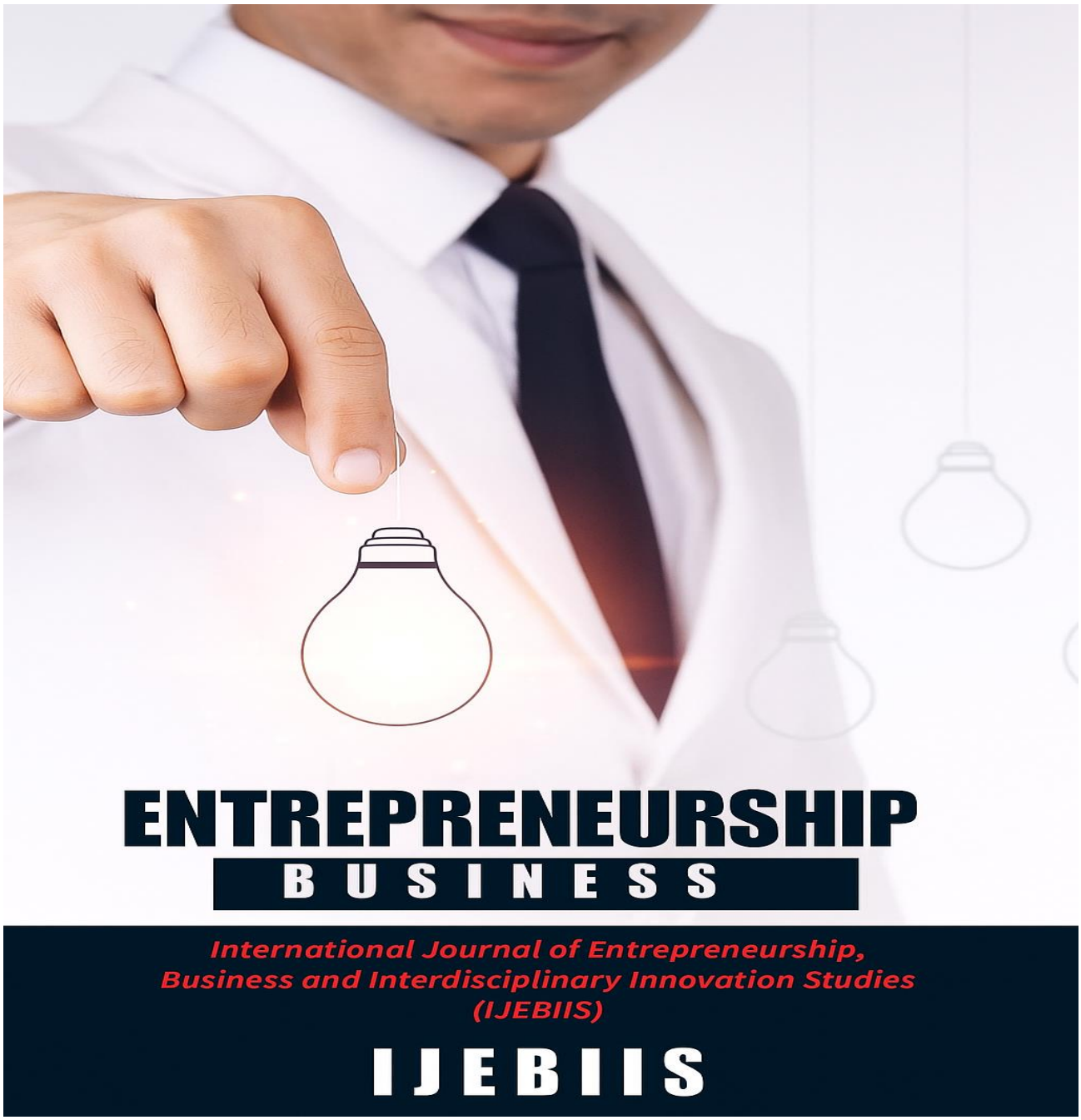

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Nonlinear Effect of Exchange Rate on Economic Growth: Empirical Investigation from Variants of Nonlinear Time Series Models

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Abstract

This study investigates the impact of exchange rate dynamics on economic growth in Nigeria, focusing on the nonlinear relationship between exchange rate fluctuations and macroeconomic variables. The aim of the study is to examine how exchange rate movements affect economic performance, specifically real GDP growth, inflation, and broad money supply. The scope of the study spans from 1990: Q1 to 2021: Q3, utilizing quarterly time series data. The study employs a Threshold Vector Autoregression (TVAR) model, which is well-suited to capture regime-dependent effects and nonlinearities in the exchange rate data. Pre-diagnostic tests confirm the presence of structural breaks in the exchange rate series, informing the selection of threshold parameters for the TVAR model. The findings reveal that the impact of exchange rate movements on economic growth, inflation, and money supply varies significantly between low and high exchange rate regimes. Specifically, real GDP growth reacts differently depending on the prevailing exchange rate regime, with nonlinear effects observed across key macroeconomic variables. The study concludes that nonlinear models, such as TVAR, provide a more accurate and parsimonious fit for exchange rate data compared to linear models. Therefore, the study recommends that policy interventions should be regime-specific, tailoring exchange rate management to the prevailing economic conditions to achieve more stable and sustainable economic growth.

Keywords:
Economic Growth, Exchange Rate Dynamics, Nonlinear Relationship, Policy Interventions.

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Introduction

Exchange rate system is a fundamental economic variable that is principally important as a determinant of macroeconomic performance of a country. Developing countries, Nigeria as one of them, experience significant exchange rate fluctuations in the domestic currency due to nature of the Nigerian economy, being a small open economy. The degree of exchange rate pass through to inflation in Nigeria is empirically found to be high as reported in Sanusi (2010), Shehu et al. (2009), and Shehu et al. (2014).

Exchange rate crisis in Nigeria has generated several policy interventions with huge macroeconomic implications for the economy. For more than a decade, the Central Bank of Nigeria has been devaluing the domestic currency under the economic theory that postulates that currency devaluation is growth enhancing. Although empirical evidences have established that exchange rate devaluation stimulates economic growth as reported, among others, in the studies conducted by Dooley et al., (2003); Aguirre and Calderon, (2005), the findings cannot be generalized as the dynamics of exchange rate equilibrium is quite unpredictable for any economy. Again, Nigeria, being small open economy, is exposed to several global macroeconomic uncertainty which creates domestic macroeconomic instability. Global shocks hit the domestic economy and make the country's exchange rate vulnerable and susceptible to the vagaries of international trade. There is increasing volatility in the Nigeria's exchange rate which distorts the country's performance in international trade with negative implication on economic growth. There is a large body of literature that analyses the correlation between exchange rate misalignment and economic growth. One of the early views is based on the "Washington Consensus".4 According to this view, exchange rate is set at a level such that internal and external balances are maintained. Thus, a deviation from this "equilibrium" in form of overvaluation or undervaluation, which is viewed as some sort of macroeconomic disequilibrium, will hamper growth (Williamson, 1994; Berg and Miao, 2010). One of the seminal papers is the work of Rodrik (2008).

One of the fundamental dynamics of exchange rate behavior is that it is highly unpredictable and therefore many empirical findings on the movement of exchange rate established that

exchange rate is inherently unstable, unpredictable and highly volatile. It is on the basis of this argument that this study is built upon to explore the nonlinear effects of exchange rate fundamental on economic growth. There are empirical evidences that produced statistical evidence that movement in exchange rate in form of depreciation or appreciation exert varying degree of effects on economic growth. This line of arguments is advanced by Phiri (2018), Tipoy and Zehirun (2016), Fourie et al. (2016), Cheung (2005), Taylor et al. (2001), Peel (2000) and Mark (1995). The empirical motivation of this study is derived on the basis of nonlinear properties of the exchange rate and how nonlinearities in exchange rate impact on economic growth. There are well researched studies on the linear relationship between exchange rate and economic growth in Nigeria, as in the case of, among others, Akpan and Atan (2011), Adedoyin (2016), Anyanwu et al. (2017), Alasha (2020), and more recently, Abolaji (2021). However, these studies assume away any form of nonlinear changes in exchange rates despite the growing empirical evidence that document that exchange rate dynamics is highly nonlinear.

2.1 Conceptual Review

This section provides a conceptual review based on the nonlinear effects of exchange rate dynamics on economic growth, particularly within the context of Nigeria as a small open economy. Each of the following sections summarizes key concepts from the study.

2.1.1 Exchange Rate Dynamics

The behaviour of exchange rates plays a critical role in shaping the macroeconomic performance of economies, especially small open economies like Nigeria. Exchange rate fluctuations are inherently linked to external economic shocks, influencing key variables such as inflation, trade balance, and output growth (Ogunleye & Adamu, 2022). Recent studies suggest that exchange rate movements in Nigeria exhibit nonlinear patterns, meaning their impact on economic growth is not uniform. While exchange rate depreciation or appreciation may have varying degrees of influence, their nonlinearity calls for more sophisticated modelling techniques, such as nonlinear time series models, to capture these complex relationships (Kalu & Nwachukwu, 2021).

2.1.2 Small Open Economy (SOE)

Nigeria, as a small open economy, is significantly influenced by external economic conditions, such as global commodity price fluctuations and international trade dynamics (Olaniyan & Akinyemi, 2023). In small open economies, domestic factors alone cannot fully explain economic performance, as external shocks tend to permeate the economy quickly. In the case of Nigeria, oil price movements, for example, directly impact the exchange rate and, consequently, broader economic indicators. The study underscores the importance of understanding how external factors, particularly exchange rate volatility, interact with domestic economic policy to shape the country's growth trajectory (Adebayo, 2022).

2.1.3 Nonlinear Relationship

The exchange rate-economic growth nexus in Nigeria has traditionally been studied within linear frameworks, but recent empirical evidence highlights the nonlinear nature of this relationship (Olamide & Fasanya, 2022). The impact of exchange rate fluctuations on economic growth does not follow a simple cause-and-effect pattern. Instead, the relationship is contingent on the prevailing exchange rate regime, with different outcomes observed under periods of currency depreciation versus appreciation. The study reveals that nonlinear models, particularly threshold models like Threshold Vector Autoregression (TVAR), offer more accurate and parsimonious representations of this relationship, better capturing regime-specific responses and macroeconomic dynamics (Chukwu & Igbinedion, 2022).

2.1.4 Exchange Rate Crisis and Policy Interventions

Nigeria has witnessed several exchange rate crises, with currency devaluation being a central feature of its monetary policy for over a decade. The Central Bank of Nigeria has frequently devalued the naira under the belief that depreciation stimulates economic growth, especially by improving the trade balance (Ogundele & Olaniyan, 2021). However, the effectiveness of such devaluation policies has been debated, as their outcomes often depend on the underlying economic context and external shocks. Studies suggest that exchange rate misalignments, particularly those driven by external volatility, can lead to macroeconomic instability, distorting trade flows and hindering growth (Adebisi & Adegboye, 2022). The study advocates for policy

interventions that are tailored to specific exchange rate regimes, highlighting the need for a nuanced approach to currency devaluation and other exchange rate management tools.

2.3 Empirical Review

Ayodele, Samson, and Olufemi (2014), investigated the impact of exchange rate on Nigeria's economic growth between 2000 and 2012. The aim of the study was to assess the relationship between exchange rate fluctuations and GDP growth in Nigeria. The study adopted a time-series methodology, utilizing the ordinary least squares (OLS) regression technique to analyse the data. The findings of the study revealed that exchange rate had a positive effect on GDP growth in Nigeria during the period under review. The study concluded that exchange rate stability is essential for fostering economic growth in the country. Therefore, the study recommended that policymakers implement measures to stabilize the exchange rate in order to encourage long-term economic development.

Abdulkadir, Olusola, and Ibrahim (2015), explored the impact of exchange rate movements on Nigeria's economic growth, using data from 2000 to 2014. The study aimed to analyse how real exchange rate fluctuations affect the country's economic performance. The study adopted an econometric approach, employing the cointegration technique and error correction model (ECM). The findings revealed that a depreciation of the real exchange rate negatively impacted economic growth, particularly in the context of Nigeria's import-dependent economy. The study concluded that exchange rate depreciation should be cautiously managed to avoid adverse effects on growth. Therefore, it recommended that the government focus on promoting domestic production to reduce reliance on imports and mitigate the negative impacts of exchange rate depreciation.

Adelowokan, Adesoye, and Balogun (2015), examined the relationship between exchange rate volatility, investment, and economic growth in Nigeria from 1986 to 2014. The aim of the study was to assess how exchange rate volatility influences investment decisions and overall economic performance. The study adopted a vector autoregression (VAR) methodology, utilizing variance decomposition and impulse response functions. The findings indicated that exchange rate volatility had a negative relationship with both investment and economic growth

in Nigeria. The study concluded that excessive exchange rate volatility could deter investment and hinder economic progress. Therefore, it recommended that the government implement policies to stabilize the exchange rate to promote investment and foster sustainable economic growth.

Anthony, Jonathan, and Chiamaka (2018), investigated the effect of exchange rate movements on Nigeria's manufacturing sector between 1981 and 2016. The aim of the study was to determine how exchange rate fluctuations influence manufacturing GDP in the country. The study adopted a multiple regression methodology, employing the generalized least squares (GLS) technique for data analysis. The findings revealed that exchange rate, government capital expenditure, imports, and foreign direct investment had a positive relationship with manufacturing GDP, while private sector credit was negatively linked with manufacturing performance. The study concluded that exchange rate stability positively impacts manufacturing output. Therefore, the study recommended that policymakers create an enabling environment for foreign direct investment and stabilize the exchange rate to improve manufacturing sector performance.

Ogunmuyiwa, Adelowokan, and Akinpelu (2018), analysed the impact of exchange rate on industrial output in Nigeria from 1986 to 2016. The aim of the study was to evaluate how exchange rate movements affect industrial output in the country. The study adopted the error correction model (ECM) methodology, utilizing annual data to estimate long-term and short-term effects. The findings showed that exchange rate had a significant positive effect on industrial output, particularly during periods of currency depreciation. The study concluded that exchange rate adjustments could boost industrial output in Nigeria. Therefore, the study recommended that the government utilize exchange rate management as a tool for stimulating industrial growth and enhancing Nigeria's industrial base.

Qaiser, Irfan, and Muhammad (2013), examined the relationship between exchange rate and economic growth in Pakistan from 1976 to 2010. The aim of the study was to assess how exchange rate fluctuations influenced Pakistan's GDP growth. The study adopted an econometric approach, utilizing the autoregressive distributed lag (ARDL) model for analysis. The findings revealed an insignificant positive relationship between exchange rate and

economic growth. The study concluded that while exchange rate adjustments may have some positive impact on growth, other domestic factors were more influential. Therefore, the study recommended that policymakers focus on improving domestic economic policies to support growth rather than relying solely on exchange rate adjustments.

Khandare, Rajesh, and Soni (2017), evaluated the nexus between exchange rate and economic growth in India from 1987 to 2014. The aim of the study was to explore how exchange rate fluctuations and interest rates influenced the Indian economy. The study adopted a cointegration methodology, using the vector error correction model (VECM) for data analysis. The findings revealed that both exchange rate and interest rate exerted statistically insignificant negative effects on India's economic growth. The study concluded that exchange rate fluctuations did not have a significant impact on the Indian economy during the study period. Therefore, it recommended that India focus on stabilizing its domestic macroeconomic policies to enhance economic performance.

2.2 Theoretical framework

The Monetary Approach to Exchange Rate Determination by Krugman (2019) offers a compelling framework for understanding the influence of monetary factors, such as money supply and inflation, on exchange rates. This theory assumes that exchange rates are primarily determined by the relative money supplies and inflation rates of two countries. The assumption is that, in small open economies like Nigeria, external factors such as fluctuations in oil prices exacerbate the effects of monetary policy on exchange rate dynamics. A key application of this theory is that exchange rates react to changes in domestic inflation and monetary policies, which in turn affects overall economic performance. Critics of this theory argue that it oversimplifies the complexities of exchange rate dynamics by ignoring structural factors like political instability or market speculation, which also contribute significantly to exchange rate volatility. However, its relevance to this study lies in Nigeria's vulnerability to external shocks, particularly oil price fluctuations, which directly influence both inflation and exchange rates. By exploring the relationship between monetary policy, exchange rates, and economic growth, this theory provides a robust framework for analysing the impact of exchange rate movements in Nigeria.

The Threshold Autoregressive Model (TAR) and TVAR proposed by Enders (2015) extends the analysis of exchange rates by introducing a nonlinear approach that captures regime-dependent behaviours. This theory assumes that exchange rates exhibit different behaviours in different regimes, such as high or low exchange rate environments. The application of this model is particularly significant for small open economies like Nigeria, where exchange rates are highly volatile and influenced by both domestic and international factors. Critics point out that while the TAR and TVAR models provide a more nuanced view of exchange rate dynamics, they can be complex to implement and require substantial data to accurately capture the regime-specific effects. Nevertheless, the model's ability to distinguish between different exchange rate regimes is highly relevant to this study, as it helps explain how Nigeria's exchange rate fluctuations might have different impacts on macroeconomic variables such as GDP growth and inflation depending on whether the country is experiencing a period of depreciation or appreciation. By utilizing this model, the study can offer a deeper understanding of how exchange rate movements, in various regimes, influence economic growth in Nigeria.

Both theories are highly pertinent to the study's exploration of the nonlinear effects of exchange rates on Nigeria's economic growth. The Monetary Approach highlights the significant role of external factors, particularly oil price fluctuations, in driving exchange rate movements and their subsequent impact on inflation and growth. On the other hand, the Threshold Autoregressive Model provides a framework for understanding how exchange rate effects can differ based on the prevailing economic regime. Together, these theories offer complementary insights into the nonlinear relationship between exchange rate dynamics and economic growth, making them crucial for understanding the complexities of the Nigerian economy.

3. 1 Methodology

The data used in the study are quarterly time series data consisting of exchange rate, real GDP, inflation and broad money supply, M3 for a period of 1990: Q1 to 2021: Q3. The endogenous variables are expressed in growth rates so that standardization of the variables is achieved. The econometric model utilized is a class of nonlinear model in a multivariate framework. Specifically, we employ the threshold vector autoregression model as the main estimation technique and use exchange rate as a threshold variable.

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Consider the reduced-form model.

$$y_t = \nu + \sum_{j=1}^{p} A_j y_{t-j} + G(x_t, \theta)\left(\nu^{+} + \sum_{j=1}^{p} A_j^{+} y_{t-j}\right) + u_t, \quad \ldots\ldots 1$$

where $\nu+$ is a constant. The $K \times K$ matrix function $G(xt, \theta)$ depends on the variable xt and the parameter θ and determines when and to what extent there is a change in the model coefficients. If $G(xt, \theta) = 0$, the model (1) is a standard linear reduced-form VAR model with intercept term ν, slope parameter matrices $Aj, j = 1, \ldots, p$, and white noise error term ut. If $G(xt, \theta)$ is nonzero, the parameters $\nu+$ and $A+$. The function $G(xt, \theta)$ is a diagonal matrix with exponential transition

$$G(x_t, \theta) = \begin{bmatrix} 1 - \exp[-\gamma(x_{1t} - c_1)^2] & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 - \exp[-\gamma(x_{Kt} - c_K)^2] \end{bmatrix} \quad \ldots\ldots 2$$

Where $\gamma > 0, x_t = (x_{it}, x_{2t}, \ldots\ldots, x_{kt})'$ *and* $\theta = (\gamma, c_i, c_2, \ldots\ldots, c_k)'$. As long as the transition variable x_{kt} is equal to the constant, c_k,

$$1 - \exp[-\gamma(x_{kt} - c_k)^2] = 0 \quad \ldots\ldots 3$$

If the difference between x_{kt} and c_k is very large,

$$1 - \exp[-\gamma(x_{kt} - c_k)^2] \approx 1 \quad \ldots\ldots 4$$

We can define a possible shift variable as;

$$x_{kt} = \begin{cases} c_k & \text{for } t < T_B, \\ t & \text{for } t \geq T_B, \end{cases} \quad \ldots\ldots 5$$

Where $1 < T_B < T$. In contrast, if the function $G(x_t, \theta)$ has the form

$$G(x_t, \theta) = \| (x_t > c) I_K \quad \ldots\ldots 6$$

A more general specification of M regime TVAR model can be expressed as;

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$$y_t = \begin{cases} \nu^{(1)} + \sum_{j=1}^{p} A_j^{(1)} y_{t-j} + u_t^{(1)} & \text{if } x_t \le c_1, \\ \nu^{(2)} + \sum_{j=1}^{p} A_j^{(2)} y_{t-j} + u_t^{(2)} & \text{if } c_1 < x_t \le c_2, \\ \vdots \\ \nu^{(M)} + \sum_{j=1}^{p} A_j^{(M)} y_{t-j} + u_t^{(M)} & \text{if } x_t > c_{M-1}, \end{cases}$$

.....7

Where $c_1, \ldots \ldots \ldots, c_M$ are the possibly unknown threshold values.

4. Presentation of Data

This section explains the estimation results of the study. The section highlights the estimation of traditional unit root as well as unit root tests in the presence of structural breaks. Regression with break points results is presented and the estimates of the structural impulse response is analyzed from threshold vector Autoregression.

Traditional Unit Root Tests

The section also presents and discusses the empirical results and findings of the study. The ADF unit root test at both level and first order difference are presented in table 1 and 2 respectively.

Table 1: ADF (LEVEL FORM)

	Statistic	C V (1%)	C V (5%)	C V (10%)	P-value
Inflation	0.078306	-4.037668	-3.448348	-3.149326	0.9968
M3	-1.723942	-4.027959	-3.443704	-3.146604	0.7353
Real GDP	-2.576042	-4.025924	-3.442712	-3.146022	0.2920
Exchange Rate	-1.711881	-4.027959	-3.443704	-3.443704	0.7408

Source: Author's computation using E-Views 10.

Table 1 utilizes Augmented Dickey Fuller (ADF) test of stationarity which indicates that the series are highly nonstationary at levels as their test statistic are less than the critical values at all levels of significance. This is further illustrated by their probability values which are all higher than 5 per cent. Thus, it suggests that differencing the series will be required to produce stationary series. This is illustrated in table 2.

Table 2: ADF (DIFFERENCE FORM)

Variable	Statistic	C V (1%)	C V (5%)	C V (10%)	P-value
Inflation	-5.605928	-4.037668	-3.448348	-3.149326	0.0000
M3	-5.764823	-4.027959	-3.443704	-3.146604	0.0000
Real GDP	-6.554862	-4.025924	-3.442712	-3.146022	0.0000
Exchange Rate	-3.551514	-4.027959	-3.443704	-3.146604	0.0381

Source: Author's computation using E-Views 10.

The table depicts the first difference of the series produced a test statistic from ADF with higher value greater than all the critical values at all level of significance. Also, the first differenced series yield lower probability values (less than 5%) indicating that the series are all stationary at first difference.

We find it appealing to use KPSS as additional test because of the lower power of ADF in detecting stationarity at level if the series is characterized with breaks. Thus, table 3 and 4 reports level and differenced KPSS.

Table 3: KPSS (LEVEL FORM)

Variable	Statistic	C V (1%)	C V (5%)	CV (10%)
Inflation	0.362449	0.216000	0.146000	0.119000
M3	0.311710	0.216000	0.146001	0.119000
Real GDP	0.301483	0.216000	0.146002	0.119000
Exchange Rate	0.359526	0.216000	0.146003	0.119000

Source: Authors computation Using E-views 10.

Table 3 Presents the KPSS test of stationarity which indicates that the series are highly nonstationary at levels as their test statistic are less than the critical values at all levels of significance. Therefore, the series will be differenced to produce stationary series. This is illustrated in table 4.

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Table 4: KPSS (DIFFERENCE FORM)

Variable	Statistic	C V (1%)	C V (5%)	C V (10%)
Inflation	0.022338	0.216000	0.146000	0.119000
M3	0.038147	0.216000	0.146001	0.119001
Real GDP	0.122829	0.216000	0.146002	0.119002
Exchange Rate	0.032778	0.216000	0.146003	0.119003

Source: Authors computation Using E-views 10.

Table 4 reveals that the first difference of the series produced a test statistic from KPSS with value less than all the critical values at all level of significance. This suggests that the series is stationary at first difference.

Unit Root Tests with Structural Break

It can be deduced that the variables, inflation, M3, real GDP and exchange rate, are integrated process and therefore contain a unit root. However, after converting all the variables to first difference, both ADF and KPSS reveal stationary series. For this, we can say that our variables are all I (1). The study also complements the traditional unit root test with modern unit root tests that allow for the presence of structural break. For this, we are reporting the test only on the exchange rate because we are interested in building a nonlinear model where the source of nonlinearity is on the exchange rate variable.

Table 5: Zivot-Andrews unit root test for exchange rate.

Allowing for break in both intercept and trend			
Lag selection via TTest:	lags of D. price included = 3		
Minimum t-statistic:	-4.950 at 2006q4 (obs 84)		
Critical values:	1%: -5.57	5%: -5.08	10%: -4.82

Source: Author's Computation using E-View 10.

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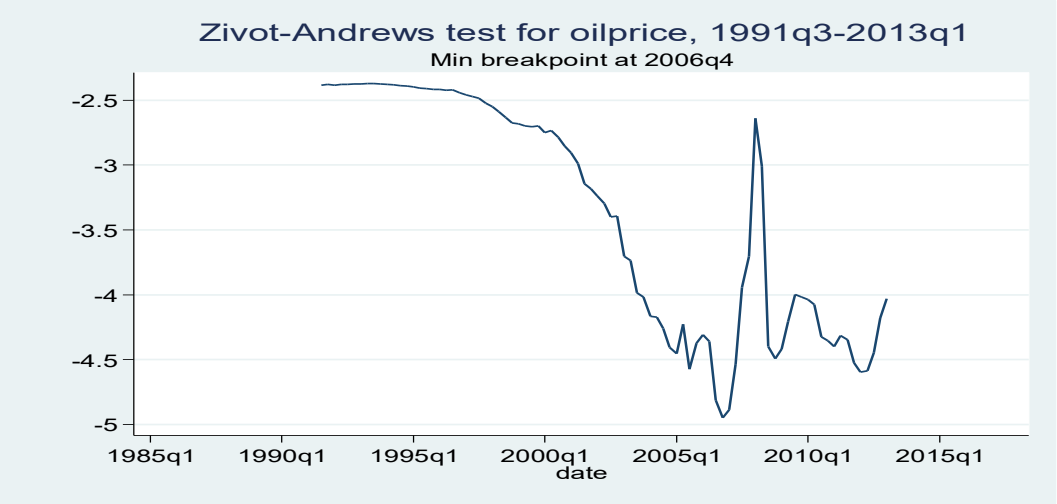
From the table, it can be seen that Zivot Andrew test has dictated significant structural break in the series of exchange rate at 2006Q4. The graph indicating the break is presented below.

Fig 1. Zivot Andrew Test for oil Price.



Source: Author's computation using Stata 15

From the display of the test, we can easily deduce the presence of the structural break in the series. This result underscore the importance of accounting for structural break when estimating the models which include exchange rate as one of the variables in the model specification using Nigerian data. However, there might be possibility of more than one break in the series and therefore we present the test of Clemente, Montayes and Reyes (1998).

Table 6: Clemente-Montañés-Reyes unit-root test

Clemente-Montañés-Reyes unit-root test with single mean shift, AO model			
AR(3)	du1	(rho - 1) const.	
Coefficient:	34.63455	-0.16604	21.00995
t-statistic:	9.585	-3.182	
P-value:	0.000	-3.560 (5% crit. value)	

Source: Author's Computation Using Stata 15

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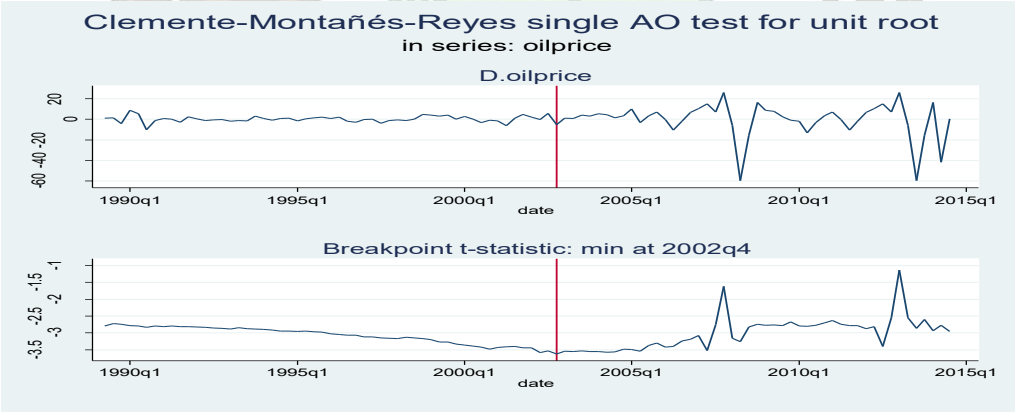
From the table, it can be said that the Clemente et al test led to the rejection of one structural break and that there are at least two structural breaks in the oil price series. In sum, both Zivot and Andrew as well as Clemente et.al have confirmed that the exchange rate is characterized with at least two structural breaks.

Fig 2. Clemente-Montanes and Reyes test.



Source: Author's computation using Stata 15

From figure 2, it can be deduced that the number of breaks in the series are at least two. However, 2002q1 and 2008q3 seem to be the period where these structural breaks occur. The importance of conducting these unit root test in the presence of structural breaks is to give some empirical justification for considering the nonlinear model that will take into account that some of the variables considered are characterized by significant breaks.

Regression with Break Point

Having established presence multiple breaks in the exchange rate, we find it a good econometric exercise to estimate regression model with break points. The table below reports the finding of the estimates.

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Table 7. Regression with Break Points Result.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1980Q1 - 1989Q4 -- 40 obs				
M3	-287.9241	19.94098	-14.43881	0.0000
EXCH_R	-0.357216	0.091704	-3.895307	0.0002
INF	0.061522	0.008593	7.159221	0.0000
1990Q1 - 1996Q4 -- 28 obs				
M3	-350.3886	24.74641	-14.15917	0.0000
EXCH_R	-0.027850	0.002750	-10.12587	0.0000
INF	0.074685	0.026099	2.861609	0.0049
1997Q1 - 2008Q3 -- 43 obs				
M3	-384.3510	25.58599	-15.02193	0.0000
EXCH_R	0.001903	0.001011	1.882727	0.0620
INF	-0.062730	0.010382	-6.042263	0.0000
2008Q4 - 2016Q4 -- 33 obs				
M3	-577.0795	31.49692	-18.32178	0.0000
EXCH_R	0.005230	0.000636	8.221517	0.0000
INF	0.030345	0.002593	11.70170	0.0000

Source: Author's Computation Using E-Views 10.

There is a total of four breaks captured by the model in the estimation. These are; 1980Q1 - 1989Q4(40 obs), 1990Q1 - 1996Q4, (28 obs), 1997Q1 - 2008Q3 (43 obs), 2008Q4 - 2016Q4 (33 obs). From the results in the regression table, one can easily see that the breaks are found to be statistically significant using Bai and Perron test and sequential L test. It must be maintained that the size of the coefficients across the regimes are statistically different.

For example, the period between 1980Q1 – 1989Q4 shows that all the estimated parameters are statistically significant at all level. The exchange rate is estimated to be -0.357216 which implies that one per cent (1%) increase in the depreciation of naira (exchange rate depreciation) will, on average, lead to a fall in the real GDP by approximately thirty-five per cent (35%). However, when we compare this estimate with the remaining three regimes (1990Q1-1996Q4, 1997Q1-2008Q3 and 2008Q4-2016Q4), we can infer that this regime (1980Q1 – 1989Q4) recorded large significant fall in the real GDP. The per cent fall in the real GDP is approximately 2% per cent, 0.1 per cent and 0.5 per cent for 1990Q1-1996Q4, 1997Q1-2008Q3 and 2008Q4-2016Q4 respectively. This suggest that the elasticity is never fixed but rather time varying and it is regime dependent. The highest fall in the elasticity of real GDP with respect to changes in exchange rates (appreciation or depreciation) was between the period of 1980Q1 – 1989Q4. In the language of economic theory, it can be deduced that real GDP is becoming more elastic with respect to changes in exchange rates, underpinning the relevance of exchange rate management in the economy. Thus, economic activities in Nigeria are becoming more sensitive to increase or decrease in the changes of exchange rate.

On the other hand, regime elasticity of real GDP with respect to the movement in exchange rates are found to be statistically significant across all the four regimes. Although there is marginal difference in the estimates of the elasticity, but we can infer that the estimates find some empirical support. In the first regime, (1980Q1 – 1989Q4), a one per cent (1%) increase in exchange rate has raised, on the average, the real GDP by approximately six per cent (6%). However, this estimate differs across the regimes. The real GDP elasticity varies across the regimes which suggest that real GDP elasticity is evolving over time. Thus, elasticity is seven per cent (7%), six per cent (6%) and three per cent (3%) for 1990Q1-1996Q4, 1997Q1-2008Q3 and 2008Q4-2016Q4 respectively. Thus, there is a negative relationship between real GDP and the exchange rates movement. Equally, the demand seems to be fairly elastic as the size of the coefficients decreases over time.

Estimates of the Threshold Vector Autoregression (TVAR)

In this empirical application, we assume that exchange rate change is the non-breaking variable. It is estimated with a negative statistically significant relationship with the real GDP and

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exchange rate. Numerically interpreting the parameter, a one per cent (1%) increase in the rate of exchange rate changes, will on average, lead to approximately more than four per cent (4%) increase in the real GDP in the economy. In sum, we can comfortably argue that the result meets the a priori expectation in terms of sign and size of the estimated coefficient. Additionally, the coefficient of determination is found to be high, (98 per cent) which is suggestive of model adequacy checks.

In another more robust econometric exercise, we estimate Threshold Vector Autoregression (TVAR) and explore deeply the response of real GDP with a unit shock from exchange rate. More specifically, we fit the data with a threshold variable which is the exchange rate. We define two regime period.

Regime one is defined to be the period in which the exchange rate is from 1 naira to 144 naira while the second regime is defined to be the period in which the exchange rate is from 145 naira and above. Put differently, the threshold is defined to be 145 naira. Regime 1 is loosely defined to be a low-price regime while regime 2 is loosely defined to be a high-price regime.

The top left panel of figure defines regime 1 of the response of real GDP with a unit shock in exchange rate shock while the top right panel of figure 5 depict the response of the real GDP with a unit shock in exchange rate shock in regime 2. A careful examination of the shape of the impulse response in the two regimes shows a significant difference.

Regime 1 **Regime 2**

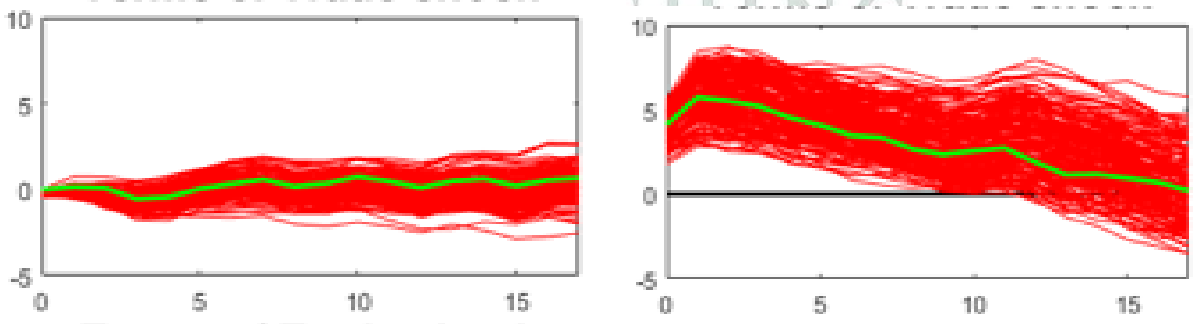


Figure 6: Response of Real GDP to one-standard deviation shock in Exchange Rate

Regime 1 **Regime 2**

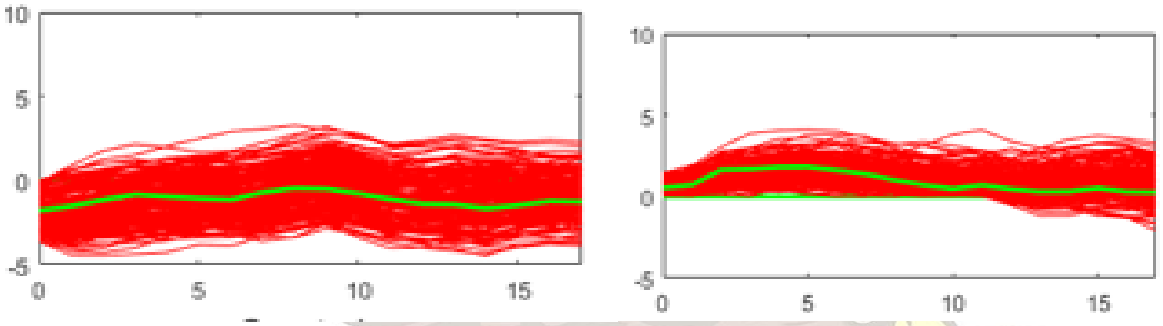
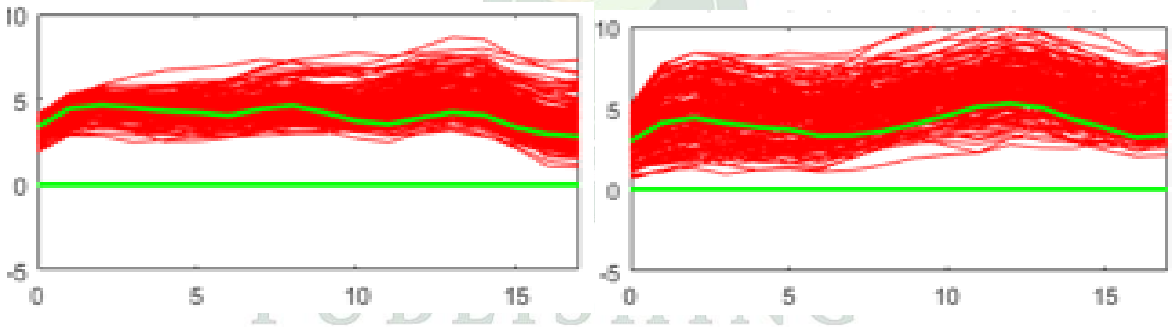


Figure 3: Response of Inflation to one-standard deviation shock in Exchange Rate

Regime 1 **Regime 2**



Source: Authors Computation using E-Views 10.

Figure 4: Response of M3 one-standard deviation shock in Exchange Rate

In the low-price regime, the response of the real GDP to a shock from exchange rate is basically insignificant and that it dies out as the time horizon increases. Thus, it can be assumed that in the low-price regime, the elasticity of real GDP is inelastic to a change in exchange rates. However, a visual exploration of the impulse response in the high-price regime indicates a significant rise in the real GDP at the initial period, and then a sudden negative response after

some period. Thus, suggests that the elasticity of real GDP in the high-price regime is highly elastic. There is some evidence that the negative impact of exchange rate on real GDP is larger in regime 2 than in regime 1.

In the middle panel, the response of inflation with shock coming from exchange rate is depicted. Regime 1 is illustrated on the left panel and it reveals that inflation does not respond to changes in the price and that the response immediately dies out indicating insignificant response. On the other hand, the high-price regime which is illustrated in the figure to the right, the response of inflation is different from regime 1. The impulse response of inflation is negative which suggests that in a high-price regime, exchange rate shock leads to a significant increase in inflation.

Discussion of Findings

The empirical results from the study reveal important insights into the relationship between exchange rate movements and economic growth in Nigeria, aligning closely with the theoretical framework. The findings from Ayodele, Samson, and Olufemi (2014) support the notion that exchange rate stability has a positive impact on GDP growth, reinforcing the argument put forth by the Monetary Approach to Exchange Rate Determination. This theory emphasizes the role of monetary factors such as inflation and money supply in influencing exchange rates, which in turn affects economic performance. The results from Ayodele et al. show a positive link between exchange rate and GDP growth, suggesting that a stable exchange rate enhances economic growth. This is consistent with the application of the Monetary Approach, which posits that exchange rate stability supports economic growth by minimizing inflationary pressures and fostering a conducive environment for investment.

Similarly, Abdulkadir, Olusola, and Ibrahim (2015) highlight a negative relationship between real exchange rate depreciation and economic growth, aligning with the findings of the study, which indicates that excessive depreciation of the exchange rate adversely affects economic growth. This result challenges the assumptions of the Monetary Approach, where the relationship between exchange rate movements and economic growth can be more complex,

especially in economies with structural dependencies on imports and external shocks like oil price fluctuations. The study by Abdulkadir et al. underscores the importance of cautious management of exchange rate depreciation, suggesting that Nigeria's dependency on imports makes it vulnerable to negative growth effects from currency depreciation. This conclusion ties into the critique of the Monetary Approach, which sometimes oversimplifies the multifaceted influences on exchange rate dynamics by neglecting the structural and external vulnerabilities of economies such as Nigeria.

The findings of Adelowokan, Adesoye, and Balogun (2015) provide further support for the argument that exchange rate volatility negatively impacts both investment and economic growth in Nigeria. The results corroborate the Threshold Autoregressive Model (TAR) proposed by Enders (2015), which captures regime-dependent behaviours in exchange rate dynamics. The TAR model assumes that exchange rate movements exhibit different effects in high and low exchange rate regimes, a nuance that is particularly relevant in the context of Nigeria, where periods of exchange rate depreciation are often accompanied by heightened inflationary pressures and a slowdown in investment. The study's finding that exchange rate volatility deters investment and growth reflects the idea that the Nigerian economy is more susceptible to the adverse effects of exchange rate volatility in periods of high exchange rate fluctuations, aligning well with the TAR and TVAR models that highlight the regime-specific impact of exchange rate changes.

Furthermore, Anthony, Jonathan, and Chiamaka (2018) emphasize the positive impact of exchange rate stability on manufacturing GDP, offering further evidence of the importance of exchange rate management for Nigeria's industrial sector. This aligns with the theoretical underpinnings of both the Monetary Approach and Threshold Autoregressive Models, as stable exchange rates contribute to a more predictable economic environment that encourages investment and supports industrial growth. The study indicates that the manufacturing sector in Nigeria responds positively to exchange rate stability, reflecting how exchange rate movements can influence real sector performance, especially when exchange rate fluctuations are kept within manageable thresholds. The results from Ogunmuyiwa, Adelowokan, and Akinpelu (2018), which reveal a positive relationship between exchange rate and industrial output,

further support the findings from Anthony et al. (2018). These findings are in line with the Threshold Autoregressive Model, which suggests that the effects of exchange rate changes are not uniform but depend on the prevailing regime. During periods of exchange rate depreciation, Nigeria's industrial output tends to rise, suggesting that exchange rate adjustments can spur industrial growth under certain conditions. This observation ties into the empirical conclusion that exchange rate fluctuations have differing effects based on the exchange rate regime, as articulated in the TAR framework, where different behaviours are exhibited in high versus low exchange rate regimes.

The study also contrasts with the results from Qaiser, Irfan, and Muhammad (2013), which found an insignificant relationship between exchange rate and economic growth in Pakistan. This finding highlights the complexity of the exchange rate-growth nexus and supports the critique of the Monetary Approach, which may not fully account for the unique institutional, economic, and structural factors that shape the relationship between exchange rates and growth. As observed in the case of Pakistan, exchange rate changes may have a muted effect on growth, especially in economies with stronger internal policies that mitigate external shocks.

Similarly, Khandare, Rajesh, and Soni (2017) found that exchange rate fluctuations had a statistically insignificant negative effect on India's economic growth. This reinforces the notion that exchange rate dynamics may vary significantly across countries, and the effect on economic growth is influenced by other factors, such as the structure of the economy, domestic policy responses, and the level of external exposure to global economic conditions. The findings from India and Pakistan suggest that the relationship between exchange rate fluctuations and economic growth is not as straightforward as the Monetary Approach might suggest. Rather, the impact is contingent on other variables, such as the level of economic diversification, the openness of the economy, and the presence of external shocks.

In conclusion, the study's findings highlight the importance of accounting for structural breaks and regime-dependent effects in the analysis of exchange rate movements and their impact on economic growth. The nonlinear effects revealed by the Threshold Autoregressive Model (TAR), where exchange rates exhibit different effects depending on the exchange rate regime, are particularly relevant for understanding the dynamics of the Nigerian economy. The results

suggest that exchange rate management in Nigeria must be tailored to the prevailing regime, as the effects of exchange rate fluctuations are not uniform and vary depending on whether the country is experiencing a period of depreciation or appreciation. These findings align with the theoretical framework, offering a deeper understanding of the complex interplay between exchange rate movements and economic growth, while also addressing the limitations of traditional models that fail to account for regime-dependent effects. Therefore, the study recommends that Nigeria adopt a regime-specific approach to exchange rate management, given the distinct impacts of exchange rate fluctuations under different economic conditions.

Conclusion

The study provides valuable insights into the nonlinear relationship between exchange rate fluctuations and economic growth in Nigeria, emphasizing the importance of accounting for structural breaks and regime-dependent effects. The findings demonstrate that exchange rate movements impact economic growth differently in high and low volatility regimes, suggesting that exchange rate management must be tailored to the prevailing economic conditions. The results align with the Monetary Approach and Threshold Autoregressive Models, offering a deeper understanding of exchange rate dynamics in Nigeria. Policymakers should consider these nonlinear effects when formulating exchange rate policies to promote sustainable economic growth.

Recommendations

1. Policymakers should adopt a regime-specific approach to exchange rate management, recognizing that the effects of exchange rate fluctuations vary in high and low volatility periods.

2. The government should implement measures to stabilize exchange rates during periods of high volatility, reducing uncertainty and fostering a conducive environment for investment.

3. Strengthening domestic production capabilities is crucial to mitigate the negative effects of exchange rate depreciation, particularly in import-dependent sectors.

Further research should explore the impact of external shocks, such as oil price fluctuations, on exchange rate dynamics to improve macroeconomic policy formulation.

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