PUBLIC EXPENDITURE AND ECONOMIC GROWTH IN NIGERIA: A NON-LINEAR ANALYSIS

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ABSTRACT
As an emerging economy, Nigeria needs to have an optimal public expenditure and thus, efficiently allocate its scarce resources to attain a high growth rate. This will only be possible by estimating the optimum size of government expenditure, hence compare it with the actual size and implement some policy measures accordingly.. Explicitly, the paper was conceived to determine the level of government expenditure that can be denoted as being able to promote the growth of Nigerian economy, Smooth Transition Regression (STR) model was employed to help accomplished the objective of the study.The findings from the estimate revealed that the association between public expenditure and economic improvement in Nigeria possesses some element of nonlinearity with a threshold value of ₦1, 212,832,925,742.03 which is the threshold value of public expenditure that can be ruled as capable of improving the Nigerian economy, and that public expenditure is above the optimal level. However, public expenditure was found to exhibit a positive and significant impact on economic growth in both directions. Nigeria needs to have optimal public expenditure and thus, efficiently allocate its scarce resources between the public and private use to attain a high growth rate. This will only be possible by estimating the optimum size of government expenditure, henceforth, compare it to actual size and implement some policy measures accordingly. However, there are few studies, if any; that tries to undertake such analysis using smooth transition regression (STR) model which could best pinpoint the needed information in that relation.
Keywords: Nonlinear Analysis, Government Size, Economic Growth

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1. INTRODUCTION
It is has been confirmed that a government role toward economic growth cannot be over emphasized, this means any society without government may not have all the social and legal framework for the

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economy to operate smoothly and this may also lead to a poor economic growth. This is because state intervention ensures economic stability and promote the rule of law and property rights. Government investment is necessary for the eradication of poverty and other similar social and economic functions performed by the state among which are the production of public goods which is capable of reducing the cost of private production as well as for the improvement in the general welfare of the citizens.

A continues public expenditure may reaches a level where the marginal productivity of government services declines up to a negative point. The aforementioned can be elaborated to as being the reason why government services tend to impact positively more on productivity at a low level of spending than when government spending is high. High spending diminish the profitability of the private sector which might cause mismatched between the spending and the growth of the economy and therefore, over fitting the economy. Thus, the most desirable government level of government expenditure should be found within the interval limit.

However, as an emerging economy, Nigeria needs to have optimal public expenditure and thus, efficiently allocate its scarce resources between the public and private use to attain a high growth rate. This will only be possible by estimating the optimum size of government expenditure, henceforth, compare it to actual size and implement some policy measures accordingly. However, there are few studies, if any; that tries to undertake such analysis by applying smooth transition regression (STR) model which could best pinpoint the needed information in that relation. Specifically the paper stands to achieve the following objectives: to determine the optimal level of government expenditure that can be denoted as being able to promote the improvement of the Nigerian economy, it also seek to assess if government spending in Nigeria dwell on the desirable position, and finally it quest to examine the implication of government spending and its proportion on economic growth in Nigeria in both levels of the regime.

The rest of the paper is organized into four sections. Section two discusses the literature review, section three discusses the methodology for attaining the objectives of the paper, while section four analyses the empirical findings, and finally section five presents the conclusion.

2. LITERATURE REVIEW

Theoretical Review

The BARS curve vividly explains the link between public expenditure and economic growth. Prominent economic scholars who writes on the association between government expenditure and economic growth pinpoint the existence a certain desirable size of government expenditure which was expressed by an inverted U shape (BARS, is named after Barro, Armey, Rahn, and Scully), Barro (1989), (see Armey *et al*. (1995), Rahn *et al*. (1996), and Scully (1998). The BARS curve studied the link between public expenditure (government expenditure) and economic growth. The BARS curve justify the fact that government expenditure affects economic growth positively at the beginning before eventually start to decline its positive contribution up to a point where it start depleting economic growth and that is a point where government expenditure is too much for the growth rate of the economy (Facchini and Melki, 2013). Hence as we keep other variables constant, steady and high increase in government expenditures produce a falling the rate of economic growth. The BARS curve therefore serve as the theoretical framework upon which the research is based.

Empirical Review

Distinct scholars have try to explore the existing links between government expenditure and economic growth by observing diverse methodologies and data sets. Some of the studies are reviewed as follows, Abdulkadir (2019), investigate the relationship between economic growth, government expenditure and financial development focusing on Nigeria in for the period of 1981 and 2016. The study was analyzed using ordinary squares technique. The study finds that specification of the expenditure-growth model with financial development is valid. All the disaggregated financial development and public expenditure indicators have significant effects on economic growth. Anjande et al (2020)

examines the impact of government spending behaviour on growth of national income and unemployment in Africa covering from 1970 to 2017. Dynamic panel models and Hausman test were used. The study found that increasing government spending has strong positive influence on growth of national income and negative influence on unemployment among African countries while reduction in government spending has significant negative influence on growth of national income and significant positive influence on unemployment of the countries. Ahmad and Farzani (2011) estimate the impact of government expenditures on economic growth in 18 developing countries for the duration of 1990-2007 using a panel data regression model. The findings present a negative relationship between government consumption expenditures and economic growth among all the countries. Stylianos and Yiannis (2015) examine the nature of the relationship between government expenditure and economic growth for 129 countries of developed and underdeveloped for the period 1980-2009 using general non-linear panel Generalized Method of Moments (PGMM) proposition. His finding was a statistically significant non-linear relationship. The study also shows that the relationship between the two variables at both the low and high regimes is statistically significant. Sabra (2016) investigates the interrelationship between government expenditure, openness, country size and economic growth among some MENA countries for the period 1977-2013 using a Two-Stage Least Squares (2SLS). The findings revealed that economic growth and government expenditure are related. Oyediran *et al*. (2016) analyze the antecedent effect of government spending on the Nigerian economic growth for the period 1980 – 2013. The study employed multiple regression analysis in estimating for the estimation. The results showed that in Nigeria there exists a significant relationship between government expenditure and economic growth. Edmund *et al*. (2017) explore the impact of government expenditure and efficiency on the economic growth of Sub Saharan African low-income countries for the period 2002-2015 using the Generalized Methods of Moments (GMM). The results showed that government expenditure can guaranteed a speedy and economic growth of low-income Sub Saharan African countries. Pascual *et al*. (2017) study the impact of government spending on economic growth in the European Union countries for the span of 1994–2012. Wanjuu *et al*. (2017) investigate the impact of government expenditure on economic growth of 27 countries of the Organization for Economic Cooperation and Development (OECD), 50 African countries, and 77 OECD and African countries for the period 1970-2014 After applying a panel regression models, the study reveals that there exists inverted u-shape curve in the three estimated models. The optimum government sizes were below the actual government sizes in the three regression models studied. The optimum government size in Africa countries is lower than the optimum government size in the OECD countries. Donald and Martin (2018) analyzed the effect of government investment spending on economic growth in Cameroon for the period 1977 to 2014. Vector Auto-Regressive (VAR) model was used. The findings revealed that the lagged value of GDP and government investments have a positive effect on growth whereas private investment affects it negatively.

Dudzevičiūtė, *et al*. (2018) study government expenditure and economic growth in the European Union countries from 1995-2015. The methodology employed consist of correlation analysis to identify the relationships between government expenditures (GEs) and economic growth and granger causality between GE and economic growth. The findings indicates that eight EU countries have a significant relationship between government spending and economic growth. Muntasir *et al*. (2018) explore the nexus between government size and economic growth in light of the Armey curve for a panel of 9 selected countries from South and Southeast Asia for the period 1980-2016 using the fixed effects panel estimation methodology. The results provide statistical evidence in favor of the validity of the Armey Curve in the context of the full panel and the Southeast Asian subpanel data.

3. METHODOLOGY

This paper employed the STR model to determine the optimum level of public expenditure and its impact on economic growth in Nigeria. The study utilized an annual time series data used is an annual time series data which was sourced from the World Bank Development Indicators (2017) statistical bulletin. The variables consists of 36 observations for the period 1981-2017. The chosen variables include real GDP (*Y*) proxy for economic growth and government consumption expenditure (*GCE*) as a proxy for public expenditure while labour (*L*) and capital (*K*) were presented as control variables

Smooth transition regression (STR) model is an extension of the of the switching regression model introduced by Watts (1971). It is a nonlinear regression model where they considered two regression lines and devised a model in which the transition from one line to the other is smooth (Mohsen *et al*., 2011). In the simplest case of two regimes, the model is given by Teräsvirta (1998). The first attempt to estimate a case where the value of certain variables lies in one region other than the other, such phenomena can be represented by discrete switching models, where a finite number of different regimes is assumed. The central mechanism of this class of models is the switching variable, which can be either apparent or unobservable (Kavkler *et al*., 2008). The mathematical representation of STR model is set down as follows:

$$y_t = x_t\phi + (x_t\theta)\cdot G(\gamma, c; st) + u_t, \qquad t = 1, 2 \ldots, T, \tag{1}$$

where $\phi = (\phi_0\phi_1 \ldots, \phi_p)'$and $\theta = (\theta_0\theta_1 \ldots \theta)'$ are the parameter vectors, x_t is the vector of explanatory variables containing lags of the endogenous variable and the exogenous variables,

′whereas u_t denotes a sequence of independent identically distributed errors. *G* stands for a continuous transition function usually bounded between 0 and 1. Because of this property, not only can the two extreme states be explained by the model, but also a continuum of states that lie between those two extremes. The slope parameter $\gamma > 0$ is an indicator of the speed of transition between 0 and 1, whereas the threshold parameter *c* points to where the transition takes place. The transition variable s_t is usually one of the explanatory variables or the time trend (Kavkler *et al*., 2008). However, there are two most popular functional forms of the STR model and these are the logistic smooth transition monotone case (*LSTR1*) and logistic smooth transition nonmonotone case *LSTR2* (Galadima and Aminu, 2018).

LSTR1 Model: $G_1(y, c, s_t) = (1 + \exp\{-\gamma(s_t - c)\})^{-1}$ (2)

G_1 is a monotonously increasing function of the transition variable s_t, bounded between 0 and 1. Also, $G_1(y, c, s_t) = 0.5$; where *c* is the location parameter representing the point of transition between the two extreme regimes with $\lim_{s_t \to -\infty} G_1 = 0$ and $\lim_{s_t \to \infty} G_1 = 1$ while γ is the slope parameter which tells how rapidly the transition of G_1 from 0 to 1 takes place. However, a moderate value of $\gamma = 1$ imposes a slow transition while $\gamma = 10$ changes quite fast. As opine by Mohsen *et al*. (2011) that, the *LSTR* model is capable of characterizing asymmetric behavior and where it describes processes whose dynamic properties are different in expansions from what they are in recessions, and the transition from one extreme regime to the other is smooth.

LSTR2 Model: $G_2(y, c_1, c_2, s_t) = (1 + \exp\{-\gamma(s_t - c)\})^{-2}$ (3)

This is a non-monotonous transition function that is particularly useful in case of reswitching where the dynamic behavior is similar for large as well as small values of the transition variable s_t. Therefore, the LSTR2 model is appropriate in situations in which the local dynamic behavior of the process is similar at both large and small values of standing different in the middle (Mohsen, *et al*. 2011). Moreover, G_2 is symmetric about the point $\frac{c_1 + c_2}{2}$ and $\lim_{s_t \to \pm\infty} G_2 = 1$. G_2 is never equal to 0; its minimal value lies between 0 and 0.5. Nevertheless, where *c* is the location parameter representing the point of transition between the two extreme regimes with $\lim_{s_t \to -\infty} G_1 = 0$ and $\lim_{s_t \to \infty} G_1 = 1$ while γ is

the slope parameter which show how quickly the transition of G1 from 0 to 1 occurs. While a moderate value of $\gamma = 1$ imposes a slow transition, the function with $\gamma = 10$ changes quite fast.

However, the estimation cycle of the model in *JMulTi* involves three steps, namely specification, estimation, and evaluation.

Specification: The foremost part of the specification begins with with setting up a linear model that configure a starting point for the analysis while the second part of specification comprise the testing for the evidence of nonlinearity in the relationship, choosing s_t i.e. the transition variable, and deciding whether to select *LSTR1*or *LSTR2*. Teräsvirta (1998) suggests testing the null hypothesis of linearity for each of the possible transition variables in turn. The transition variable is to be chosen from amongst the explanatory variables and the time trend. If the null hypothesis is rejected for more than one variable, then, the variable with the strongest rejection of linearity is chosen for the transition variable. If the transition variable has already been decided upon, the next step in the modelling process involves the choosing of the transition function. The decision rule is based on a sequence of nested hypotheses that test for the order of the polynomial in auxiliary regression. Terasvirta (2004) present the following tests of null hypotheses:

H_{04}: $b_3 = 0$

H_{03}: $b_2 = 0 \,|b_3 = 0$

H_{02}: $b_1 = 0 \,|b_2 = b_3 = 0$.

The three hypotheses are tested with a sequence of F-tests named F4, F3 and F2, respectively. Teräsvirta (1998) called for choosing the LSTR2 or the ESTR model, if the rejection of the hypothesis H_{03} is the strongest,. In practice, one usually chooses the LSTR2 model and additionally tests the hypothesis $c_1 = c_2$ after estimation. If it cannot be rejected, then is better to select the LSTR2 model; otherwise, ESTR should be selected. Where there is a strongest rejection of the hypotheses H_{04} or H_{02}, LSTR1 is chosen as the best model.

Estimation: This is concerned with finding the appropriate starting values for the nonlinear estimation and estimating the model. This implies that, the parameters of the Smooth Transition Regression model are assessed using the nonlinear optimisation method that are used to maximize the log-likelihood or to minimize the sum of squared residuals

Evaluation: The evaluation of the model is the final step and it usually includes graphical checks as well as various tests for diagnostic and misspecification tests such as error autocorrelation, parameter non-constancy, ARCH, remaining nonlinearity, , and non-normality tests.

4. RESULTS AND DISCUSSION OF FINDINGS

This section starts with presenting the result of the nonlinearity test to determine statistically whether there is a nonlinear relationship between public expenditure and economic growth in Nigeria.

Table 1: Testing Linearity against Smooth Transition Regression

Transition variable	F	F4	F3	F2	suggested model
LOGE(t)	9.5411e-08	1.2371e-01	6.7224e-02	2.9318e-08	LSTR1
LOGL(t)*	3.0724e-11	1.0550e-01	1.1025e-05	2.5114e-08	LSTR1
LOGK(t)	8.4540e-09	2.3600e-02	1.7304e-02	3.2087e-08	LSTR1
TREND	6.0072e-11	1.4493e-01	3.8013e-02	3.5410e-12	LSTR1

Source: Researchers' Computation (*J-Multi*)

Based on the result obtained from the nonlinearity test in Table 1, the variables display for transition variable selection include public expenditure (*Log E*), labour (*Log L*), capital (*Log K*), and trend. However, the variable that indicates the strongest test rejection of linear relationship (i.e. the variable with the smallest *p*-value and hence the highest *F*-test) is *Log E* and as a result of this, it is selected as

the transition variable and therefore, it was selected to serve as the chosen transition variable. Nonetheless, the asterisk"*" symbol is used to indicate the rejection of the null hypothesis of a linear relationship. Hence, LSTR1 (logistic) model is the appropriate model for the estimation of the STR. Here we need to impose restriction on the redundant variables in order to reduce the size of the nonlinear model and to increase the performance of the model.

The LSTR1 model and the estimated coefficients for the two regimes (i.e. the low and high regimes otherwise given as $G = 0$ and $G = 1$ in the model) are reported in Table II. This section also explains how the transition from one regime to another affects the relationship between public expenditure and economic growth in Nigeria. The nonlinear parameters of the estimated LSTR1 model shown in Table 2 revealed that public expenditure is positively and significantly related to economic growth in Nigeria. The speed of transition or the function changes quite fast from one regime to another as shown by the coefficient of the parameter gamma (g) which is 8.1 and this can be considered as a high value. It also shows that public expenditure affects economic growth rapidly. The location parameter (c) which is the threshold value indicates that the transition from one regime to another is 27.82398. Hence, the threshold value is ₦1,212,832,925,742.03trillion ($e^{27.82398}$). This signifies that any level of public expenditure below this threshold value is regarded as a low regime and above it is a high regime. Thus, public expenditure in Nigeria should not be less than or more than ₦1,212,832,925,742.03 trillion.

Table 2: Smooth Transition Regression Estimation

Variable	Start	Coefficients	SE	t-stat	*p*-value
----- *Linear Part* ------					
CONST	19.19135	21.23197	47.9190	0.4431	0.6612
LOGE(t)	-2.04347	-2.27375	3.5567	-0.6393	0.5280
LOGL(t)	3.27262	3.49685	2.7813	1.2573	0.2194
LOGK(t)	0.24574	0.24738	0.1029	2.4043	0.0233*
---- *Nonlinear Part* ----					
CONST	-27.15146	-29.03130	48.1001	-0.6036	0.5512
LOGE(t)	2.11094	2.34162	3.5572	0.6583	0.5159
LOGL(t)	-1.29599	-1.53401	2.7847	-0.5509	0.5863
LOGK(t)	-0.19471	-0.19367	0.1452	-1.3338	0.1934
Gamma	8.13343				
C1	27.82398				
AIC:	-6.2004e+00				
SC:	-5.7650e+00				
HQ:	-6.0469e+00				

R2:	9.9498e-01				
adjusted R2:	0.9951				
variance of transition variable:	0.0814				
SD of transition variable:	0.2853				
variance of residuals:	0.0016				
SD of residuals:	0.0402				
G(transition function) = 1	0.89027	1.26278	0.4018	3.1426	0.0038
G(transition function) = 0	0.08189	0.07814	0.0136	5.7347	0.0000

Source: Researcher's Computation (*J-Multi*)

Furthermore, from the data, the average public expenditure is ₦1, 560,000,000,000 trillion. And since ₦1,212,832,925,742.03 trillion (i.e. the threshold value) is less than ₦1560,000,000,000 trillion, it means that public expenditure in Nigeria is above the optimal level. This implies that Nigerian government is over spending. However, in the high regime which is the regime of high public expenditure denoted as (G = 1), a 1 per cent change in public expenditure will induce 0.89027 per cent change in economic growth and is statistically significant at 1 per cent level. In the low regime, which is the regime of low government expenditure denoted as (G = 0), a 1 per cent change in public expenditure will induce 0.08189per cent change in economic growth and is statistically significant at 1 per cent level. Furthermore, the goodness of fit of the model i.e. the *R*-squared is 94per cent with a low value of standard error of residuals of 0.04.

Lastly, specification and diagnostic tests are carried out to ensure the statistical adequacy of the model. The *p*-value of the Jarque-Bera test and the test of no remaining error autocorrelation revealed that the null hypothesis of no error autocorrelation and that of the normally distributed errors respectively cannot be rejected (Table 2). Table 2 also reveals that there are no ARCH effects present in the model.

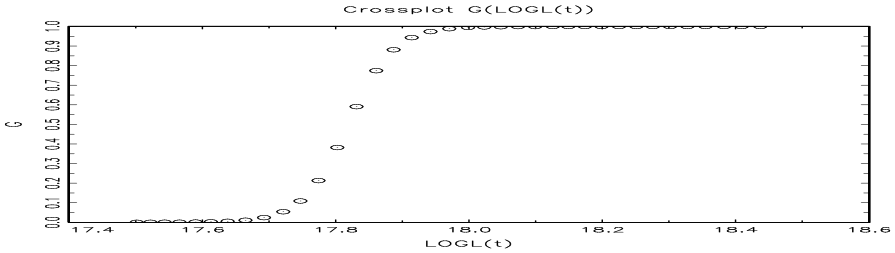

Figure 1: Graphical representation of the transition function

Figure 1 shows that the transition is indeed smooth with quite an *S*-shape which describes the STR model as LSTR1 (logistic rather than exponential). Nevertheless, the observations are expressed by the small circles in the figure and each circle conform with more than one observation.

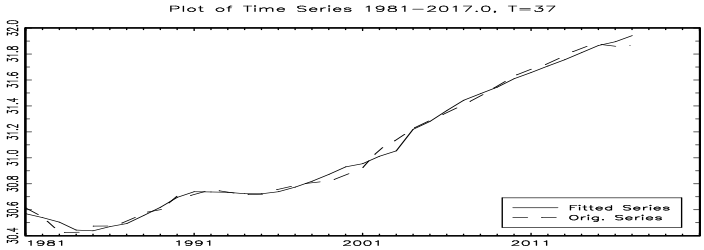

Figure 2: shows the graph of the fitted series versus the original series

Figure 2 depicts the graph of the fitted series versus the original series. The original series and the fitted series reveal that the model captures the dynamics of the time series process.

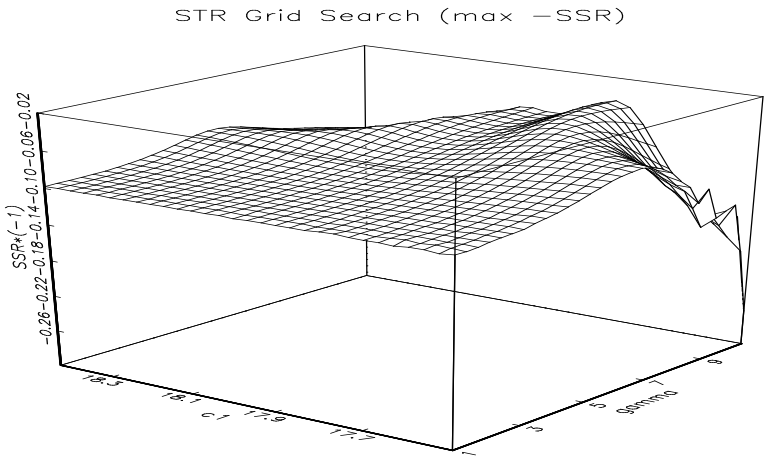

Figure 3: Negative of the sum of squares function

As can be seen from Figure 3, the sum of squares functions is imperatively flat in the direction of gamma for fixed values of the location parameter.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This paper investigates the relationship between public expenditure and economic growth in Nigeria from 1981 to 2017 using a nonlinear approach of Smooth Transition Regression (STR) model. The results revealed that the relationship between public expenditure and economic growth in Nigeria is nonlinear. The public expenditure threshold value in the country is ₦1, 212,832,925,742.03trillion, whereas the average level of public expenditure in the country is ₦1, 560,000,000,000trillion. This means that government spending in Nigeria is above the optimal level, and that, both in the low and high regimes public expenditure has had a significant impact on the growth of the Nigerian economy. The results imply that public expenditure is prompting the growth of Nigerian economy but the size of public expenditure is too much for the growth rate of the economy and this is in line with the BARS curve which delineates that when keeping other variables constant, an enormous increase in government expenditures leads to a decline in the rate of economic growth which implies that government has been spending excessively on the unproductive sectors of the economy. These sectors of the economy should be left in the hands of the private sectors or are not yielding positive impact to economic growth. This findings is in conformity with the findings of Wanjuu (2014) and Stylianos and Yiannis (2015) and Muntasir *et al*. (2018). Therefore, the paper recommends that the government should reduce the size of its expenditure but at least not less than the threshold value, and should reduce its spending in areas of the economy that are less productive or better operates by the private sector, and intensify more effort to in fighting corruption in the country.

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