then we can compare the theoretical reduced form expression with the estimated reduced from. Thus, eliminate the contemporaneous effect of *m* on *y*. Substitute the right-hand side of the *m*-equation in the *Y*-equation:

$$y_t = \alpha_1(\beta_1 y_{t-1} + \beta_2 m_{t-1} + \varepsilon_t^m) + \alpha_2 y_{t-1} + \varepsilon_t^Y$$

$$= (\alpha_1\beta_1 + \alpha_2) y_{t-1} + \alpha_1\beta_2 m_{t-1} + \alpha_1\varepsilon_t^m + \varepsilon_t^Y$$

This is the theoretical reduced form. The estimated coefficients are estimates of the composite coefficients in front of the variables. We derive the individual structural coefficients by comparing the composite coefficients to the reduced form coefficients:

$$a_1 = \alpha_1\beta_1 + \alpha_2,\ a_2 = \alpha_1\beta_2$$

It follows that $\alpha_1 = a_2 / \beta_2$ and $\alpha_2 = a_1 - (a_2/\beta_2)\beta_1$. Since a's and b's are known we can calculate the remaining a coefficients. Thus, *we have identified the structural form from the reduced from using the assumption of a recursive structural form.* Finally, the structural errors in the *y*-equation can be calculated from the known *e*'s and the calculated a_1 using $e_t^Y = \alpha_1\varepsilon_t^m + \varepsilon_t^Y$. Rearranging, the structural *y*-errors are: $\varepsilon_t^y = e_t^y - \alpha_1\varepsilon_t^m$.

Structural m-y-VAR 2: y reacts with a lag to monetary policy

Here, we turn around the assumption: instead of assuming that monetary policy reacts with a lag, we assume that output reacts with a lag. Monetary policy acts quickly, but the economy is slow to react that we assume that within the period, GDP does not react at all to a change in the money supply. Thus the structural form is:

$$Y_t = \alpha_1 m_{t-1} + \alpha_2 y_{t-1} + \varepsilon_t^y$$

$$m_t = \beta_1 y_t + \beta_2 m_{t-1} + \varepsilon_t^m$$

Now, the structural GDP equation is identical to the reduced form output equation and we immediately identify the structural parameters as:

$$a_1 = \alpha_1,\ a_2 = \alpha_2 .$$

and the reduced form errors are identical to the structural errors: $e_t^y = \varepsilon_t^y$.

To find the reduced form for money, substitute the right-hand side of the GDP-equation for Y in the *m*-equation:

$$m_t = \beta_1(\alpha_1 m_{t-1} + \alpha_2 y_{t-1} + \varepsilon_t^y) + \beta_2 m_{t-1} + \varepsilon_t^m$$

$$= (\beta_1\alpha_1 + \beta_2) m_{t-1} + \beta_1\alpha_2 y_{t-1} + \beta_1\varepsilon_t^y + \varepsilon_t^m$$

Comparing the derived reduced form and estimated reduced form (VAR) for coefficients for the *m*-equation we get:

$$b_1 = \beta_1\alpha_1 + \beta_2,\ b_2 = \beta_1\alpha_2,\ e_t^m = \beta_1\varepsilon_t^y + \varepsilon_t^m$$

By rearranging the terms, you can calculate the structural b's from the known *b*'s and a's.

Structural m-y-VAR 3: y reacts with a lag to monetary policy and m reacts with a lag to GDP

In this case, there is no interaction within the period. Setting both contemporaneous effects equal to zero, the structural form is identical to the VAR. This means that we can associate the estimated reduced form coefficients and errors directly with the structural form coefficients and errors, that is: $a_1 = \alpha_1$, $a_2 = \alpha_2$, $b_1 = \beta_1$,

$b_2 = \beta_2$, $e_t^m = \varepsilon_t^m$ and $e_t^y = \varepsilon_t^y$.

3.3 STRUCTURAL VAR MODELS WITH MORE THAN TWO VARIABLES

In the two-variable recursive model case one variable directly affects the other within the period, but not the other way. The model is also said to follow a certain casual ordering with one variable causally prior to the other one. In our first example, *m* is causally first since it affects *y* immediately, while *m* is not immediately affected by *y*.

Recursive models are also called *causal chain models* because they imply a certain timing order in which variables affect each other. As we saw in the two-variable case, a structural shock of the variable first in the chain affects both variables, because the first causal variable appears contemporaneously as an explanatory variable for the other variable.

To illustrate the general principle, consider a three-variable recursive or casual chain model with following order: $x_t y_t z_t$. Thus a shock to *x* affects all the other variables in the same period; a shock in *y* affects *y* and *z*, and a shock in *z* affects only *z*. The next period, all the variables are affected by any shock because of the lagged inclusion of all variables in each other'sequations. The recursive three-variable model in this case would be:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 y_{t-1} + \alpha_2 z_{t-1} + \varepsilon_t^x$$

$$y_t = \beta_0 + \beta_1 x_t + \beta_2 x_{t-1} + \beta_3 y_{t-1} + \beta_4 z_{t-1} + \varepsilon_t^y$$

$$z_t = \delta_0 + \delta_1 x_t + \delta_2 y_t + \delta_3 x_{t-1} + \delta_4 y_{t-1} + \delta_5 z_{t-1} + \varepsilon_t^z$$

Note that the contemporaneous x_t is included as an explanatory variable in the y_t and the z_t equation; the contemporaneous y_t as an explanatory variable in the z_t equation, while the contemporaneous z_t is not an explanatory variable in any of the equations. Of course there may be more lags of all the right-hand side variables.

4.0 DATA PRESENTATION AND ANALYSIS

The data used for this study were collected from a secondary source; publication of the Central Bank of Nigeria (CBN). Annual data on national savings and investment was sourced from the CBN bulletin, 2010 which covered a period of forty-eight (48) years, that is, from 1960 – 2008 in Nigeria.

4.1 DATA ANALYSIS

The data was analysed using Eviews-7 statistical software. The results are presented in the following sections: stationarity test, causality test, cointegration test, lag selection criteria, vector autoregressive (VAR) model, and then concluded with impulse response graph.

4.2 STATIONARITY TEST

The Augmented Dickey-Fuller (ADF) test for unit root was employed. The results are presented below.

H_0: There is unit root Vs H_1: There is no unit root

From table 1, stationarity test for investment time series shows that the series is stationary at the 2nd difference with the t-value = -4.102232 and p-value = 0.0027 < 0.05, that is H_0 is rejected.

From table 2 as in appendix, stationarity test for savings time series shows that the series is stationary at the 1st difference with the t-value = -3.411445and p-value = 0.0167 < 0.05, that is H_0 is rejected.

4.3 GRANGER CAUSALITY TEST

The table below (as shown in the appendix) shows the result of Granger causality test for investment and savings.

From Table 3, the Granger Causality test revealed a bi-directional relationship between investment and savings, that is, the relationship is running from investment to savings (investment → savings) with p-value <0.05 and also running from savings to investment (savings → investment) with p-value < 0.05.

Therefore it can be concluded that savings contains useful information that can be used to predict investment, and also, investment contains useful information that can be used to predict savings. Hence we can say that investment Granger causes savings, and also say that savings Granger causes investment.

4.4 LAG SELECTION CRITERIA

VAR analysis was carried out for the time series data from lag1 to lag4 in order to obtain the minimum Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn information Criterion (HQ). After a careful inspection of the lag selection criteria table, it can be seen that the three information criteria (AIC, SC, HQ) it can be seen that VAR of lag 3 (VAR(3)) was selected.

4.5 VECTOR AUTOREGRESSIVE (VAR) MODEL

The lag 3 VAR model for the time series is presented below in Table 5 in the appendix

The VAR estimation results are just the coefficient estimates for each equation in the VAR. The E-views output for the VAR (3) estimated for Investment (I_t) and savings (S_t) is given in table 5 above. Each column of the table corresponds to an equation. The coefficient estimates can be represented as follows:

$$I_t = 2311.07 + 0.85I_{t-1} + 0.65I_{t-2} - 0.61I_{t-3} - 0.15S_{t-1} + 0.26S_{t-2} + 0.01S_{t-3} + \varepsilon_{I,t}$$

$$S_t = -3704.54 + 2.31I_{t-1} - 3.25I_{t-2} + 0.02I_{t-3} + 1.53S_{t-1} + 0.45S_{t-2} - 0.52S_{t-3} + \varepsilon_{S,t}$$

The responses are presented by the connected lines as shown in Figure1in appendix, whereas the shades represent the confidence regions within two standard errors. It appears from the graphs above that investment responds to the unitary shock in investment and savings, while savings responds to the unitary shock in savings and investment.

Furthermore, it should be pointed out that investment responds immediately starting at point 0 to a unitary shock in savings, while savings responds immediately starting at point 0 to a unitary shock in investment.

5.0 SUMMARY

In this study, I set out to empirically investigate the direction of causality between investment and savings in Nigeria, using annual time series data from 1960 to 2008. Several statistical tools were employed to explore the relationship between investment and savings under study. The analysis started with examination of stochastic characteristics of each time series by testing their stationarity by using Augumented Dickey-Fuller (ADF) test. The test revealed that investment was stationary after the second difference and savings was also stationary at the first difference. The essence of this test is to avoid spurious regression. Then I performed the Granger Causality test which showed that in Nigeria, there is a bi-directional Granger Causality between investment and savings. That is, the causation runs from investment to savings and also from savings to investment. These results indicated that investment depends on savings and savings also depends on investment in Nigeria

Furthermore, VAR analysis was carried out for lag 1 to lag 4 of the time series variables. The essence is to select the VAR model with the minimum AIC, HQ, SC. Using the VAR model of lag 1 to lag 4, a bi-directional relationship between investment and savings (investment to savings, and savings to investment). Therefore, from VAR lag 1 to lag 4, lag order selection criteria was at minimum at lag 3with AIC, HQ, SC as 46.19, 46.40 and 46.76 respectively. The result from the lag order selection and VAR model revealed that the bi-directional relationship between investment and savings is best explained by VAR model at lag 3 (i.e. VAR (3)).

Finally, the effects of stochastic shocks to investment on savings and to savings on investment are explored, using impulse response function graph. The evidence from impulse response function graph shows that savings is sensitive to investment, and investment is sensitive to savings in Nigeria.

5.1 CONCLUSION

Based on the findings in this study, the evidence in Nigeria within this period under study that is, from 1960 to 2008 statistically revealed that investment Granger causes savings, and savings Granger causes investment.

5.2 RECOMMENDATIONS

From the conclusion of this study, this research therefore recommends that for Nigeria to experience future economic growth, investment and savings should be encouraged through economic and political policies.

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Table 1: Unit root test for investment time series (ADF)

Null Hypothesis: D(INVESTMENT,2) has a unit root				
Exogenous: Constant				
Lag Length: 7 (Automatic - based on SIC, maxlag=10)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.102232	0.0027
Test critical values:	1% level		-3.610453	
	5% level		-2.938987	
	10% level		-2.607932	
*MacKinnon (1996) one-sided p-values.				

Table 2: Unit root test for savings time series (ADF)

Null Hypothesis: D(SAVINGS) has a unit root				
Exogenous: Constant				
Lag Length: 9 (Automatic - based on SIC, maxlag=10)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.411445	0.0167
Test critical values:	1% level		-3.615588	
	5% level		-2.941145	
	10% level		-2.609066	
*MacKinnon (1996) one-sided p-values.				

Table 3: Result of the Granger Causality Test

VAR Granger Causality/Block Exogeneity Wald Tests			
Sample: 1960 2008			
Included observations: 47			
Dependent variable: INVESTMENT			
Excluded	Chi-sq	df	Prob.
SAVINGS	9.680855	2	0.0079
All	9.680855	2	0.0079
Dependent variable: SAVINGS			
Excluded	Chi-sq	df	Prob.
INVESTMENT	36.37832	2	0.0000
All	36.37832	2	0.0000

Table 4: Lag Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: INVESTMENT SAVINGS
Exogenous variables: C
Sample: 1960 2008
Included observations: 45

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1225.893	NA	1.72e+21	54.57304	54.65333	54.60297
1	-1049.004	330.1935	7.92e+17	46.88906	47.12995	46.97886
2	-1033.981	26.70778	4.86e+17	46.39915	46.80063	46.54881
3	-1025.383	14.51996*	3.98e+17*	46.19482*	46.75689*	46.40436*
4	-1022.014	5.391636	4.11e+17	46.22283	46.94550	46.49223

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 5: Result of VAR model at lag 3

Vector Autoregression Estimates
Date: 03/11/13 Time: 19:17
Sample (adjusted): 1963 2008
Included observations: 46 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	INVESTMENT	SAVINGS
INVESTMENT(-1)	0.850037	2.310146
	(0.14589)	(0.62676)
	[5.82665]	[3.68584]
INVESTMENT(-2)	0.650106	-3.247402
	(0.20789)	(0.89314)
	[3.12717]	[-3.63596]
INVESTMENT(-3)	-0.605995	0.017033
	(0.18047)	(0.77533)
	[-3.35791]	[0.02197]
SAVINGS(-1)	-0.149124	1.533932
	(0.03646)	(0.15665)
	[-4.08975]	[9.79202]
SAVINGS(-2)	0.256619	0.447153
	(0.06046)	(0.25976)
	[4.24420]	[1.72139]
SAVINGS(-3)	0.005905	-0.524464
	(0.05753)	(0.24716)
	[0.10264]	[-2.12197]
C	2311.070	-3704.544
	(2076.12)	(8919.42)
	[1.11317]	[-0.41533]
R-squared	0.990175	0.996540
Adj. R-squared	0.988663	0.996008
Sum sq. resids	4.99E+09	9.21E+10
S.E. equation	11313.23	48603.87
F-statistic	655.0501	1872.255
Log likelihood	-490.8258	-557.8814
Akaike AIC	21.64460	24.56006
Schwarz SC	21.92287	24.83833
Mean dependent	69687.87	307656.6
S.D. dependent	106252.1	769263.9
Determinant resid covariance (dof adj.)		2.83E+17
Determinant resid covariance		2.03E+17
Log likelihood		-1047.181
Akaike information criterion		46.13831
Schwarz criterion		46.69486

Figure 1: Impulse Response Graphs