

THE DETERMINANTS OF DOMESTIC INVESTMENT IN NIGERIA: A NEW EVIDENCE FROM NON-LINEAR AUTOREGRESSIVE DISTRIBUTED LAG (NARDL) MODEL

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Abstract

This study employs an extended Nonlinear ARDL cointegration approach to examine the determinants of domestic investment in Nigeria over the 1980-2018 period. The result from bound testing reveal the presence of cointegrating relationship between domestic investment and the included variables. The empirical evidence demonstrates that domestic investment in Nigeria is determined by inflation, real interest and exchange rate, government spending, electric power consumption, savings, per capita income, credit to private sector and the interaction between government spending and oil price in the short-run; and inflation, interest and exchange rate, government spending, internal conflict, savings, and interaction between oil price and government spending in the long-run. The results also suggest that the impact of increase in interest, inflation and exchange rate is statistically different from their decrease. In essence, this study recommends the increase in government capital expenditure, savings, diversification of the economy, reduction of lending interest rate, maintenance of investment-friendly inflation rate, and conflicts control.

Keywords: Investment, Interest rate, inflation, exchange rate, government, internal conflict, Nigeria, NARDL

JEL Codes: E22, E21, E62, H54, O16

1. Introduction

Both in developed and developing economies, it has been argued that investment plays a very significant role in the functioning of an economy and the expansion of productive capacity in the economy (Ghassemi, 1996). In that, it drives growth and triggers development (Ojong, Ogar, & Arikpo, 2018), raise the level of employment/provide more jobs, promote production techniques, and enhance income level and standard of living (Meyer & Sanusi, 2019; Ali & Shaheen, 2016; Ojong, Ogar, & Arikpo, 2018). Investment is also one of the most important weapons for poverty alleviation. That is, as investment increases, resulting to higher growth and lower unemployment, lots of opportunities is

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opened to the poor to improve their income and livelihoods (Agbarakwe, 2019). In other words, low level of investment or capital formation is the principal factor behind suboptimal growth rates (Trade and Industrial Policy Secretariat [TIPS], 2000), unemployment, low income levels, income inequality, and poverty.

Notwithstanding the relevance of investment, an important aspect of investment is its instability – it is the most volatile component of aggregate effective demand (Anushree, 2019), and tends to vary by a greater extent than other components of aggregate demand (Hassett, 2020). Perhaps, this is because the fundamentals that drive investment - interest rate, cost of capital, expected return - also fluctuates. However, a small variation in investment tend to create a much larger fluctuations in aggregate demand, output level, employment and other macroeconomic variables, which often have major implications for government economic policies (Ghassemi, 1996). Apparently, this understanding was arguably responsible for the rise in research on the major factors which drives the level of investment in countries, even as policy actions by governments intended to raise the level of domestic investment often fails (Ojong, Ogar, & Arikpo, 2018; Agbarakwe, 2019).

There exists voluminous literature on investment that attempts to quantify and prioritise the key determinants of investment behaviour. Though the determinants of investment will depend on country specificities, yet, there is an almost universal consensus on some of the important factors that determine investment (TIPS, 2000). While it is argued that the expected profit (expected return on an investment) is the most important consideration in terms of all the variables which affect investment decision (Van der Walt & De Wet, 1995), and the cost of capital is its obvious complement. However, macroeconomic factors such as real interest rate, inflation rate and real exchange rate are arguably the most important, of all the variables that influence investment decisions or firms' investment behaviours. Indeed, this is not unconnected to the fact that macroeconomic factors alongside their fluctuations have important influence on firm investment behaviour. In that, instabilities can negatively impact the investment decision by increasing uncertainty. For instance, while highly volatile interest rate increases the value of waiting, and potentially results in investment being deferred; and highly volatile inflation rate creates uncertainty that acts as an expectation variable to discourage investment. On the other hand, fluctuations in the real exchange rate can influence investment decisions by affecting the profitability of export-oriented firms and the cost of capital sourced from abroad by domestic firms (TIPS, 2000).

Nevertheless, aside from macroeconomic factors, there also exist several factors that create instability, and therefore may negatively impact on investment behaviour. These includes: changes in regulatory, fiscal, monetary or other policy regimes; wars; infrastructural demand; financial factors; variations in global supplies of basic industrial

products; disparities in conditions of international trade and competition; and technological changes; (Bernake, 1983). Similarly, external conflict risk; government leadership; corruption; racial and ethnic tensions; rule of law; threats of civil war; efficiency of the legal system (with particular importance on the status of property rights); political terrorism; quality of bureaucracy (including its degree of independence from political pressure); risk of repudiation of contracts; political rights and civil liberties; risk of expropriation by government (Poirson, 1998); the rate of change in governments – whereby frequent changes create uncertainty with government policies (TIPS, 2000); and threats of secession, among others are also important determinants of investment.

In Nigeria, while several efforts have been made to enhance the level of investment in the country through policy actions, legislations, etc., however, the current reality indicates the otherwise. For instance, the Structural Adjustment Programme (SAP) of 1986 and its privatisation exercise; industrial policy of 1989; promulgation and subsequent adoption of the Export Processing Zone Decree of 1991; the creation of the Nigerian Investment Promotion Commission (NIPC) through decree 16 of 1995; provision of tax relief and other incentives to investors; signing of bilateral investment treaties and double taxation agreements (Ojong, Ogar, & Arikpo, 2018); repeal of laws that are inimical to foreign investment, promulgation of investment laws, and various overseas trips for image laundry by presidents (Iya & Aminu, 2015) among others were all geared towards promoting an enabling investment climate, thus raising the level of investment in the country, and thus the level of output, employment, income and standard of living, among others. Regrettably, these policies have achieved the opposite, as the level of domestic investment in the country has continued to decline, coupled with the prevalence of the menace of wide spread of poverty, poor growth rates, low living standard, and high level of unemployment among other macroeconomic anomalies in the country.

While the failure of policy makers to identify the key factors which determines the level of investment has been signalled as the major reason for the inconsistency and failures of policies in raising the level of domestic investment in Nigeria, thus attracting the inward flow of Foreign Direct Investment into the country (Agbarakwe, 2019; Ojong, Ogar, & Arikpo, 2018). However, it is apparent, as depicted in *figure 1*, that domestic investment (gross domestic fixed capital formation) in Nigeria has been erratic over time. Unequivocally, between 1981 to 2018, domestic investment has been on the decrease, falling from as high as 89.3 percent of the GDP in 1981 down to 16.92 percent in 2018, notwithstanding the implementation of policies such as the Structural Adjustment Programme (SAP), Nigerian Investment Promotion Commission (NIPC), etc., and the introduction of incentives to investors. In fact, efforts to raise the level of domestic investment in the country from 46.40 percent in 1985 to 54.95 percent in 1986 was dashed

after domestic investment fell to 43.96 percent in 1988, and even further to 14.21 percent in the year 2012 (Central Bank of Nigeria [CBN], 2018).

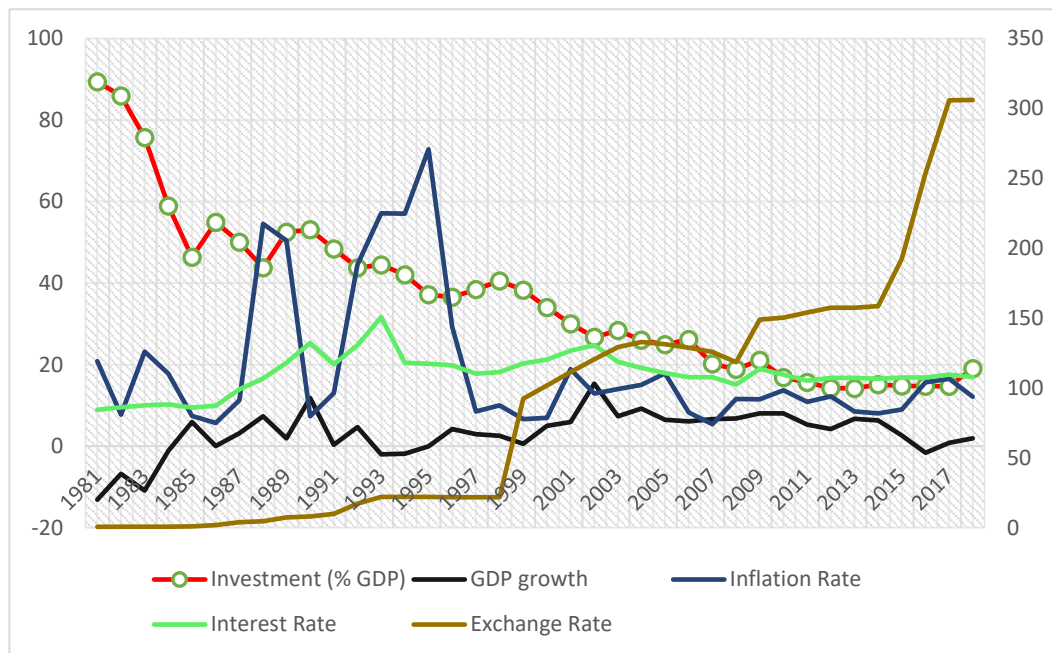


Figure 1: Plot of gross fixed capital formation (Domestic investment), Inflation, Interest and Exchange rate in Nigeria

Nevertheless, though the volatility and decline in domestic investment is accompanied by large variations in the lending interest rate, inflation rate and GDP growth rate, as well as the depreciation of the Naira, however, their movement cannot not be used to totally explain the level of domestic investment in the country, even as they have strong potentials to dictate the level of domestic investment. Apparently, this is not unconnected to the fact that the country's economic environment has also been bedevilled by several changes in fiscal and monetary policy, political instabilities (coups), civil wars and ethno-religious crises, insecurity, macroeconomic instabilities, and corruption, among others, which also have potentials in influencing changes in the level of domestic investment in the country. Thus, in order to arrive at a plausible conclusion, it is imperative to evaluate the major factors responsible for changes in the Nigerian domestic investment empirically.

On this note, the main objective of this study is to empirically evaluate the major determinants of domestic investment in Nigeria. The remainder of this paper is organised as follows: the second section is the review of previous studies on the determinants of investment, while section three describes the theoretical framework and the model. Section

four provides the data, econometric techniques and discussion of results. Conclusion and recommendations are provided in section five.

2. Review of Previous Studies on the Determinants of Investment

Over time, scholars have attempted to examine the nature of investment both from within and outside Nigeria. However, on the determinants of investment, majority of the studies has been largely based on the determinants of foreign direct investment or the determinants of aggregate investment – domestic and foreign (Belloumi & Alshehry, 2018; Ekpo, 1997; Obida & Abu, 2010; Agosin & Mayer, 2000). Nevertheless, studies on the determinants of domestic investment are also available, albeit sparse.

For instance, Mekonnen (2010) explored the determinants of domestic private investment in Ethiopia during the 1950-2003 period. Employing a multivariate single equation ECM estimation methodology, the estimation result reveals that private investment in Ethiopia is been influenced positively by domestic market, return to capital, trade openness and liberalisation measures, infrastructural facilities and FDI, while government activities, macroeconomic uncertainty and political instability affect domestic investment negatively. Ali and Shaheen (2016) employed the Error Correction Model (ECM) to investigate the economic factors that affect private investment in Pakistan during the period from 1980 to 2011. The empirical results suggest that savings, credit and gross domestic product are the positive determinants of domestic private investment in Pakistan, while inflation and external debt stock are the negative determinants of domestic private investment negatively. Muhdin (2016) used the Ordinary Least Square (OLS) technique to explore the determinants of domestic private investment. The results from the empirical analysis indicates that, while the level of national income, public investment and exchange rate influence the level of domestic private investment positively, interest rate, inflation rate and money supply impact the level of domestic private investment negatively.

Hecht, Razin, and Shinar (2004) employed Ordinary Least Square (OLS) and Two-Stage Least Square (TSLS) estimation techniques to evaluate the determinants of domestic investment in Israel and developing countries. The empirical results indicate that foreign direct investment, loan inflow (external debt), portfolio investment inflows, output growth and government expenditure influences domestic investment positively in the short-run, in Israel and the selected developing countries. Similarly, the authors also discovered that, while foreign direct investment and portfolio investment inflows have a significant long-run positive effect on domestic investment, loan inflows show a significant negative impact on domestic investment in the long-run in Israel and the selected developing countries.

In Nigeria, researchers have also made effort to identify the determinants of investment in the country. For example, Ojong, Ogar and Arikpo (2018) examined the determinants of domestic investment in Nigeria over the 1983 to 2015 period. Using ARDL model, the authors discovered that past values of domestic investment, government expenditure, and inflation rate are the positive determinants of domestic investment, while exchange rate determines domestic investment negatively in Nigeria. Agbarakwe (2019) employed the Autoregressive Distributed Lag (ARDL) model to examine the macroeconomic determinants of investment in Nigeria during the 1980 to 2018 period. The empirical results suggest that inflation, exchange rate and interest rate (both in current and past values) impact domestic investment negatively, while government spending have a positive impact on domestic investment.

Bakare (2011) employed the Error correction model (ECM) to examine the determinants of domestic private investment in Nigeria over the 1978 to 2008 period. Empirical results indicate that, while savings rate influences domestic private investment positively, public investment, exchange rate, corruption, and electricity, and political instability indicates negative impact on domestic private investment in Nigeria. Agu (2015) also used the Error Correction Model (ECM) procedure to examine the determinants of private investment in Nigeria over the 1970 to 2012 period. The submitted that domestic private investment rate is determined positively by real interest rate and political stability, while domestic public investment (public spending) determines domestic private investment negatively. Ayeni (2014) employed Autoregressive Distributed Lagged (ARDL) technique to investigate the determinants of private investment in Nigeria during the 1979 to 2012 period. The empirical results suggest that, real GDP growth rate is the only significant determinant of domestic private investment in Nigeria.

Ajayi and Kolapo (2018) examined the sensitivity of domestic private investment to macroeconomic indicators in Nigeria over the 1986 to 2015 period, using the Ordinary Least Square (OLS) and Engle Granger causality techniques. The empirical results suggest that, while GDP and exchange rate influence domestic private investment positively, changes in the money supply impact domestic private investment negatively. Agbarha and Monye (2017) employed the Error Correction Mechanism (ECM) to examined the determinants of domestic private investment in Nigeria during the 1980-2015 period. The results from the empirical analysis indicates that, interest rate is a significant negative determinant of private investment, while the previous level of private investment, aggregate demand, savings, and electricity generation determines private investment positively. Osmond (2015) evaluated the determinants of domestic private investment in Nigeria from 1970 to 2012, using the Error Correction Model (ECM). The empirical results show that disposable income and real interest rate determines the level of domestic investment

positively, while lending interest rate is responsible for the decline in the level of investment in Nigeria.

Kazeem (2013) examined the role of governance on private investment in Nigeria from 1970 to 2010. Using the Autoregressive Distributed Lag (ARDL) bound testing approach, the empirical results suggest that the degree of openness of the Nigerian economy (proxy by the difference between export and import, deflated by the nation output size), previous inflation rates and governance are important determinants of domestic private investment in Nigeria. Chete and Akpokodje (1998) employed the Ordinary Least Square (OLS) technique to examine the macroeconomic determinants of domestic private investment in Nigeria. Results from the empirical analysis indicates that private investment in Nigeria is influenced by public investment, inflation rate, real exchange rate, domestic credit to the private sector, and foreign capital inflow.

Duruechi and Ojiegbe (2015) employed Error correction techniques (ECM), Johansen cointegration, and Granger causality estimation techniques to evaluate the determinants of investments in Nigerian Economy during the 1990 to 2013 period. The empirical results indicate the presence of cointegrating relationship between investment and its determinants (inflation rate, government expenditure, exchange rate and interest rate), and a unidirectional causality running from government expenditure to investment. The authors also discovered that exchange rate is a significant determinants of domestic investment, while government expenditure determines investment in the long-run. Agwu (2015) employed the Autoregressive Distributed lag model (ARDL) technique to assess the determinants of investment in Nigeria. The results of the empirical analysis suggest that past income level, capital investment, government size and interest rate are the significant and positive determinants of investment in the long-run in Nigeria.

Clearly, a survey of literatures indicates that, while there is a dearth of study on the determinants of domestic investment in Nigeria, the few studies are also poised with certain drawbacks. A major drawback in the scanty research on the determinants of domestic investment in Nigeria is the use of linear time series models to examine the determinants of domestic investments. Moreover, while macroeconomic factors such as interest rate, exchange rate and inflation, among others have been considered to influence domestic investment linearly, however, in reality, these variables have asymmetric characteristics (Falk, 1986). In essence, this study contributes to literature and fill this gap by using the novel Nonlinear Autoregressive Distributive Lag (N-ARDL) advanced by Shin, Yu, and Greenwood-Nimmo (2014), to examine the asymmetric effect of interest rate, inflation rate, and exchange rate, in addition to the interactive and direct effect of other potential determinants on domestic investment in Nigeria.

3. Theoretical Framework and the Model

The framework for the analysis for this study is based on the flexible accelerator model (Anushree, 2019; Chand, 2019). The flexible accelerator model was developed to remove the major weaknesses of the simple acceleration – the principle that the capital stock is optimally adjusted without any time lag – by considering the time lags in the adjustment process between the level of output and the level of capital stock (Chand, 2019). However, due to the exclusion of potential determinants of investment such as wage rates, interest rates, taxes, and other macroeconomic and investment climate indicators; and the tendency of generating a spurious result and making empirical characterisation of the time structure of investment implausible due to the unrestricted lag structure of the model (Jorgenson & Siebert, 1968; Song, Liu, & Ping, 2001), researchers have adopted the use of a simplified version of the flexible accelerator model after disregarding the lags and the inclusion of relevant variables.

Thus, in line with the objective of this study, a simplified version of the accelerator investment model improved with the inclusion of variables such as real interest rate (*INT*), Inflation rate (*P*), exchange rate (*EXC*), Government expenditure (*G*), electricity power consumption (*ELE*), internal conflict (*INTC*), domestic savings (*DS*), per capita income (*pcY*), and credit to private sector (*CPS*), which tends to influence the variation in domestic investment will be employed. As such, a functional form of the model is formulated as:

$$INV_t = f(INT_t, P_t, EXC_t, G_t, ELE_t, INTC_t, DS_t, pcY_t, CPS_t, \varepsilon_t) \quad (1)$$

However, given that the Nigerian economy and budget is hinged on oil and gas export, as it accounts from more than 80 percent of the central government's revenue source (Central Bank of Nigeria [CBN], 2018), it is logical to also examine the interactive effect of government expenditure (*G*) and oil price (*OILP*) on domestic investment. Taking this into account, the new domestic investment model is:

$$INV_t = f(INT_t, P_t, EXC_t, G_t, ELE_t, INTC_t, DS_t, pcY_t, CPS_t, G \times OILP_t, \varepsilon_t) \quad (2)$$

If re-written in an explicit form, the model above is specified as:

$$INV_t = a_1 + \sum_{i=1}^n b_i Q_t + \varepsilon_t \quad (3)$$

Where: *a* is the intercept (or constant term); *b* denotes the slope coefficient; *Q* is the vector of the independent variables (potential determinants of domestic investment); ε is the random error term having zero mean and constant variance; *t* is number of times series observation; and $i = 0, 1, 2, \dots n$.

4. Data, Econometric Techniques and Discussion of Results

4.1 Data Issues

The data used in this study are interpolated quarterly time series data sets covering the past four decades (1980-2018), with a total of 156 observations. The technique of data interpolation has been extensively explained in the literature (see Abu, Kadandani, Obi, & Modibbo, 2019; Sakanko, Obilikwu, & David, 2019). The data set were collected from secondary sources, such as the Central Bank of Nigeria (CBN), the World Development Indicators (WDI), and Organisation of Petroleum Exporting Countries (OPEC). Specifically, data on domestic investment, real interest rate, government expenditure, inflation, exchange rate, per capita income, domestic savings and electricity power consumption were collected from WDI, while the data on credit to private sector was sourced from the CBN bulletin. Furthermore, data on internal conflict was collected from Political Risk Service's International Country Risk Guide (ICRG), and data on Nigerian oil (Bonny light crude) price was collected from OPEC.

The variables are measured/defined as thus. Domestic investment (*INV*) is the aggregate gross fixed capital formation (as used in Ajayi & Kolapo, 2018; Atoyebi, et al., 2012; Agu, 2015; Mekonnen, 2010). Real interest rate (*INT*) is the lending interest rate adjusted for inflation (as in Alfa & Garba, 2012; Obafemi, Oburota, & Amoke, 2016). Inflation (*P*) is measured by the consumer price index. Exchange rate (*EXC*) is the nominal exchange of Naira currency to the U.S. dollar. Government expenditure (*G*) is the aggregate total government expenditure. Electricity (*ELE*) is the annual electric power consumption (kWh per capita), as used in previous studies (Agu, 2015; Bakare, 2011). Internal conflict (*INTC*) is measured by the rescaled ICRG internal conflicts index, which takes a value of 0 to 12, with higher values indicating that internal conflicts is higher and vice versa (as used in Abu, et al., 2019). Domestic savings (*DS*) is gross domestic savings as a percentage of the GDP (as in Agu, 2015). Per capita income (*pcY*) is measured by the annual percentage growth rate of GDP per capita based on constant local currency (as used in Ayeni, 2014). Credit to private sector (*CPS*) is the domestic credit to private sector as a percentage of the GDP. And oil price is measured by the Nigerian Bonny light oil spot price. Four variables – *INT*, *P*, *DS*, *CPS* and *pcY* are in rates (%), while the natural logarithm of *INT* and *G* were used in this study.

4.2 Econometrics Techniques

In the literature of domestic investment, researchers have adopted several estimation techniques to examine the determinants of domestic investment. However, for the purpose of this study, the Autoregressive Distributed Lag (ARDL) bound testing approach (Pesaran & Shin, An autoregressive distributed lag modeling approach to cointegration analysis: The Ragnar Frisch Centennial Symposium, 1999; Pesaran, Shin, & Smith, 2001) was employed. The choice of this model is not unconnected to the numerous advantages which it has over other cointegration methods such as the residual-based technique (Engle & Granger, 1987) and Maximum Likelihood test (Johansen, 1988, 1991; Johansen & Juselius, 1990), which are well documented (see Abu, Kadandani, Obi, & Modibbo, 2019; Abu, 2017, 2019; Sakanko & David, 2018; Sakanko et al., 2019; David et al, 2019).

Based on the model specified in *equation (3)* above, a multivariate ARDL(p,q) model can be expressed as:

$$\Delta \ln INV_t = \alpha_1 + \sum_{j=1}^p \delta_j \Delta \ln INV_{t-j} + \sum_{i=1}^K \sum_{j=0}^q \beta_{ij} \Delta Q_{i,t-j} + \lambda_1 \ln INV_{t-1} + \lambda_2 Q_{t-1} + \varepsilon_{1t} \quad (4)$$

Where: $\sum_{i=1}^K Q_i$ is the vector of k explanatory variables (determinants of investment), $i = 1, 2, \dots, k$; α is the constant term; δ and β are the short-run coefficients; λ_1 and λ_2 are the long-run coefficient; Δ is the differentiation identity.

However, while the standard ARDL (here after Linear ARDL) model specified above enables evaluation of the long-run relations between time series variables, it only presumes linear or symmetric relations between them. Hence, the linear ARDL model and other techniques that presume symmetric dynamics are not able to capture the potential nonlinearity or asymmetry that lie within the relationship between domestic investment and variables such as interest rate, inflation rate and exchange rate which are volatile in nature. In light of this, this study adopts the Nonlinear ARDL (hereafter, NARDL) approach, which is developed by Shin et al. (2014), as an asymmetric extension to the linear ARDL model. The NARDL model is designed to capture both short run and long run asymmetries in a variable of interest, while reserving all merits of the linear ARDL approach (Cheah, Yiew, & Ng, 2017).

In the N-ARDL model, asymmetric/non-linear explanatory variables are split into their positive and negative partial sum series. While the positive partial sum series captures the increase of the explanatory variable, the negative partial sum series reflects the decrease of the explanatory variable (Pal & Mitra, 2016). In order to develop a NARDL model, the independent variables INT_t , P_t , and EXC_t , which are assumed to have nonlinear relationship with the dependent variable INV_t are split into two parts: INT_t^+ , P_t^+ and EXC_t^+ ;

and INT_t^- , P_t^- and EXC_t^- as partial sums corresponding to the positive and negative changes of INT_t , P_t , and EXC_t , which are generated by computing:

$$INT_t^+ = \sum_{i=1}^t \Delta INT_i^+ = \sum_{i=1}^t \max(\Delta INT_t, 0) \quad (5a)$$

$$INT_t^- = \sum_{i=1}^t \Delta INT_i^- = \sum_{i=1}^t \min(\Delta INT_t, 0) \quad (5b)$$

$$P_t^+ = \sum_{i=1}^t \Delta P_i^+ = \sum_{i=1}^t \max(\Delta P_t, 0) \quad (5c)$$

$$P_t^- = \sum_{i=1}^t \Delta P_i^- = \sum_{i=1}^t \min(\Delta P_t, 0) \quad (5d)$$

$$EXC_t^+ = \sum_{i=1}^t \Delta EXC_i^+ = \sum_{i=1}^t \max(\Delta EXC_t, 0) \quad (5e)$$

$$EXC_t^- = \sum_{i=1}^t \Delta EXC_i^- = \sum_{i=1}^t \min(\Delta EXC_t, 0) \quad (5f)$$

Following the splitting of interest rate, inflation rate and exchange rate changes, an extended N-ARDL model, which is a modification of *equation (4)*, with the inclusion of both the decomposed partial sums of the asymmetric variables (INT_t , P_t , and EXC_t) and other symmetric variables (G_t , ELE_t , $INTC_t$, DS_t , pcY_t , CPS , and $G_t \times OILP_t$) is given as:

$$\Delta \ln INV_t = \alpha_0 + \sum_{i=1}^p \delta_i \Delta \ln INV_{t-i} + \sum_{i=0}^q (\gamma_{1i} \Delta v_{t-i}^+ + \gamma_{2i} \Delta v_{t-i}^- + \gamma_{3i} \Delta h_{t-i}) + \sigma_1 \ln INV_t + \sigma_2 v_{t-1}^+ + \sigma_3 v_{t-1}^- + \sigma_4 h_{t-1} + \varepsilon_t \quad (6)$$

Where: v^+ and v^- are the vector of the partial sums of the asymmetric variables (INV_t , P_t , EXC_t) corresponding to the positive and negative changes in interest rate (INV), inflation rate (P_t), and exchange rate (EXC_t); h is the vector of regressors entering the model symmetrically (G_t , ELE_t , $INTC_t$, DS_t , pcY_t , CPS , and $G \times OILP_t$); δ_i and γ_i are the short-run coefficient of the lagged dependent variables, decomposed asymmetric variables, and symmetric variables; and $\sigma_1 - \sigma_4$ are the long-run coefficient of the dependent variable, decomposed asymmetric variables and symmetric variables.

As in the linear ARDL model, the null hypothesis of no (asymmetry) cointegration is being tested against the alternative hypothesis of cointegration using Wald F-statistics. The computed F-statistic from Wald statistics is then compared with the critical values provided by Pesaran et al. (2001) and/or Narayan (2005). If the computed F-statistic is greater than the upper bound $I(1)$, we reject the null hypothesis of no cointegration and

conclude that there is cointegration between the series. On the other hand, if the computed F-statistic is lesser than the lower bound $I(0)$, then we accept the null hypothesis and conclude that there is no cointegration among the series. Furthermore, if the calculated statistic is between $I(0)$ and $I(1)$, the inference would be inconclusive (Meo, et al., 2018; Sakanko & David, 2018; Abu, et al., 2019).

Presence of nonlinear effect of interest rate, inflation rate and exchange rate on domestic investment can be analysed by comparing coefficients σ_2 with σ_3 ; and δ_{1i} with δ_{2i} . If the difference in the value of coefficients σ_2 and σ_3 is significant, then the asymmetric relationship is confirmed in the long-run relationship. Similarly, if the coefficients δ_{1i} and δ_{2i} differ significantly, asymmetric influence can be confirmed in the short-run part of the model (Pal & Mitra, 2016).

4.3 Discussion of Results

One of the most appealing advantages which Pesaran, et al, (2001) ARDL approach has over other cointegration methods such as the residual-based technique (Engle & Granger, 1987) and Maximum Likelihood test (Johansen, 1988, 1991; Johansen & Juselius, 1990), is that it can be applied for the series, which are purely stationary at $I(0)$ or purely $I(1)$ or the mixture of $I(0)$ and $I(1)$. Though it has been argued that there may be no need for a unit root or stationarity test when employing an ARDL estimation technique (see Akinlo, 2006; Duasa, 2007, cited in Abu, Kadandani, Obi, & Modibbo, 2019). However, in order to avoid the inclusion of $I(2)$ series, which tend to generate spurious regression result (Sakanko & David, 2018; Sakanko, Obilikwu & David, 2019, Abu, 2017, 2019; Sakanko, Abu & David, 2019; David, 2018), we employed the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) techniques to check the stationarity properties of the series entering the model. These tests compare the null hypothesis of a series “has a unit root” against the alternative hypothesis that the series “does not have a unit root”.

Table 1: Results of Unit Root Test

Series	ADF		P-P		Decision
	Levels	First Diff.	Levels	First Diff.	
<i>lnINV</i>	-2.314320	-3.589538*	5.093330	-3.636063*	$I(1)$
<i>INT</i>	-4.604763*	-4.259804*	-3.091107*	-5.798973	$I(0)$
<i>P</i>	-2.650129***	-3.844900*	-1.666398***	-4.753068*	$I(0)$
<i>EXC</i>	-2.505137	-3.357420*	3.442253	-3.440811*	$I(1)$
<i>lnG</i>	-1.935933	-4.032449*	-1.301953	-5.050804*	$I(1)$
<i>ELE</i>	-2.423928	-2.795568*	0.810050	-4.648342*	$I(1)$
<i>INTC</i>	-2.382753	-3.438907*	-2.085091	-4.061718*	$I(1)$

<i>DS</i>	-5.108886*	-3.498124*	-2.676857*	-4.077104*	<i>I</i> (0)
<i>pcY</i>	-3.262149*	-3.601675*	-2.473674*	-5.604336	<i>I</i> (0)
<i>CPS</i>	-3.709895**	-4.169014*	-3.341686***	-4.350034*	<i>I</i> (0)
<i>OILP</i>	-3.162498***	-4.084077*	-0.272771	-3.914115*	<i>I</i> (1)

Note: * and *** denotes a rejection of the null hypothesis of no unit root at 1% and 10% levels, respectively

Clearly, from the stationarity result presented in Table 1 (above), ADF and P-P test indicates that the series in the model are mixture of *I*(0) and *I*(1), which thus validates the use of the ARDL bounds testing method to cointegration (Pesaran & Shin, 1999; Pesaran, Shin, & Smith, 2001) in the estimation of the relationship between the variables.

Having confirmed the validity of the series for ARDL bound testing approach, two ARDL (linear and nonlinear) models were estimated for the purpose of comparison. From the ARDL bound testing result presented in Table 2, the Wald f-statistics for both the linear and nonlinear ARDL models (4.47 and 5.19) exceeds the 90% 95% and 99% upper critical bounds. This result thus confirms the presence of linear (symmetric) and nonlinear (asymmetric) cointegrating relationship between the variables.

Table 2: Results of Bound Test

Table 2: Results of Bound Test					
Model		$k-1$	F-Statistics		Decision
Linear ARDL		10	4.464677		Cointegration
Asymmetric ARDL			5.186353		Cointegration
Critical values					
1%		5%		10%	
$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
2.41	3.61	1.98	3.04	1.76	2.77

Note: F-statistic values are calculated by the bound testing approach described by Pesaran et al. (2001).

Given the confirmation of a long-run relationship between the variables, the linear and nonlinear ARDL model was estimated taking into consideration the optimal lag-length (2,0,1,2,2,1,1,2,2,0,2) and (2,2,2,1,2,2,2,2,0,2,2,2,1) respectively, suggested by the Akaike Information Criterion (AIC). Moreover, prior to further inference, the adequacy of the dynamic specifications of the model was evaluated based on diagnostic test, including the Jarque–Bera normality test, Durbin–Watson and Breusch–Godfrey autocorrelation diagnostics, Breusch–Pagan–Godfrey tests for heteroscedasticity, Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMQ) plots for testing parameter and variance stability, and Ramsey RESET for model stability. The results of diagnostic tests are reported in Table 6, and figures 2a, 2b, 3a and 3b. The results of the tests suggest that both the linear and nonlinear ARDL model

does not have the problem of serial correlation, heteroscedasticity and functional form, and the residuals of the models are normally distributed. However, while the CUSUM plots confirms the stability of the models and estimated parameters, the CUSUMQ plots of both model suggests otherwise. Regardless, the long-run and short-run results of the linear and nonlinear ARDL model are jointly presented in **Table 3** and **Table 4** respectively.

Table 3: Nonlinear and Linear ARDL model Diagnostic tests

LM Test Statistics	<i>Nonlinear ARDL</i>	<i>Linear ARDL</i>
	<i>Results</i>	
Autocorrelation: CHSQ(2)	3.641504 [0.1619]	1.108932 [0.5744]
Heteroscedasticity: CHSQ(25)	39.08625 [0.3762]	32.80246 [0.1361]
Normality: Jaque-Bera	38.73280 [0.0000]	77.15915 [0.0000]
Functional Form: Ramsey RESET F-stat	0.447133 [0.5052]	0.581963 [0.4471]

Source: Author computation using E-views 10

From the long run result presented in **Table 4**, the nonlinear ARDL (NARDL) model show that interest rate, inflation rate, exchange rate, government spending, internal conflict, and domestic savings are the significant determinants of domestic investment in Nigeria in the long run. The model suggests that, a percent increase in interest rate reduces investment by 0.0032. Likewise, while a percent increase in inflation rate increase domestic investment by 0.0128, a percent decrease in inflation rate reduces investment by 0.0172. While positive and negative partial sum of exchange rate are both positively related to domestic investment, appreciation (decrease) in the exchange rate increases domestic investment by 0.0615, depreciation (increase) in the exchange rate increases domestic investment by only 0.0075. Similarly, a unit increase in government expenditure, internal conflict index (increase in internal conflicts), and a percent increase in domestic savings increase domestic investment by 0.929, and reduces domestic investment by 0.1056 and 0.0337 respectively.

Alternatively, in agreement with the nonlinear ARDL model, the linear ARDL model also reveal that interest rate and the interaction between government spending and oil price are the significant negative determinants of domestic investment, while exchange rate and government expenditure determines domestic investment positively in Nigeria. The result suggests that a percent increase in real interest rate reduces domestic investment by 0.002 percent. Similarly, a unit increase government spending as a result of increase in oil (bonny light) price will also reduce domestic investment in Nigeria by 0.357 percent. In contrast, a unit increase in government expenditure and naira to dollar exchange rate (depreciation)

raises the level of domestic investment in the country by 1.195 percent and 0.0042 percent respectively.

In the short run estimates reported in **Table 5**, the nonlinear ARDL model reveal that the past quarter level of domestic investment, interest rate, inflation rate, exchange rate, government expenditure, electric power consumption, domestic savings, per capita income, credit to private section and the interaction between government spending and oil price are the significant determinants of domestic investment in Nigeria in the short run. Result from the nonlinear ARDL model imply that a unit change in past quarter level of domestic investment raises domestic investment in current quarter by 0.405. Similarly, domestic investment is reduced by 0.405 for a percent increase in real interest rate in the current quarter, and 0.003 for a percent decrease in the real interest rate in the past quarter, in contrast to a 0.008 increase when real interest rate is increased by a percent in the past quarter. Likewise, domestic investment is reduced by 0.002 for a percent increase in inflation rate, and 0.006 for a percent decrease in inflation rate. However, in the past quarter, a percent decrease in inflation raises domestic investment by 0.003.

Furthermore, domestic investment is reduced by 0.005 for a unit depreciation in the naira exchange rate in the current quarter, and 0.045 for a unit appreciation in exchange rate in the past quarter. Similarly, investment in Nigeria is raised by 0.087 for a unit appreciation in the exchange rate in the current quarter, and 0.002 for a unit depreciation in the naira-dollar exchange rate. In addition, a unit increase in government expenditure in the current raises domestic investment by 0.547, and a unit increase in government expenditure in the past quarter reduces domestic investment by 0.196. While a kWh increase in the past quarter raised domestic investment by 0.0001, a kWh increase in electric power consumption in the current quarter reduces domestic investment by 0.0039. Similarly, while a percent increase in domestic savings, per capita income and credit to private sector in the current quarter raises domestic investment by 0.082, 0.0054, and 0.028 respectively, a percent increase in domestic savings, per capita income, and the interaction (product) of government spending and oil prices (increase in government spending as a result of increase in the global oil prices) reduces the level of domestic investment by 0.0039, 0.0022 and 0.133 respectively.

In similitude to the long run estimates, save the slight magnitude (size) of the impact of the variables on domestic investment, the result of the short-run linear ARDL model presented in **Table 5** is also similar (in sign) with the short-run estimates of the nonlinear ARDL model. In that, the Linear ARDL model shows that the past quarter of investment and exchange rate, government expenditure, internal conflict, domestic savings, per capita income, and past quarter interaction between government spending and changes in oil price are also the significant positive determinants of domestic investment, while inflation rate,

current exchange rate, past quarter government expenditure, current electric power consumption, past quarter per domestic savings and per capita income, and interaction between government spending and oil price determines domestic investment in Nigeria negatively.

The coefficient of the error correction term lagged by one period [ε_{t-1}] in both models are statistically significant, correctly signed, less than 1, and also similar. This indicates at about 4% of the deviations from the equilibrium will be corrected within one quarter.

Table 4: Estimation Result of Linear and Nonlinear ARDL models (Long-run coefficients)
Dependent variable: *INV*

Regressor	Asymmetric ARDL		Linear ARDL	
	<i>Coefficient</i>	<i>t – stat</i>	<i>Coefficient</i>	<i>t – stat</i>
<i>Constant</i>	1.281924	0.163010	7.747209*	5.108442
<i>INT</i>	–	–	-0.020430*	-2.465573
<i>INT</i> ⁺	-0.003188*	-2.435014	–	–
<i>INT</i> [–]	0.012765	-0.265448	–	–
<i>P</i>	–	–	0.003497	0.806540
<i>P</i> ⁺	0.012765**	2.063962	–	–
<i>P</i> [–]	-0.017221***	-1.489988	–	–
<i>EXC</i>	–	–	0.004198**	2.078775
<i>EXC</i> ⁺	0.007466*	2.563382	–	–
<i>EXC</i> [–]	0.061450**	2.129514	–	–
<i>lnG</i>	0.929126*	2.281518	1.194495*	4.739758
<i>ELE</i>	0.006422	1.208892	-0.001408	-0.344775
<i>INTC</i>	-0.105564***	-1.803834	-0.035812	-0.581703
<i>DS</i>	-0.033668**	-2.095097	-0.005173	-0.620851
<i>pcY</i>	-0.002070	-0.097466	0.024412	1.238656
<i>CPS</i>	0.040091	1.223030	-0.011736	-0.756881
<i>lnG</i> × <i>OILP</i>	0.305848	1.259275	-0.357392***	-1.628037

Note: *, ** & *** indicates 1%, 5% & 10% significance level; *ln* denotes logarithm; Δ is the first difference operator

In whole, the nonlinear ARDL model suggest that the movement in interest rate and exchange rate are asymmetrically related with the level of domestic investment. This suggests that, increase in interest rate and depreciation in exchange rate decreases the level of domestic investment, while the decrease in interest rate and appreciation in the exchange rate raises the level of domestic investment in Nigeria. Inflation rate on the other hand reduces domestic investment both with decrease of increase in inflation, though the impact

is not the same. However, this suggests that increase in real (lending) interest rate makes borrowing expensive; exchange rate depreciation makes import of machineries, raw materials, etc. expensive, thus discouraging domestic investors; and changes in inflation rate increases uncertainty.

On the other hand, the negative impact of electric power consumption on domestic investment both in the short run linear and nonlinear ARDL model suggest that, increase in electric power consumption reduces domestic investment in Nigeria. Perhaps this is due to the epileptic power supply in the country which is responsible for increase in production cost. The positive effect of government spending, domestic savings, per capita income, and credit to private sector on domestic investment in the short run suggests that the increase in government spending, domestic savings, per capita income and credit to private sector raises the level of domestic investment in Nigeria. Expectedly, this is consistent with the findings of previous studies (Mekonnen, 2010; Ali & Shaheen, 2016; Muhdin, 2016; Hecht, et al., 2004; Ojong, et al., 2018; Agbarakwe, 2019; Bakare, 2011; Agu, 2015; Ajayi & Kolapo, 2018; Agbarha & Monye, 2017; Agwu, 2015).

Moreover, as predicted, the interaction between government spending and oil prices is also statistically significant in explaining the determinant of domestic investment in Nigeria. Though government expenditure determines the level of domestic investment in Nigeria positively, however, due to the dependence of the Nigerian government revenue of oil gas export which is highly volatile, the interaction between government spending and oil price is negatively related to domestic investment. Two reasons can be suggested why the interaction between domestic investment and oil price is negative. First, during periods of oil boom (rising oil price), revenue from oil is mostly mismanaged by the political office holders, with meagre going into meaningful or beneficial projects which could make investment thrive. Secondly, public expenditure on capital projects such as roads, bridges, rail ways, port, electricity, etc. which tend to reduce the cost of production, thus enhancing the level of domestic investment and attracting more investment into the country has been historically less than 30 percent of the total expenditure.

While an asymmetric relationship can be observed from the size and sign of the coefficients of asymmetric variables (INT_t , P_t and EXC_t) presented in **Table 4**; however, the Wald test was employed to determine the presence of asymmetric relationships or otherwise between interest rate, inflation rate, exchange rate, and domestic investment in Nigeria. As reported in **Table 6**, the asymmetric result from Wald test suggest the presence of asymmetric relationship between the nonlinear/asymmetric variables (interest, inflation and exchange rate) and domestic investment. In other words, this implies that the partial sum of the variables (corresponding to increase and decrease in interest rate, exchange rate, and inflation rate) are statistically different. Hence, the effect of the increase in interest rate

and inflation, and depreciation of exchange rate on domestic investment is statistically different from the negative impact of interest rate, exchange rate (appreciation), and inflation on domestic investment.

Table 5: Estimation Result of Linear and Nonlinear ARDL models (Short-run coefficients)

Dependent variable: ΔINV

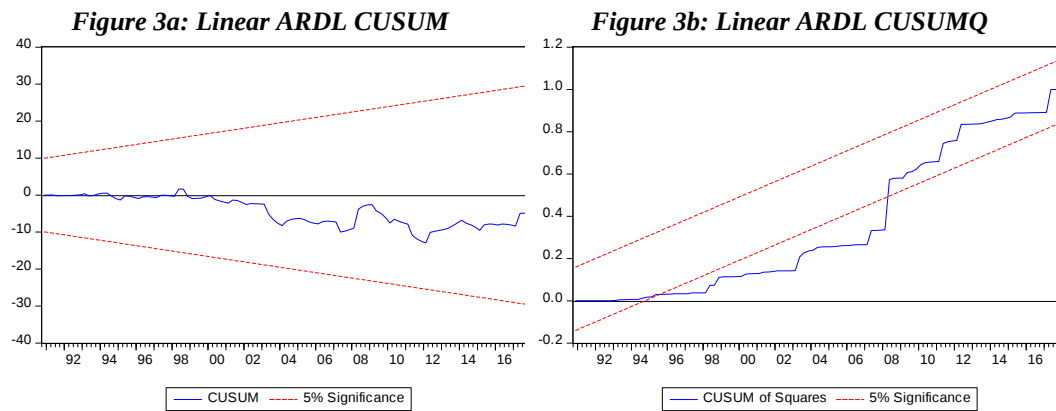
Regressor	Asymmetric ARDL		Linear ARDL	
	Coefficient	t – stat	Coefficient	t – stat
$\Delta INV(-1)$	0.405325*	6.590089	0.508255*	8.471822
ΔINT^+	-0.015263*	-7.674088	—	—
$\Delta INT^+(-1)$	0.008406*	4.149825	—	—
ΔINT^-	0.001207	0.871554	—	—
$\Delta INT^-(-1)$	-0.003157**	-2.332425	—	—
ΔP	—	—	-0.000868**	-2.334636
ΔP^+	-0.001584*	-2.869926	—	—
ΔP^-	-0.005622*	-4.756540	—	—
$\Delta P^-(-1)$	0.002658**	2.176788	—	—
ΔEXC	—	—	-0.002613*	-5.074489
$\Delta EXC(-1)$	—	—	0.000848***	1.584371
ΔEXC^+	-0.004651*	-9.679626	—	—
$\Delta EXC^+(-1)$	0.001992*	3.386567	—	—
ΔEXC^-	0.087346*	10.32113	—	—
$\Delta EXC^-(-1)$	-0.044521*	-4.538640	—	—
$\Delta \ln G$	0.547322*	12.33935	0.380112*	7.030262
$\Delta \ln G(-1)$	-0.196002*	-5.603025	-0.200183*	-3.600244
ΔELE	-0.003939*	-7.633436	-0.002093*	-4.487883
$\Delta ELE(-1)$	0.001047***	1.774703	—	—
$\Delta INT C$	—	—	0.018379*	2.989008
ΔDS	0.008183*	9.134707	0.009180*	9.824690
$\Delta DS(-1)$	-0.003989*	-3.875762	-0.005706*	-5.168452
ΔpcY	0.005378*	3.531988	0.004558*	2.736942
$\Delta pcY(-1)$	-0.002175***	-1.607163	-0.004161*	-2.564582
ΔCPS	0.027700*	6.664713	—	—
$\Delta CPS(-1)$	-0.013904	-0.013904	—	—
$\Delta(\ln G \times OILP)$	-0.132622*	-6.343889	-0.192530*	-6.252822
$\Delta(\ln G \times OILP)(-1)$	—	—	0.074062**	2.305823
ε_{t-1}	-0.041544*	-9.297979	-0.043384*	-7.667562
Adj. R^2	0.935025		0.862732	

F-stat	39.67117*	32.12591*
D-W Stat	1.926265	1.904302

Note: *, ** & *** indicates 1%, 5% & 10% significance level; $\ln$ denotes logarithm; Δ is the first difference operator

Table 6: Testing the presence of (Long-run) asymmetries

Series	F-statistic [Prob.]	Asymmetric relationship
Interest rate (INT_t)	9.472835 [0.0027]	Long-run asymmetric relationship exist
Inflation rate (P_t)	5.173747 [0.0250]	Long-run asymmetric relationship exist
Exchange rate (EXC_t)	3.846061 [0.0526]	Long-run asymmetric relationship exist



5. Conclusion and Recommendations

This study explored the determinants of domestic investment in Nigeria using quarterly time series data over the 1980 to 2018 period. In order to capture the impact of volatile interest rate, exchange rate and inflation rate, which has historically been identified as major determinants of investment, both within and outside Nigeria, the novel Nonlinear ARDL cointegration approach proposed by Shin, et al. (2014), which allows an examination of the potential asymmetric impact both in long- and in short-run time sphere, was adopted, in addition to the general (linear) ARDL bound testing approach of Pesaran, et al. (2001), for comparison. Among other things, the result from both the linear and nonlinear ARDL bound testing indicate the presence of cointegrating (long-run) relationship between domestic investment and asymmetric variables (interest rate, exchange rate and inflation rate), symmetric variables (government expenditure, electric power consumption, internal conflict, domestic saving, per capita income, and credit to private sector) and interaction variable (moderation between government spending and oil

price). Furthermore, the empirical evidence suggests that, in the short-run, interest rate, exchange rate and inflation rate are asymmetrically related to domestic investment in Nigeria. That is, while increase in interest rate and depreciation in exchange rate reduces investment, decrease in their value increases investment. Though inflation rate is negatively related with domestic investment both with increase and decrease in inflation, however, the magnitude is more severe with fall in the general price level. In addition, while government expenditure, domestic savings, per capita income, and credit to private sector raises domestic investment, however, electric power consumption and the interaction between government spending and oil price (increase in government spending with increase in global oil price) reduces domestic investment in the short-run.

In the long-run, while increases in interest rate, decrease in inflation rate, internal conflict, domestic savings and the interaction between government spending and oil price (increase in government spending with rise in the price of Nigerian bonny light crude oil) impact domestic investment negatively, however, increase in inflation rate, exchange rate (appreciation and depreciation), and government spending raises the level of domestic investment in the long-run. Based on these findings, this study recommends the increase in government capital expenditure, savings, credit to private sector, diversification of the economy away from oil and gas export, reduction of the lending interest rate, maintaining of investment friendly inflation rate, and the control/reduction of internal conflicts.

For instance, due to the high impact of government spending, it is recommended that the central and regional governments increase their spending expenditure, specifically capital expenditure which has been historically lower at less than 30 percent of aggregate expenditure, in comparison with recurrent expenditures. However, given the negative impact of the interaction between government spending and oil price (bonny light crude), it is advisable for the government to diversify the Nigerian economy away from the volatile oil and gas export, in addition to the cut in the cost of governance. It is also advisable to eliminate corruption in Nigeria, reason being that increase in oil price, which translates to increase in oil revenue is often beneficial to political elites and officials, because it avails them more money to loot, at the expense of the larger public.

In addition, given the positive impact of the appreciation of the naira; the negative impact of inflation; the positive impact of lower interest rate; the negative impact of electricity and internal conflict; and the positive effect of domestic savings, per capita income and credit to private sector, relevant policy actions should be instituted in order to increase credits to private sector, reduce the inflation rate, and obtain an investment-friendly lending interest rate and savings-friendly deposit interest rate. Furthermore, internal crises in part of the country should be holistically tackled as they scare investors

away, coupled with the increase in export so as to cause the naira to appreciate, and the enhancement of power distribution, generation and stability.

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