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The Effect of Exchange Rate, Oil Price, Economic Policy Uncertainty, and Geographical Risk on Inflation in Nigeria: Evidence from Novel Non-parametric Causality Approach

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ABSTRACT

This study examines the long-run and short-run effects of exchange rates, oil prices, economic policy uncertainty, and geographical risks on inflation in Nigeria from January 2012 to June 2023, utilizing the Dynamic ARDL simulations and Diks-Panchenko causality test. he results reveal significant impacts of the examined factors on inflationary dynamics. Notably, bidirectional causalities are identified between inflation and exchange rates, oil prices, and economic policy uncertainty, along with unidirectional causality from geographical risks to inflation. The findings contribute to a comprehensive understanding of inflation determinants in Nigeria, informing policy formulation and highlighting the importance of accounting for non-linearities in macroeconomic analyses. The study's novel methodological approach and contextualized insights enhance its originality and practical relevance.

Keywords: *Inflationary Dynamics, Dynamic ARDL Simulations, Diks-Panchenko Causality Test, Macroeconomic Analyses, Non-linearities*

3. INTRODUCTION

Inflation has been a persistent challenge for many economies, including Nigeria, with far-reaching implications for economic growth, investment, and overall macroeconomic stability. The fluctuations in exchange rates, oil prices, economic policy uncertainty, and geographical risks have been identified as potential drivers of inflationary pressures, making it imperative to understand their intricate relationships and dynamics. According to the Central Bank of Nigeria's statistical database, the country's inflation rate has remained consistently high, averaging around 16% in 2022 and reaching a staggering 22% in April 2023 [1]. This alarming trend has severe consequences for purchasing power, consumer confidence, and overall economic stability. [2] highlights that high inflation rates can erode real incomes, disproportionately affecting the poorest segments of the population and exacerbating existing income inequalities. Exchange rate volatility has been a significant contributor to inflationary pressures in Nigeria. According to the [3], the depreciation of the Nigerian naira against major currencies, such as the US dollar, has led to increased import costs, fueling inflationary pressures. Furthermore, the IMF estimates that a 10% depreciation of the naira could potentially increase inflation by around 1.5 percentage points. Oil prices have also played a crucial role in shaping Nigeria's inflationary dynamics. As a major oil-exporting country, fluctuations in global oil prices can significantly impact the country's terms of trade and, consequently, its inflation rate. [4] reveals that a $10 increase in oil prices could potentially lead to a 0.5% increase in Nigeria's inflation rate. Economic policy uncertainty has been identified as another factor influencing inflationary pressures. The Economic Policy Uncertainty Index for Nigeria, developed by researchers at the University of Chicago and Stanford University, has shown a significant increase in recent years, reflecting the uncertainties surrounding government policies, regulations, and political instability [5]. High levels of economic policy uncertainty can discourage investment, disrupt supply chains, and ultimately

contribute to rising inflation. Geographical risks, encompassing climate, health, and sociopolitical instability, have also emerged as potential drivers of inflationary pressures in Nigeria. The ND-GAIN Country Index (2022), which measures a country's vulnerability to climate change and its readiness to adapt, ranks Nigeria as one of the most vulnerable countries globally. Environmental challenges, such as droughts, floods, and climate-related disasters, can disrupt agricultural production and food supply chains, leading to food price inflation. Additionally, health crises, like the COVID-19 pandemic, and sociopolitical instability can further exacerbate inflationary pressures by disrupting economic activities and supply chains. The purpose of this study is to provide a comprehensive analysis of the intricate relationships between exchange rates, oil prices, economic policy uncertainty, geographical risks, and inflation in Nigeria. By employing advanced econometric techniques, such as the Dynamic Autoregressive Distributed Lag (ARDL) model and the Diks and Panchenko Causality test, the research aims to unravel the long-term and short-term effects, as well as the nonlinear causal linkages among these variables

4. LITERATURE REVIEW

Numerous empirical studies have explored the determinants of inflation, focusing on various macroeconomic factors and their potential implications. However, there is a lack of consensus regarding the specific roles of exchange rates, oil prices, economic policy uncertainty, and geographical risks in shaping inflationary dynamics, particularly in the context of an oil-exporting economy like Nigeria. Several studies have examined the relationship between exchange rates and inflation, yielding mixed results. Musa, (2021) investigated the impact of exchange rate volatility on inflation in Nigeria using the generalized autoregressive conditional heteroskedasticity (GARCH) and vector error correction model (VECM) found a significant positive relationship between the two variables. Similarly, [7] employed the Auto Regressive Distributed Lag (ARDL) and confirmed the existence of a long-run equilibrium relationship between exchange rate movements and inflation in Nigeria. Conversely, [8] utilized the Generalized Method of Moments (GMM) and reported an insignificant impact of exchange rate fluctuations on inflation, suggesting that other factors may play a more dominant role. The nexus between oil prices and inflation has also been extensively studied, with varying conclusions across different economies. [9] examined the impact of oil price shocks on inflation in Nigeria using the Structural Vector Autoregressive (SVAR) model and found a significant positive relationship, indicating that oil price increases contribute to inflationary pressures. However, [10], employing the ARDL approach, reported a negative association between oil prices and inflation in Nigeria, suggesting that the country's status as an oil exporter might mitigate the inflationary impact of higher oil prices. Economic policy uncertainty has emerged as a potential driver of inflationary pressures, particularly in recent years. [11] investigated the impact of economic policy uncertainty on inflation in Nigeria using the ARDL model and found a significant positive relationship, implying that higher levels of uncertainty contributed to inflationary pressures. Conversely, [12] utilized the Vector Autoregressive (VAR) model and reported an insignificant impact of economic policy uncertainty on inflation in Nigeria, suggesting that other factors may be more influential. The role of geographical risks, encompassing climate, health, and sociopolitical instability, in shaping inflationary dynamics has received relatively less attention in empirical studies, particularly in the context of developing economies like Nigeria. Nonetheless, some researchers have attempted to explore these relationships. [13] examined the impact of climate change on food price inflation in Nigeria using the Panel Corrected Standard Errors (PCSE) estimator and found a significant positive relationship, suggesting that climate-related risks can contribute to inflationary pressures through disruptions in agricultural production and food supply chains. However, the study did not account for other dimensions of geographical risks, such as health and sociopolitical instability. Despite the growing body of literature on the determinants of inflation, several research gaps remain. First, there is a lack of comprehensive studies that simultaneously examine the effects of exchange rates, oil prices, economic policy uncertainty, and geographical risks on inflation, particularly in the context of an oil-exporting economy like Nigeria. Most existing studies have focused on individual or a subset of these factors, overlooking their potential interplay and combined impact. Second, there is a need for more robust methodological approaches that can capture the nonlinear and potentially complex causal relationships among these variables. While traditional linear models have been widely employed, they may fail to adequately capture the intricate dynamics and nonlinearities inherent in macroeconomic and structural phenomena. Third, the existing literature has primarily focused on the short-term or long-term effects of these factors on inflation, with limited attention given to the simultaneous examination of both short-term and long-term dynamics. A comprehensive understanding of both time horizons is crucial for effective policy formulation and decision-making. Finally, there is a dearth of empirical studies that explicitly incorporate geographical risks, such as climate, health, and analysed political instability, as potential determinants of inflation in developing economies like Nigeria. Given the increasing prevalence of these risks and their potential impacts on economic activities and supply chains, it is imperative to investigate their role in shaping inflationary dynamics.

5. RESEARCH METHODOLOGY

3.1 Empirical Model

The first goal of this study focuses on examining the relation of the long-term and short-term effect of the Exchange Rate, Oil Price, Economic Policy Uncertainty, and Geographical Risk on Inflation in Nigeria. Meanwhile, we study the non-linear directional causality of Exchange Rate, Oil Price, Economic Policy Uncertainty, Geographical Risk and Inflation in Nigeria. The study utilized four variables that set Inflation as a function of Exchange Rate, Oil Price, Economic Policy Uncertainty, and Geographical Risk, as shown in the equation below:

$$lnINF_t = f(lnEXR_t, lnOP_t, lnEPU_t, lnGR_t) \quad (1)$$

The model is re-written in eq (2) below:

$$lnINF_t = \alpha_0 + \varphi_1 lnEXR_{t-1} + \varphi_2 lnOP_{t-1} + \varphi_3 lnEPU_{t-1} + \varphi_4 lnGR_{t-1} + \mu_t \quad (2)$$

Where, $lnINF_t$ is the natural logarithms of Inflation, $lnEXR_t$ is the natural logarithms of Exchange Rate, $lnOP_t$ is the natural logarithms of Oil Prices, $lnEPU_t$ is the natural logarithms of Economic Policy Uncertainty, $lnGR_t$ is the natural logarithms of Geographical Risks, t is the time, α_0 is the constant, $\varphi_1 to\ \varphi_4$ are the slopes, and finally, μ_t is the error term.

3.2 Data

This study utilizes monthly data covering key macroeconomic indicators and structural factors spanning January 2012 to June 2023. Endogenous variables comprise the consumer price index measuring inflation, global Brent crude oil prices per barrel in US dollars representing terms of trade shocks, the bilateral USD/Naira exchange rate capturing currency fluctuations, along with exogenous indices of Nigeria-specific economic policy uncertainty and wider geographical risk factors related to climate, health and analysed political instability. Data is obtained from reputable sources including the Central Bank of Nigeria statistical database, the FRED database from the Federal Reserve Bank of St. Louis, and private financial data providers like Bloomberg. Additionally, Whereas the data related to geographical risk and economic policy uncertainty are sourced from www.policyuncertainty.com and https://epuindexng.com/.

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3.3 Methodology

The paper employed the Dynamic ARDL procedure, as well as the Diks and Panchenko Causality test, for the purpose of establishing the long-run effect of the Exchange Rate, Oil Price, Economic Policy Uncertainty, and Geographical Risk on Inflation in Nigeria. To determine the order of integration between the variables, the data set was first examined for stationarity. This study initially applied traditional unit root assessments such as the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Dickey-Fuller Generalized Least Squares (DF-GLS), and Kapetanios and Shin Unit Root (KSUR) tests. While many researchers have unveiled that the unit root testing techniques don't consider possible structural breaks on the data, this results in misapprehension of the conditions of stationarity ([14]; [15]; [16]; [17]; [18]; [19]; [20]; [21]). However, to deal with this problem, this unit root examination was adopted; the Lee-Strazicich (LS) and Clemente-Montanes-Reyes (CMR) that can accommodate even up to two structural breaks.

3.4 Cointegration Approach

The cointegration examination, or F-statistics, was used to analyse the long-term relationship between the research variables. The cointegration of the study variables is ascertained by the F-statistics value ([22]; [23]; [24]; [25]). In cases when the computed F-statistics value is higher than the upper bound critical value, cointegration between the research variables is present. There is no cointegration if the F-statistic is less than the lower bound critical value. When the calculated F-statistics number lies between the higher and lower critical levels, the result is inconclusive ([26]). Based on current methodological techniques, the following two hypotheses were developed to assess the cointegration between the dependent and independent variables in both models:

$$H_0 : \propto_1 = \propto_2 = \propto_3 = \propto_4 = 0 \quad (3)$$

$$H_1 : \propto_1 \neq \propto_2 \neq \propto_3 \neq \propto_4 \neq 0 \quad (4)$$

If the variables in this study were found to be cointegrated based on the two hypotheses stated previously, the following equation was utilized to 35nalyse the short and long-term relationship between them:

$$\Delta lnINF_t = \propto_0 + \propto_1 lnINF_{t-1} + \propto_2 lnEXR_{t-1} + \propto_3 lnOP_{t-1} + \propto_4 lnEPU_{t-1} + \propto_5 lnGR_{t-1} + \sum_{i=1}^{p} \gamma_1 \Delta lnINF_{t-1} + \sum_{i=1}^{p} \gamma_2 \Delta lnEXR_{t-1} + \sum_{i=1}^{p} \gamma_3 \Delta lnOP_{t-1} + \sum_{i=1}^{p} \gamma_4 \Delta lnEPU_{t-1} + \sum_{i=1}^{p} \gamma_5 \Delta lnGR_{t-1} + \varepsilon_t \quad (5)$$

In the preceding equation, the Schwarz Information Criterion (SIC) was utilized for optimal lag selection, with the change operators denoted by t-1. For large sample sizes, SIC has been found to provide more accurate lag order selections ([27]; [28]). The elements explored in the above equations include $\propto_1$ to $\propto_6$ and γ_1 to γ_6. If cointegration exists between the study variables based on the F-statistics, the short and long-run dynamic ARDL simulation models were analysed further ([29]).

3.5 Dynamic ARDL Simulations

Following precedent from previous researchers, this study employed the Dynamic ARDL Simulations model, originally proposed by [30]. The dynamic ARDL simulations model was developed to address a limitation of the conventional ARDL framework regarding the inability to examine short- and long-term relationships between variables. By introducing positive and negative shocks to the independent variables while holding other predictors constant, the dynamic ARDL approach can automatically inspect, simulate, and forecast trajectories over time. If the variables exhibit cointegration, the dynamic ARDL model can assess simulated responses. The criteria were met in this analysis to apply dynamic ARDL simulations. The parameters in the model were simulated 5000 times using multivariate normal distributions, in line with recent applications.

$$\Delta lnINF_t = \omega_0 lnINF_{t-1} + \tau_1 lnEXR_t + \omega_1 \Delta lnEXR_{t-1} + \tau_2 lnOP_t + \omega_2 \Delta lnOP_{t-1} + \tau_3 lnEPU_t + \omega_3 \Delta lnEPU_{t-1} + \tau_4 lnGR_t + \omega_4 \Delta lnGR_{t-1} + \sigma ECT_{t-1} + \varepsilon_t \quad (6)$$

The above equation shows the dynamic ARDL simulations model, where τ represent the long-run coefficients, ω denote the short-run coefficients, and ECT signifies the error correction terms. The ECT examines the adjustment speed from disequilibrium back towards the long-run equilibrium state.

3.6 Granger Non-Causality Test

This analysis utilized the nonparametric Diks and Panchenko (2005; 2006) Granger causality assessment to investigate potential nonlinear causal linkages exchange rate, oil price, economic policy uncertainty, and geographical risk and inflation in Nigeria. Unlike traditional linear Granger methods, this approach based on conditional independence testing can capture more complex dynamic causal relationships between time series. The null hypothesis states that the variables are conditionally independent, implying an absence of predictive causality over time. Recent research applying this technique to examine interconnected economic, financial and environmental factors motivated its selection for this study. Testing for nonlinear lagged dependencies can provide unique causal insights not evident through linear modelling alone. The Diks-Panchenko approach has gained increasing recognition for enabling more flexible and sensitive detection of causal mechanisms tied to sustainability issues.

6. RESULTS AND DISCUSSION

Table 1. Descriptive Statistics

	$lnINF_t$	$lnEXR_t$	$lnOP_t$	$lnEPU_t$	$lnGR_t$
Mean	4.987	4.819	4.179	3.220	2.165
Median	5.179	4.773	4.171	3.703	2.380
Maximum	5.699	6.122	4.668	4.854	3.842
Minimum	4.507	4.612	3.608	1.091	0.437
Std. Dev.	0.337	0.285	0.330	0.941	0.779
Skewness	-0.221	0.998	-0.124	-0.986	-0.658
Kurtosis	1.496	1.375	1.620	2.806	2.414

Table 1 presents the descriptive statistics of the variables used in the study. The mean values indicate the average levels of inflation (4.987), exchange rate (4.819), oil prices (4.179), economic policy uncertainty (3.220), and geographical risk (2.165) over the period under consideration. The standard deviations show the degree of variability in these variables, with economic policy uncertainty (0.941) and geographical risk (0.779) exhibiting higher volatility compared to inflation (0.337), exchange rate (0.285), and oil prices (0.330). The skewness and kurtosis values provide insights into the distribution of the data, which can help in selecting appropriate estimation techniques ([31]; [32]; [33]; [34]).

Table 2. Correlation Matrix

Variables	$lnINF_t$	$lnEXR_t$	$lnEPU_t$	$lnGR_t$
$lnINF_t$	**1.000**			
$lnEXR_t$	0.345* (0.000)	**1.000**		
$lnOP_t$	-0.264** (0.002)	0.203** (0.017)		
$lnEPU_t$	0.732* (0.000)	0.318* (0.000)	**1.000**	
$lnGR_t$	0.639* (0.000)	-0.175** (0.039)	0.795* (0.000)	**1.000**

Table 2 presents the correlation matrix, which shows the strength and direction of the relationships between the variables. Inflation is positively correlated with the exchange rate (0.345), economic policy uncertainty (0.732), and geographical risk (0.639), indicating that an increase in these variables is associated with higher inflation rates. However, inflation exhibits a negative correlation with oil prices (-0.264), suggesting that an increase in oil prices may lead to a decrease in inflation levels in Nigeria.

Table 3. Unit root Without Breaks

Variables	I(0)		I(1)	
	KSUR	DF-GLS	KSUR	DF-GLS
$lnINF_t$	-2.991	-1.799	-6.049*	-7.573*
$lnEXR_t$	-0.111	-0.840	-11.746*	-8.187*
$lnOP_t$	-1.727	-1.060	-5.236*	-4.725*
$lnEPU_t$	-2.418	-1.804	-3.529**	-7.853*
$lnGR_t$	-1.810	-1.277	-3.730**	-8.332

Table 3 presents the results of traditional unit root tests without accounting for structural breaks, such as the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Dickey-Fuller Generalized Least Squares (DF-GLS), and Kapetanios and Shin Unit Root (KSUR) tests. These tests are commonly used to assess the stationarity of time series data, which is a crucial assumption for many econometric models ([14]. However, as noted in the study, these traditional tests may fail to capture potential structural breaks in the data, leading to misleading conclusions about stationarity. This limitation motivated the use of alternative unit root tests that can accommodate structural breaks, such as the Lee-Strazicich (LS) and Clemente-Montanes-Reyes (CMR) tests, which are presented in Table 4.

Table 4. Unit root tests with two structural breaks

Variables	I(0)		I(1)	
	LS	**CMR**	**LS**	**CMR**
$lnINF_t$	-3.874	-0.019	-10.401*	-0.869*
$lnEXR_t$	-1.453	-0.009	-12.362*	-1.029*
$lnOP_t$	-2.417	-0.011	-6.295*	-0.531*
$lnEPU_t$	-5.189	0.046	-10.902*	1.233*
$lnGR_t$	-5.144	-0.022	-11.094*	0.638*

The results from Table 4 present the findings of unit root tests with two structural breaks, using the Lee-Strazicich (LS) and Clemente-Montanes-Reyes (CMR) methods. These tests account for potential structural breaks in the data, which can lead to inaccurate conclusions from traditional unit root tests. The findings indicate that all variables are non-stationary at level I(0) but become stationary after taking the first difference, I(1), at the 1% significance level. This implies that the variables have a unit root and are integrated of order one, justifying the use of cointegration techniques to investigate long-run relationships.

Table 5. Cointegration test result

Cointegration Bounds Testing (*k*=*4*)		
Estimated Models		***F*-statistics**
$lnINF_t = f(lnEXR_t, lnOP_t, lnEPU_t, lnGR_t)$		4.920**
Level of significant	*I*(0)	*I*(1)
1 percent level	3.740	5.060
5 percent level	2.860	4.010
10 percent level	2.450	3.520

Table 5 reports the cointegration test results using the bounds testing approach within the ARDL framework. The F-statistic of 4.920 lies above the upper critical value at the 5% significance level, suggesting the presence of a long-run cointegrating relationship among the variables: inflation, exchange rate, oil prices, economic policy uncertainty, and geographical risk. The cointegration result implies that these variables share a common stochastic trend and move together in the long run, despite potential short-term deviations.

Table 6. DARDL Estimates Results

	Dependent variable: LNINF$_t$		
Variables	**Coefficients**	**Stand. Error**	**P-value**
$lnEXR_t$	0.707*	0.088	0.000
	(8.03)		
ΔlnEXR$_t$	-0.519**	0.198	0.018
	(-2.62)		
$lnOP_t$	0.401*	0.092	0.000
	(4.36)		
ΔlnOP$_t$	-0.106	0.014	0.000
	(-7.57)		
$lnEPU_t$	0.250*	0.022	0.000
	(11.36)		
ΔlnEPU$_t$	-0.118*	0.051	0.000
	(-4.72)		
$lnGR_t$	0.321*	0.024	0.000
	(13.38)		
ΔlnGR$_t$	0.146*	0.015	0.000
	(9.73)		
ECT_{t-1}	-0.565*	0.093	0.000
	(-6.08)		
R^2	0.641		
Adj-R^2	0.503		
Simulation	5000		
γ_{ser}	0.678 (1.435)		
γ_{Hetr}	1.987 (0.209)		
γ_{Nor}	0.779 (1.431)		

Table 6 presents the dynamic ARDL (DARDL) estimates, which reveal the short-run and long-run relationships between inflation and the explanatory variables: exchange rate, oil prices, economic policy uncertainty, and geographical risk. The long-run coefficients indicate that a 1% increase in the exchange rate (lnEXR) leads to a 0.707% rise in inflation, confirming the adverse impact of currency depreciation on price levels. This finding aligns with recent studies by [6] and [7], who found similar effects of exchange rate movements on inflation dynamics. The positive long-run coefficient associated with the exchange rate variable underscores the inflationary consequences of currency depreciations, which can increase the costs of imported goods and services, thereby exerting upward pressure on domestic prices. Furthermore, a 1% increase in oil prices (lnOP) results in a 0.401% increase in inflation, highlighting the significant pass-through effect of global energy prices on domestic inflation in Nigeria, an oil-exporting economy. This result corroborates the findings of [35], who documented the inflationary impact of oil price shocks on various economies. The coefficient on economic policy uncertainty (lnEPU) reveals a positive and statistically significant relationship, suggesting that a 1% rise in policy uncertainty leads to a 0.250% increase in inflation. This outcome is consistent with the findings of [11], who demonstrated that heightened economic policy uncertainty exacerbates inflationary pressures by fueling speculation, undermining business confidence, and disrupting investment decisions. Additionally, the positive and significant coefficient of

0.321 for geographical risk (lnGR) implies that a 1% increase in factors such as climate change, health crises, and sociopolitical instability contributes to a 0.321% rise in inflation. This finding aligns with the recent literature on the inflationary consequences of environmental and geopolitical risks ([36]). The short-run coefficients also provide valuable insights. While the exchange rate and economic policy uncertainty exhibit negative short-run impacts on inflation, the coefficients for oil prices and geographical risk are positive, suggesting diverse short-term dynamics across these variables. The error correction term (ECT) coefficient of -0.565 is negative and statistically significant, confirming the presence of a long-run equilibrium relationship among the variables. This implies that approximately 56.5% of any disequilibrium in inflation is corrected within one month, indicating a relatively rapid adjustment towards the long-run equilibrium path. The diagnostic tests, including the R-squared, adjusted R-squared, and residual tests for serial correlation (χ2ser), heteroscedasticity (χ2Hetr), and normality (χ2Nor), suggest that the DARDL model is well-specified and robust. The dynamic ARDL simulation plots presented in Figures 1-4 provide a visual representation of the long-run and short-run impacts of exchange rate, oil prices, economic policy uncertainty, and geographical risk on inflation in Nigeria. These graphical illustrations offer valuable insights into the nature and magnitude of these relationships over time. Figure 1 depicts the positive long-run effect of exchange rate depreciation on inflation. The initial positive shock to the exchange rate results in a persistent increase in inflation, highlighting the lasting impact of currency movements on price levels. Figure 2 illustrates the inflationary impact of positive oil price shocks. The observed increase in inflation following a positive oil price shock underscores the significant pass-through effect of global energy prices on domestic inflation in oil-exporting economies like Nigeria. Figure 3 visually demonstrates the positive long-run relationship between economic policy uncertainty and inflation. The persistent rise in inflation following a positive shock to economic policy uncertainty highlights the destabilizing effect of heightened uncertainty on price levels. Furthermore, Figure 4 graphically represents the positive long-run impact of geographical risk factors, such as climate change, health crises, and sociopolitical instability, on inflation dynamics. This finding is consistent with the growing body of literature exploring the economic consequences of environmental and geopolitical risks.

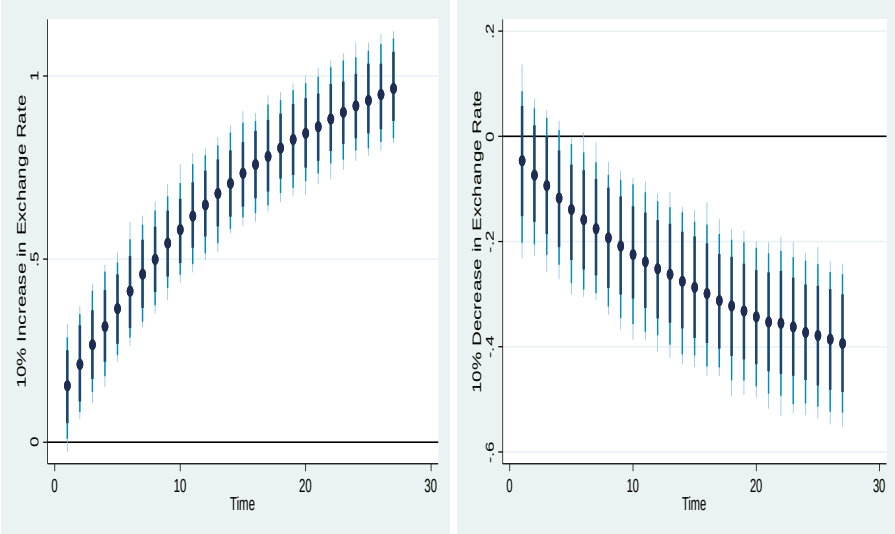

Figure 1. Exchange Rate and Inflation

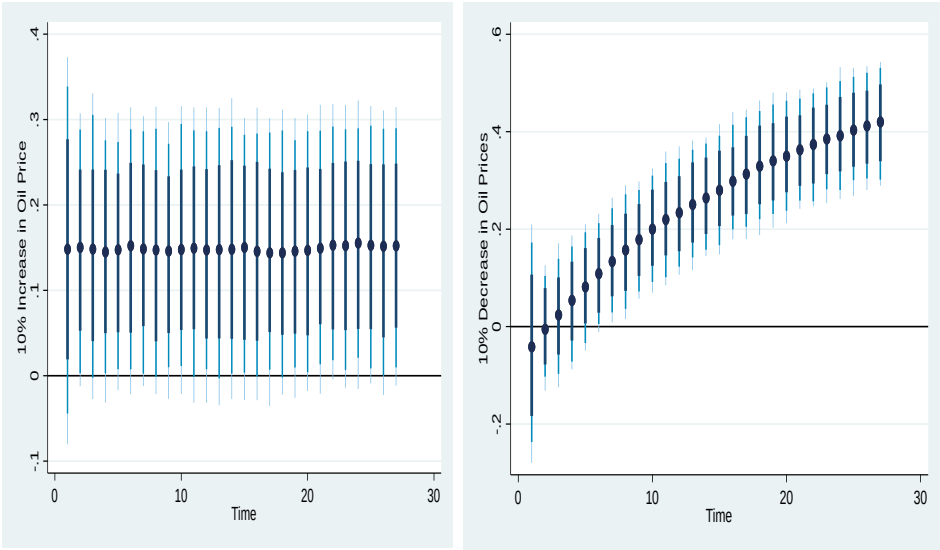

Figure 2. Oil Prices and Inflation

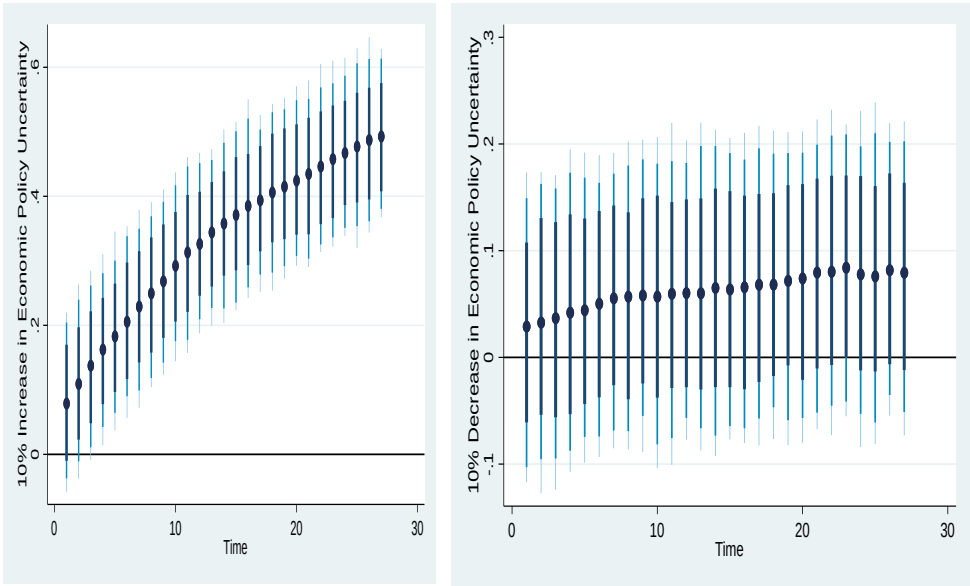

Figure 3. Economic Policy Uncertainty and Inflation

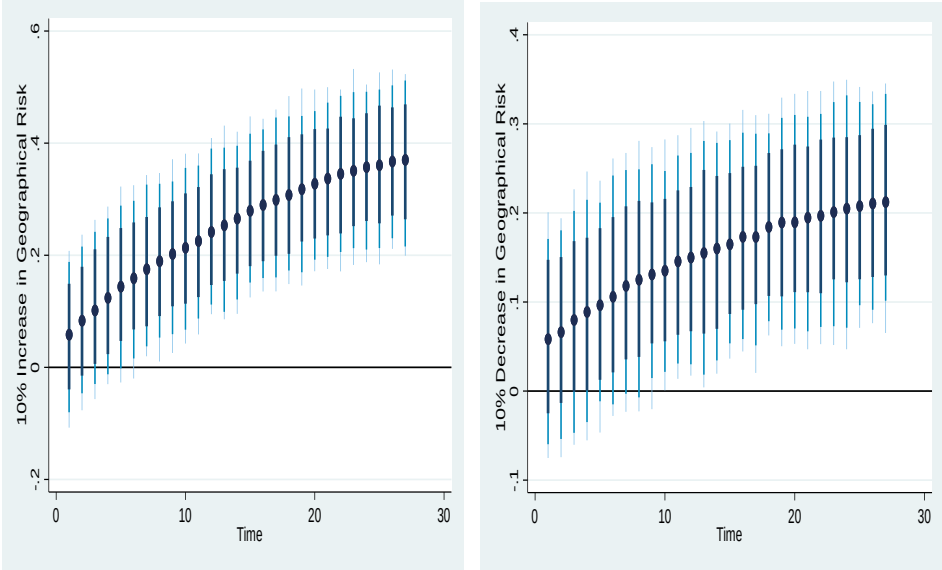

Figure 4. Geographical Risk and Inflation

Table 7. Diks and Panchenko Causality test

lnINF −/→ lnEXR	**lnEXR−/→ lnINF**	**Direction**
4.100* (0.000)	6.942* (0.000)	Bidirectional
LnINF −/→ lnOP 11.248* (0.000)	lnOP−/→ lnINF 9.061* (0.000)	Bidirectional
LnINF −/→ lnEPU 2.704** (0.017)	lnEPU−/→ lnINF 3.231 (0.000)	Bidirectional
LnINF −/→ lnGR 1.097 (0.136)	LnGR−/→ lnINF 1.656** (0.049)	Unidirectional

Table 7 presents the results of the Diks and Panchenko (2005, 2006) non-parametric causality test, which investigates potential non-linear causal relationships among inflation, exchange rate, oil prices, economic policy uncertainty, and geographical risk in Nigeria. This approach overcomes the limitations of traditional linear Granger causality tests by capturing more complex dynamic causal linkages between time series. The results indicate a bidirectional causal relationship between inflation and exchange rate, implying that changes in one variable can lead to changes in the other, and vice versa. This highlighted the intricate interplay between exchange rate movements and inflation dynamics. Additionally, a bidirectional causal link is observed between inflation and oil prices. This suggests that fluctuations in global oil prices not only influence domestic inflation but also that inflationary pressures can potentially impact oil prices, given Nigeria's status as an oil-exporting economy. The results also reveal a bidirectional causal relationship between inflation and economic policy uncertainty. This implies that heightened policy uncertainty can contribute to inflationary pressures, while rising inflation levels can also exacerbate economic policy uncertainty, creating a feedback loop. Interestingly, a unidirectional causal relationship is found, running from geographical risk factors to inflation. This suggests that exogenous factors such as climate change, health crises, and sociopolitical instability can influence inflation dynamics, but the reverse causality does not hold. This finding aligns with the growing literature on the economic consequences of environmental and geopolitical risks. The detection of these non-linear causal linkages highlights the complex interrelationships among the variables under investigation and underscores the importance of adopting flexible modeling approaches to capture potential non-linearities and feedback effects.

7. CONCLUSIONS

The primary objective of this research was to investigate the long-term and short-term effects of exchange rates, oil prices, economic policy uncertainty, and geographical risks on inflation in Nigeria, as well as to examine the non-linear directional causality among these variables. Utilizing advanced econometric techniques, such as the Dynamic ARDL simulations and the Diks and Panchenko causality test, the study provided valuable insights into the intricate relationships governing inflationary dynamics in the Nigerian economy. The empirical findings revealed a significant long-run impact of exchange rates, oil prices, economic policy uncertainty, and geographical risks on inflation in Nigeria. Specifically, the results indicated that an increase in exchange rates, economic policy uncertainty, and geographical risks contributed to higher inflationary pressures, while a rise in oil prices had a dampening effect on inflation. Furthermore, the study uncovered bidirectional causality between inflation and exchange rates, oil prices, and economic policy uncertainty, highlighting the complex interplay among these variables. Notably, the research demonstrated the importance of considering non-linear causal relationships, as the Diks and Panchenko causality test uncovered unidirectional causality running from geographical risks to inflation, a nuance that might have been overlooked by traditional linear approaches. These findings underscore the need for policymakers and business leaders to adopt a holistic and dynamic perspective when assessing and responding to inflationary pressures in Nigeria. Therefore, this study contributes to a deeper understanding of the determinants of inflation in Nigeria, shedding light on the critical roles played by exchange rates, oil prices, economic policy uncertainty, and geographical risks. By employing rigorous econometric techniques and accounting for potential non-linearities, the research provides a solid foundation for informed decision-making and the development of effective strategies to promote price stability and economic growth in the Nigerian context.

5.1 Implications of the Study

The study's findings offer valuable managerial, practical, social, and theoretical implications. From a managerial perspective, the analysis provides insights into how macroeconomic factors, such as exchange rates, oil prices, economic policy uncertainty, and geographical risks, influence inflation dynamics in Nigeria. This information can assist policymakers and business leaders in developing effective strategies to mitigate inflationary pressures and promote economic stability. Additionally, the study's emphasis on nonlinear causality highlights the need for managers to adopt a holistic and dynamic approach when assessing the interplay between these variables. Practically, the research underscores the importance of monitoring and responding to changes in key economic indicators. For instance, businesses can leverage the findings to adjust pricing strategies, hedging mechanisms, and operational costs in response to fluctuations in exchange rates or oil prices. Moreover, the study's focus on geographical risks and economic policy uncertainty reinforces the need for contingency planning and risk management frameworks that account for potential disruptions stemming from these factors. Socially, the study contributes to a better understanding of the drivers of inflation, which has a direct impact on the purchasing power and living standards of the Nigerian population. By identifying the determinants of inflationary pressures, policymakers can implement targeted interventions to promote price stability and protect the welfare of citizens, particularly those in lower-income brackets. Furthermore, the research highlights the significance of addressing issues related to economic policy uncertainty and geographical risks, which can exacerbate social inequalities and hinder sustainable development. Theoretically, the study's utilization of advanced econometric techniques, such as the Dynamic ARDL simulations and the Diks and Panchenko causality test, contributes to the methodological rigor and robustness of empirical investigations in the field of macroeconomics. The application of these cutting-edge approaches enhances the understanding of complex relationships between variables, capturing nonlinearities and dynamic interactions that may be overlooked by traditional linear models. Consequently, the research expands the theoretical foundation for analyzing inflationary dynamics and their determinants, paving the way for further scholarly inquiries and refinements in this domain.

7.2 Limitations of the Study and Recommendation for Future Studies

While the study provides valuable insights into the effects of exchange rates, oil prices, economic policy uncertainty, and geographical risks on inflation in Nigeria, it is essential to acknowledge its limitations and propose recommendations for future research endeavors. Firstly, the reliance on monthly data might not capture the full extent of the intricate relationships between the variables, as some economic indicators and policy changes may exhibit more pronounced effects over longer periods. Future studies could consider employing higher-frequency data or exploring alternative time frames to enhance the granularity and robustness of the analysis. Moreover, the study's scope is confined to the Nigerian context, which may limit the generalizability of the findings to other economies with distinct characteristics. Comparative analyses across multiple countries or regions could yield additional perspectives on the interplay between macroeconomic factors and inflationary pressures, enabling more comprehensive policy implications. Additionally, incorporating a broader set of variables, such as fiscal policy indicators, trade dynamics, or financial market factors, could provide a more holistic understanding of the determinants of inflation. Another potential limitation lies in the assumption of linearity inherent in the ARDL approach, despite the application of nonlinear causality testing. Future research could explore the implementation of nonlinear modeling techniques, such as regime-switching models or threshold autoregressive models, to capture potential asymmetries and nonlinearities in the relationships between the variables more explicitly. Furthermore, the study's reliance on specific data sources for variables like economic policy uncertainty and geographical risks could be further strengthened by triangulating with alternative data sources or employing alternative measurement approaches. Finally, as the study primarily focuses on the determinants of inflation, future research could delve deeper into the implications of inflationary dynamics

on various economic sectors, socioeconomic groups, and developmental indicators. Such analyses could inform targeted policy interventions and mitigation strategies to address the potential adverse consequences of inflation on economic growth, income inequality, and overall social welfare in Nigeria.

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