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# Mobilizing Public-Sector Funds to Achieve Optimum Levels of Government Size in Africa's Oil-Exporting Countries in the Future: Evidence from an *Ex Post* Forecasting Analysis of Nigeria's Government Size

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## Abstract

One of the key determinants of government size is the quantity of expenditure the government does out of the funds it gets from revenues and borrowings. Therefore, effective mobilization of public-sector funds requires exploring how the revenues and borrowings impact on the future values of government expenditure. In this line, using government expenditure as the proxy for government size and Nigeria as a case study, this paper examines the future course of government size in Africa's oil-producing countries through an *ex post* forecasting analysis which involves forecasting Nigeria's government expenditure in an autoregressive distributed lag (ARDL) model. The analysis is based on time series data spanning 1981 to 2017, out of which the ARDL model is estimated for the 1981-2014 period, before *ex post* forecasting is done for the remaining 2015-2017 period. The results show that oil revenue, external debt, and the past level of government expenditure will have positive correlations with the future levels of government size, while non-oil revenue and domestic debt will have negative correlations. However, current oil revenue will play a unique role in the future path of government size, in that oil revenue is the only exogenous variable without any lagged term selected with its current term by the information criterion (Akaike Information Criterion) used for selecting the optimal ARDL model, which is selected among 2,500 competing models. A key policy implication of these findings is that optimum mobilization of public funds in the concerned countries requires paying special attention to current oil revenue.

**Keywords:** Government size, African oil-producing countries, mobilization of public-sector funds, government revenues, government debts, time-series forecasting.



## 1. INTRODUCTION

Government size is a macroeconomic and public-finance issue that affects development in low-income countries. For example, big government, defined as a government with a huge size relative to the size of the economy, could be the result of military leadership in contrast to democratic governance. Big government crowds out the economic activities (e.g. investment and production) of the economic agents in the private sector of the economy, which consequently reduces the incomes and well-being of the agents.

On the other hand, democratic governance impacts positively on the per capita income and well-being of economic agents. Acemoglu, Naidu, Restrepo and Robinson (2019) show through a dynamic panel model that democratic governance induces a rise of about 20% in the GDP per capita in the long-run, after country fixed effects and GDP dynamics that could obscure such an effect are controlled for. Government, particularly its size, therefore plays a significant role in the developmental process of the economy.

Government may be defined as an institutionalized public-sector entity that exercises authority over the people of a sovereign geographic area via its activities, such as spending, borrowing, taxation, regulation, etc (Di Matteo, 2013). As the author shows, the terms "government" and "state" are different but related concepts, in that the state is the sovereign geographic location that is governed via the operations of the government, mainly to achieve the objective of optimum resource allocation. However, the government does not usually work alone to allocate resources in the economy. The market and government usually work together in the economy; hence the size of government is a key determinant of the relative role of government in resource allocation and mobilization.

Government size can be measured via variables that show government activities in the economy, such as government expenditure, revenue, consumption, borrowing, investment, etc. But measuring government size via government expenditure is a very useful way of examining the current policy choices of government, which determine the current use of resources by government (Di Matteo, 2013). Government expenditure is an important variable for studying the size and performance of African governments in particular, because these governments are large spenders that tend to adopt procyclical and budget-deficit fiscal policies.

As shown in Afonso, Schuknecht & Tanzi (2005), the right size of government is required to achieve the desired levels of government performance and efficiency. As the authors show, while government performance points to the outcome of government activities in the economy, government efficiency points to the outcome relative to the resources used to finance it. For example, suppose the government of a country increases petrol subsidy in order to control inflation in the economy. Government performance on the subsidy can be described as high if inflation is successfully kept at the required level, while government efficiency can be said to be high if the desired level of inflation is achieved with a minimal amount of resources.

Although government size is an important determinant of government performance and efficiency, findings on the effects of government size in the economy are inclusive. While some studies (e.g. Martinez-Mongay, 2002) show that government size impacts positively on the economy, other studies (e.g. Afonso & Furceri, 2008) find that government size impacts negatively on economic performance due to certain factors, such as rent-seeking behaviour of government. Undertaking further studies on this subject is therefore necessary. Studies relating to government expenditure in African oil-producing countries are particularly necessary, because the expenditure is the main indicator of government size in these economies, in that these governments are oil-driven spenders whose fiscal behaviour tends to have procyclical and deficit-financing features, as mentioned earlier. Besides, rather than estimating only the relationship between government expenditure and its determinants, a more robust way of exploring government size is to determine the best model for such a relationship, estimate the model, and forecast with it in order to investigate the future course of government expenditure.

In line with the foregoing background, the objective of this study is to investigate how public-sector funds, got through revenues and borrowings, can be mobilized to achieve optimum levels of government size in Africa's oil-producing countries in the future through a forecasting analysis of government expenditure, using Nigeria as a case study. Overall, the results of the analysis show that, for a typical African oil-producing country, the mobilization of public-sector funds got through revenues and borrowings, with the aim of achieving the optimum level of government size, will likely be influenced by the following: (i) current oil revenue that crowds out past values of oil revenue; (ii) positive correlation between oil revenue and government expenditure; (ii) positive correlation between external borrowing and government expenditure; (iii) positive correlation between the past and current levels of government expenditure; (iv) negative correlation between non-oil revenue and government expenditure; and (v) negative correlation between domestic debt and government expenditure.

The above correlations suggest that the mobilization of public funds in the countries under consideration will likely be influenced by the following fiscal behaviour of their governments: financing expenditure mainly through current oil revenue and external debt; seeking to get funds from the non-oil sector and the domestic debt market when current oil revenue is low and securing external debt is difficult; and spending to finance the fiscal liabilities of previous fiscal years.

The findings of the paper imply that mobilizing public funds to achieve the optimum level of government size in a typical African oil-producing country in the future requires that benchmarks are used to employ oil revenue, non-oil revenue, external debt, and domestic debt for public spending. With this benchmark policy, government size will impact maximally on the developmental process of the economy, by limiting the crowding-out of the economic activities of households and firms, thereby increasing their incomes and well-being.

The benchmark policy is particularly required in channeling current oil revenue into the budget, in that the paper finds that the current level of the variable has a unique role in the analysis relative to its past values. The paper employs the autoregressive distributed lag (ARDL) model for its analysis and among all the exogenous variables considered, oil revenue is the only variable without a single lagged term in the optimal ARDL model, which is selected by an information criterion among 2500 competing models. The remaining part of the paper is structured as follows: the review of relevant literature is done in section two; the methodology of the paper is discussed in section three; results are presented and discussed in section four; while concluding remarks are presented in section five.

## 2. LITERATURE REVIEW

The literature review of this paper is done under two divisions. The theoretical framework of the paper is discussed under the first division. The purpose of the theoretical framework is to "frame" the theoretical foundation of the links between the variables of the empirical analysis of the paper. This involves showing how these links are justified by a combination of relevant theories. The second division of the literature review is devoted to discussing empirical studies that are related to the paper.

### 2.1. Theoretical Framework

The key variables of the empirical analysis of this paper are government expenditure which is the proxy for government size, public revenue which consists of oil revenue and non-oil revenue, and public debt which consists of external debt and domestic debt. The theoretical underpinning of the links between the variables derives from the following theories: (i) Wagner's theory; and (ii) the neo-classical fiscal deficit theory.

The Wagner's theory (Wagner, 1883) shows that government expenditure, which is an indicator of government size, increases as economic activities increase. This is because as economic activities increase, government spends more to provide welfare services such as education, health, and food subsidy. Government also needs to protect the economy against any monopolistic tendencies of large firms that arise as economic activities increase, by increasing spending to neutralize the tendencies. Government expenditure is therefore an endogenous variable that is determined by economic performance, which implies that causality runs from economic growth, the broad measure of economic performance, to government expenditure (Paparas, Richter & Kostakis, 2019).

The Keynesian and classical views on government expenditure are different from that of Wagner. The Keynesian view shows that causality runs from government expenditure to growth, while the role of the market in the workings of the economy is the emphasis of the classical view. According to the Keynesian view, government is the economic agent that is responsible for providing direction for optimum growth in the economy, hence government expenditure is exogenous. This makes the Keynesian view to be unsuitable for the empirical analysis of this paper, in that government expenditure is treated as an outcome in the analysis. The classical view is also not suitable for the analysis because it emphasizes the role of the market and not that of government.

What the Wagner's theory shows regarding government expenditure is consistent with what the neoclassical fiscal deficit theory shows on the variable. As shown in studies on the latter theory (e.g. Carrasco, 1998; Cebula & Hung, 1992), if fiscal deficit increases, the government has to finance expenditure by borrowing externally and by selling bonds in the domestic debt market. Getting buyers for the bonds requires that the government increases the interest rate, which will lead to a reduction in the investment of the private sector. The increase in fiscal deficit therefore increases government size via government expenditure and crowds out the activities (investments) of the private sector.

While the neoclassical fiscal deficit theory shows that an increase in fiscal deficit has the described effects on the economy, another fiscal deficit theory called Ricardian equivalence theory shows that the overall effect of financing a fiscal deficit would be zero, making the latter theory to be unsuitable for the analysis of this paper. As shown in Barro (1989), the Ricardian equivalence theory shows that if the government chooses to reduce tax and finance a fiscal deficit through borrowing, households will respond by saving the tax cut because they expect a future increase in tax, so that they pay the future increase in tax with the saving. Besides, higher government expenditure financed with debt means that government will reduce spending in the future. Therefore, the overall effect of fiscal deficit is zero because consumers' incomes and spending, and government expenditure, are all smoothened across time.

The foregoing explanations provide justification for treating government size, measured through government expenditure, as a function of oil revenue, non-oil revenue, external debt, and domestic debt, as done in the empirical analysis of this paper. It is deducible from the Wagner's theory and neoclassical fiscal deficit theory that government expenditure is an outcome that can be determined by the broad economic condition (i.e. growth) or by the condition of public funds (i.e. other fiscal policy variables). That is, government expenditure can be modelled as an outcome that is determined by the revenues and debts that are employed to finance it.

### 2.2. Empirical Review

The empirical literature has mixed findings on the effects of government size on the economy. While some studies (e.g. Afonso & Furceri, 2008; Babatunde, 2011; Nakibullah & Islam, 2007; and Babatunde, 2018) show that government size has negative or week effects on the economy; other studies (e.g. Martinez-Mongay, 2002; Loizides & Vamvoukas, 2005; Attari & Javed, 2013; and Hamdi & Sbia, 2013) show that government size impacts on the economy positively.

The existence of government in the economy should not have any negative effects in the first place, since government is constituted to guide the economy regarding the allocation of resources, in order to achieve the optimal growth path. The negative and weak effects of government are therefore due to certain factors that hinder government performance, as shown in the studies with such findings. Key ones among such factors are big government, weak institutions, and ineffective fiscal policy.

Big government, which points to a government whose size is very large, usually hinders economic performance, even when factors that should insulate against such performance exist. Bergh & Bjornskov (2020) show that big government hinders growth by reducing private investment, even in countries with high social trust which should insulate against such a negative effect. In simple terms, social trust can be defined as the belief that an economic agent has in another economic agent or a group of economic agents that makes the behaviour of the latter to be predictable to the former (Verducci &Schroer, 2010).

While big government hinders economic performance, different levels of institutional quality make the effects of government size to vary across countries. That is, even if two countries do not have big governments, the variations in their institutions can make government size to impact on them differently. Folster & Henrekson (2001) show that institutional factors, such as democratic governance, cause differential effects of government size across countries. In particular, weak institutions promote rent-seeking behaviour of government officials in oil-producing countries and make government size to have negative effects in these countries, compared to countries without oil (Sala-i-Martin Xavier &Subramanian, 2003). According to North (1990), institutions point to the laws, cultures, and regulations that guide the interactions of economic agents in the economy, implying that institutions can be described as the "rules of the game" in the society. Measures of institutions include governance, rule of law, level of corruption, level of economic freedom, level of violence, etc.

Ineffective fiscal deficit policy often makes government size, manifesting via government expenditure, to impact negatively on the economy. In particular, ineffective management of oil revenues, which usually fluctuates due to the volatility of oil price, often hinders the sustainability of fiscal policies in oil-producing countries, because the volatility affects the level of resources that are available to finance expenditure. In such countries, government size, manifesting via government expenditure, often increases during oil booms due to political and growth pressures on concerned governments, but reducing the size is often difficult to achieve by the governments when the booms cease (Liuksila, Garcia & Bassett, 1994). This usually makes the governments to finance fiscal deficits via borrowing, particularly external borrowing. Developing countries in particular, such as African oil exporters, usually prefer external debt to domestic debt for deficit financing and only opt for the latter when there are undesirable conditions in the international capital market (Borensztein, Cowan, Eichengreen & Panizza, 2008; Panizza, 2008). Examples of such undesirable conditions are international financial crisis and unfavourable loan conditions given by creditors.

Two key factors that make governments, particularly governments of developing countries, to prefer external debts are the concessional rates at which they are issued and their longer maturity rates (Beaugrand, Loko & Mlachila, 2002; Panizza, 2008). The shorter maturity rates of domestic debts can result in high burden of interest payments and financial instability for the economy (IMF, 2006; UNCTAD, 2002). Also, domestic debts are issued at market rates because profit-driven economic agents (e.g. banks, institutional investors, and individuals) are the buyers of bonds. Therefore, government size in developing countries, particularly Africa's oil-producing countries, is influenced largely not only by revenues but also by public debts.

The revenues and debts contribute significantly to the cyclicality of fiscal policy and government size in developing countries, such as Africa's oil-producing countries. Fiscal policy and government size (measured via government expenditure) tend to be procyclical in these countries, especially when there are permanent shocks to the GDP (Talvi & Vegh, 2005; Barhoumi, Cherif & Rebei, 2016). This necessitates controlling for oil revenue, non-oil revenue, external debt, and domestic debt, in examining the future course of government size for Africa's oil-producing countries, as done in this paper.

## 3. RESEARCH METHODOLOGY

The main aim of the paper is to undertake an *ex post* forecasting of government size, using government expenditure as the proxy for government size. The forecasting analysis involves the following steps: (i) estimating the current values of government size, explained by oil revenue, non-oil revenue, external debt, and internal debt, in an econometric model; (ii) forecasting the values of government size after estimating the current values; (iii) determining the reliability of the forecasts by comparing the forecast evaluation statistics of the model used for forecasting with the forecast evaluation statistics of benchmark models, namely random walk and univariate autoregressive models; and (iv) making inferences about the future course of government size.

The econometric model used for estimation and forecasting government size and whose forecasts are compared with those of benchmark models is the autoregressive distributed lag (ARDL) model. The ARDL model is a type of model in which the dependent variable is explained by its own lag(s) and the current values and lags of other regressors, which makes a dynamic and robust analysis to be possible.

The following diagnostic tests are done for the ARDL model used for estimation, in order to determine the adequacy of the model before it is used for forecasting: (i) unit root tests to investigate the stationarity properties of the variables of the model, using Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) techniques; (ii) serial correlation test to test whether the errors of the model are correlated across time, using the Breusch-Godfrey Lagrange Multiplier (LM) technique; (iii) heteroskedasticity test to test whether the error term of the model has a constant variance, using the Breusch-Pagan-Godfrey technique; and (iv) normality test to test whether the error term is normally distributed, using the Jarque-Bera technique.

The data used for the analysis span 1981 to 2017. The estimation of the current values of government expenditure, the proxy for government size, is done through the ARDL model for the 1981-2014 periods, while *ex post* forecasts of the variable are obtained for the 2015 to 2017 period. As indicated earlier, in order to determine the reliability of the forecasts of the ARDL model, its forecasting strength is compared with those of the random walk and the univariate autoregressive models, which are usually used as benchmarks because of their strong forecasting abilities. The comparison of forecasting strengths involves examining the forecast evaluation statistics of the three models, as mentioned earlier.

### 3.1. Data

The time-series data used for the analysis of this paper, which cover the period of 1981 to 2017 as mentioned earlier, were sourced from a secondary source. Table 1 provides information on the data. The information covers the names and descriptions of variables and the source of data.

**Table-1: The Data of the Study**

| Variables | Description of Variable | Source of Data |
|---|---|---|
| Government expenditure | Total spending of the federal government in nominal terms. | Central Bank of Nigeria Statistical Bulletin. |
| Oil revenue | Total oil revenue collected by the federal government in nominal terms. | Central Bank of Nigeria Statistical Bulletin. |
| Non-oil revenue | Total non-oil revenue collected by the federal government in nominal terms. | Central Bank of Nigeria Statistical Bulletin. |
| Domestic debt | Total domestic debt of the federal government in nominal terms. | Central Bank of Nigeria Statistical Bulletin. |
| External debt | Total external debt of the federal government in nominal terms. | Central Bank of Nigeria Statistical Bulletin. |
| GDP deflator | Implicit price deflator (a price index). | Central Bank of Nigeria Statistical Bulletin. |

**Note:** Government expenditure, oil revenue, non-oil revenue, domestic debt, and external debt, were deflated by the GDP deflator to obtain their values in real forms.

### 3.2. The ARDL Model

ARDL models are models in which the current value of dependent variables are regressed against their lagged terms and the current and lagged terms of independent variables. An ARDL (p, n) model is of the following form:

$$y_t = a_0 + \sum_{i=1}^{p} \propto_i y_{t-i} + \sum_{i=0}^{n} \beta_i \boldsymbol{x}_{t-i} + u_t \qquad (1)$$

where p is the lag order of the lagged terms of the dependent variable; n is the lag order of the independent variables; $y_t$ is the dependent variable, which is a scalar; $a_0$ is a constant term; $\boldsymbol{x}_t$ is a column vector process; $\propto_i$ which are scalars, and $\beta_i$ which are row vectors, are the coefficients of the lagged terms of $y_t$ and $\boldsymbol{x}_t$ respectively; and $u_t$ is a scalar error term with zero mean. In line with the objective of this paper, the dependent variable of the ARDL model is Nigeria's real government expenditure; while the variables of the $\boldsymbol{x}_t$ vector are the country's real oil revenue, real non-oil revenue, real domestic debt and real external debt.

The lag orders, p and q, are usually determined by information criteria, such as Akaike and Schwarz information criteria. Suppose the values of p and q are both 1 in equation (1), the resulting ARDL model will be:

$$D(LNRGOVEXP)_t = \gamma_0 + \gamma_1 D(LNRGOVEXP)_{t-1} + \gamma_2 D(LNROILREV)_t + \gamma_3 D(LNROILREV)_{t-1} + \gamma_4 D(LNRNONOILREV)_t + \gamma_5 D(LNRNONOILREV)_{t-1} + \gamma_6 D(LNREXDEBT)_t + \gamma_7 D(LNREXDEBT)_{t-1} + \gamma_8 D(LNRDMDEBT)_t + \gamma_9 D(LNRDMDEBT)_{t-1} + \varepsilon_t \qquad (2)$$

Where LNRGOVEXP, LNROILREV, LNRNONOILREV, LNREXDEBT, and LNRDMDEBT are the natural log forms of real government expenditure, real oil revenue, real non-oil revenue, real external debt, and real domestic debt; "D" points to first difference; while "LN" stands for natural log. All the variables are in their "real", differenced and logged forms in equation (2). As mentioned earlier, estimation with the ARDL model is done for the 1981-2014 period.

### 3.3. Forecasting

After estimating the ARDL model for the 1981-2014 period, the dynamic forecasting technique is used to obtain the *ex post* forecasts of real government expenditure for the 2015-2017 period.

In line with ARDL model of equation (1), the forecasted value of the dependent variable in the model, real government expenditure, is based on the following equation:

$$\hat{y}_{t+h} = \hat{\delta}_0 + \hat{\delta}_1(L)y_t + \hat{\delta}_2(L)x_{1t} + \hat{\delta}_3(L)x_{2t} + \hat{\delta}_4(L)x_{3t} + \hat{\delta}_5(L)x_{4t} \quad (3)$$

where $\hat{y}_{t+h}$ is the forecasted value of the dependent variable at time t; h is any positive integer; L is the lag operator; $(L)y_t$ represents the lagged term(s) of the dependent variable; $x_{1t}$ to $x_{4t}$ are the independent variables, which are real oil revenue, real non-oil revenue, real external debt, and real domestic debt, respectively.

Dynamic forecasting in a model in which the lags of the dependent variable are part of the regressors, such the ARDL model, is a multi-step forecast of the dependent variable that begins from the first observation of the forecast sample. The information criterion used for the selection of the optimal model for the ARDL model of equation (1) selects two lags of the dependent variable, as shown in Table 3 below. Based on the two lags, suppose the first and second observations in the forecast sample are denoted as Z and Z+1 respectively, the algorithm for multi-step forecasts of the dependent variable (real government expenditure) in equation (3) involves treating the two lags as follows (Wooldridge, 2006; Eviews, 2017):

(i) For the first observation (Z), the actual values of the two lags will be used.

(ii) For the second observation (Z+1), the actual value for $y_{Z-1}$ and the forecasted value $\hat{y}_Z$ of the first lag of $y_{Z+1}$ will be used.

(iii) The forecasted values for the two lags will be used for all subsequent observations in the forecast sample.

That is, dynamic forecasting of the dependent variable involves combining the described treatment of the lagged terms of the variable with the estimated parameters and corresponding values of the other regressors (i.e. the current and lagged values of $x_{1t}$, $x_{2t}$, $x_{3t}$, and $x_{4t}$ in equation (3)). Furthermore, since the forecasts to be obtained are *ex post* forecasts, the forecasting power of the ARDL model used to obtain the forecasts can be evaluated with forecast evaluation statistics whose computation involves the use of the actual values of the dependent variable forecasted. The evaluation involves examining the forecasts evaluation statistics of the ARDL model for the forecast period of 2015-2017 and comparing the statistics with the forecast evaluation statistics of other models used for forecasting the same variable for the same 2015-2017 period. These other models, which are usually used for such comparison because of their forecasting strengths, are the random walk and univariate autoregressive models.

While the ARDL model of equation (1) provides information on the current value of government expenditure, conditional on the past, the forecasting model of equation (3) provides information on the future value of government expenditure, conditional on the present and past. This means that the purpose of the forecasting model of equation (3) is to extrapolate observed past data. Inferences on the future course of government size, with respect to government expenditure, can therefore be drawn from the equation.

## 4. RESULTS

### 4.1 Unit Root Tests

The unit roots results are presented in Table 2 below. The results show that all the variables of the analysis are I(1). In line with these results, the variables are modelled in the first-difference form in the ARDL model used for estimation for the 1981-2014 period.

**Table-2: Results of Unit Root Tests**

| ADF | | | | | PP | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | ADF Test Statistic | 1% Critical Value | 5% Critical Value | 10% Critical Value | PP Test Statistic | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| LNRGOVEXP (with intercept) | -1.030754 | -3.632900 | -2.948404 | -2.612874 | -0.818080 | -3.626784 | -2.945842 | -2.611531 |
| D(LNRGOVEXP) (with intercept) | -8.326430 | -3.632900 *** | -2.948404** | -2.612874* | -8.746090 | -3.632900*** | -2.948404** | -2.612874* |
| LNROILREV (with intercept) | -1.748374 | -3.626784 | -2.945842 | -2.611531 | -1.726254 | -3.626784 | -2.945842 | -2.611531 |
| D(LNROILREV) (with intercept) | -6.268201 | -3.632900 *** | -2.948404** | -2.612874* | -6.308002 | -3.632900*** | -2.948404** | -2.612874* |
| LNRNONOILREV (with intercept) | -1.110240 | -3.632900 | -2.948404 | -2.612874 | -0.987001 | -3.626784 | -2.945842 | -2.611531 |
| D(LNRNONOILREV) (with intercept) | -8.325025 | -3.632900 *** | -2.948404** | -2.612874* | -15.61226 | -3.632900*** | -2.948404** | -2.612874* |
| LNREXDEBT (with intercept) | -1.923912 | -3.632900 | -2.948404 | -2.612874 | -2.452823 | -3.626784 | -2.945842 | -2.611531 |
| D(LNREXDEBT) (with intercept) | -4.416515 | -3.632900 *** | -2.948404** | -2.612874* | -4.436945 | -3.632900*** | -2.948404** | -2.612874* |
| LNRDMDEBT (with intercept) | -1.481053 | -3.626784 | -2.945842 | -2.611531 | -1.542350 | -3.626784 | -2.945842 | -2.611531 |
| D(LNRDMDEBT) (with intercept) | -5.168033 | -3.632900 *** | -2.948404** | -2.612874* | -5.154281 | -3.632900*** | -2.948404** | -2.612874* |

**Notes:** ADF stands for Augmented Dickey-Fuller, PP for Phillip Perron; while ***, **, and* point to stationarity at 1%, 5% and 10% respectively.

### 4.2. Estimated ARDL, 1981-2014

The results of the ARDL model estimated for the 1981-2014 period are presented in Table 3 below. The ARDL model was estimated with Eviews. Based on the Akaike Information Criterion (AIC), the optimal model was selected as ARDL (2, 0, 4, 1, 4) among 2,500 ARDL competing models, according to the output of the estimation. Figure 1 below presents the graph of the best 20 ARDL models selected by the AIC.

**Table-3: ARDL Model, 1981-2014**

| Dependent Variable: D(LNRGOVEXP) | | | |
|---|---|---|---|
| | | **Coefficient** | **P-Value** |
| **Regressors** | | | |
| D(LNRGOVEXP) | L1 | -0.375125 | 0.2023 |
| | L2 | 0.812815 | 0.0465 |
| | L3 | | |
| | L4 | | |
| D(LNROILREV) | | 0.169999 | 0.0647 |
| | L1 | | |
| | L2 | | |
| | L3 | | |
| | L4 | | |
| D(LNRNONOILREV) | | -0.385695 | 0.0157 |
| | L1 | 0.183154 | 0.1546 |
| | L2 | -0.186469 | 0.0993 |
| | L3 | -0.006464 | 0.9584 |
| | L4 | 0.160146 | 0.1319 |
| D(LNREXDEBT) | | 0.301112 | 0.0003 |
| | L1 | -0.229621 | 0.0464 |
| | L2 | | |
| | L3 | | |
| | L4 | | |
| D(LNRDMDEBT) | | 0.339709 | 0.1370 |
| | L1 | -0.910811 | 0.0074 |
| | L2 | -0.236371 | 0.2212 |
| | L3 | 0.358560 | 0.1258 |
| | L4 | -0.339667 | 0.0451 |
| Constant | | 0.057120 | 0.3221 |
| F-Statistic | | 5.359019 | |
| Prob (F-Statistic) | | 0.002107 | |
| R-squared | | 0.860792 | |

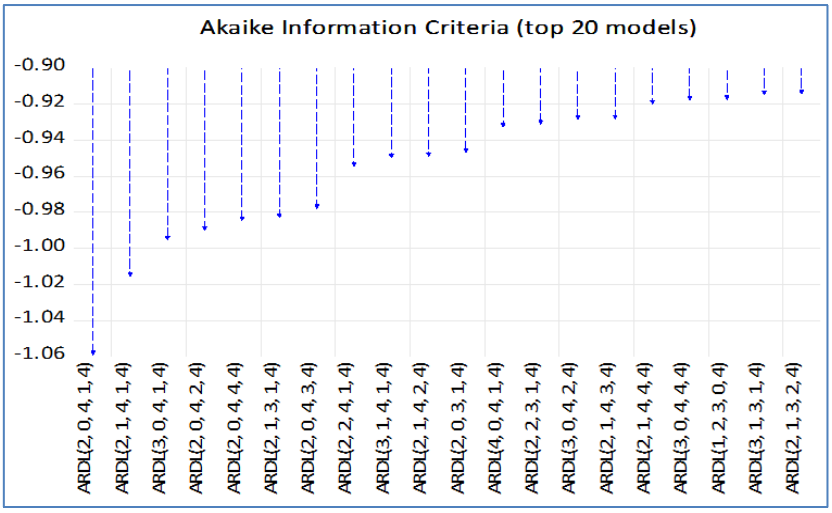


**Fig-1: Best 20 ARDL Models**

There are important findings in the ARDL results of Table 3. First, the second lag of government expenditure has a statistically significant positive impact of about 81% on it, implying that the "history" of government size is an important determinant of its current value. That is, the current level of government size has a strong link with the previous level of government size in a typical African oil-producing country, in that current government expenditure tends to increase due to the fiscal "remnants" of previous years, such as uncompleted projects and salary arrears, which are due to bad management of resources which usually increase during oil booms. Second, the current value of oil revenue has a statistically significant impact on government size, with no lag terms of oil revenue selected by the information criterion in the optimal model. Oil revenue is the only regressor without any lag term selected with its current term by the information criterion, implying that the current value of the variable plays a unique role in the optimal model. The current value of oil revenue is therefore a sensitive economic factor in a typical African oil-producing country, in contrast to the past values of the variable.

Third, the current term and second lag of non-oil revenue have negative statistically significant impacts on government expenditure. The plausible reason for this is that the current value of oil revenue leads to low non-oil revenue in current and even in subsequent periods, since revenues come only from the oil and non-oil sectors. That is, focus on current oil revenue makes non-oil revenue to reduce and have an inverse relationship with government expenditure when oil revenue is pushing the expenditure up.

Fourth, the current value of external debt has a statistically significant impact on government expenditure. The current values of external debt and oil revenue are the only exogenous variables with statistically significant positive impacts on government expenditure in the ARDL model. Thus, the current values of the two variables are key factors that push government size up in Africa's oil producing countries. The effects of the current values of oil revenue and external debt are the plausible reason for the negative correlation between the first lag of external debt and government expenditure shown in the ARDL results. That is, when oil revenue and external debt are pushing government expenditure up, authorities will reduce financing public spending with external debt in subsequent periods.

The last key finding of the ARDL results is that the first and fourth lags of domestic debt have statistically significant negative impacts on government expenditure. The impact of the first lag is particularly high. The plausible reason for these impacts is that when government expenditure is financed with oil revenue and external debt, government tends to reduce financing the expenditure with domestic debt and also uses domestic debt largely as a stabilization instrument. Such stabilization involves using domestic debt to reduce and increase money in circulation, based on prevailing economic conditions. Basically, the values of domestic debts tend to be low in developing countries when government expenditures are financed with external debts, because the governments of these countries prefer external debts to domestic debts for the following reasons (Panizza, 2008): (i) external debts are usually issued at concessionary rates while domestic debts are issued at market rates; (ii) external debts tend to have longer maturity rates; (iii) external debts are easier to restructure than domestic debts; and (iv) defaults by governments to repay domestic debts may have undesirable political consequences that defaults on external debt do not have.

### 4.3. Serial Correlation, Heteroskedasticity and Normality Tests

The results of the serial correlation, heteroskedasticity and normality tests are presented below in Tables 4 and 5 and Figure 2 respectively. The serial correlation test result shows that the errors of the estimated ARDL model are not correlated across time; the heteroskedasticity test result shows that the error term of the ARDL model is constant over time; while the normality test result shows that the error term of the ARDL model is normally distributed. These results, together with the $R^2$ and F statistic of the ARDL model, show a good level of fitness of the model, making forecasting with it plausible.

**Table-4: Breusch-Godfrey Lagrange Multiplier Serial Correlation Test**

| Breusch-Godfrey Serial Correlation LM Test: | | | |
|---|---|---|---|
| Null hypothesis: No serial correlation at up to 1 lag | | | |
| F-statistic | 0.357426 | Prob. F(1,12) | 0.5611 |
| Obs*R-squared | 0.838795 | Prob. Chi-Square(1) | 0.3597 |

**Table-5: Breusch-Pagan-Godfrey Heteroskedasticity Test**

| Heteroskedasticity Test: Breusch-Pagan-Godfrey | | | |
|---|---|---|---|
| Null hypothesis: Homoskedasticity | | | |
| F-statistic | 0.997813 | Prob. F(15,13) | 0.5067 |
| Obs*R-squared | 15.51992 | Prob. Chi-Square(15) | 0.4147 |
| Scaled explained SS | 2.310284 | Prob. Chi-Square(15) | 0.9999 |

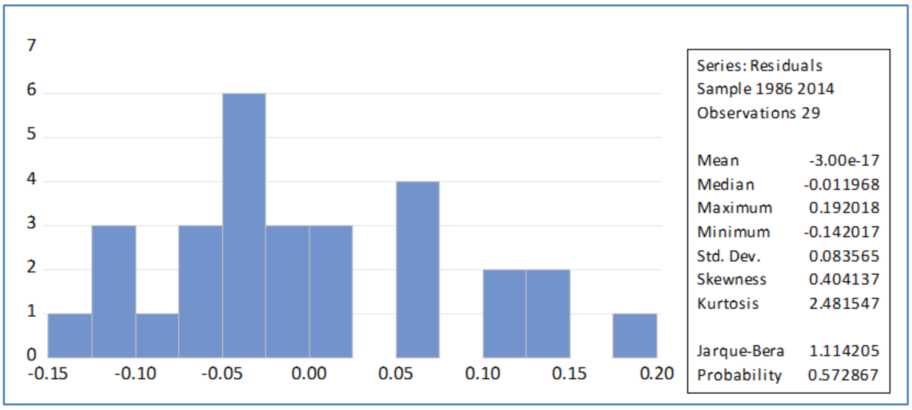


**Fig-2: Normality Test**

### 4.4. The Forecasts

Figure 3 presents the graph of the forecasted dependent variable (real government expenditure) together with the forecast evaluation statistics. The results shown in Figure 3 indicate that the ARDL forecasts perform well, in that the forecast evaluation statistics are low. The low values point to low forecast errors. Besides, the forecast evaluation statistics of the ARDL model and those of the univariate autoregressive and random walk models presented in Table 6 show that the forecasts of the ARDL model compete well with those of the latter (benchmark) models, with respect to performance.

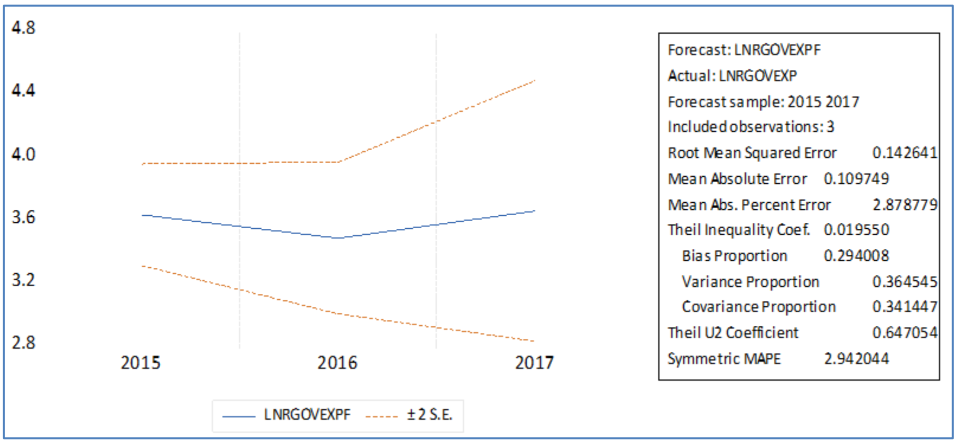


**Fig-3: ARDL Forecasts of Real Government Expenditure, 2015-2017**
**Note:** Real government expenditure is in natural log form.

 

**Table-6: Forecast Evaluation Statistics of ARDL, Univariate Autoregressive and Random Walk Models**

| Model | RMSE | MAE | MAPE | TIC |
|---|---|---|---|---|
| ARDL | 0.142641 | 0.109749 | 2.878779 | 0.019550 |
| AR | 0.140270 | 0.126667 | 3.386421 | 0.019049 |
| RW | 0.249270 | 0.178989 | 4.664943 | 0.034651 |

**Note:** RMSE, MAE, MAPE and TIC stand for Root Mean Squared Error, Mean Absolute Error, Mean Absolute Percentage Error and Theil Inequality Coefficient respectively; while ARDL, AR and RW point to autoregressive distributed lag, univariate autoregressive, and random walk models respectively.

As indicated earlier, the forecasts of Figure 3 are products of the extrapolation of historical data. Hence, inferences about the future course of government size, with respect to government expenditure, can be made from the forecasts. In particular, inferences about the future course of government size can be drawn from the estimated parameters of the ARDL model used for forecasting. This implies that the future behaviour of government size will likely be influenced by the parameters as discussed under section 4.2.

## 5. CONCLUSIONS

We have derived important conclusions from the findings of this paper, which examines the future course of government size in Africa's oil-producing countries, using Nigeria as a case study and an ARDL model in which government expenditure, the proxy for government size, is forecasted. The conclusions are useful guides on how public-sector funds can be mobilized effectively to achieve the optimum level of government size in a typical African oil-producing country in the future.

The first conclusion is that the forecasting ability of the ARDL model is good, hence the forecasts of government size got from the model are reliable. Consequently, the remaining conclusions are inferences drawn from the estimated parameters of the model regarding the future course of government size in a typical African oil-producing country, since forecasting is the extrapolation of historical data. The second conclusion is that it is likely that the main drivers of future increases in government size in a typical African oil-producing country will be the current values of oil revenue and external debt, implying that benchmarks are required on these variables. Benchmarks are particularly required on the current value of oil revenue because its unique role shows in the ARDL model.

The third conclusion is that it is likely that non-oil revenue would not drive up government size in a typical African oil-producing country in the future when oil revenue is driving up government size, which points to the neglect of the non-oil sector due to dependence on current oil revenue and the need to reduce oil dependence. The fourth conclusion is that it is likely that a typical African oil-producing country would not be using domestic debt to finance government expenditure in the future, as long as it has good access to the international capital market to secure external debt. But the economy will likely be using domestic debt as a fiscal stabilization instrument largely.

The fifth and final conclusion is that the "history" of government expenditure (i.e. past levels) will likely be a large driver of its future value in a typical African oil-producing country, hence reaching an optimal value of government size in the future requires dealing with history-related issues. An example of such issues is the difficulty to reduce government expenditures after increasing them during years of oil booms, due to uncompleted projects.

It is worth noting as a final word that although the present paper has done a useful *ex post* forecasting analysis of the future course of government size in Africa's oil-producing countries, using Nigeria as a case study, an *ex-ante* forecast analysis would still be useful. It would be useful that future research work focuses on this. Such an *ex ante* forecast analysis would provide forecasts for years on which there are no actual data. This implies that undertaking an *ex ante* forecasting analysis may require the use of forecasted values of exogenous variables.

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