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Economic Policy Uncertainty, Institutional Quality, and Renewable Energy Transitioning in Nigeria

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This study examines the influence of economic policy uncertainty as well as the strength of institutions and sustainable policies on renewable energy adoption in Nigeria. Findings reveal heterogeneous effects of short-term economic uncertainty on renewable energy adoption. However, strong institutions and sustainable policies are revealed to consistently promote renewable energy use across the spectrum, same as economic size. Again, multinational corporations exert limited but positive impact on renewable energy transition.

I. Introduction

Globally, there is increasing advocacy for a systemic shift towards green energy due to the adverse externalities associated with fossil fuel production and consumption. Nonetheless, Nigeria's energy sector remains predominantly reliant on fossil fuels, particularly petroleum, which constitutes over 80% of the primary energy consumption. This dependence presents several challenges, including resource depletion, greenhouse gas emissions, environmental impact, and vulnerability to fluctuations in global oil prices (Usman et al., 2020).

The Nigerian Energy Transition Plan (ETP), established in 2021 and launched in 2022 with support from the 26th Conference of Parties (COP26), commits Nigeria to achieving net-zero emissions by 2060. Similarly, the Renewable Energy Master Plan (REMP) aims to increase the renewable electricity supply from 13% to 25% by 2025 and 36% by 2030. Furthermore, the Climate Change Act of 2021 targets the reduction of greenhouse gas emissions and the protection of ecosystems. Despite these policies, the energy sector remains dominated by fossil fuels, as observed by Ohunakin (2010), and the polluting energy sources are inadequate to meet growing demand. This dependence on non-renewable energy undermines sustainability, underscoring the urgent necessity of transitioning to renewable energy.

The energy transition thesis is influenced by factors such as Economic Policy Uncertainty (*EPU*) (Gen-Fu & Mingbo,

2022). *EPU* reflects uncertainty in government policies affecting the economy, including fiscal, monetary, trade, and regulatory changes, which can impede energy diversification. Expert opinions, including Sendstad and Chronopoulos (2020), highlight the negative effect of *EPU* on renewable energy investments. Specifically, Cao et al. (2020) found that oil price uncertainty can negatively influence renewable energy firms. Zhang (2021) suggests that the impact of *EPU* on renewable energy consumption can be moderated by foreign direct investment and financial development. Institutions and policies play a crucial role in facilitating a smooth energy transition by providing an environment conducive to policy formulation, implementation, and enforcement, as supported by SDG-16 (Olaniyi et al., 2023). This is particularly relevant for developing countries. Institutional quality and policy depth contribute to plan stability, regulatory clarity, market competition, investor confidence, capacity building, and stakeholder engagement (Iormom et al., 2024; Musa et al., 2021).

The interplay of policy variables is crucial for renewable energy development in Nigeria but has not been fully examined. With increased efforts to develop renewable energy, it's important to evaluate the relationship between economic policy uncertainty, institutional quality, and the transition to renewable energy, which links to SDG goals 7 and 16.

Emerging research suggests a connection between economic policy uncertainty (*EPU*) and renewable energy adoption. Shafiullah et al. (2021) found a negative link be-

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tween *EPU* and renewable energy consumption. Similarly, Appiah-Otoo (2021) observed a negative but insignificant relationship between *EPU* and renewable energy growth across 20 countries. Studies by Olaniyi et al. (2023) and Gen-Fu and Mingbo (2022) show varying impacts of economic policies on Nigeria's renewable energy development.

Strong institutions and effective policies are essential for adopting renewable energy. Research by Uzar (2020) and Zhou et al. (2022) indicates that improved institutional quality encourages the use of renewable energy. Wu and Broadstock (2015) highlighted the importance of institutional quality and financial development. Olaniyi et al. (2023) showed the threshold effect of institutional quality on the renewable energy transition in Africa. This study utilizes a Quantile ARDL approach to examine how economic policy uncertainty (*EPU*) and institutional quality affect Nigeria's renewable energy transition. Unlike previous research, this framework assesses these influences across the entire adoption spectrum, offering a comprehensive understanding.

The paper is structured as follows: Section II covers the methodology, Section III discusses the main findings, and the final section concludes the paper.

II. Methodology

This study employs a Quantile Autoregressive Distributed Lag (QARDL) model to analyze the impact of Economic Policy Uncertainty (*EPU*), Institutions and Policy Strength for Sustainability (*IPS*), Economic Size (*SIZE*), and Multinational Corporations (*MNCs*) on Renewable Energy Transition (*RET*). Monthly time-series data for Nigeria, covering the period from April 2016 to June 2023, were utilized. Data on Renewable Energy Transition, measured as renewable energy consumption, were obtained from the International Renewable Energy Agency (IRENA). The study used the novel *EPU* index for Nigeria developed by Tumala et al. (2023), following the procedure established by Baker, Bloom, and Davis (2016). This data was sourced from the Economic Policy Uncertainty Index. For institutions and policy strength, measured as institutions and policies for environmental sustainability, data was sourced from the World Development Indicators. The control variables in this study included economic size, measured as gross domestic product (*GDP*), and Multinational Corporations (*MNCs*), measured as foreign direct investment in the renewable energy sector. These variables' data were obtained from the World Bank Development Indicators.

The Quantile ARDL approach in this study surpasses traditional OLS regression by addressing heterogeneity. It captures the impact of regressors across different segments of the outcome variable and handles Conditional Quantile Dependence, allowing for error term dependence on regressors at various quantiles without normality constraints.

The following quantile regression equation will be estimated for the τ th quantile of renewable energy transition:

$$\begin{aligned} \Re T_{\tau}(\tau) = & \beta_0(\tau) + \sum_{i=1}^n \beta_1(\tau) \Delta \ln RET_{t-i} \\ & + \sum_{i=0}^n \beta_2(\tau) \Delta \ln EPU_{t-i} \\ & + \sum_{i=0}^n \beta_3(\tau) \Delta \ln IPS_{t-i} \\ & + \sum_{i=0}^n \beta_4(\tau) \Delta \ln SIZE_{t-i} \\ & + \sum_{i=0}^n \beta_5(\tau) \Delta \ln MNCs_{t-i} \\ & + \eta_1 \ln EPU_t + \eta_2(\tau) \ln IPS_t \\ & + \eta_3(\tau) \ln SIZE_t + \eta_4(\tau) \ln MNCs_t \\ & + \eta_5(\tau) ECT(-1) + \varepsilon_t(\tau) \end{aligned} \quad (1)$$

where τ represents the quantiles, $\beta_0(\tau)$ is the constant term at the τ th quantile, $\beta_0 - \beta_5$ are the short-run regression coefficients, $\eta_1 - \eta_4$ are the long-run regression coefficients, ε_t is the error term at time t , and i denotes the lag order.

III. Results

A. Preliminary analysis

The analysis in this study began with an examination of the statistical properties of the series as shown in [Table 1](#). The results indicate that *RET* and *MNCs* are slightly skewed to the left, while *EPU*, *IPS*, and *SIZE* are also skewed to the left, with *IPS* displaying a heavy tail. The Jarque-Bera test statistic suggests normality for *RET*, *SIZE*, and *MNCs*, but indicates significance for *EPU* and *IPS*.

We further examined the unit root characteristics of the data, finding all series to be integrated of order one, as demonstrated in [Table 2](#). Given this result, we assessed whether cointegration exists among the variables using the symmetric bound test. The findings presented in [Table 3](#) confirm the existence of a long-run equilibrium association, as the F-statistic exceeds the $I(0)$ and $I(1)$ bounds at all levels of significance.

B. Main findings

The study utilizing the QARDL approach indicates that short-run economic policy uncertainty effects vary based on renewable energy consumption levels. The result presented in [Table 4](#) shows that at lower quantiles (10th and 25th), positive coefficients for *EPU* suggest that increased short-run uncertainty may promote renewable energy consumption. This result aligns with Gen-Fu and Mingbo (2022), who also identified a positive impact of *EPU* on renewable energy growth. However, at higher quantiles (50th and 90th), the coefficients become negative, indicating that prolonged uncertainty may discourage renewable energy investments.

The analysis indicates positive coefficients for institutional and policy strength, with significance at the 25th, 50th, and 90th quantiles. This suggests that robust institutions and policies substantially facilitate Nigeria's renewable energy transition in the short term. Findings by Musa

Table 1. Descriptive statistics

	<i>RET</i>	<i>EPU</i>	<i>IPS</i>	<i>SIZE</i>	<i>MNCs</i>
Mean	85.03000	3.150000	1.691167	282367.0	85.03000
Median	85.15000	3.000000	1.565000	274232.8	85.15000
Std. Dev.	2.353889	0.233046	1.210916	68244.33	2.353889
Skewness	-0.298939	0.872872	1.812717	0.198237	-0.298939
Kurtosis	1.996355	1.761905	6.643228	1.398560	1.996355
Jarque-Bera	1.705953	5.725624	33.02110	3.402252	1.705953
Probability	0.426145	0.05010*	0.000***	0.182478	0.426145

Note: The symbols * and *** indicate levels of significance at 5% and 1%, respectively.

Table 2. ADF unit root test

	Level form	First difference form	
	Test-Statistic	Test-Statistic	Order of Integration
<i>LnRET</i>	-1.795920	-5.259774**	I(1)
<i>LnIPS</i>	-0.610257	-5.291503**	I(1)
<i>LnSIZE</i>	-0.830257	-3.685096**	I(1)
<i>LnMNCs</i>	-2.461455	-6.535589**	I(1)
Sig. Level	Critical Values		
1%	-3.670170		
5%	-2.963972		
10%	-2.621007		

Note: ** indicates stationarity at the 5% significance level. *Ln* means natural logarithm form of the included variable.

Table 3. ARDL Bounds test for cointegration

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	11.44951	10%	2.37	3.2
K	3	5%	2.79	3.67
		1%	3.65	4.66

Note: I(0) and I(1) represent lower bound and upper bound critical values. K represents the degree of freedom.

et al. (2021) and Uzar (2020) also demonstrate that institutional quality positively impacts renewable energy consumption in Nigeria. Moreover, Gen-Fu and Mingbo (2022) reported that economic policy uncertainty (*EPU*) enhanced renewable energy development in countries with high institutional quality. The study further identifies consistently positive and significant coefficients for economic size across all quantiles in the short term, highlighting a strong correlation between economic size and renewable energy transition in Nigeria. This outcome aligns with theoretical expectations and is corroborated by Jia et al. (2023) and Umeji et al. (2023), who observed bi-directional causality between renewable energy consumption and economic growth in China and Nigeria, respectively.

The impact of multinational corporations on the transition to renewable energy in Nigeria is consistently positive across all quantiles, although it is only statistically significant at the 10th quantile. This finding suggests that *MNCs*

particularly stimulate renewable energy development at the lower end of the spectrum. These results are consistent with the findings of Dossou et al. (2023), which indicate that foreign direct investment enhances renewable energy consumption in sub-Saharan Africa. The error correction term (*ECT(-1)*) is negative and statistically significant across all quantiles, implying that deviations from the long-run equilibrium are corrected over time. This effectively captures the dynamic interactions between economic factors, institutional quality, and renewable energy adoption in Nigeria.

In the long term, economic policy uncertainty exhibits a negative and insignificant relationship at the 10th quantile, suggesting that it may not have a definitive or consistent impact on Nigeria's adoption of renewable energy. Conversely, the strength of institutions and policies consistently shows negative coefficients. Gen-Fu and Mingbo (2022) also concluded that weak institutions hinder the

Table 4. Quantile ARDL results of the main regression model

(τ)	$\Delta \ln EPU$	$\Delta \ln IPS$	$\Delta \ln SIZE$	$\Delta \ln MNCs$	$\ln EPU$	$\ln IPS$	$\ln SIZE$	$\ln MNCs$	$ECT(-1)$
0.10	0.00261 (0.9029)	0.64841 (0.2839)	0.03998 (0.0068)	0.01594 (0.0000)	-0.00016 (0.5257)	-0.22065 (0.0000)	0.51591 (0.0263)	-0.00059 (0.8875)	-0.10057 (0.0012)
0.25	0.05000 (0.2766)	0.67310 (0.0000)	0.09090 (0.0009)	0.20000 (0.3025)	-0.00009 (0.7570)	-0.22614 (0.0000)	0.188008 (0.6607)	0.005244 (0.6714)	-0.06213 (0.2107)
0.50	-0.0100 (0.9991)	0.67357 (0.0000)	0.00015 (0.0027)	0.02000 (0.7936)	-0.00001 (0.9806)	-0.23399 (0.0000)	-0.03636 (0.7676)	0.01332 (0.0172)	-0.0283 (0.2461)
0.90	0.03001 (0.2766)	0.67310 (0.0000)	0.00009 (0.0006)	0.00001 (0.3632)	0.00002 (0.9197)	-0.25889 (0.0000)	-0.10112 (0.1231)	0.00033 (0.9574)	0.01651 (0.3854)

Note: Here, p-values are reported in parentheses. (τ) means the estimated quantiles.

transition to renewable energy. This finding aligns with previous observations that robust institutions, supportive policies, and efficient regulatory frameworks are crucial for fostering long-term progress (Bature et al., 2022).

In the long-run, the effect of economic size on sustainable energy consumption is heterogeneous; it has a positive influence at lower quantiles but a negative and insignificant impact at the median and 90th quantiles. This indicates that periods of increased economic activity often lead to higher energy demands, which could incentivize a shift towards cleaner and more sustainable energy sources. Similarly, multinational corporations exhibit heterogeneous impacts, with a negative coefficient at the 10th quantile and a positive and significant coefficient at the median percentile. This suggests a potential long-term benefit from the presence and activities of *MNCs* in the renewable energy sector.

IV. Conclusion

This study examines the relationship between economic policy uncertainty, institutional quality, economic size, multinational corporations, and renewable energy transi-

tion in Nigeria. The analysis indicates that short-term uncertainty can enhance renewable energy adoption, while long-term uncertainty reduces investment. Additionally, strong institutions, economic growth, and multinational involvement positively influence renewable energy. The study also shows that renewable energy adoption varies across different levels of economic development. To promote renewable energy adoption, the study suggests implementing stable policies, strengthening institutions, encouraging multinational investment, fostering economic growth, and continuously evaluating policy effectiveness. Strengthening institutions and improving governance are considered important for creating a supportive environment for renewable energy development.

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