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Asymmetric impact of oil price shocks on government educational expenditure: Evidence from Nigeria

Ahmed Rufai Mohammad[1], Yahaya Sani[2]

[1]*Department of Economics, Jigawa State College of Education 1002, Gumel, Nigeria*
[2] *Department of Business Education, Jigawa State College of Education 1002, Gumel, Nigeria*

Email: elrufai18@gmail.com

Abstract
This study examines the asymmetric impact of oil prices on government educational expenditure. In the investigation, a Non-linear ARDL approach is put in to use for the period 1990 to 2016. The empirical evidence suggests the presence of asymmetric between oil prices and public educational expenditure. Moreover, a rise in oil prices (positive shock) adds to public educational expenditure in the short run, and the oil prices negative shock retards government educational expenditure significantly in the long run. The rise and drop in oil prices stimulate and decay public educational expenditure. GDP, Net educational tax, Government capital formation, and population total affect public expenditure positively and negatively through the positive and negative shocks. The empirical discovery has brought about a new sight for policymaking in public expenditures and income.

Keywords: Oil prices, asymmetric, educational expenditure, NARDL, Nigeria

1. Introduction

Fluctuations in oil prices in 2014 had drawn the attention of scholars and policymakers to the need to understand the connection between oil prices and economic performance, especially in countries with oil revenue as their dominant source of income. A significant body of literature in existence focuses on how oil price volatility affects different segments of the economy in both the industrialized and in emerging economies. This paper ventured into the lingering issue that says that significant and unexpected changes in the price of hydrocarbon could have a tremendous negative effect on oil-revenue-based economies. However, recent drops in the prices of petroleum resources, which are still struggling to date, have stimulated the appetite of scholars to focus on some new possible equilibria that have resulted from higher and lower oil price shocks.

The most significant route through which the lower level of oil prices can affect vital economic indicators in petroleum resource-dependent countries is that of lower government revenues. Piercing and incessant drops in government revenue would hurt government strategic plans for the economy, especially in a country like Nigeria. In Nigeria, oil revenues have accounted for more than 70% of state revenues (Nigerian National Bureau of Statistics, 2017). So it would not be something amazing to see the 2014/2015 oil price drop, coupled with higher spending from the new government, to meet up in fulfilling election promises. Following this situation, the Nigerian fiscal deficit stood at $18.46 million in 2015 and 2016, almost 45.9% of GDP (Eboh, 2017).

Figure 1 represents the annual and recent decrease in the price of oil, which is very significant in generating revenue for the Nigerian government (OPEC, 2019; Uzonwanne, 2015). The global oil price increased from 1999 to 2007 and witnessed a decrease in the year 2008 due to the global financial crunch. In the year 2009 to 2011, the global oil price got back to an increasing trend. Suddenly, the price witnessed a persistent decrease from 2012 down to 2015.

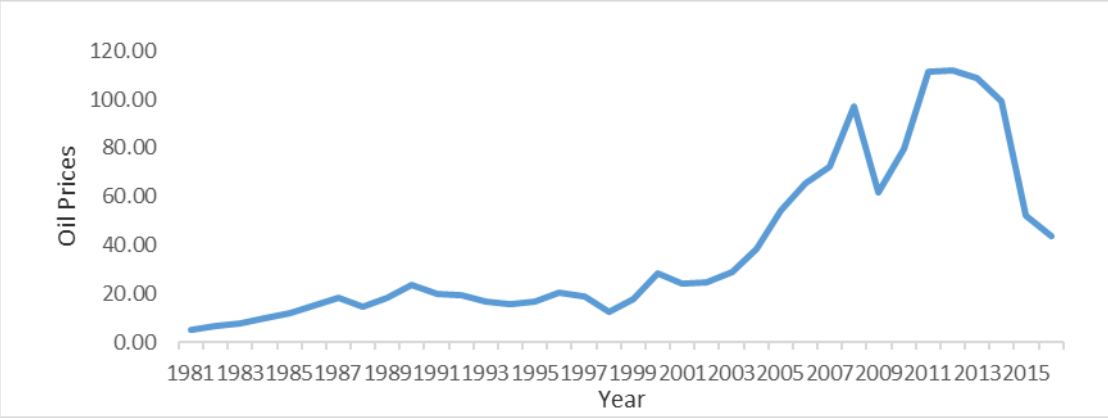

Figure 1 Change in oil price

Meanwhile, Figure 2 presents the trend of educational expenditure in Nigeria. The figures indicate that from 1981-1997 the expenditure on education was stagnant. It started trending upward as from 1978 and reach its peak in 2012. The decreasing trend started in 2013 to 2015 following the same pattern with the decrease in oil price. Could this be the reason why expenditure on Nigeria's education also indicated a decrease?

This research will attempt to shed more light on the negative implications of oil price shock on government expenditures on the educational sector in Nigeria. This issue is of importance to policymakers in Nigeria and other oil-rich countries for many reasons. Nigeria is among the countries that signed the integrated Sustainable Development Goals (iSDGs) transformation plan 2030, with the aim to diversify from an oil-driven economy to an industrial-based economy. This ambitious plan is targeted toward the improvement of three significant areas. The first is to triple non-oil revenues through recouping the loss in revenue from taxes and other levies on the private sector and public services. The second step is to diversify the economy to agriculture, mining, and tourism. The third step is to reduce the cost of governance through subsidy reductions. These policies are expected to inject sufficient amounts into the reserves of the Nigerian treasury.

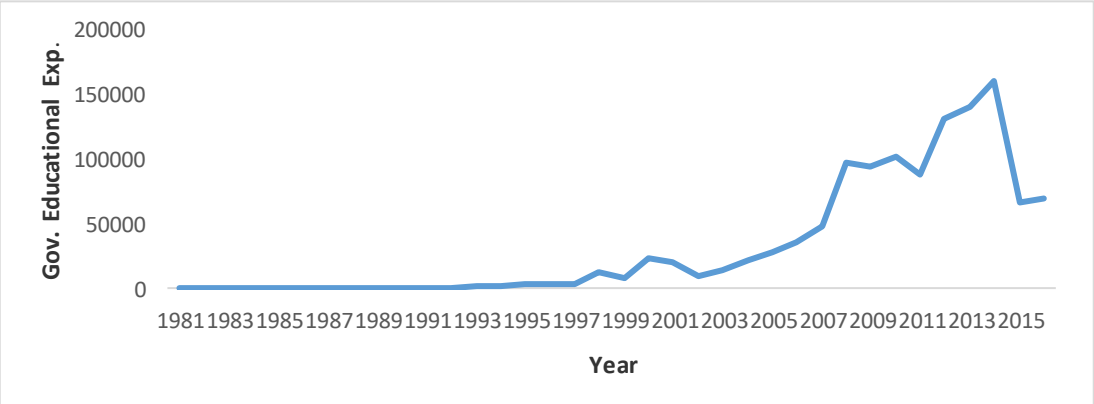

Figure 2 Government educational expenditure

The primary concern of this paper is to show how the low price of oil may necessitate policy strategists to make a difficult adjustment, which could have severe repercussions on the welfare of the Nigerian citizens and other oil-based revenue countries. The paper focuses more on the adverse shocks of oil on education expenditure, given the significance of human capital development to economic progress. This is in line with the efforts to actualize vision 2030 in Nigeria, which is designed to diversify the economy away from heavy reliance on oil to a semi-industrialized nation. To achieve this great objective of economic transformation, quality and qualified human capital are necessary to man the economy through the provision of high-quality education to the people.

The paper empirically assesses the relationship between oil price shocks and government educational finances over a couple of years. Unlike the dominant perspective of literature that views the relationship to be linear, this paper extends the literature by taking the relationship to be non-linear, adopting autoregressive distribution lag (ARDL) to aggregate between the weight of positive and negative shocks of oil prices on educational expenditures in Nigeria

The paper is structured into five parts. Section 2 looks at the review of the related literature. Section 3 discusses the variables used in the study. Section 4 presents the appropriate methodology to answer the research question. Section 5 entails the presentation of results. Finally, section 6 presents the conclusion and policy implications of the study.

2. Previous literature review

There is growing literature that investigates the impact of oil revenue on government expenditure on education at the country level or from a cross-country perspective. Majority of these studies have highlighted the significant roles that oil prices play in policy decisions in oil-revenue-driven economies. The early literature that investigated the asymmetric impact of oil price is dated back to the efforts of Hamilton (1983) who centralised his study on the US economy. The work of Hamilton later received significant support from those of Lee et al. (1995) and Kilian & Vigfussion (2011). In the context of cross country studies, El-Anshasy and Bradley (2012) found an increase in oil prices to induce the public to spend more on education in both the short and long run. The studies used the data set of 16 oil-producing states from 1957 to 2008. They arrived at a conclusion using the Generalized Method of Moment (GMM) condition. The

investigation received significant support from Schneider (2004); Hamdi and Sbia (2013); Nusair (2016); Lardic and Mignon (2006); Farzanegan and Markwardt (2009) Schubert and Turnovsky (2011) have emphasised the direct affiliation in the model between the shocks in oil prices and economic development. The work of Moshiri (2015) has revealed the homogeneous response of oil-exporting countries to oil price shock. These researches have argued that an increase in the international oil price has a significant effect on economic activities, especially in oil-exporting nations. Using data from nine emerging economies, which include Brazil, Chile, China, India, Malaysia, Mexico, Russia, South Africa and Thailand, Raza et al. (2016) have found the negative effects of low oil price on the stock market in these countries, both in the short and long run. In some single country analysis, Adedokun (2018), using the structural VAR model and the Nigerian oil price dataset from 1981-2014 found the oil price shocks in the short run to predict the variation in public expenditure. Shocks in public sector revenue have significant predicting power on public expenditure in both the short and long-run terms. Similarly, Olayungbo (2019), adopting the ARDL approach on the Nigerian data from 1970 to 2017, found the asymmetric effect of oil price on government agricultural expenditure. Fowowe (2011), using the unrestricted VAR model, found the shocks in oil prices have little influence on economic growth.

The study revealed a shred of asymmetrical evidence that oil price shocks affect the GDP and the official exchange rate in Nigeria. On a similar note, Dizaji (2014) has explained the dynamic relationship between shocks in both oil price and oil revenue and the government's public expenditure on education in the oil-based economy like Iran. The study found that oil revenue shocks could explain government expenditure solidly higher than oil price shocks. Exploring the same Iranian economy, Farzanegan (2011) investigates the dynamics of oil price shock and security expenditure of the Iranian military, revealing a significant response of public expenditure on security to the shocks in oil price and oil revenue, respectively.

Given the existing literature, we found no study that used nonlinear relationships to investigate the effects of oil price shocks on public educational expenditure in Nigeria. A vast majority of literature tend to focus on general public expenditures without disaggregating the expenditure to some specific units.

3. Methodology of research

The vast majority of the literature that conducted the field investigation between government expenditure and revenue centred on the linear association between the two components of fiscal nature. Testing the non-linear relationship between government expenditure and revenue nexus remains very new with limited consideration. Moreover, investigating the existence of asymmetries in government expenditure and revenue cannot be left behind because there is every tendency that both positive and negatives shocks of expenditure and revenues might respond inversely. The NARDL is a model that believes in different order integration of the time series. This is contrary to the rigid assumption of the same integration of the series as found in the ECM model. The ARDL model also permits the researcher to precisely distinguish among the components in the absence of cointegration, linear and non-linear association.

In their work, Granger and Yoon (2002) have revealed the existence of hidden cointegration. This has demonstrated the special case of standard linear cointegration. The other round reveals the case of a non-

linear relationship. The non-linear ARDL approach is famous because it can reveal the non-linear connection between government expenditure and government revenues. The new approach was developed by Shin et al. (2011). It is unique as it provides an opener for asymmetric adjustments than the standard linear model (Athanasenas et al., 2013; Pesaran et al., 2001; Raza et al., 2019). Going in line with Shin et al. (2011), we arrived at the non-linear regressions below:

$$GE_e = \partial_o + \partial^+ op_t^+ + \partial^- op_t^- \quad equation\ (1)$$

Where $\partial^+ op_t^+$ and $\partial^- op_t^-$ stand for the partial positive and negative shocks in op_t^Δ.

The data set used in this study is the annual Nigeria data from 1981 to 2016. Government expenditure on education data were sourced from the National Bureau of Statistics. The annual data of oil price fluctuation were sourced from the IMF. Other variables were derived from the World Bank. To practically examine the association between oil price shocks and government educational expenditures, the study employs an asymmetrical form of autoregressive distributed lag (ARDL) model (Pesaran, Shin & Smith, 2001).

The theoretical framework adopted to underpin this study is the Human Resource Management hypothesis and Growth Theory proposed by Samuelson and Nordhaus, which incorporate energy price as another factor of production. The essence of integrating the model is to show the significance of oil price variations on aggregate and sectoral expenditures. A synthesizes of both theories will permit the study to incorporate sectoral specific factors in the model. This is in line with the views of Gounder, Narayan and Prasad (2007) and Narayan (2005). Their model, which shows the correlation between government expenditure and revenues generated by the government, is presented in equation 2 below:

$$GE_e = GR_t$$

Expanding on the equation (1) to highlight our contribution, we add some factors to government expenditure. We will model the government expenditure as the function of various components of government revenues:

$$GE_E = f(K_i L_i OP_t)$$

K stands for the capital formation and level of economic activities, *L* is the collection of levies by government, which include educational tax and *OP* is the oil price revenue.

To explore the empirical connection between the shocks of oil price and government educational expenditures, the study deploys the nonlinear/asymmetrical model of Autoregressive distributed lag ARDL (Pesaran, Shin, & Smith, 2001). The model is an excellent performer, especially if the sampled size is said to be small, flexible and integrated at a different property of the regressors. The non-linearity prosperities of the model were extended to find positive and negative changes through the extensive works of Abdul-Latif, Osman & Ahmed (2018); Shin, Yu, & Greenwood-Nimmo (2014). Consider the equation below:

$$GE_e = \partial^+ op_t^+ + \partial^- op_t^- + GDP_t + NET_t + GFCF_t + PT_t + \varepsilon_i \quad equation\ (4)$$

Where GE_e represents government educational expenditures, ∂^0 represents exogenous variables. op_t^+ is the positive partial shock of oil price, op_t^- stands for the negative shock of oil prices. GDP represents economic progress, NET represents net educational tax, GFCF is the government capital formation, PT stands for population total, subscripts t stands for time and ε_i is the error terms.

4. Results

For the noticeable feature of the ARDL model to be valid, the series must be

integrated at a combined order I (0) and I (1). The order I (2) in the series renders the model inappropriate. In the study, Table 1 indicates the Augmented Dickey-Fuller (ADF) test of unit root carried out to identify the properties of the variables in the model (Dickey & Fuller, 1981). In the series, only OIL and GDP variables are cointegrated at the first difference. The rest of the variables are cointegrated at the same level.

Table 1: Unit Root Test

Test Variables	ADF Level	ADF First Difference
GEE	-0.68***	-4.75
	(0.002)	(0.008)
OILP	-0.09	-0.92***
	(0.166)	(0.000)
GDP	-0.017	-0.91***
	(0.75)	(0.000)
PT	0.009***	0.034
	(0.000)	(0.12)
GFCF	-0.28***	-0.83
	(0.000)	(0.000)
NET	-1.16***	-2.11
	(0.000)	(0.000)

Source: Author's calculation 2019 Note: *, **, *** stance for the level of significance of Augmented Dicky-Fuller test (ADF) all at 1%, 5%, 10% level of probability.

Before the proper estimation of the model, the study conducted a descriptive analysis of the variables to quantitatively provide a summary of the features of the reprinting samples in the study. The descriptive features of the data in this study are presented in table 2.

Table 2: Descriptive Analysis

Details	GEE	GDP	GFCF	NET	OIL	PT
Mean	33005.61	911.0304	12.77	0.175	38.730	64821070
Median	8865.800	412.6313	12.03	0.163	22.200	62852698
Maximum	160078.8	3221.678	35.22	0.428	111.63	98882303
Minimum	139.1000	153.6467	5.459	1.33E	5.3191	39874896
Std. Dev.	46392.42	933.3600	6.331	0.112	33.112	17828454
Skewness	1.364903	1.333268	2.003	0.566	1.1067	0.303728
Kurtosis	3.618395	3.281442	7.538	2.611	2.8527	1.887533
Jarque-Bera	11.75138	10.78443	54.98	2.155	7.3802	2.409879
Probability	0.002807	0.004552	0.000	0.340	0.0249	0.299710
Sum	1188202.	32797.09	459.8	6.307	1394.2	2.33E+09
Sum Sq. Dev.	7.53E+10	30490633	1402.8	0.441	38373.	1.11E+16
Observations	36	36	36	36	36	36

Source: Author's calculation 2019

In table 3, the ARDL general model (1,3,2,3,0,3,0) is presented following the AIC lag section criterion. The estimation is used to guide the researcher on the conduct of short and long-run relationships together with the bound test of cointegration. Similarly, the

table also presents the estimated ARDL with GEE, OIL, GDP, NET, GFCF, and PTOTAL variables at the same level of significance.

Table 3. ARDL (1,3,2,3,0,3,0) Estimation

Variables	Coefficient	Std. Error	t-statistics	Probabilities
LGEE(-1)	0.155*	0.159	0.973	0.349
LOIL-POS	1.750*	0.659	2.657	0.021
LOIL-POS(-1)	-3.027*	1.073	-2.82	0.015
LOIL-POS(-2)	2.450*	1.041	2.354	0.036
LOIL-POS(-3)	-2.169*	0.785	-2.76	0.017
LOIL-NEG	0.817	0.938	0.871	0.401
LOIL-NEG(-1)	4.383*	1.133	4.037	0.001
LOIL-NEG(-2)	-0.991	0.919	-1.079	0.302
LGDP	-1.461*	0.359	-4.067	0.002
LGDP(-1)	-0.110	0.477	-0.231	0.822
LGDP(-2)	-9.938*	0.436	-2.149	0.053
LGDP(-3)	1.438*	0.329	4.347	0.001
LNET	0.061	0.050	1.208	0.250
NET(-1)	-0.078	0.066	-1.179	0.261
NET(-2)	-0.094	0.088	-1.063	0.308
NET(-3)	-0.405**	0.092	-4.391	0.009
LP	75.76	65.02	1.165	0.267
C	-1322.4	1.899	0.719	0.474
TREND	-1.248	1.899	-0.657	0.523
R-square	0.994			
Adjusted R	0.985			

Source: Author's calculation 2019 Note: *, **, *** stance for the level of significance at 1%, 5% and 10%, respectively

Table 4 presents the Bound test for the long-run cointegration. Since the series are integrated at a different order, the study conducts the Bound test offered by Pesaran, Shin & Smith (2001). The result indicates the presence of cointegration with F-statistic greater than the critical bound at the respective percentages.

Table 4 Bound Test

Dependent Variable	F-Statistic	Critical Bound (1)	Decision
GEE	8.287	3.35	Estimate (long-run)
		3.79	
		4.68	

Source: Author's calculation 2019 Note: *, **, *** stance for the level of significance at 1%, 5% and 10%, respectively

In an attempt to assess the existence of short-run asymmetries together with long-run asymmetries relation, the NARDL estimation conducts have revealed that the positive shocks of oil price on government educational expenditures are different in both the short and long run. The estimated short-run coefficient of *OP* (+) is significant at 5%;

that is, a one percent increase in oil price would lead to an increase in government educational expenditure by 1.75%. The coefficients of *OP* (-) is not significant. This means that any drop in oil price would not affect government educational expenditure in the short run. Based on the result got, it means that in the long-run, the estimated coefficients of *OP* (+) is not significant. That the *OP* (-) is significant at 1% indicates that a one percent decrease in oil price would be accompanied by a significant drop in government educational expenditure of 5.2 %. More so, the positive and negative dynamics of shocks in the model are not forthright as short-run and long-run vary. Similarly, it is worth noting the shift of equilibrium to a new position after nearly 12 years. The paper concludes that whenever oil prices increase, government public expenditure on education will react straight away. Similarly, the adverse shocks would manifest a stronger concern on the educational expenditure of the government.

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Table 5. Short and Long Run Estimations

Variables	Coefficient	Std-statistic	t-statistic	Prob.
		Short-Run Est.		
D(LOIL-POS)	1.750*	0.659	2.657	0.021
D(LOIL-PO(-1))	-2.450*	1.041	-2.354	0.036
D(LOIL-PO(-2))	2.169**	0.785	2.763	0.017
D(LOIL-NE)	0.817*	0.938	0.871	0.401
D(OIL-NE(-1))	0.991**	0.919	1.079	0.302
D(LGDP)	-1.461**	0.359	-4.066	0.002
D(LGDP(-1)	0.937*	0.046	2.149	0.053
D(LGDP(-2))	-1.43	0.329	-4.347	0.001
D(LGFCF)	1.339	0.435	3.076	0.009
D(LNET(-1))	0.094	0.088	1.208	0.250
D(LNET(-2))	0.405	0.092	4.391	0.000
D(LPT)	75.76	65.02	1.165	0.266
Coin. (-1)	-0.068*	0.018	-3.825	0.000
		Long-Run Est.		
LOIL-POS	-1.178	1.479	-0.796	0.441

LOIL-NEG	5.205***	1.261	4.127	0.001
LGDP	-1.276	0.465	-2.745	0.017
LGFCF	1.586	0.533	2.974	0.011
LNET	-0.612	0.252	-2.431	0.032
LPT	89.67	82.69	1.084	0.299
C	1565.3	1447.2	-1.082	0.301

Post estimations and diagnostics checks

For the study to check and confirm the reliability and stability of our model, a series of post-diagnostics tests were carried out. These are indicated below:

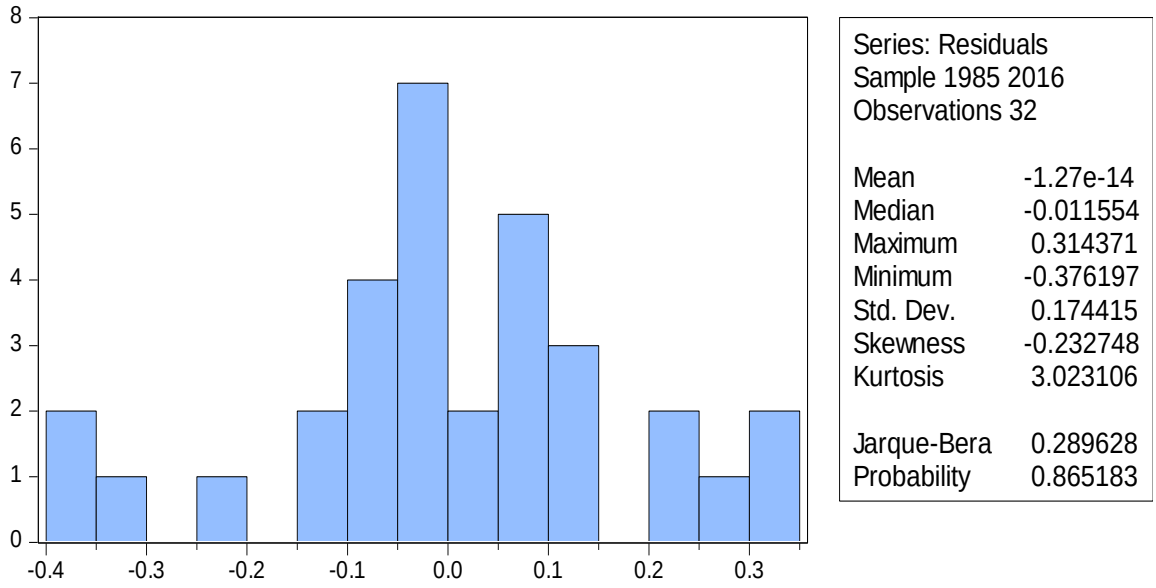


Figure 3. Jarque-Bera test of normality

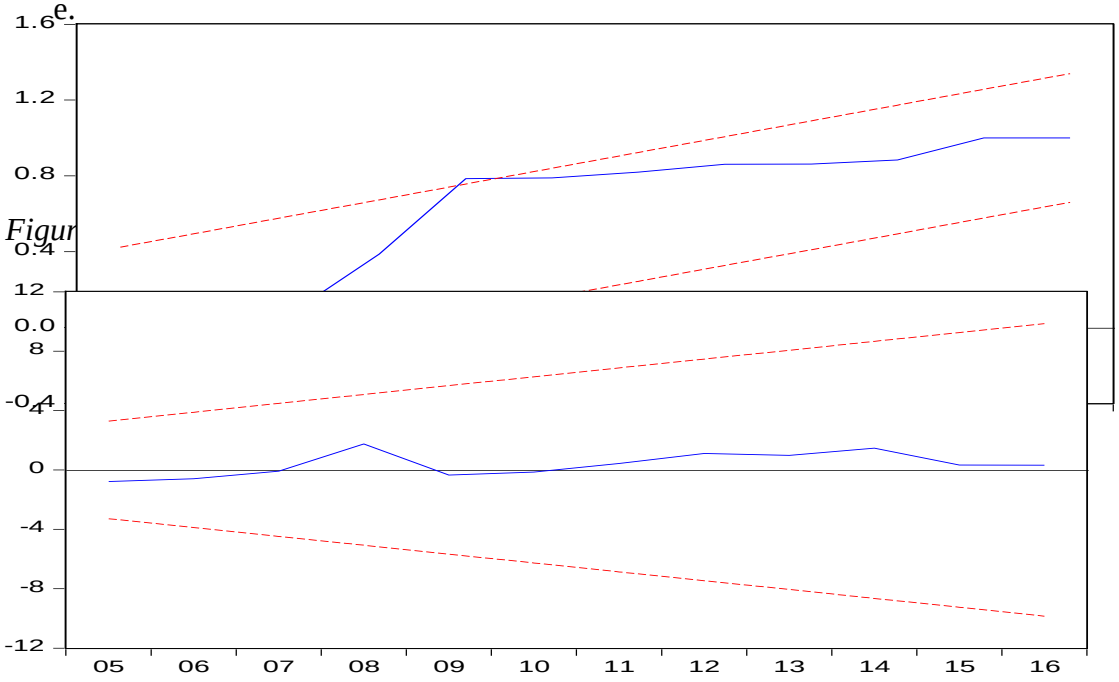
a. Test for serial correlation: the result presented by Breusch-Godfrey Correlation reveals that our study is free from any form of serial correlation with an F-statistic value of 1.99 and a probability of 0.197 this is obtainable in table 5.
b. Test of Heteroscedasticity: the result presented by Breusch Pagan-Godfrey reveals a constant variance of the error term of the model in table 6, following the value of F-statistics of 1.33 with a probability of 0.313.
c. Test of Normality: the result of Jarque-Bera indicated that the model to be generally distributed with value 0.2896 and probability of 0.865; this is shown in figure 3.

Table 6. Post Estimation Analysis Checks

Test	F-statistics	Probabilities	Outcomes
Breusch-Pagan	1.33	0.313	Absent of Heteroscedasticity
Breusch-Godfrey	1.99	0.197	Absent of serial correlation
Ramsey Reset	0.481	0.489	Model Correctly specified

d. Test of stability model: The Cusum and Cusum of square upper and lower ridgelines indicate the dynamic stability of the estimated model in the sketch of Figure 4 and Figure 5

e.



Figur

Figure 5. Cusum square

Figure 6 shows the cumulative dynamic of multiple adjustments. The results indicate the form of adjustment in government educational expenditure and how a new long-run equilibrium is formed due to both positive and negatives shocks in oil prices. The black lines and the black dash lines indicate the dynamic adjustment that captures the fluctuation in government expenditure as a result of positive and negative shocks in the independent variable (oil). The red line represents the asymmetric curve indicating the variance in cumulative dynamics accompanying positive and negative shocks. The dotted spot red lines stand for the lower and upper bands of the significance level of asymmetry at the horizon h in figure 6. We find that oil price contributes to an increase in public expenditure with its positive shocks compared to adverse shocks of oil prices.

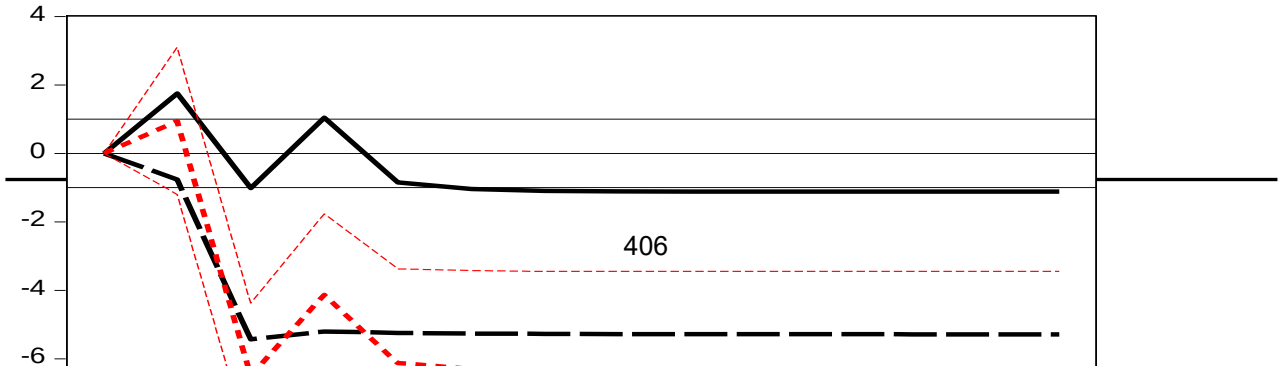


Figure 6. Cumulative Dynamic Multiplier of SR and LR Asymmetries

5. Conclusion and policy implications

This study has looked at the asymmetrical impact of oil price shocks on the government's educational expenditures. We deployed the non-linear Autoregressive Distributed Lag Model in observing the correlation between oil price fluctuations and government educational expenditures of an oil-exporting economy like Nigeria. The empirical evidence indicates asymmetrical impacts of oil price shocks on public expenditure, specifically in the long run. In general, this study backs the non-linearity position of the model where the negative shock in oil prices manifests a different and significant impact on the government's educational expenditure compared to the positive shocks of oil price. Additionally, in the short run, the positive impact of oil price shocks on government expenditure on education is found positive and significant compared to the negative impact of oil price shocks.

The most crucial policy lesson that we can derive from these findings is that the negative shocks in oil price hit the government's educational expenditure more severely in the long run. Therefore, it remains very significant to diversify the sources of funding education system in the country to offset any similar negative oil prices shock that could cause a drop in public educational expenditures. Secondly, curtailing the issue of oil shocks and the uncertainties that it generates are among the crucial challenges affecting Nigeria as an oil-exporting economy. It is significant to build a substantial fiscal reserve that could be used to cushion the severity of shocks when oil prices drop. Increasing the role of the private sector in the funding education can reduce the pressure on government especially when there is a drop in oil prices. Using the educational trust funds and such sundry bodies to fund educational expenditure will help to reduce the effects of the drop in oil prices. Consequently, our findings confirm the results of Abdel-Latif, Osman, and Ahmed (2018); Foudeh (2017); Mohammad, Hidthiir, and Nor (2019) that oil-dependent countries such as Nigeria need to diversify their economies away from oil dominance.

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