

Impact of Exchange Rate Fluctuation on Nigeria Economy Growth

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Abstract- *The Nigerian economy is currently challenged by exchange rate fluctuations, leading to rising inflation and economic instability. Despite numerous studies and government interventions, these issues persist. This research investigates the impact of exchange rate volatility on Nigeria's economic growth, focusing on the low growth rates linked to inconsistent exchange rate policies and the country's economic structure. The study utilizes both quantitative data, sourced from the Central Bank of Nigeria, the National Bureau of Statistics, IMF, and the World Bank, covering the period from 1960 to 2022, and qualitative data from journal reviews. Employing the Multivariate Adaptive Regression Spline (MARS) method, the research identifies nonlinear relationships between GDP and key variables, including exchange rates, interest rates, inflation, imports, and exports. The findings indicate that exchange rate fluctuations are the most significant factor affecting economic growth, with a direct and substantial impact on GDP. Additionally, the study reveals that interest rates, imports, and exports have bidirectional effects on GDP. The results underscore the need for Nigerian government reforms to stabilize the exchange rate and mitigate its adverse effects on economic growth.*

Indexed Terms- *Exchange rate, Economic growth, Nigeria, GDP*

I. INTRODUCTION

Background of the Research Work.

No economy exists in isolation, as countries depend on each other for goods and services where they lack a comparative advantage, necessitating international trade and the concept of exchange rates. An exchange rate, as defined by Henry et al. (2020), is the rate at which one country's currency is exchanged for

another's. It plays a crucial role in determining the prices of goods across borders and reflects the extent of a country's involvement in global trade (Morina et al., 2020). In Nigeria, exchange rate fluctuations are a major concern due to the economy's heavy reliance on imports. As Nigeria aspires to become one of the leading global economies by 2050 (Obi et al., 2016), achieving sustainable economic growth is critical. Gross Domestic Product (GDP) growth, a key indicator of economic progress, is influenced by various macroeconomic factors, including the exchange rate. As such, strategic international trade and exchange rate policies are essential for Nigeria's economic development. Exchange rates significantly impact macroeconomic variables like inflation, foreign exchange earnings, interest rates, and international trade. The volatility of Nigeria's exchange rate has had a negative and significant impact on the country's economic growth, as highlighted by Aderemi et al. (2020). This study aims to assess the effect of exchange rate fluctuations on Nigeria's economic performance, focusing on the implications for GDP and the broader economy.

Historical Analysis of Exchange Rate

The need for a formalized international payment system emerged in the 19th and 20th centuries due to economic growth and trade expansion (Kallianiotis, 2013). The British pound served as the world reserve currency until after World War II, when the U.S. dollar took over under the Bretton Woods system. This fixed exchange rate system collapsed in 1971, and the U.S. dollar remains the preferred reserve currency today due to its stable economy (Chahrour and Valchev, 2020). Like many countries, Nigeria has adopted the dollar as its reserve currency.

Aims and Objectives of the Study

Nigeria's exchange rate was stable post-independence when agriculture dominated GDP, but volatility began

in 1979 with the rise of crude oil exports (Ewa, 2013). Despite its natural resources, Nigeria struggles with poverty and unstable macroeconomic indices. The aim of this research is to assess the impact of exchange rate fluctuations on Nigeria's economic growth. Objectives include understanding the relationship between economic growth and exchange rate volatility, analyzing GDP growth trends, and identifying measures to address exchange rate fluctuations.

Research Questions

- What is the relationship between economic growth and exchange rate volatility?
- How has Nigeria's current economic structure affected its exchange rate policies?
- What are the trends in Nigeria's GDP growth over the past decade?
- What are the influences of exchange rate fluctuations on Nigeria's economy?

Problem Discussion

Nigeria faces significant challenges due to inflation, reduced investment, and increasing debt, exacerbated by declining foreign reserves and unstable exchange rate policies. Inflation rose to 16.95% in 2021, reflecting broader economic instability (Statista, 2023). Issues like inadequate infrastructure and poor confidence in currency valuation contribute to exchange rate fluctuations. Nigeria's external debt, which rose from \$10.32 billion to \$22.08 billion in 2018, is a major factor in these challenges (Afolabi and Oji, 2021).

Rationale for the Study

Nigeria's economy is vulnerable due to significant currency volatility, leading to instability and inflation (Henry et al., 2020). This study aims to understand the connection between Nigeria's economic growth and exchange rate fluctuations, identify variables affecting exchange rates, and suggest solutions to stabilize the economy.

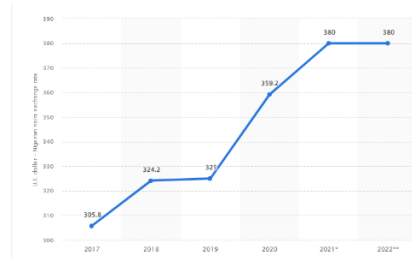


Figure 1: Nigeria's Exchange rate fluctuation

Significance of the Study

Exchange rate fluctuation is a major issue in Nigeria's economy, causing disequilibrium in the foreign exchange market. Despite various policies, stability remains elusive. This research seeks to identify the factors behind exchange rate fluctuations and suggest measures for stabilization, aiding the Central Bank of Nigeria in policy formulation and serving as a reference for future research.

Research Methodology

This study will collect secondary quantitative data from sources like CBN, National Bureau of Statistics, IMF, and World Bank, and qualitative data from journal reviews. Statistical tools will be used for data analysis.

Scope

The research covers the period from 1980 to 2022, including both fixed and floating exchange rate systems, and post-COVID-19 economic changes.

II. LITERATURE REVIEW

This section outlines the theoretical foundations supporting the research objectives, including GDP growth rate, exchange rate volatility, and Nigeria's economic context. The theoretical contributions will be stated in the form of themes as the relationship between economic growth and the volatile exchange rate will be explained. It also identifies gaps in the literature and presents a conceptual framework linking economic growth and exchange rate fluctuations.

Theoretical Concepts

GDP Growth Rate

GDP growth rate measures the economic expansion or contraction within a specific period, usually expressed as a percentage. According to Liu and Gao (2022),

GDP represents the total value of goods and services produced within a country. For instance, Nigeria's GDP contracted by 8.3% from 2021 to 2022 (World Bank, 2023). GDP growth rate is a crucial indicator for policymakers and economists, reflecting the health and performance of an economy.

Exchange Rate Volatility

Exchange rate volatility refers to fluctuations in the value of one currency relative to another. This volatility, often caused by economic, political, and market conditions, introduces exchange rate risk, complicating international trade and investment decisions (Barguelli et al., 2018).

Nigeria's Economic Structure and Scenario

Nigeria is a nation with strong economic capabilities and a vast supply of natural resources, including graphite, marble, lead, coal, tin, columbine, limestone, and many others. Nigeria is one of the five African nations that supply 10% of the world's crude oil production. Nigeria is seen as an economy with a poor income despite having a great endowment and resources (Metu, Nwogwugwu, and Okeyika, 2019). Nigeria's current GDP rate is 429.42 billion dollars, which is much lower than the GDP in 2014 (see figure 3). In Nigeria, the inflation rate peaked in 2022 at 18.91 up from 2018 (see figure 2) (Sasu, 2022).

Exchange Rate Practices in Nigeria

Nigeria's exchange rate policy has evolved significantly over the decades:

- 1960-1967: The naira was pegged one-to-one with the British pound. This fixed parity ended in 1967 when the pound was devalued, but Nigeria did not follow suit due to the civil war.
- 1967-1974: The naira was pegged to the US dollar. The collapse of the Bretton Woods system revealed the drawbacks of pegging to a single currency, worsening inflation, and leading to the adoption of an independent managed exchange rate system by 1974.
- 1975-1986: Nigeria pegged the naira to a basket of currencies from major trading partners, providing stability until an economic crisis in 1981. In 1986, the government introduced the Second-Tier Foreign Exchange Market (SFEM), leading to a dual exchange rate system.

- 1987-1994: Efforts to stabilize the naira included merging the dual markets into a single Foreign Exchange Market (FEM) in 1987, creating the Autonomous Foreign Exchange Market (AFEM) in 1988, and modifying the Interbank Foreign Exchange Market (IFEM) in 1989. Despite these efforts, the naira continued to depreciate, leading to further deregulation and floating of the naira in 1992.
- 1995-2006: A policy reversal in 1995 reintroduced AFEM alongside an official fixed rate, but the dual exchange rate system persisted. The official rate was abolished in 1999, leading to the reintroduction of the Retail Dutch Auction System (RDAS) in 2002 and its replacement by the Wholesale Dutch Auction System (WDAS) in 2006, which aimed to stabilize the exchange rate.
- 2013-2023: RDAS was reintroduced in 2013 to curb money laundering and address declining oil prices and foreign reserves. In 2016, the foreign exchange market was further liberalized with a flexible exchange rate regime, leading to the introduction of the Investors and Exporters (I&E) window in 2017. In June 2023, Nigeria devalued the naira, unified exchange rates, and shifted to a 'willing buyers, willing sellers' model, with all FX trading now conducted through the I&E window.

Variables

In this study, Nigeria's economy is the dependent variable, while exchange rate fluctuations are the independent variable. Understanding the interplay between these variables is central to the research, as exchange rate volatility directly impacts economic performance.

Themes

Relationship between Economic Growth and Volatile Exchange Rate.

The relationship between exchange rates and economic growth is a focal point in finance and international commerce literature. Research highlights both the long-term correlation of exchange rates with macroeconomic fundamentals and their short-term irrationality. For example, Alagidede and Ibrahim (2016) utilized a vector error correction model (VECM) on data from 1980–2013 to evaluate the impact of exchange rate volatility on Ghana's

economy, revealing that excessive volatility negatively influenced growth. Conversely, Vieira et al. (2016) observed that fluctuating exchange rates could have positive effects on GDP, although controlling this volatility had minimal impact on economic variables in their model. The relationship between economic growth and exchange rate volatility extends beyond growth figures. For instance, Khan et al. (2020) posited that trade and foreign direct investment (FDI) are critical to understanding economic growth. Technological advancements and efficient resource allocation can mitigate some adverse effects of exchange rate volatility. Moreover, Oseni (2016) demonstrated the adverse effects of fluctuating exchange rates on the manufacturing sector in Sub-Saharan Africa, highlighting the complex and multifaceted impacts of currency fluctuations on economic performance. Exchange rate volatility also affects consumption and investment decisions, as shown by Hamidu et al. (2023) and Majee (2023), who discussed its implications for GDP and product pricing in African nations. Conversely, Magwedere and Chisasa (2023) noted that exchange rate fluctuations could boost credit scores, potentially benefiting banking sectors by influencing interest rates and internal systems.

Identification and Comparison of GDP Growth Rate and Factors Affecting It in Developing Economies.

Several factors influence GDP growth rates in developing economies, with labour productivity and working hours being primary determinants. Stoica et al. (2020) noted that developing economies could replicate production methods, institutional frameworks, and technologies from developed countries, enhancing their GDP growth rates. For instance, Joshi et al. (2023) observed that Asia and Oceania experienced a GDP growth rate of 5.3%, while American developing economies saw a more modest increase of 0.7%.

The GDP growth rate in developing countries has been significantly influenced by factors such as the rule of law, government size, consumption levels, life expectancy, investment rates, democracy, inflation, and trade openness (Ahmad et al., 2022). In Tanzania, for example, GDP is heavily influenced by consumption and exports, with political instability and

external economic shocks contributing to GDP fluctuations (Calabrese et al., 2019).

Country-specific analyses further reveal diverse growth patterns. India's economy, for example, grew by 6.1% year-on-year, while Brazil's GDP in 2021 was \$1.61 trillion, highlighting the varied economic trajectories of developing nations (Team, 2023). China's GDP growth is largely driven by agricultural services, reflecting the importance of sectoral contributions to national economic performance (Kharazishvili et al., 2020). Factors such as industrialisation, domestic demand, and income services play pivotal roles in stimulating GDP growth in developing countries. For instance, Mexico's economy relies heavily on agriculture, while Arabia's GDP was estimated at \$833.54 billion in 2021, underscoring the importance of sector-specific strategies for economic development (Team, 2023).

Exchange Rate Volatility and Its Impact on Foreign Direct Investments (FDI) and International Trade

Exchange rate volatility significantly impacts FDI and international trade. While some studies (e.g., Kim, 2017; Vieira & Macdonald, 2016) suggest a positive trend in economic activity in emerging markets with variable exchange rates, others, such as Serenis and Tsounis (2013), found that exchange rate volatility negatively affects exports in countries like Croatia and Cyprus.

Fluctuations in exchange rates introduce uncertainty in investment planning and international trade. Aftab, Syed, and Katper (2017) noted that currency depreciation could deter foreign investors due to increased risk and uncertainty. The impact of exchange rate fluctuations extends to multinational corporations (MNCs), which often rely on global supply chains. For example, Chen et al. (2020) found that exchange rate volatility affects MNCs' pricing strategies, acquisitions, and mergers, ultimately influencing their global competitiveness.

The depreciation of currencies, exacerbated by global events such as the Ukraine war, has had far-reaching effects on international trade and investment. For instance, the sharp rise in the USD against other currencies has affected trade balances, with the US share in world exports declining (Fibre2Fashion,

2023). Moreover, the fluctuation in exchange rates has led to increased costs for companies, influencing their strategic decisions regarding mergers, acquisitions, and market expansion (Lessard & Lightstone, 2014). In countries like India, exchange rate volatility has significantly impacted industries involved in export and import, leading to long-term effects on multiple sectors (Iqbal et al., 2023). The volatility of currencies like the Rupee against the USD has posed challenges for Indian industries, affecting their export competitiveness and overall economic stability.

Challenges Faced by Developing Economies under the Influence of Fluctuation in the Exchange Rate

Developing economies face multiple challenges due to exchange rate fluctuations, including increased import costs, inflation, debt burdens, reduced export competitiveness, policy challenges, and market volatility.

Import Costs and Inflation: Currency depreciation often leads to higher import costs, which can trigger inflation. In Nigeria, for example, inflationary pressures exacerbated by exchange rate volatility have led to price instability and reduced purchasing power (Musa, 2021). Similar trends have been observed in India, where exchange rate fluctuations have contributed to inflation and economic instability.

Debt Burden: Many developing economies carry significant foreign debt, often denominated in foreign currencies. Exchange rate fluctuations can increase the burden of servicing this debt, as seen in emerging markets where debt levels have reached their highest point in 50 years (Kose et al., 2022). Countries like Nigeria have experienced increased financial strain due to rising foreign debt, which hampers economic growth and development.

Export Competitiveness: Fluctuating exchange rates can undermine export competitiveness by making goods more expensive in international markets. Turkey, for example, has struggled with reduced competitiveness due to the appreciation of its currency (Atta, 2017). Similarly, Indonesia has seen its GDP decline due to a combination of reduced exports and domestic consumption pressures (Sugiharti et al., 2020).

Policy Challenges: Managing exchange rate fluctuations poses significant challenges for policymakers in developing economies. Balancing exchange rate stability, inflation control, and economic growth requires careful policy design, as seen in Bangladesh's response to inflation through flawed banking policies (The Financial Express, 2023). Central banks often intervene in foreign exchange markets to stabilize rates, but such interventions can deplete foreign reserves, further complicating policy decisions.

Uncertainty and Market Volatility: Exchange rate volatility introduces uncertainty in financial markets, affecting investor confidence and business planning. In Turkey, for example, excessive volatility has delayed investment decisions, leading to economic uncertainty and reduced productivity (Kilicarslan, 2018). This uncertainty complicates macroeconomic policy and disrupts the broader economic environment, making it difficult for companies to manage costs and revenues effectively.

Theory

Optimal Currency Area Theory

Mundell's Optimal Currency Area (OCA) theory, introduced in 1961, provides a foundation for a nation's exchange rate strategy (Drossart-Demond, 2022). The theory suggests that countries should ensure the stability of trade and business cycles, supported by market openness, shock symmetry, and labor mobility. It advocates that economies can grow in output and trade under a fixed exchange rate regime, reducing uncertainty and encouraging foreign investment (Iheanachor and Ozegbe, 2021). The OCA theory emphasizes that currency implementation should be region-based rather than country-based, aiming to enhance financial stability. However, it also highlights challenges like labor market flexibility, which can impact GDP stability.

Key criteria for OCA include labor mobility, pricing, wages, and economic similarities. Nations must establish robust labor laws, pricing, and wage policies to support business processes and ensure economic stability (Dufour, 2023). For Nigeria, adopting the OCA framework presents challenges due to its low GDP and high poverty levels. With an exchange rate of 1 USD to 776.50 NGN, the country's poor

investment environment complicates its entry into international markets (Exchange Rates, 2023). OCA could strain Nigeria's economy, risking bankruptcy. Instead, Nigeria should focus on financial growth strategies to stabilize its exchange rate and support international investments, considering the potential outcomes of OCA before implementation (Pasara and Garidzirai, 2020).

Literature Gap

The review of literature lacks a focus on Nigeria's economy, with no recent studies addressing exchange rate volatility in this context. The impact of successive political administrations on exchange rate policies in Nigeria is underexplored. This review fails to provide adequate information and conclusive arguments on the exchange rate's effects on Nigeria's economic pattern. These gaps are addressed in the subsequent research study.

III. METHODOLOGY

Introduction: This chapter outlines the systematic approach used to address the research questions and achieve the study's objectives. It provides a detailed roadmap for data collection, analysis, and interpretation, ensuring the study's findings are both reliable and consistent.

Research Onion: The Research Onion model, developed by Saunders, Lewis, and Thornhill, serves as a metaphorical framework for the research process in social sciences. It consists of six layers: Research philosophy, Research approach, Research strategy, Research design, Data collection, and Data Analysis. This model guides researchers in making informed decisions about their research methodology.

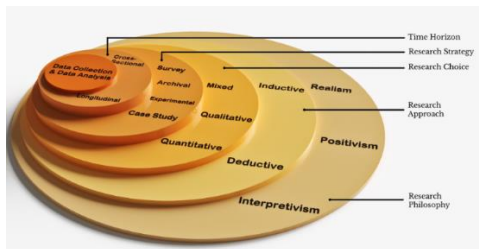


Figure 2: Research Onion

(Source: Sinha *et al.*, 2018)

Research Philosophy This study adopts pragmatism as its research philosophy, bridging the gap between positivism and interpretivism. Pragmatism allows the use of both qualitative and quantitative methods, which is essential for exploring the relationship between economic growth and exchange rate volatility in developing nations like Nigeria.

Research Approach An abductive research approach is employed, combining qualitative and quantitative methods. This approach facilitates the formation of hypotheses and new observations, making it suitable for studying how exchange rate fluctuations impact Nigeria's economy.

Research Design An exploratory research design is chosen due to its flexibility in gathering diverse information from various sources. This design helps in identifying key concepts and theories relevant to understanding the impact of exchange rate fluctuations on Nigeria's economy.

Research Strategy The study uses secondary qualitative and quantitative research strategies, leveraging existing data to gain new insights and validate findings. This approach is crucial for understanding the broader impact of exchange rate fluctuations on Nigeria's economic growth.

Research Choice A mixed-method research choice is adopted, integrating both qualitative and quantitative methods. This approach provides a comprehensive view of the research topic, enhancing the accuracy and depth of the analysis.

Inclusion and Exclusion Criteria Inclusion criteria: Peer-reviewed journal articles published after 2018 and reputable news sources. Exclusion criteria: Articles irrelevant to the topic and quantitative data from developed nations.

Selection of Data Sources Secondary qualitative data is gathered from academic journals, news articles, and government websites, while quantitative data is sourced from institutions like the World Bank, IMF, and Nigeria's central bank. These sources provide comprehensive data on Nigeria's economy and exchange rate.

Data Collection Method The study relies on secondary qualitative and quantitative data collection. Keywords related to exchange rate fluctuation, Nigeria, and economic growth are used to search for relevant articles. Quantitative data on economic indicators like GDP, inflation, and trade are collected from reliable sources.

Data Analysis Technique Thematic analysis is used for qualitative data, allowing for systematic interpretation and deeper insights. For quantitative data, statistical analysis is employed to examine the relationship between exchange rate fluctuations and Nigeria's economic growth.

Model Specification The study utilizes an ex post facto research design, which investigates variables that have already occurred. Unlike previous studies that employed the Ordinary Least Squares (OLS) method, this research adopts the Multivariate Adaptive Regression Spline (MARS) approach, which effectively models both linear and nonlinear relationships in the data. The study's model is expressed as:

$$GDP = a_0 + a_1EXP + a_2INT + a_3INF + a_4IMP + u$$

Where:

- GDP: Economic growth of Nigeria (dependent variable)
- EXP: Exchange rate
- INT: Interest rate
- INF: Inflation rate
- IMP: Exports and imports
- u: Error term

Ethical Considerations The study adheres to ethical guidelines, including proper citation and referencing to avoid plagiarism. Data is collected from reputable sources, ensuring accuracy and credibility.

Time Horizon A cross-sectional time horizon is chosen due to time constraints, allowing for the collection and analysis of data at a single point in time, which is sufficient for meeting the study's objectives.

IV. ANALYSIS OF RESULTS

Data Analysis and Interpretations

This chapter presents the analysis of data and the findings of the research, exploring the relationship between exchange rate fluctuations, other economic variables, and GDP. While past studies have generally assumed a linear relationship between GDP and other economic variables, this assumption often does not hold true, violating the basic ordinary least squares (OLS) assumptions. As a result, this study employs a more advanced machine learning technique, the Multivariate Adaptive Regression Spline (MARS), which can simultaneously accommodate both linear and nonlinear relationships within the dataset.

The first section of this chapter covers exploratory data analysis, followed by an in-depth discussion of the MARS method used for analysis. The goal is to establish the relationship between the explanatory variables and the dependent variable, justifying the approach taken in this study.

Exploratory Data Analysis

In the analysis, we denote the variables as follows: EXP for exchange rate, INT for interest rate, INF for inflation rate, and IMP for the balance of trade (the difference between imports and exports).

Over the last six decades, Nigeria's GDP averaged 147.147 billion USD, with a range between 27.766 and 258.358 billion USD. The summary statistics are presented in Table 1 below.

Table 1: Summary statistics

Statistics	GDP (in Billion)	EXP (in Billion)	INT	INF	IMP
Min.	4.196	0.6040	6.00	-3.726	0.6657
1st Qu.	27.766	0.7143	7.00	7.566	2.3788
Median	54.604	12.0599	15.14	12.095	8.6798
Mean	147.147	86.4421	13.88	15.804	19.8386
3rd Qu.	258.358	141.0635	18.07	16.738	27.3866
Max.	574.184	454.1530	31.65	72.835	89.7777

The mean and median values for the exchange rate (EXP) show a significant gap, indicating the presence

of outliers, as also reflected in the boxplots (Figure 3). EXP, INF, and IMP exhibit outlier sets and are heavily skewed, signaling non-normality in the data distribution.

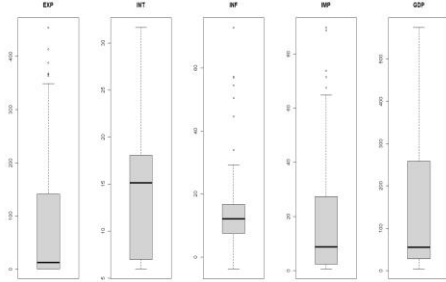


Figure 3: Boxplot of Study Variables of Interest

Figure 4 illustrates the behavior of these variables over time. While EXP follows a strict upward trend, other variables show significant fluctuations, with INT and INF experiencing notable declines over the period studied.

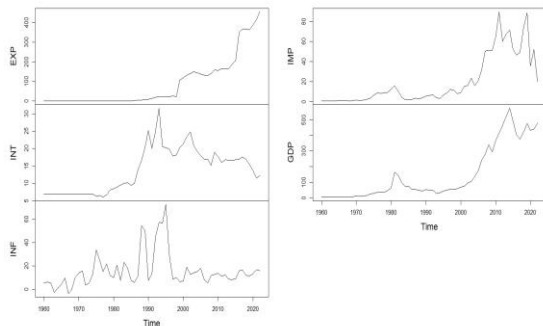


Figure 4: Behavior of Variables Over Time

To validate the hypothesis that the relationship between GDP and other economic variables is nonlinear, we plotted basic line plots of the explanatory variables (Figure 5) and a modeled relationship between GDP and these variables (Figure 6). The analysis shows that only IMP exhibits a clear linear relationship with GDP, while other variables do not, thereby supporting the hypothesis.

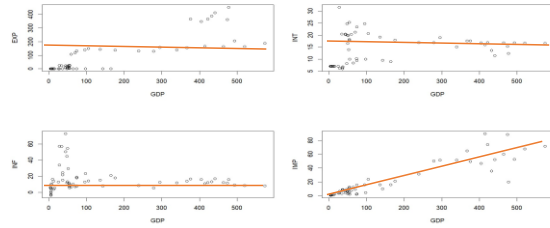


Figure 5: Direct Line Plot of the Relationship Between Explanatory Variables and GDP

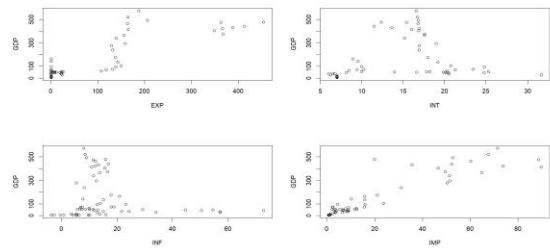


Figure 6: Modeled Line Plot of the Relationship Between Explanatory Variables and GDP

Model Fitting and Analysis

A linear regression model was fitted to confirm the exploratory analysis findings. As shown in Table 1, EXP and IMP have significant statistical relationships with GDP, and the model explains 89.92% of the total variation in GDP. However, residual analysis indicates that the assumptions of the OLS regression model are not met, making the model's output unreliable.

Linear Regression Model Output:

- $GDP = 30.136 + 0.534*(EXP) + 0.2816*(INF) - 1.705 (INT) + 4.539(IMP)$
- Adjusted R-squared: 0.8992
- F-statistic: 139.2, p-value: < 2.2e-16

This equation above indicates that, holding other explanatory variables constant, each unit increase in EXP is associated with an average increase in GDP of 0.534 billion. Similarly, a unit increase in INF corresponds to an average GDP increase of 0.2816 billion.

The statistical significance of the model coefficients is reflected in their corresponding p-values. Notably, the p-value for EXP (3.50e-08) is significantly lower than the 0.05 threshold, indicating a statistically significant relationship between EXP and GDP. The adjusted R-

squared value (0.8992) suggests that 89.92% of the variability in GDP can be explained by the model's explanatory variables.

The residual standard error of 54.82 indicates the average deviation between observed GDP values and those predicted by the regression model. A lower residual standard error would indicate a better fit, but in this case, the error remains relatively high.

The F-statistic of 139.2, with an associated p-value of less than 2.2e-16, suggests that the model is statistically significant overall, meaning that the predictor variables (EXP, IMP, INT, and INF) are effective in explaining the variation in GDP.

However, it is essential to verify the assumptions underlying the Ordinary Least Squares (OLS) regression model. The residuals vs. fitted plot (Figure 6) was created to check the assumption of homoscedasticity, which requires that the residuals exhibit constant variance at all levels of the predictor variables. The plot shows that the residuals are randomly scattered around zero, but noticeable patterns suggest that the homoscedasticity assumption is violated.

The assumption of normality, which posits that the residuals should be normally distributed, was assessed using a Q-Q plot (Figure 7). The plot reveals that the residuals deviate from the 45-degree line, indicating a failure to meet the normality assumption.

Given that the residuals are neither normally distributed nor homoscedastic, the assumptions of the OLS regression model are not met. Consequently, the model output is unreliable, which validates the hypothesis stated earlier in this chapter and justifies the adoption of the Multivariate Adaptive Regression Spline (MARS) algorithm as a more suitable approach.

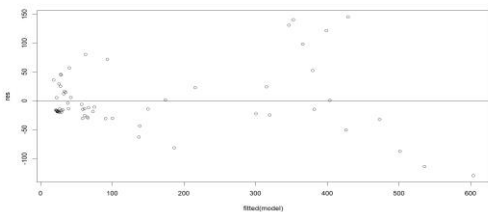


Figure 6: Residuals vs. Fitted Plot

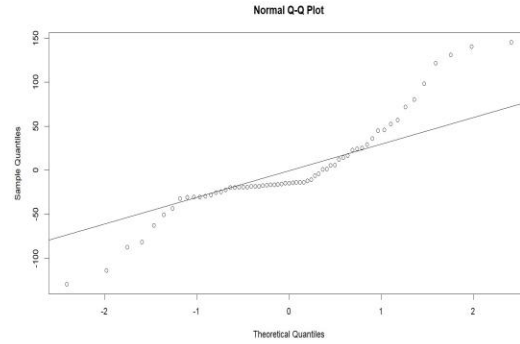


Figure 7: Q-Q Plot

Since the residuals are not normally distributed and exhibit heteroscedasticity, the assumptions of the OLS regression model are not met, justifying the adoption of the MARS algorithm.

MARS Model

The MARS model was fitted, and the output is presented in Table 2.

Knot/hinges - nonlinear	Coefficients
(Intercept)	345.62570
h(EXP – 128.85)	0.45990
h(9.97667-INT)	-22.83344
h(INT – 16.7917)	-21.40455
h(INT – 20.29)	23.00611
h(46.5525 - IMP)	-5.96683
h(IMP -46.5525)	2.03791
GCV (degree)	3052.958 (1)

The fitted MARS models are:

$$GDP = 345.62 + 0.45990*(EXP) + 23.006 *(INT) + 2.0379*(IMP) \rightarrow \text{Linear}$$

$$GDP = 345.62 + 0.45990*(EXP) - 22.833 *(INT) - 5.9668*(IMP) \rightarrow \text{Non-linear}$$

The results suggest that EXP (export rate) directly influences GDP, with a unit increase in EXP resulting in a 0.4599 billion increase in GDP, holding other variables constant. The impact of the independent variables is further highlighted by the "knot" effects, which reveal the true magnitude of their influence on GDP. Specifically, EXP has the most significant impact, with a unit increase leading to a 59.258 billion increase in GDP. INT (interest rate) exhibits a bidirectional influence on GDP, contributing to a

359.4188 billion increase in one scenario and a 227.8017 billion decrease in another. Similarly, IMP (imports) also shows a bidirectional effect, causing a 94.8698 billion decrease in one instance and a 277.7709 billion increase in another. This bidirectional nature indicates that the relationships between INT, IMP, and GDP are complex and vary over time. Together, the variables IMP, EXP, and INT (excluding INF) explain 92.99% of the total variation in GDP, highlighting their significant predictive power. The analysis shows that INF (inflation rate) is not a relevant predictor of Nigeria's GDP in this dataset. When compared with the results from the linear regression model, it is evident that the MARS model outperforms the linear model substantially.

Variable Importance and Relationships

Figure 8 displays the order of importance of the predictors to GDP, with IMP contributing the most to the linear relationship, followed by EXP and INT.

Figure 9 illustrates the relationship between GDP and the predictors IMP and EXP. The data reveals that EXP initially follows a nonlinear pattern but then maintains a strong positive linear relationship with GDP, suggesting that EXP has a greater impact on GDP than any other predictor used in the model. IMP, on the other hand, shows a bidirectional relationship with GDP. At certain points, IMP is inversely related to GDP, but this relationship reverses from a specific period onward, continuing in a direct relationship thereafter. Figure 10 explores the relationship between GDP and INT. Similar to IMP, INT exhibits both linear and nonlinear behaviors. The impact of INT on GDP is strong in both directions, indicating that its influence fluctuates over time.

Model Performance Comparison

The table below compares the performance of the Multiple Linear Regression (MLR) and MARS models

Model	MSE	RMSE	MAE	Adj. R Square
MLR	2766.749	52.5998	37.6575	0.8992
MARS	1923.002	43.8521	27.7206	0.9299

The results clearly indicate that the MARS model has a lower Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Error (MAE) compared to the MLR model, along with a higher Adjusted R-Squared value, demonstrating its superior performance in predicting Nigeria's GDP.

CONCLUSION

In summary, the variables IMP, EXP, and INT are the most significant explanatory variables, collectively accounting for 92.99% of the variation in Nigeria's GDP. The MARS model provides a more accurate and reliable fit than the traditional linear regression model, making it a more suitable method for modeling complex economic relationships in this context.

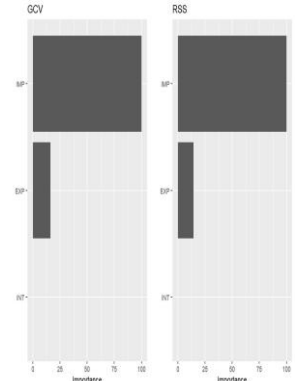


Figure 8: Order of Variable Importance

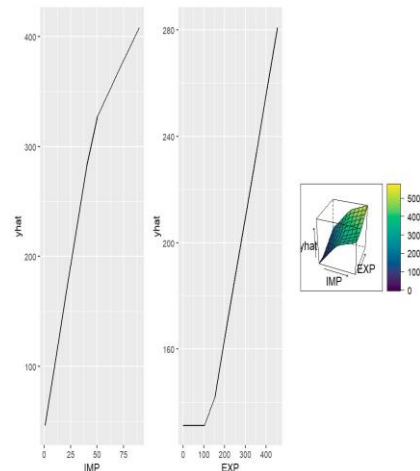


Figure 9: Relationship between variables – IMP, EXP versus GDP

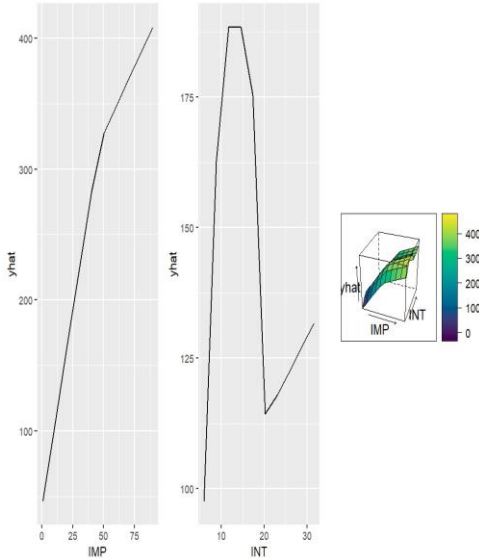


Figure 10: Relationship between variables – IMP, INT versus GDP

Model Outputs

year	Actual. GDP	MLR.GDP	MARS.GDP
1 1960	4.196175	23.34226	4.124777
2 1961	4.467288	23.65887	4.231944
3 1962	4.909399	23.09010	3.859439
4 1963	5.165590	21.00070	4.059617
5 1964	5.552931	22.71163	4.994022
6 1965	5.874538	24.01198	5.501524

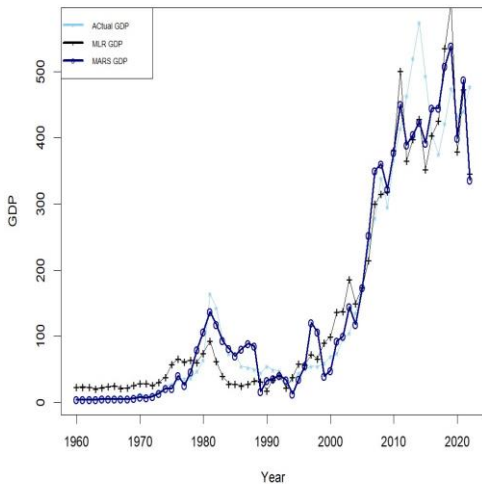


Figure 11: Model Output Comparison

CONCLUSION

Introduction

This chapter presents the summary, conclusion, and recommendations derived from the study on the impact of exchange rate fluctuations on economic growth in Nigeria. The research primarily focused on understanding how fluctuations in the exchange rate affect Nigeria's GDP, while also considering the influence of other economic variables such as inflation, interest rates, imports, and exports. The study utilized secondary quantitative data from the Central Bank of Nigeria, National Bureau of Statistics, IMF, and World Bank, complemented by a qualitative review of relevant academic literature.

Summary of Findings

The summary of findings is structured around the study's key objectives, addressing the following research questions:

What is the relationship between economic growth and the volatile exchange rate?

- The analysis confirmed a nonlinear relationship between GDP and exchange rate fluctuations. This indicates that changes in the exchange rate do not correspond proportionally with changes in GDP.
- Exchange rate fluctuations were found to have a direct impact on Nigeria's economic growth.
- Among the independent variables examined, exchange rate volatility had the most significant effect on economic growth.

How has the current economic structure of Nigeria affected the country's exchange rate policies?

- The study explored Nigeria's transition to a mono-economy, heavily reliant on crude oil exports, and the impact of this on exchange rate policies.
- The findings show that the balance of trade, representing the net effect of imports and exports, significantly influences GDP.
- Exchange rate, imports, and exports together explain 89.92% of the variation in GDP.
- Imports and exports exhibit a bidirectional relationship with GDP, where the balance of payments is inversely related to GDP at certain times, and directly related at others.

What is the trend of GDP growth in Nigeria over the past decades?

- The analysis of GDP trends over time revealed fluctuations, with periods of both high and low growth rates, indicating an unstable growth pattern.

What are the dimensions of the influence of exchange rate fluctuations in Nigeria over the past decades?

- Through a literature review, the study highlighted how Nigeria's economy has shifted towards a mono-economic structure, with crude oil as the major revenue source. Exchange rate fluctuations have contributed to economic instability, leading to inflation, unemployment, and reduced investment.

Conclusion

Exchange rate fluctuations have posed a significant challenge to Nigeria's economic stability. This study, utilizing the Multivariate Adaptive Regression Spline (MARS) model, established that the relationship between GDP and exchange rate fluctuations is nonlinear. Additionally, other economic variables, such as inflation, interest rates, imports, and exports, were found to influence economic growth in Nigeria. The findings indicate that the exchange rate is a critical indicator of economic growth in Nigeria, with its volatility directly impacting GDP. The study also observed that Nigeria's economic growth has been inconsistent over the past decades, with the economy heavily reliant on oil exports and foreign goods. The analysis affirmed that the balance of payments can have both direct and inverse effects on economic growth.

Recommendations

Based on the findings, the following policy recommendations are suggested to stabilize the exchange rate and enhance economic growth:

- Promote Local Production: Discourage the importation of goods that can be produced locally by supporting local industries and imposing restrictions on imports of such goods.
- Diversify Exports: Encourage export diversification beyond crude oil to sectors such as agriculture, agro-investment, and agro-allied industries to increase foreign exchange earnings.

- Reduce Foreign Debt: The government should reduce the foreign debt burden, as debt servicing depletes the country's limited foreign reserves.
- Invest in Infrastructure: Invest in infrastructure to create employment and attract foreign investment, which will improve the balance of payments.
- Implement Economic Reforms: The government should implement economic reforms to stabilize the exchange rate and mitigate the adverse effects of foreign exchange volatility.
- Optimize Interest Rates: Set interest rates that promote economic growth, considering their significant impact on the economy.
- Adopt Advanced Production Strategies: Nigeria should adopt production strategies, institutions, and technologies from developed countries to enhance economic performance.

Study Limitations

This study focused on the impact of exchange rate fluctuations on Nigeria's economic growth, with independent variables limited to exchange rate, inflation, interest rates, imports, and exports. The scope was restricted to Nigeria's foreign exchange policies and their effects on economic growth. Consequently, the findings may not be directly applicable to developed nations, given Nigeria's status as a developing country.

Suggestions for Future Research

Future research could expand upon this study by considering additional economic variables and exploring the effects of different exchange rate policy regimes on economic growth. This would provide a more comprehensive understanding of the dynamics between exchange rate fluctuations and economic performance.

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