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Political Environment and the Use of Energy Resources in Nigeria

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ABSTRACT

This study examines the dynamic relationship between political environment and the use of energy resources in Nigeria covering the period from 1978 to 2017 using the autoregressive distributed lag bounds testing approach. The results reveal that democracy has a significant long run and short run positive influence on energy consumption in Nigeria. However, the positive effect decreases significantly with an increase in the level of oil dependence in the short run. The results of this study in general support the view that high dependence of political democratic structures on oil wealth influences the positive effects of democracy in making public goods available in developing net oil-exporting economies. Economic diversification in Nigeria may therefore require formulating policies that will enhance access to clean energy sources in the economy.

Keywords: ARDL, Civil Liberties, Democracy, Nigeria, Oil Dependence, Political Rights
JEL Classifications: P48, Q3, Q4, Q40

1. INTRODUCTION

A number of studies highlight the importance of political environment in making public goods available and in influencing economic and social actions of various institutions in the economy that offer better quality of life to the people (Brown and Mobarak, 2009; Deacon, 2009; Acemoglu and Robinson, 2006; Lake and Baum, 2001; McGuire and Olson, 1996). These studies argue that, in comparison with autocracies, democratic process enhances fundamental civil liberties, promotes property rights protection and contract enforcement, ensures more constraints on the discretion of political institutions, and fosters more participation of electorates in the political decision-making process. These economic and institutional conditions create enabling environment that supports greater access to public goods and enhance household and private sector activities. However, Bhattacharyya and Hodler (2010), Ross (2001), Sandbakken (2006) and Jensen and Wantchekon (2004) argue that with high rents from natural resource production, democratic political institutions in developing oil-dependent economies become detached and less accountable to the electorates as they do not need to levy taxes. This creates economic conditions in the economy that encourage diversion of scarce financial resources to personal and non-productive uses, discouraging investors from growth generating economic activities.

Therefore, it is expected that, the activities of political democratic institutions would influence significantly energy consumption in the economy. Khennas (2012) explains how political economy drives energy access in the north and sub-Saharan Africa. Baskaran et al. (2015) shows that state governments in India use the provision of energy as an electoral strategy. There are also some empirical studies supporting the argument that democratic political environment indeed matters for energy consumption. Boräng et al. (2016) and Ahlborg et al. (2015) considered the significance of institutional quality and democracy in determining the per capita electricity consumption of household in African countries and Small Island Developing States respectively with the results showing that democracy has a significant positive effect on per capita household electricity consumption. However, Chou and Zhang (2020) in a study of some selected European countries express that democracy has a significant positive influence on energy efficiency.

This study examines how political environment drives energy consumption mix in Nigeria. The inauguration of the nascent democracy on May 29, 1999, gave rise to a number of expectations from the government. One of the major expectations is that the democratic structures and principles will provide the framework that will resolve the various issues related to availability and access to modern energy in the Nigerian economy. Nigeria is blessed with abundant natural energy resources including crude oil, natural gas, hydro, solar, wind, biomass (fuel-wood, animal and plant wastes) among others.

Despite these abundant natural energy resources, it still struggles to meet the energy demands of its growing economy. Energy potential is vital, but availability and access is the driver of social, economic and technological activities that generate growth and development (Oseni, 2012). In the face of the increasing importance of household welfare in poverty reduction and the need to enhance social, economic and technological activities in the economy, a proper understanding of the influence of political environment on energy consumption in the country is needed. This study aims to contribute empirically to achieving this objective. This study would in this aspect help in understanding the influence of political environment on the welfare of households, commercial, industrial and social activities in the Nigerian economy. The rest of the paper is structured as follows: section 2 is materials and methods; section 3 is empirical results and discussion while section 4 concludes the study.

2. MATERIALS AND METHODS

2.1. Data Description and Definition of Variables

In this study, annual time series data spanning the period 1978 to 2017 were used to investigate the dynamic association between the level of political democratic structures and fossil fuel energy consumption in Nigeria. Fossil fuel energy consumption (% of total energy use) which represents the proportion of fossil fuels in the energy utilization mix serves as the explained variable. Explanatory variables are the Freedom House Political Rights and Civil Liberties measures of political democratic environment in Nigeria. The Freedom House (2016) Civil Liberties and Political Rights ratings allocate countries a numerical score ranging from 1 to 7, where 1 indicate the highest level of democratic freedom and 7 the lowest level of democratic freedom. These two indices are inverted such that 7 stand for the highest degree of democratic freedom and 1, the lowest degree of democratic freedom. The level of political democracy is constructed as the average of Political Rights and Civil Liberties scores.

It is essential in comprehending the dynamic association between the level of political democratic structures and the amount of fossil energy utilization in Nigeria, to control for other variables that can affect the amount of fossil fuel energy consumption in Nigeria. Therefore, this study incorporates financial sector development, foreign trade, economic growth and oil resource dependence as additional explanatory variables or control variables. The inclusion of oil resource dependence among the control variables is considered necessary in this study given its dominant economic and political role in influencing economic activities and the distribution of public goods in oil-dependent economies. A huge body of literature hint that oil resource inspires a considerable rent-seeking behaviour amongst rival economic agents which shape economic actions of different institutions by altering the production and allocation of public goods in a country (Dell'Anno and Maddah, 2022; Oduyemi et al., 2021; Fuinhas et al., 2015 and Sala-i-Martin and Subramanian, 2003).

The list of all the variables utilized in this study, data sources, mean, minimum and maximum values, in addition to the standard deviation over the period 1978-2017 are presented in Table 1. Figure 1 exhibits the scatter diagram of the linear association between fossil fuel energy consumption and Freedom House political democracy scores for Nigeria (average of CL and PR). The figure shows that on average, there is a positive correlation between the share of fossil fuel energy consumption in the total energy utilization mix and the level of political democratic structures in Nigeria during the period under study. The correlation result depicted in Figure 1 underscores the linear association between the level of political democratic structures and the amount of fossil fuel energy consumption in Nigeria but does not confirm the size of the causal effects of democracy on the amount of fossil fuel energy consumption in Nigeria.

2.2. Empirical Models and Method of Estimation

This study specified two models in log-linear form, in order to unearth the extent of the causal effect of democracy on the amount of fossil fuel energy consumption in Nigeria spanning 1978-2017. Model 1 stated in Eq. (1) controls for the effect of financial sector development, economic growth, foreign trade and oil dependence (OD) on the amount of fossil fuel energy in Nigeria.

2.2.1. Model 1

$$\begin{aligned} lnFengy &= \psi_0 + \psi_1 lnDem + \psi_2 lnRgdpc \\ &+ \psi_3 ln\mathrm{Trdgdp} + \psi_4 lnDcrdgdp + \psi_5 OD + e_t \end{aligned} \tag{1}$$

Fengy is fossil fuel energy and stands for the amount of fossil fuels in the energy consumption mix, Dem[1] represents indicators of political democratic structures (Dem-AV, Dem-CL and Dem-PR), Rgdpc is real gross domestic product per capita and stands for economic growth, Trdgdp is foreign trade measured as export plus import as a percentage of GDP, Dcrdgdp represents the economy's financial sector development measured as private sector domestic credit by banks as a ratio of GDP (in percentages), OD represents OD measured as oil rent as a percentage of GDP, while e_t is the error term.

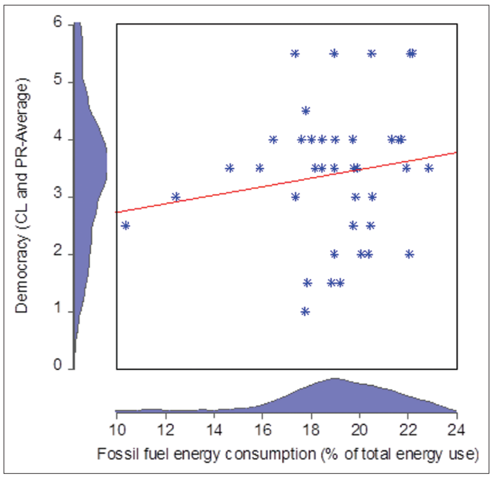
1 Following Narayan et al. (2011) the three indicators of political democratic structures are used in the natural logarithm form in the estimation of Eq.1.

Table 1: Data sources and variable definition

Variable	Definition	Source	Mean	Maximum	Minimum	Std. Dev.
Fengy	Fossil fuel energy consumption (% of total energy use)	WDI	18.94	22.84	10.35	2.57
Dem-CL	Freedom house civil liberties index	Freedom House	3.62	5.00	1.00	0.96
Dem-PR	Freedom house political rights index	Freedom House	3.18	6.00	1.00	1.57
Dem-AV	Democracy index (consists of CL and PR-average)	Freedom House	3.40	5.50	1.00	1.19
Rgdpc	GDP per capita (constant 2005 US$)	WDI	706.07	1060.72	494.24	173.39
Dcrdgdp	Domestic credit to private sector (% of GDP)	GFD	14.26	38.39	6.81	6.22
Trdgdp	Trade (Export+Import % of GDP)	WDI	51.37	81.81	23.61	14.84
OD	Oil Rent (% of GDP)	WDI	32.63	62.21	13.50	10.46

WDI is World Development Indicators, World Bank while GFD is Global Financial Development Indicators, World Bank

Figure 1: Fossil fuel energy consumption (% of total energy use) by (average of CL and PR)



Given some studies (Brooks and Kurtz 2022, 2016; Bhattacharyya and Hodler, 2010; Sandbakken, 2006; Jensen and Wantchekon, 2004; Ross, 2001), which suggest that OD hampers the role of political democratic structures in oil-rich economies, this study also deems it important to examine the role of OD in the relationship between political democratic structures and the amount of fossil fuel in Nigeria's energy consumption mix. This is accomplished in the linear model specified in log form as Eq. (2) by the incorporation of the interaction term of OD and political democratic structures:

2.2.2. Model 2

$$lnFengy = \mho_0 + \mho_1 lnDem + \mho_2 lnRgdpc + \mho_3 ln\text{Trdgdp} + \mho_4 lnDcrdgdp + \mho_5 OD + \mho_6 (lnDem * lnOD) + e_t \quad (2)$$

(*ln*Dem**ln*OD)[2] is the interaction term of political democratic structures and OD. It is used in this study to account for the effect of oil resource dependence on the impact of political democratic structures on Nigeria's fossil fuel energy utilization. The partial derivatives of fossil fuel energy consumption with respect to political democratic structures in Eq. (3) show the extent to which the marginal effects of political democratic structures on the amount of fossil fuel energy consumption vary with the level of OD.

$$\frac{\partial lnFengy}{\partial lnDem} = \mho_1 + \mho_6 lnOD \quad (3)$$

Where $\mho_6$ characterizes the effect of OD in the connection between the level of political democratic structures and the amount of fossil fuel in the energy utilization mix. If $\mho_6 > 0$, OD has a negative influence on the relationship between political democratic structures and the amount of fossil fuel energy consumption. But, if $\mho_6 > 0$, the influence of OD on the association between political democratic structures and the amount of fossil fuel energy consumption is positive.

We employ the autoregressive distributed lag (ARDL) bounds testing approach which was developed by Pesaran et al. (2001) to estimate the log-linear models specified in equation 1 and equation 2. According to Pesaran et al. (2001), the ARDL technique presents a number of enviable statistical improvements over the other co-integration procedures. First, whereas the other procedures oblige all variables in the model to have same order of integration, the ARDL method gives efficient estimates even if the variables are I(0) or I(1) or have mixed order of integration. Second, the ARDL approach permits concurrent investigation of both long-run and short-run associations between the dependent variable and the independent variables in a model. Thirdly, it produces correct and reliable outcomes whether the size of the study sample is small or large. The mixed order of integration of the variables as can be observed from Table 2, qualifies the ARDL technique as the superior analytical technique for this study. To implement the ARDL test for Equations 1 and 2, we estimate the following models:

$$\begin{aligned} \Delta lnFengy_t = {} & \psi_0 + \sum_{i=1}^{n} \psi_{1i} \Delta lnFengy_{t-i} + \sum_{i=0}^{n} \psi_{2i} \Delta lnDem_{1t-i} \\ & + \sum_{i=0}^{n} \psi_{3i} \Delta lnRgdpc_{2t-i} + \sum_{i=0}^{n} \psi_{4i} \Delta lnTrdgdp_{3t-i} \\ & + \sum_{i=0}^{n} \psi_{5i} \Delta lnDcrdgdp_{4t-i} + \sum_{i=0}^{n} \psi_{6i} \Delta lnOD_{5t-i} \\ & + \psi_7 lnFengy_{t-1} + \psi_8 lnDem_{t-1} + \psi_9 lnRgdpc_{t-1} \\ & + \psi_{10} lnTrdgdp_{t-1} + \psi_{11} lnDcrdgdp_{t-1} \\ & + \psi_{12} lnOD_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

2 While Narayan et al. (2011) used political democracy scores in the natural logarithm form; Adams et al. (2016) used democracy variables in the non-logarithm form. To extend the robustness of the results from the interaction variable in Eq. 2 the democracy variable in the natural logarithm form (*ln*Dem-AV) and in the non-log form (Dem-AV) are used.

Table 2: ARDL bounds cointegration test results

Specifications	ARDL	F-statistic	Result
1. F_{Fengy} (*ln*Fengy|*ln*Dem-AV, *ln*Rgdpc, *ln*Trdgdp, *ln*Dcrdgdp, *ln*OD)	(1, 0, 0, 1, 1,0)	6.0961***	Cointegration
2. F_{Fengy} (*ln*Fengy|*ln*Dem-CL, *ln*Rgdpc, *ln*Trdgdp, *ln*Dcrdgdp, *ln*OD)	(1, 0, 0, 0, 1, 0)	5.1249**	Cointegration
3. F_{Fengy} (*ln*Fengy|*ln*Dem-PR, *ln*Rgdpc, *ln*Trdgdp, *ln*Dcrdgdp, *ln*OD)	(1, 1, 0, 1, 0, 0)	5.9789***	Cointegration
Critical Value Bounds (k = 5)	**1%**	**5%**	**10%**
I (0) Bound	3.90	2.804	2.331
I (1) Bound	5.49	4.013	3.417
4. F_{Fengy} (*ln*Fengy|*ln*Dem-AV, *ln*Rgdpc, *ln*Trdgdp, *ln*Dcrdgdp, *ln*OD, *ln*Dem-AV***ln*OD)	(1,0,0,1,0,0,0)	4.6732**	Cointegration
5. F_{Fengy} (*ln*Fengy|*ln*Dem-AV, *ln*Rgdpc, *ln*Trdgdp, *ln*Dcrdgdp, *ln*OD, *ln*Dem-AV***ln*OD)	(1,0,0,1,0,0,0)	4.8988**	Cointegration
Critical Value Bounds (k = 6)	**1%**	**5%**	**10%**
I (0) Bound	3.713	2.685	2.254
I (1) Bound	5.326	3.960	3.388

***Denotes significance at 1% level. **Denotes significance at 5% level. *Denotes significance at 10% level. Source of critical value bounds: Narayan (2005) Appendix: Case II Restricted intercept and no trend

$$\begin{aligned}\Delta lnFengy_t &= \mho_0 + \sum_{i=1}^{n}\mho_{1i}\Delta lnFengy_{t-i} + \sum_{i=0}^{n}\mho_{2i}\Delta lnDem_{1t-i} \\ &+ \sum_{i=0}^{n}\mho_{3i}\Delta lnRgdpc_{2t-i} + \sum_{i=0}^{n}\mho_{4i}\Delta lnTrdgdp_{3t-i} \\ &+ \sum_{i=0}^{n}\mho_{5i}\Delta lnDcrdgdp_{4t-i} + \sum_{i=0}^{n}\mho_{6i}\Delta lnOD_{5t-i} \\ &+ \sum_{i=0}^{n}\mho_{7i}\Delta(lnDem*lnOD)_{6t-i} + \mho_8 lnFengy_{t-1} \\ &+ \mho_9 lnDem_{t-1} + \mho_{10} lnRgdpc_{t-1} + \mho_{11} lnTrdgdp_{t-1} \\ &+ \mho_{12} lnDcrdgdp_{t-1} + \mho_{13} lnOD_{t-1} \\ &+ \mho_{14}(lnDem*lnOD)_{t-1} + \varepsilon_t \end{aligned} \quad (5)$$

In Equations 4 and 5, Δ denotes the first difference operator and ε_t stands for the error term, while the definitions of the dependent and explanatory variables remain as formerly given in Table 1.

In order to test for the existence of co-integration among the variables in Eq. (4), the following hypotheses are tested: H_0: $\psi_7 = \psi_8 = \psi_9 = \psi_{10} = \psi_{11} = \psi_{12} = 0$ the null hypothesis of no cointegration among the variables as against the alternative hypothesis; H_1: $\psi_7 \neq \psi_8 \neq \psi_9 \neq \psi_{10} \neq \psi_{11} \neq \psi_{12} \neq 0$. In Eq. (5), the null of no cointegration is H_0: $\mho_8 = \mho_9 = \mho_{10} = \mho_{11} = \mho_{12} = \mho_{13} = \mho_{14} = 0$ as against the alternative hypothesis; H_1: $\mho_8 \neq \mho_9 \neq \mho_{10} \neq \mho_{11} \neq \mho_{12} \neq \mho_{13} \neq \mho_{14} \neq 0$. We reject H_0: (no co-integration among the variables) if the computed F-statistics is greater than the upper critical bound, thus the variables are co-integrated, while H_0 is accepted, if the calculated F-statistics is lower than the lower critical value, implying that, there is no co-integration among the variables. However, if the computed F-statistics lies in between the upper and lower critical values, then the decision is inconclusive (Pesaran et al., 2001). Following the confirmation that the variables are cointegrated, we estimate the long-run elasticities. Cointegration among the variables entails that causality runs in at least one way. To select the optimal lag length for the analysis, the Akaike Information Criterion (AIC) was used. The AIC is always employed to select the optimal lag order of each variable in first difference and is known to be robust. Equations 6 and 7 denote the error correction model for the evaluation of the short run relationships:

$$\begin{aligned}\mho lnFengy_t &= \psi_0 + \sum_{i=1}^{n}\psi_{1i}\mho lnFengy_{t-i} + \sum_{i=0}^{n}\psi_{2i}\Delta lnDem_{1t-i} \\ &+ \sum_{i=0}^{n}\psi_{3i}\Delta lnRgdpc_{2t-i} + \sum_{i=0}^{n}\psi_{4i}\Delta lnTrdgdp_{3t-i} \\ &+ \sum_{i=0}^{n}\psi_{5i}\Delta lnDcrdgdp_{4t-i} + \sum_{i=0}^{n}\psi_{6i}\Delta lnOD_{5t-i} \\ &+ \lambda_1 ECM_{t-1} + u_{2t}\end{aligned} \quad (6)$$

$$\begin{aligned}\Delta lnFengy_t &= \mho_0 + \sum_{i=1}^{n}\mho_{1i}\Delta lnFengy_{t-i} + \sum_{i=0}^{n}\mho_{2i}\Delta lnDem_{1t-i} \\ &+ \sum_{i=0}^{n}\mho_{3i}\Delta lnRgdpc_{2t-i} + \sum_{i=0}^{n}\mho_{4i}\Delta lnTrdgdp_{3t-i} \\ &+ \sum_{i=0}^{n}\mho_{5i}\Delta lnDcrdgdp_{4t-i} + \sum_{i=0}^{n}\mho_{6i}\Delta lnOD_{5t-i} \\ &+ \sum_{i=0}^{n}\mho_{7i}\Delta(lnDem*lnOD)_{6t-i} + \lambda_2 ECM_{t-1} + u_{2t}\end{aligned} \quad (7)$$

ECM_{t-1} denotes the error correction term while λ_1 and λ_2 are the coefficients of the error correction term and indicate the rate at which the prior period imbalances are corrected by cointegration models or the speed of adjustment to restore the long-run equilibrium position. A significant and negative ECM_{t-1} coefficient means that any movement in the short run between fossil fuel energy consumption and the explanatory variables will converge to the long-run equilibrium.

We control the parameter stability of the ARDL models by employing the cumulative sum of recursive residuals test (CUSUM) and the cumulative sum of square of recursive residuals test (CUSUMQ). In addition, the validity of the ARDL models is controlled by employing: the Breusch-Godfrey serial correlation LM test, the ARCH test for heteroscedasticity, the Jarque-Bera test of normality, and the Ramsey RESET test for functional form.

According to Bekhet and Matar (2013), if the plot of CUSUM and CUSUMSQ statistics lies within the range of the 5% significance level, in that case, all the coefficients in the error correction model are stable, but if the plot of CUSUM and CUSUMSQ statistics crossed the range of the 5% significance level, the coefficients in the error correction model are said to be unstable.

3. EMPIRICAL RESULTS AND DISCUSSION

3.1. Unit Root Tests

According to Pesaran et al. (2001), the ARDL-bounds testing approach permits variables to be integrated of different order (*I*(0) and *I*(1)), however, the approach is not useful for variables which are integrated of order two; *I* (2). Consequently, it is crucial to check the stationarity properties of the series to make certain that no one of them is *I*(2). This was achieved by employing the Ng-Perron (2001) unit root test. The null hypothesis of this test is: H_0 = Ʊ = 0 (i.e. Ʊ has a unit root). The results indicate that the series are *I*(0) and *I*(1) but none is *I*(2). The mixed order of integration of the series (*I*(0) and *I*(1)) with none *I*(2) makes ARDL the ideal technique for this study.

3.2. ARDL Co-integration Test Results

Because of the comparatively small size of the sample of 40 observations (1978-2017) utilized in this study, we obtain the critical values for testing of hypothesis from Narayan (2005). Narayan (2005) calculated two sets of critical values: lower bounds I(0) and upper bounds I(1) for sample sizes from T = 30 to T = 80. The outcome of the co-integration test using the ARDL approach is reported in Table 2. The results show that the F-statistic is larger than the upper critical value at 1% significance level for specifications 1 and 3 and at 5% significance level for specifications 2, 4 and 5. Consequently, we reject the null hypothesis which states that the variables are not cointegrated, implying existence of a long-run causal relationship between the amount of fossil fuel in the energy utilization mix and the level of political democratic structures and the selected control variables in Nigeria.

3.3. Long-run and Short-run Estimates

The estimated long-run multipliers are reported in Table 3. The long-run coefficients of political democratic structures in all the specifications is statistically significant and positive in specifications 1, 2, 3 and 5. Specification 1 indicates that a 1% rise in the level of political democratic attributes would cause the amount of fossil fuel in the energy utilization mix to amplify by about 0.32% in the long run. Dividing political democratic attributes into two components; civil liberties and political rights, the results in specification 2 show that a 1% rise in the level of civil liberties leads to an increase in the amount of fossil fuel in the energy utilization mix by about 0.34% in the long run while specification 3 suggests that an improvement in the level of political rights generates about 0.22% increase in the amount of fossil fuel in the energy utilization mix in Nigeria. Specifications 4 and 5 examine the impact of the interaction between political democratic structures and OD on the amount of fossil fuel in the energy utilization mix in Nigeria. While specification 4 uses democracy variable in the natural logarithm form (***ln***Dem-AV), the variable is used in the non-logarithm form (Dem-AV) in specification 5 to extend the robustness of this empirical analysis. The results of these two specifications (4 and 5) show that the long run influence of political democratic attributes on the amount of fossil fuel in the energy utilization mix remains statistically significant and positive in specification 5, while the coefficient of the interaction variable is found negative, but however insignificant in the long run.

Table 4 presents the estimated short-run coefficients. The coefficients of ECM (−1) are negative and significant at 1% level. The coefficients suggest that about 30% of the short-run

Table 3: Long-run estimates

	1	2	3	4	5
C	4.5798***	3.8999**	5.4664***	3.2147	2.8879
	[3.3037]	[2.6800]	[4.3476]	[1.6493]	[1.5819]
*ln*Dem-AV	0.3184***			0.1631	
	[2.7882]			[1.4311]	
Dem-AV					0.7213*
					[1.8262]
*ln*Dem-CL		0.3426**			
		[2.2807]			
*ln*Dem-PR			0.2191***		
			[3.2909]		
*ln*Rgdpc	−0.2180	−0.1658	0.2850*	−0.2423	−0.2198
	[−1.3237]	[−0.9335]	[−1.9120]	[−1.4654]	[−1.3725]
*ln*Trdgdp	−0.0326	0.0732	−0.0761	−0.0676	−0.0528
	[−0.3129]	[0.6769	[−0.8078]	[−0.6485]	[−0.5274]
*ln*Dcrdgdp	−0.1863	−0.2227	−0.1836	−0.2337*	−0.2332*
	[−1.3860]	[−1.4414]	[−1.6556]	[−1.7238]	[−1.7747]
*ln*OD	0.0212	0.0109	−0.0217	0.5092	0.5460
	[0.1838]	[0.0886]	[−0.2083]	[1.1590]	[1.4510]
*ln*Dem-AV**ln*OD				−0.4429	
				[−1.2155]	
Dem-AV**ln*OD					−0.1713
					[−1.5949]

***Denotes significance at 1% level. **Denotes significance at 5% level. *Denotes significance at 10% level; t-statistics in [ ]

Table 4: Short-run estimates

	1	2	3	4	5
ECM(-1)	−0.3197***	−0.2914***	−0.3411***	−0.3030***	−0.3014***
	[−6.7497]	[−6.2017]	[−7.2544]	[−6.2906]	[−6.2742]
Δ*ln*Dem-AV	0.0767**			0.6604**	
	[2.4153]			[2.3468]	
ΔDem-AV					0.2639***
					[3.0392]
Δ*ln*Dem-CL		0.0896**			
		[2.5241]			
Δ*ln*Dem-PR			0.0355*		
			[1.7888]		
Δ*ln*Rgdpc	−0.0807	−0.1090	−0.0976	−0.0429	0.0062
	[−0.6339]	[−0.4251]	[−0.7739]	[−0.3342]	[0.0493]
Δ*ln*Trdgdp	0.0476	0.0525	0.0345	0.0651	0.0707*
	[1.2315]	[1.2845]	[0.8971]	[1.6708]	[1.8649]
Δ*ln*Dcrdgdp	−0.1117***	−0.1285***	−0.0948***	−0.1062***	−0.0994***
	[−3.2476]	[−3.4618]	[2.8089]	[−3.0704]	[−2.9500]
Δ*ln*OD	−0.0007	0.0021	−0.0063	0.1786*	0.2148**
	[−0.0206]	[0.0596]	[−0.1843]	[1.7983]	[2.3369]
Δ(*ln*Dem-AV**ln*OD)				−0.1587**	
				[−2.0487]	
Δ(Dem-AV**ln*OD)					−0.3014***
					[−2.7641]
Adj R^2	0.7954	0.7737	0.7960	0.7928	0.8010
D-W stat	2.2028	2.1579	2.2807	2.2030	2.1464
SC x^2 (1)	0.5055 (0.4771)	0.3506 (0.5538)	1.1518 (0.2832)	0.5394 (0.4627)	0.2749 (0.6000)
Het x^2 (1)	0.0241 (0.8767)	0.0347 (0.8522)	0.8355 (0.3607)	0.5383 (0.4631)	0.3493 (0.5545)
RESET	0.0024 (0.9981)	0.2300 (0.6351)	0.1213 (0.7302)	0.0587 (0.8103)	0.0171 (0.8968)
JB	1.2584 (0.5330)	2.2547 (0.3239)	1.0296 (0.5976)	0.9379 (0.6257)	0.7265 (0.6954)

***Denotes significance at 1% level. **Denotes significance at 5% level. *Denotes significance at 10% level. t-statistics in [ ] and p-values in ( ); SC: Breusch-Godfrey serial correlation LM test, Het: ARCH test for heteroscedasticity; RESET: Ramsey RESET test, JB: Jarque-Bera Normality test.

disequilibrium is corrected in the long run. Specifications 1-3 show that in the short run, political democratic attributes also exert significant positive influence on the amount of fossil fuel in the energy utilization mix. The results reveal that civil liberties exert more influence in the short run with a 1% increase in the attribute causing about 0.09% increase in the amount of fossil fuel in the energy utilization mix. Among the control variables, only domestic credit from financial intermediaries show significant influence in specifications 1-3, but its influence on the amount of fossil fuel in the energy utilization mix is found to be negative. Specifications 4 and 5 yield interesting results in the short run. With the interaction between political democratic structures and OD included in the model, the influence of political democratic attributes on the amount of fossil fuel in the energy utilization mix increased in the short run. While specification 4 suggests the magnitude of the influence of political democracy to be 0.66%, specification 5 yields 0.26%. The coefficients are all found to be significant and positive at 5% significance level. However, this positive impact decreases by increasing the degree of OD in the economy. This is indicated by the significant negative coefficient of the interaction term between political democratic structures and OD in both specifications (see the coefficient of ***ln***Dem-AV***ln***OD and Dem-AV***ln***OD in specifications 4 and 5 respectively). Specifically, an increase in the level of OD decreases significantly at 5% level the positive effect of political democratic structures on the amount of fossil fuel in the energy utilization mix in the short run by at least 0.15%.

Figure 2: CUSUM plot for specification 1

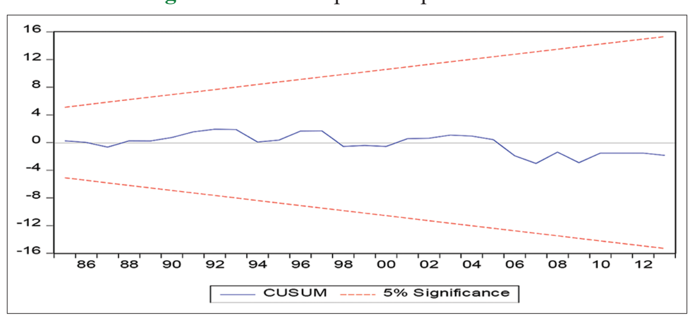
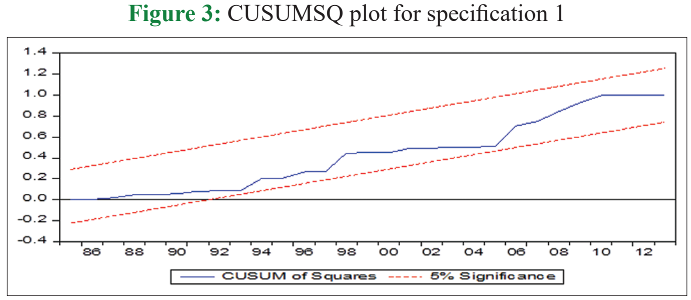


Figure 3: CUSUMSQ plot for specification 1



3.4. Diagnostic and Stability Tests

The results of the diagnostic tests are reported in Table 4 and reveal no indication of heteroscedasticity, serial correlation or misspecification of functional form in the specified ARDL models. In addition, the CUSUM and CUSUMSQ tests of parameter

Figure 4: CUSUM plot for specification 2

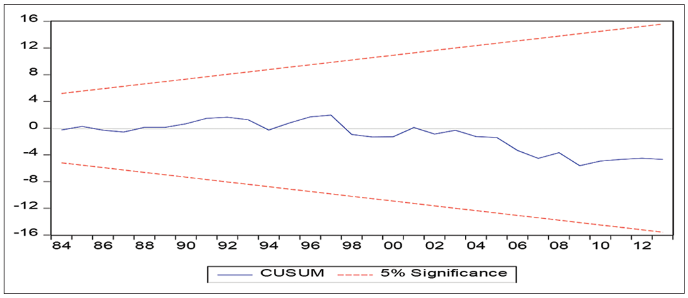


Figure 5: CUSUMSQ plot for specification 2

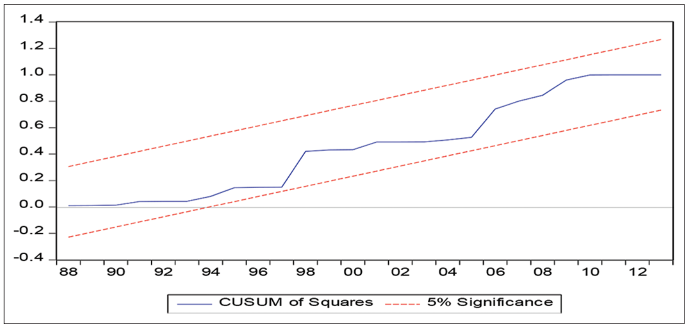


Figure 6: CUSUM plot for specification 3

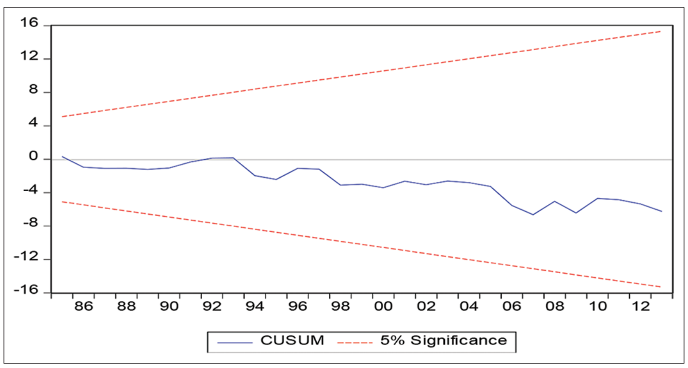
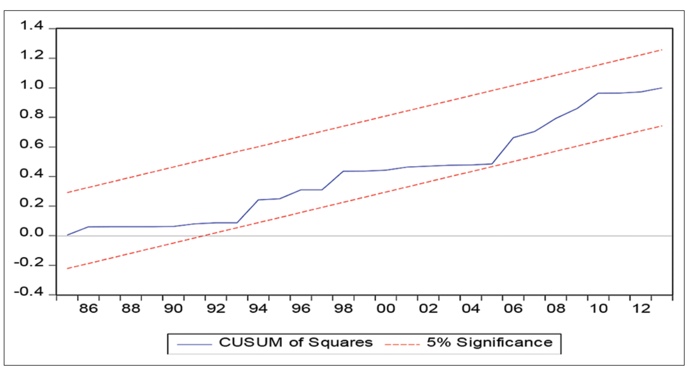


Figure 7: CUSUMSQ plot for specification 3



stability results are shown in Figures 2-11. The line graphs are inside the critical boundaries for the 5% level of significance implying that the parameters of the ARDL model in each of the specifications are stable thus confirming the stability of the ARDL models.

Figure 8: CUSUM plot for specification 4

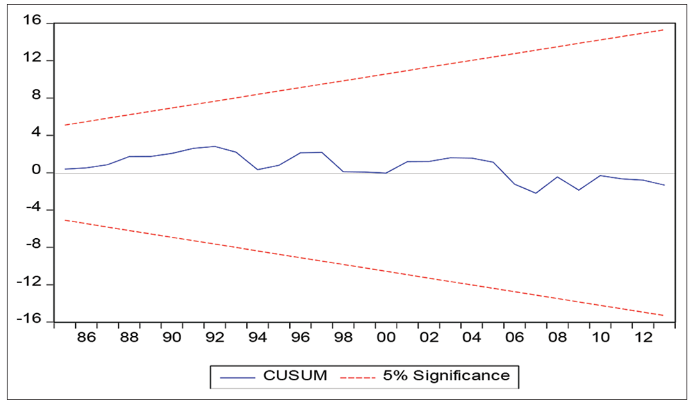


Figure 9: CUSUMSQ plot for specification 4

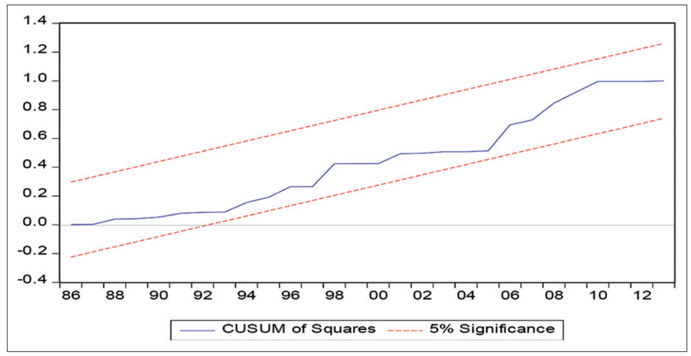


Figure 10: CUSUM plot for specification 5

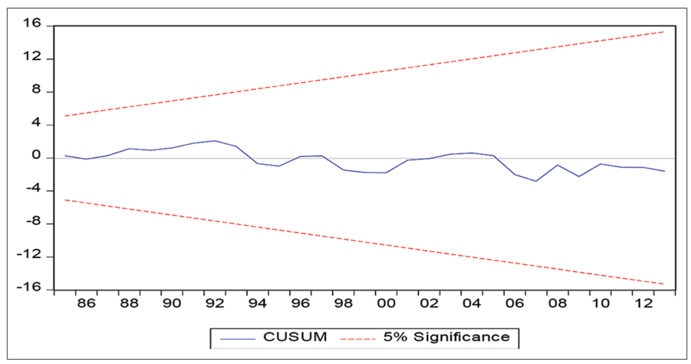
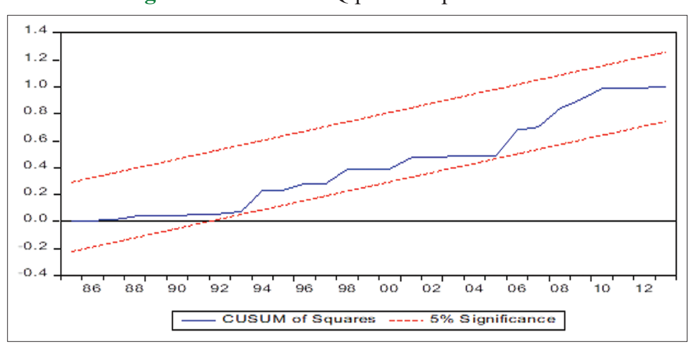


Figure 11: CUSUMSQ plot for specification 5



4. CONCLUSION

This study examines the causal relationship between the level of political democracy and the amount of fossil fuel in the energy consumption mix in Nigeria over the period 1978 to 2017 using the ARDL approach to cointegration analysis. Freedom House civil liberties and political rights scores are used to measure political democratic attributes in Nigeria over the period of the study. The results reveal that the long-run and short-run effect of political democratic attributes on the amount of fossil fuel in the energy consumption mix in Nigeria is statistically significant and positive. This finding supports Boräng et al. (2016) and Ahlborg et al. (2015) which highlight the significant influence of democratic political environment on energy consumption in some selected African countries and the small island developing states respectively. This study also considers the role of OD in the relationship between political democratic structures and the amount of fossil fuel in the energy consumption mix in Nigeria, giving the high dependence of the economy on oil. While the effect of the interaction is found negative but insignificant in the long run, the short run results show that the positive effect of political democratic structures on the amount of fossil fuel in the energy utilization mix decreases significantly with an increase the degree of OD.

In general, the results of this study indicate that the high dependence of the Nigerian political democratic structures on oil rent influences the positive effects of political democratic structures in making fossil fuel energy sources available for economic and social activities in Nigeria. This supports the view that high dependence of political democratic structures on oil wealth influences the positive effects of democracy in making public goods available in developing oil-exporting economies (Bhattacharyya and Hodler, 2010; Sandbakken, 2006; Jensen and Wantchekon, 2004; Ross, 2001).

This empirical evidence could help policy makers in explaining the low level of economic activities in major sectors of the Nigerian economy that depend solely on fossil fuel energy including industrial and commercial activities for instance, manufacturing, banking services, communication services, transportation, education and healthcare delivery and the high dependence of households on combustible non-renewable and waste energy. A well thought-out economic diversification strategy is therefore required to reduce the over reliance of the Nigerian economy on oil. In addition, attention could be directed to formulating policies to enhance access to clean energy sources (such as wind and solar energy) in the economy.

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