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CRYPTOCURRENCY AND ITS ROLE IN NIGERIA'S ECONOMIC GROWTH: AN EXPLORATION OF INVESTMENT AND TRADE OPPORTUNITIES

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Abstract

This study investigates the impact of cryptocurrency adoption on the Nigerian economy, with a focus on three key economic variables: exchange rates, financial inclusion, and remittance flows. Cryptocurrency adoption is proxied using aggregate cryptocurrency transaction values and trend data on user engagement in Nigeria. Using a quantitative research design, the study employs time-series data from 2010 to 2023 and applies advanced econometric techniques, including the Vector Error Correction Model (VECM), which is particularly suitable for examining both short-run dynamics and long-run equilibrium relationships among co-integrated variables. The results reveal that cryptocurrency adoption has a negative impact on exchange rates, potentially contributing to the depreciation of the Nigerian Naira due to increased capital outflows. Conversely, cryptocurrency adoption positively influences financial inclusion, as it provides access to financial services for the unbanked and underserved populations in Nigeria. Additionally, the study finds that cryptocurrencies facilitate remittance flows, with digital currencies serving as an efficient and cost-effective alternative to traditional remittance channels. The findings suggest a long-term equilibrium relationship between cryptocurrency adoption and these key economic variables. Although not the primary focus, improvements in financial inclusion and remittance flows linked to digital currencies may have indirect implications for broader economic growth. The study concludes with policy recommendations, including the development of a clear regulatory framework, promoting cryptocurrency adoption for financial inclusion, and encouraging its use for remittances. The research highlights the need for balanced regulation to harness the benefits of cryptocurrencies while mitigating their potential risks to the economy.

Keywords: Cryptocurrency, Digital Currency, Economic Growth, Exchange Rate, Financial Inclusion, Nigeria, Remittances, VECM

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1. INTRODUCTION

1.1. Background of Study

Cryptocurrencies, including Bitcoin, Ethereum, and other digital currencies, have emerged as significant players in the global financial ecosystem, offering an alternative to traditional banking and monetary systems. In recent years, cryptocurrencies have gained substantial traction in many emerging economies, including Nigeria, largely due to limitations within the conventional financial infrastructure, persistent inflation, and exchange rate volatility (Ahannaya et al., 2021). These structural and macroeconomic challenges have increased the attractiveness of digital currencies. With Nigeria's growing reliance on remittances, cryptocurrencies present an opportunity to bypass conventional financial barriers and promote broader financial participation. However, while the adoption of cryptocurrencies has increased, particularly in exchange-related activities, financial inclusion efforts, and remittance services, the broader economic implications of these digital currencies, particularly their role in promoting or hindering economic growth, remain unclear.

Nigeria, as Africa's largest economy, is at the forefront of cryptocurrency adoption in the region. According to Cryptocurrency Ownership Data (2022), Nigeria ranks among the top countries in terms of crypto usage, driven by factors such as limited access to traditional banking, a youthful tech-savvy population, and the need for faster remittance channels. Despite these metrics reflecting rising adoption, the question remains: how does cryptocurrency adoption truly affect Nigeria's economic growth? Is its impact positive, in terms of enhancing financial inclusion and remittances, or does it undermine economic stability by introducing volatility?

Several studies have explored different aspects of cryptocurrency's impact on the Nigerian economy. For example, Ahannaya et al. (2021) analyzed the effect of cryptocurrencies on Nigeria's economy, highlighting their potential to stimulate economic activities such as financial transactions and cross-border payments. However, their study primarily focused on sector-specific impacts without delving into the broader economic growth effects. Similarly, Chris et al. (2021) examined the influence of cryptocurrency adoption on Nigerian businesses and found that while it offers diversification opportunities, it also introduces volatility risks that could destabilize the financial market. However, these studies largely overlook the broader impact on national economic performance and fail to integrate key economic drivers like exchange rates, financial inclusion, and remittances in assessing their cumulative effect on economic growth.

Moreover, while research by Ekong and Ekong (2022) sheds light on how digital currencies can enhance financial inclusion, it does not explore the link between cryptocurrency adoption and Nigeria's overall economic growth. Aminu et al. (2022) addressed the intersection of digital currencies and monetary policy, discussing how cryptocurrencies might challenge traditional monetary frameworks, but their analysis did not extend to assessing how cryptocurrencies influence economic growth as a whole.

The existing literature has largely focused on isolated aspects such as financial inclusion, remittances, and volatility, but there is a noticeable gap in comprehensive studies that assess the combined influence of cryptocurrency adoption on exchange rate stability, inclusion in financial systems, and remittance flows, and how these elements collectively contribute to the economic growth of Nigeria. This research seeks to fill that gap by investigating the relationship between cryptocurrency adoption and economic growth in Nigeria. Specifically, the study evaluates the impact of cryptocurrency usage in key areas such as exchange rate, financial inclusion, and remittances on Nigeria's broader economic performance.

By examining these variables, this study aims to provide a more holistic understanding of how cryptocurrency adoption can either facilitate or hinder economic growth in Nigeria. The research will offer valuable insights for policymakers and financial institutions, providing a framework for integrating cryptocurrencies into the national economic structure while mitigating associated risks. Furthermore, this study will contribute to the ongoing discourse on the role of digital currencies in developing economies, offering practical recommendations for leveraging cryptocurrencies to foster sustainable economic development in Nigeria.

1.2. Research Objectives

The primary objective of this study is to investigate the relationship between cryptocurrency adoption and economic growth in Nigeria, focusing on three key factors: trade, investment, and remittances. The specific objectives of the study are as follows:

i. To evaluate the impact of cryptocurrency adoption on economic growth in Nigeria.
ii. To assess the effect of exchange rate fluctuations on Nigeria's economic growth.
iii. To examine the influence of financial inclusion on Nigeria's economic growth.
iv. To analyze the relationship between remittance flows and economic growth in Nigeria.

2. LITERATURE REVIEW

2.1. Conceptual Literature Review

This section presents the conceptual framework surrounding the key variables of interest—cryptocurrency adoption, trade, investment, remittances, and economic growth—by reviewing relevant literature to understand the existing theoretical perspectives and empirical findings on how these variables interact, particularly in the context of Nigeria.

2.1.1. Cryptocurrency Adoption

Cryptocurrency adoption refers to the process through which individuals, businesses, and governments embrace and integrate digital currencies into their financial systems,

economic activities, and day-to-day operations. According to Nakamoto (2008), cryptocurrencies, like Bitcoin, operate on decentralized networks, enabling peer-to-peer transactions without the need for traditional financial intermediaries. This decentralization is seen as a revolutionary change to financial systems, as it challenges conventional monetary policy and banking infrastructure.

In Nigeria, the adoption of cryptocurrencies has been significant, primarily driven by issues related to inflation, currency devaluation, and limitations in financial inclusion (Ahannaya et al., 2021). Cryptocurrencies offer an alternative to the traditional financial system by providing a medium of exchange that is not directly influenced by government monetary policies. However, while adoption has increased, especially among younger Nigerians and those in the diaspora, challenges such as regulatory uncertainty, security concerns, and the volatility of cryptocurrencies remain significant barriers (Aminu et al., 2022).

Empirically, studies by Ekong and Ekong (2022) and Safiyanu et al. (2022) have shown that despite these challenges, the increasing popularity of cryptocurrencies can act as an alternative store of value and method of payment, thus pushing forward the integration of digital currencies into Nigeria's financial landscape.

2.1.2. Cryptocurrency and Trade

Trade refers to the exchange of goods and services, and the efficiency of trade in any economy is largely determined by the ease of conducting transactions, payment systems, and the speed at which goods and services are exchanged across borders. Cryptocurrencies can enhance trade by reducing transaction costs, improving efficiency, and facilitating international transactions. According to Chris et al. (2021), cryptocurrencies provide faster, cheaper, and more secure cross-border transactions compared to traditional banking systems, especially in countries with underdeveloped financial systems like Nigeria.

In the context of Nigeria, cryptocurrencies such as Bitcoin and Ethereum have been particularly useful in facilitating trade by bypassing currency restrictions, which have often been a limitation due to the volatile naira and periodic currency devaluation (Ahannaya et al., 2021). Research by Ojiakor et al. (2022) further highlights how Nigerian businesses engaged in import and export activities have leveraged cryptocurrencies to overcome the high costs of currency conversion and delays associated with traditional banking systems. Thus, cryptocurrency adoption in trade has the potential to reduce friction in international trade and lower the barriers to entry for small and medium-sized enterprises (SMEs).

2.1.3. Cryptocurrency and Investment

Investment is critical for economic growth, as it contributes to the capital accumulation needed for expanding productive capacity and driving economic activity. Cryptocurrencies have been perceived as a form of speculative investment, offering high returns at significant risks due to their inherent volatility (Choi & Rocheteau, 2021). In Nigeria, cryptocurrencies have attracted considerable attention

from both domestic and international investors looking for alternative asset classes, particularly during times of economic uncertainty (Aminu et al., 2022).

The adoption of cryptocurrencies has the potential to increase investment in Nigeria by opening up new opportunities for individuals and institutional investors. Cryptocurrencies provide a decentralized alternative to traditional investment avenues like stocks, bonds, and real estate. Studies by Jimoh and Oluwasegun (2020) suggest that the high volatility and speculative nature of cryptocurrencies can lead to short-term investment gains but may also deter conservative investors seeking stable returns. However, the increasing acceptance of cryptocurrencies by Nigerian investors highlights their role as a new investment class, which could influence investment decisions at both the domestic and international levels.

Furthermore, studies by Holtmeier and Sandner (2019) argue that cryptocurrencies could enhance access to global capital markets, offering investors in Nigeria a broader range of investment opportunities. This is particularly relevant for a country that often faces challenges related to liquidity and limited access to international markets due to infrastructural and regulatory constraints.

2.1.4. Cryptocurrency and Remittances

Remittances play a crucial role in the Nigerian economy, contributing significantly to foreign exchange reserves and poverty alleviation. Nigeria is one of the largest recipients of remittances in Sub-Saharan Africa, with millions of Nigerians in the diaspora sending money back home to support family members and fund businesses. However, the cost of transferring money through traditional remittance channels like banks and money transfer operators can be high, with fees often exceeding 10% of the total amount sent (Cryptocurrency Ownership Data for Nigeria, 2022).

Cryptocurrencies present a potential solution to reduce remittance costs, enabling faster, cheaper, and more transparent cross-border transactions. According to Ozili (2022), the use of cryptocurrencies like Bitcoin for remittances offers a lower-cost alternative, as it eliminates the need for intermediary financial institutions and provides near-instantaneous transfers. This could be particularly beneficial for Nigerian families who rely heavily on remittances for their livelihoods. Studies by Li et al. (2022) and Ekong and Ekong (2022) highlight that the ease of using cryptocurrencies for cross-border remittances is a key driver behind their adoption, particularly among the Nigerian diaspora.

Moreover, the rise of cryptocurrency adoption in Nigeria has been mirrored by increasing use in remittance corridors from the United States, Europe, and other regions, demonstrating the growing role of digital currencies in facilitating global money transfers. This shift is expected to reduce the transaction costs traditionally associated with remittances, directly improving financial inclusion and economic participation among the Nigerian population.

2.1.5. Cryptocurrency and Economic Growth

Economic growth is a broad concept that measures the increase in the value of goods and services produced by an economy over time. It is often used as an indicator of a country's economic health and prosperity. The relationship between cryptocurrency adoption and economic growth, particularly in developing economies like Nigeria, is still a subject of debate. On one hand, cryptocurrencies may provide a boost to economic growth by enhancing trade, increasing investment, and reducing remittance costs (Choi & Rocheteau, 2021). On the other hand, the volatility and lack of regulatory oversight associated with cryptocurrencies can lead to financial instability and undermine economic growth (Holtmeier & Sandner, 2019).

In the case of Nigeria, studies have shown that while cryptocurrencies offer certain benefits, their potential to destabilize the economy cannot be overlooked. According to Safiyanu et al. (2022), cryptocurrencies could introduce risks such as capital flight, speculative bubbles, and illegal activities, which could negatively affect economic stability. However, as noted by Fernández-Villaverde and Sanches (2018), if properly regulated, cryptocurrencies could contribute to financial inclusion, enhance international trade, and stimulate investment, thus fostering economic growth in the long run.

The conceptual literature on cryptocurrencies and their impact on trade, investment, remittances, and economic growth suggests that these digital currencies have both positive and negative implications for developing economies like Nigeria. While the adoption of cryptocurrencies can enhance trade efficiency, reduce remittance costs, and attract investments, their volatility and regulatory challenges pose significant risks. This study will explore these complex relationships in the Nigerian context to provide a comprehensive understanding of how cryptocurrency adoption affects economic growth in the country.

2.2. Theoretical Literature

2.2.1. Transaction Cost Theory

The Transaction Cost Theory was developed by Ronald Coase (1937) and further extended by Oliver Williamson (1981). It posits that individuals and organizations aim to minimize the costs associated with economic transactions, including search, negotiation, enforcement, and monitoring costs. The theory suggests that technological innovations (such as cryptocurrencies) can reduce transaction costs and increase efficiency, thereby altering the structure of markets.

Cryptocurrencies, through decentralized platforms, significantly reduce transaction costs compared to traditional financial systems. In Nigeria, cryptocurrency transactions can bypass the high fees associated with banking institutions and international money transfer services (Aminu et al., 2022). As cryptocurrency usage grows, it becomes an attractive alternative for trade, remittances, and investment, particularly in a country with financial inclusion challenges. By facilitating low-cost

financial transactions, cryptocurrencies contribute to reducing barriers for individuals and businesses, thus supporting economic growth.

The study investigates how cryptocurrencies can influence Nigeria's trade, remittances, and investment patterns. The Transaction Cost Theory supports the hypothesis that the adoption of cryptocurrencies reduces costs for businesses and individuals engaging in cross-border transactions, leading to enhanced economic activities. This theory helps in explaining the mechanism by which cryptocurrencies contribute to economic growth by making transactions more efficient and cost-effective.

2.2.2. Theory of Financial Intermediation

The Theory of Financial Intermediation, primarily developed by Diamond (1984) and other scholars, explains the role of intermediaries (banks, financial institutions) in facilitating the flow of capital in an economy. It argues that intermediaries reduce information asymmetry, manage risk, and provide liquidity in financial markets. With the advent of digital currencies like Bitcoin, the theory can be adapted to explain the shift from traditional financial intermediaries to decentralized systems.

In Nigeria, where traditional financial institutions often fail to provide inclusive and affordable services, cryptocurrencies serve as a new form of financial intermediation. They enable peer-to-peer transactions without the need for centralized banks, reducing dependence on financial intermediaries and providing a new avenue for investment and savings. According to Ozili (2022), the rise of cryptocurrencies offers significant opportunities for financial inclusion in emerging markets like Nigeria, which is central to this study's focus on how cryptocurrencies impact economic growth.

This theory provides the conceptual framework for understanding how cryptocurrencies can act as an alternative financial intermediary in Nigeria. It suggests that by reducing reliance on banks and formal financial systems, cryptocurrencies can facilitate smoother, faster, and more inclusive economic transactions. The theory supports the study's objective of evaluating how cryptocurrencies influence economic activities, such as trade, investment, and remittance flows, by creating new forms of financial intermediation that are more accessible and less costly.

2.2.3. Innovation Diffusion Theory

Innovation Diffusion Theory, proposed by Everett Rogers (1962), explains how, why, and at what rate new ideas and technology spread within a society. It identifies factors that influence the adoption of innovations, such as perceived benefits, compatibility with existing systems, simplicity, trialability, and observable results. Rogers' framework has been widely applied in understanding the adoption of technological innovations, including digital currencies.

In Nigeria, the adoption of cryptocurrencies is seen as part of a broader technological shift, influenced by factors such as financial inclusion, economic instability, and remittance inflows (Safiyanu et al., 2022). The Innovation Diffusion Theory helps to explain how cryptocurrencies are gaining popularity in Nigeria, especially among young people and tech-savvy entrepreneurs who see it as a tool for financial empowerment and investment diversification. This theory is crucial for understanding how cryptocurrency adoption is progressing in the Nigerian economy and its potential long-term impacts.

This theory supports the study by providing insights into the factors influencing cryptocurrency adoption in Nigeria, including the perceived advantages (such as lower transaction costs and faster transactions) and the obstacles (like regulatory uncertainties). By applying this theory, the study can examine how the diffusion of cryptocurrencies impacts economic growth, particularly in the context of trade, investment, and remittance channels. The theory helps in understanding the dynamics of cryptocurrency adoption and its role in reshaping Nigeria's economic landscape.

2.3. Empirical Literature Review

Several studies have examined the impact of cryptocurrencies on various aspects of the Nigerian economy, including financial inclusion, exchange rates, economic growth, and the regulatory environment.

Ahannaya et al. (2021) explored the relationship between cryptocurrency adoption and Nigeria's economy, focusing on the effect of digital currencies on transaction costs, investments, and financial inclusion. Their findings highlight that cryptocurrencies have a positive impact on reducing transaction costs and improving financial inclusion, though challenges related to regulation remain significant. The study concludes that the adoption of digital currencies can be a catalyst for economic development in Nigeria, especially by fostering remittance flows and investment.

Similarly, Aminu et al. (2022) analyzed the role of digital currencies in Nigeria's monetary policy and economic growth. The authors found that cryptocurrencies can positively influence economic growth by enhancing financial inclusion and reducing the cost of remittances, which are a vital part of Nigeria's foreign exchange inflows. Their study provides empirical support for the assertion that digital currencies can help improve monetary policy effectiveness and economic stability in the Nigerian context.

In contrast, Jimoh and Oluwasegun (2020) investigated the volatility of cryptocurrency returns and its impact on Nigeria's stock market and exchange rate volatility. They observed a significant relationship between cryptocurrency returns volatility and exchange rate fluctuations, suggesting that cryptocurrencies could amplify exchange rate volatility in Nigeria. This study contributes to the growing body of literature on the link between cryptocurrency markets and traditional financial markets, particularly in emerging economies like Nigeria.

Ojiakor et al. (2022) focused on the regulatory challenges faced by Nigeria in adopting and regulating cryptocurrencies. They highlighted that the lack of a clear regulatory framework for cryptocurrencies has led to uncertainty in the market, deterring investment and hindering the broader adoption of digital currencies. Their study emphasizes the importance of a well-defined regulatory structure to support cryptocurrency adoption while mitigating associated risks.

Okpalaojiego (2021) examined the economic consequences of the Nigerian government's ban on cryptocurrencies. His research found that the ban negatively affected the economy by reducing the efficiency of remittance channels and discouraging foreign investment. This ban, according to Okpalaojiego, highlighted the potential of cryptocurrencies to provide alternative financial systems that bypass traditional banking infrastructure.

Safiyanu et al. (2022) explored the effects of cryptocurrencies on exchange rates in Nigeria. They found a significant inverse relationship between the adoption of cryptocurrencies and the Nigerian Naira exchange rate. Their study suggests that cryptocurrencies have the potential to stabilize or destabilize exchange rates, depending on their usage and regulation, which directly influences Nigeria's trade balance and economic stability.

Ekong and Ekong (2022) investigated the impact of digital currencies on financial inclusion in Nigeria. Their findings indicate that digital currencies have the potential to enhance financial inclusion by providing access to banking services for the unbanked and underbanked populations. This study reinforces the argument that cryptocurrencies can offer a solution to financial exclusion in developing economies.

Chris et al. (2021) analyzed the broader impact of cryptocurrency adoption on Nigeria's economy. They noted that cryptocurrencies have the potential to contribute significantly to Nigeria's economic growth by enhancing cross-border trade, offering an alternative to unstable local currencies, and attracting foreign investments. However, the study also points to the challenges of regulating cryptocurrencies, which could limit their long-term economic benefits.

Corelli (2018) examined the relationship between cryptocurrencies and exchange rates, providing a cross-country analysis that includes Nigeria. His study established that cryptocurrency prices are linked to exchange rate movements in developing economies. The results suggest that cryptocurrencies, like Bitcoin, can play a role in mitigating currency depreciation in countries facing high inflation or exchange rate instability.

Finally, Ozili (2022) discussed the potential of Central Bank Digital Currencies (CBDCs) in Nigeria, focusing on their role in reshaping the monetary system. He argued that CBDCs could help improve transaction efficiency, financial inclusion, and transparency in financial markets. However, the author also noted the risks of CBDC implementation, including security concerns, regulatory challenges, and financial stability issues.

These studies collectively highlight the complex interplay between cryptocurrencies and various aspects of the Nigerian economy. While the potential benefits of digital currencies are clear, particularly in terms of financial inclusion, reduced transaction costs, and investment opportunities, regulatory and volatility concerns remain significant obstacles to broader adoption. As such, this study aims to examine the impact of cryptocurrency adoption on Nigeria's economic growth, specifically focusing on its relationship with exchange rates, financial inclusion, and remittances.

3. METHODOLOGY

This section outlines the research approach, data sources, and analytical techniques used to examine the impact of cryptocurrency adoption on Nigeria's economy. The study specifically evaluates how cryptocurrency adoption influences key macroeconomic indicators: exchange rates, financial inclusion, and remittance flows, with economic growth serving as the overall dependent variable.

3.1. Research Design

The study adopts a quantitative research design suitable for time-series econometric analysis. This approach enables the examination of both short-run dynamics and long-run equilibrium relationships between cryptocurrency adoption and key economic variables using secondary data collected from 2010 to 2023. The choice of this time period reflects the years of most active cryptocurrency activity in Nigeria.

3.2. Population and Sample

In the context of this study, the population refers to time-series macroeconomic and financial indicators, rather than individual respondents. The analysis uses a census of annual macro-financial data related to cryptocurrency adoption, exchange rates, financial inclusion, remittance flows, and economic growth in Nigeria. No sampling technique was required, as complete time-series data over the 14-year period (2010–2023) was analyzed.

3.3. Data Collection and Sources

Data were obtained from multiple reliable secondary sources: Central Bank of Nigeria (CBN) - exchange rates, remittances, financial inclusion metrics, World Bank and IMF - GDP growth and remittance inflows, TripleA.io and Chainalysis - cryptocurrency user statistics and transaction volume, Academic databases and industry reports - contextual and trend analysis.

Table 1: Variables and Measurement

Variable	Proxy/Measurement
Economic Growth (Y)	GDP growth rate (annual %)

Cryptocurrency Adoption (CA)	Composite index created from: (i) volume of crypto transactions in Nigeria and (ii) % of population using crypto. Each indicator is normalized and averaged.
Exchange Rate (EX)	Annual NGN/USD exchange rate
Financial Inclusion (FI)	% of adult population with access to formal financial services
Remittance Flows (RF)	Annual inflows of remittances to Nigeria (USD)

3.4. Model Specification

To examine the impact of cryptocurrency adoption on Nigeria's economy, this study will employ an econometric model that incorporates the key variables listed above. The model will be based on a multiple regression framework, with cryptocurrency adoption as the independent variable and economic indicators such as exchange rates, financial inclusion, and remittance flows as dependent variables.

The empirical model is specified as follows:

$$Y_t = \beta_0 + \beta_1 CA_t + \beta_2 EX_t + \beta_3 FI_t + \beta_4 RF_t + \epsilon_t$$

Where:

- Y_t = Economic growth indicator at time t (proxy for the Nigerian economy's performance, e.g., GDP growth rate)
- CA_t = Cryptocurrency adoption rate at time t
- EX_t = Exchange rate at time t
- FI_t = Financial inclusion rate at time t
- RF_t = Remittance flows at time t
- β_0 = Constant term
- $\beta_1, \beta_2, \beta_3, \beta_4$ = Coefficients to be estimated
- ϵ_t = Error term at time t

In addition, the study employed the Granger Causality Test to examine the directional relationship between cryptocurrency adoption and the dependent variables, particularly the exchange rate and financial inclusion. The Granger Causality test helps identify whether cryptocurrency adoption leads to changes in economic variables or if the reverse is true.

3.5. Estimation Technique and Time-Series Diagnostics

Given the time-series nature of the data, preliminary tests were conducted before estimation:

Augmented Dickey-Fuller (ADF) and Phillips-Perron tests to assess stationarity of all variables, Johansen co-integration test to determine the presence of long-run equilibrium relationships, based on these diagnostics, the Vector Error Correction Model (VECM) was selected for estimation. VECM is ideal when variables are non-stationary at levels but co-integrated, as it captures both short-run adjustments and long-run relationships.

The Granger Causality Test was also employed to assess the directional causality between cryptocurrency adoption and each economic indicator.

3.6. Hypotheses

1. H_1 : Cryptocurrency adoption has a significant impact on economic growth in Nigeria.
2. H_2 : Exchange rate fluctuations significantly affect economic growth in Nigeria.
3. H_3 : Financial inclusion has a significant influence on economic growth in Nigeria.
4. H_4 : Remittance flows have a significant impact on economic growth in Nigeria.

3.7. Model Validity and Robustness

The model was tested for: Multicollinearity using Variance Inflation Factor (VIF), Heteroscedasticity using Breusch-Pagan and White tests, Serial correlation using the Durbin-Watson statistic, all diagnostics were reported to ensure the reliability, robustness, and validity of the results.

4. RESULTS AND DISCUSSION

The analysis section of this study presents the results of the econometric models used to assess the impact of cryptocurrency adoption on key economic indicators in Nigeria. This section begins by providing an overview of the data characteristics, including descriptive statistics and visualizations, followed by the results from diagnostic tests such as stationarity, multicollinearity, and heteroscedasticity. The primary objective is to examine the relationship between cryptocurrency adoption and its effects on exchange rates, financial inclusion, and remittance flows within Nigeria.

To achieve this, we utilized Ordinary Least Squares (OLS) regression analysis to estimate the model, with the focus on testing the hypotheses formulated in the previous section. The findings from these analyses will shed light on the role of cryptocurrency adoption in shaping Nigeria's economy, especially in the context of economic growth, monetary policy, and financial inclusion. Furthermore, the results

were interpreted in relation to existing literature, contributing to the ongoing discourse on the economic implications of digital currencies in developing economies like Nigeria.

Table 2: Descriptive Statistics.

Variable	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Cryptocurrency Adoption	0.32	0.25	0.00	1.00	0.72	2.45
Exchange Rate (NGN/USD)	380.45	45.23	330.00	450.00	0.08	2.98
Financial Inclusion Index	52.75	10.34	30.00	70.00	-0.24	3.04
Remittances (USD Billion)	23.45	5.63	15.00	35.00	0.45	2.12

Source: *Gretl Software, 2025*

Cryptocurrency Adoption: The mean value of 0.32 for cryptocurrency adoption indicates that, on average, approximately 32% of the population is involved in cryptocurrency transactions or holds cryptocurrencies. The standard deviation of 0.25 suggests a moderate level of variation in cryptocurrency adoption across the sample. The skewness of 0.72 indicates a slight rightward skew, meaning there are a few observations where cryptocurrency adoption is very high.

Exchange Rate (NGN/USD): The exchange rate has a mean of 380.45 NGN per USD, with a standard deviation of 45.23, reflecting considerable fluctuations in the exchange rate over the study period. The minimum exchange rate recorded is 330.00 NGN, while the maximum reached 450.00 NGN, showing that there are periods of significant devaluation. The skewness of 0.08 suggests a nearly symmetric distribution of exchange rates, with no extreme outliers in either direction.

Financial Inclusion Index: With a mean of 52.75, the financial inclusion index suggests that approximately 53% of the population has access to formal financial services. The standard deviation of 10.34 shows some variability in financial inclusion across regions or subpopulations. The negative skewness of -0.24 suggests that the distribution of financial inclusion is slightly skewed to the left, indicating that more individuals tend to have access to financial services, but there are still notable gaps.

Remittances (USD Billion): The mean of 23.45 billion USD in remittances shows that Nigeria receives substantial remittances annually, with a standard deviation of 5.63 indicating moderate volatility in remittance flows. The skewness of 0.45 implies a slight rightward skew, indicating that while most remittance values are below the average, there are some higher values that contribute to the overall mean.

To test for stationarity, the Augmented Dickey-Fuller (ADF) test was employed, incorporating both a constant and trend term where appropriate. Lag length selection

was based on the Akaike Information Criterion (AIC) to ensure optimal model performance.

Table 3: Unit Root Test Results (At Level)

Variable	Augmented Dickey-Fuller (ADF) Test	p-value	Conclusion
Cryptocurrency Adoption	-1.762	0.405	Non-Stationary
Exchange Rate (NGN/USD)	-2.140	0.234	Non-Stationary
Financial Inclusion Index	-1.989	0.275	Non-Stationary
Remittances (USD Billion)	-1.540	0.502	Non-Stationary

***Source**: Gretl Software, 2025*

Cryptocurrency Adoption: The ADF test statistic for cryptocurrency adoption is -1.762, with a p-value of 0.405, which is greater than the significance level of 0.05. This indicates that the variable cryptocurrency adoption has a unit root and is non-stationary at level. This suggests that the data for cryptocurrency adoption may have a trend or is influenced by a random walk.

Exchange Rate (NGN/USD): The ADF test statistic for exchange rates is -2.140, with a p-value of 0.234, also greater than 0.05. This implies that the exchange rate series is non-stationary at level, suggesting it is likely to follow a stochastic trend.

Financial Inclusion Index: The ADF test statistic for the financial inclusion index is -1.989, with a p-value of 0.275. Since the p-value exceeds 0.05, it also fails to reject the null hypothesis of a unit root, meaning financial inclusion is non-stationary at level.

Remittances (USD Billion): The ADF test statistic for remittances is -1.540, with a p-value of 0.502, indicating that the remittance series is non-stationary at level.

In summary, all four variables fail to reject the null hypothesis of a unit root at the level, meaning they are non-stationary at level. This suggests that further transformation, such as differencing, may be necessary to achieve stationarity before proceeding with further analysis.

As a robustness check, additional stationarity tests such as the Phillips-Perron (PP) test was conducted. The PP test confirmed the ADF results became stationary after first differencing.

Table 4: Unit Root Test Results (At First Difference)

Variable	Augmented Dickey-Fuller (ADF) Test	p-value	Conclusion
Cryptocurrency Adoption	-4.551	0.000	Stationary
Exchange Rate (NGN/USD)	-5.312	0.000	Stationary
Financial Inclusion Index	-4.236	0.001	Stationary
Remittances (USD Billion)	-6.013	0.000	Stationary

***Source**: Gretl Software, 2025*

Cryptocurrency Adoption: The ADF test statistic for cryptocurrency adoption at the first difference is -4.551, with a p-value of 0.000, which is well below the 0.05 significance level. This indicates that the variable is stationary at the first difference.

Exchange Rate (NGN/USD): The ADF test statistic for exchange rates at the first difference is -5.312, with a p-value of 0.000, confirming that the exchange rate series is stationary at the first difference.

Financial Inclusion Index: The ADF test statistic for the financial inclusion index at the first difference is -4.236, with a p-value of 0.001, which is also below the 0.05 significance level, indicating that the financial inclusion series is stationary at the first difference.

Remittances (USD Billion): The ADF test statistic for remittances at the first difference is -6.013, with a p-value of 0.000, which shows that the remittance series is stationary at the first difference.

Summary

All variables become stationary at the first difference, as indicated by their respective ADF test statistics and p-values. This is a positive outcome, as non-stationary data at the level is often problematic for regression analysis, and differencing the data ensures that the assumptions of stationarity are met. Hence, the variables are now suitable for further analysis, including model estimation.

Table 5: Multicollinearity Test Results (Variance Inflation Factor - VIF)

Variable	VIF	Tolerance	Conclusion
Cryptocurrency Adoption	1.250	0.800	No Multicollinearity
Exchange Rate (NGN/USD)	1.300	0.769	No Multicollinearity
Financial Inclusion Index	1.380	0.725	No Multicollinearity
Remittances (USD Billion)	1.420	0.705	No Multicollinearity

***Source:** Gretl Software, 2025*

Cryptocurrency Adoption: The VIF value for cryptocurrency adoption is 1.250, which is well below the threshold value of 10. This indicates that there is no significant multicollinearity with other variables.

Exchange Rate (NGN/USD): The VIF value for exchange rates is 1.300, which also indicates no multicollinearity as the value is well below the acceptable threshold of 10.

Financial Inclusion Index: The VIF for financial inclusion is 1.380, which suggests no multicollinearity.

Remittances (USD Billion): The VIF for remittances is 1.420, indicating that there is no multicollinearity among the variables.

Conclusion

Since all the VIF values are below the critical threshold of 10, we can conclude that multicollinearity is not a problem in this model. The variables are not highly correlated with each other and can be used in the regression analysis without concern for multicollinearity issues.

Table 6: Heteroscedasticity Test Results (Breusch-Pagan / Cook-Weisberg Test)

Chi-Square Statistic	p-value	Conclusion
4.307	0.230	No Heteroscedasticity

Source: *Gretl Software, 2025*

The Breusch-Pagan test statistic is 4.307, with a p-value of 0.230, which is greater than the 0.05 significance level. This means that we fail to reject the null hypothesis, indicating that heteroscedasticity is not present in the model. The variance of the residuals is constant across observations, suggesting that the assumption of homoscedasticity holds.

Since the p-value for the Breusch-Pagan test is greater than 0.05, we conclude that heteroscedasticity is not an issue in this model. The variance of the residuals appears to be constant, meaning the assumption of homoscedasticity is valid.

These results support the validity of the regression model, as both multicollinearity and heteroscedasticity are not significant concerns in this analysis.

Table 7: Correlation Matrix

Variable	Cryptocurrency Adoption	Exchange Rate (NGN/USD)	Financial Inclusion Index	Remittances (USD Billion)
Cryptocurrency Adoption	1.000	-0.248	0.312	0.098

Exchange Rate (NGN/USD)	-0.248	1.000	-0.159	-0.420
Financial Inclusion Index	0.312	-0.159	1.000	0.202
Remittances (USD Billion)	0.098	-0.420	0.202	1.000

***Source**: Gretl Software, 2025*

Cryptocurrency Adoption and Exchange Rate (NGN/USD): The correlation coefficient between cryptocurrency adoption and the exchange rate is -0.248, which indicates a weak negative correlation. This suggests that as cryptocurrency adoption increases, the exchange rate may slightly decrease, but the relationship is not strong.

Cryptocurrency Adoption and Financial Inclusion Index: There is a moderate positive correlation of 0.312 between cryptocurrency adoption and the financial inclusion index. This suggests that higher cryptocurrency adoption may be associated with better financial inclusion, but again, the relationship is not very strong.

Cryptocurrency Adoption and Remittances (USD Billion): The correlation coefficient between cryptocurrency adoption and remittances is 0.098, indicating a very weak positive correlation. This suggests that cryptocurrency adoption does not have a strong relationship with remittances.

Exchange Rate (NGN/USD) and Financial Inclusion Index: The correlation between the exchange rate and financial inclusion is -0.159, suggesting a weak negative relationship. As the exchange rate increases, financial inclusion seems to decrease slightly, but this relationship is also weak.

Exchange Rate (NGN/USD) and Remittances (USD Billion): There is a moderate negative correlation of -0.420 between the exchange rate and remittances. This indicates that as the exchange rate becomes more volatile or increases, remittances tend to decrease, though this relationship is not extremely strong.

Financial Inclusion Index and Remittances (USD Billion): The correlation coefficient of 0.202 between financial inclusion and remittances shows a weak positive relationship. This suggests that higher levels of financial inclusion may be slightly associated with increased remittances.

The correlation results show a mix of weak and moderate relationships between the variables of interest.

There are no strong correlations among the variables, indicating that each variable provides unique information to the model.

The absence of strong correlations reduces concerns about multicollinearity, and supports the choice of these variables in the regression analysis.

While the correlation matrix shows relationships between variables, it does not establish causality or the direction of influence. Therefore, further analysis using co-

integration and Vector Error Correction Models (VECM) was necessary to uncover both short-term dynamics and long-term equilibrium relationships.

Table 8: Co-Integration Test Results (Johansen Test for Co-Integration)

Hypothesized No. of Co-integrating Equations	Trace Statistic	Critical Value (5%)	p-value	Conclusion
None (r = 0)	39.821	29.797	0.005	Co-integrated
At most 1 (r ≤ 1)	21.543	15.494	0.012	Co-integrated
At most 2 (r ≤ 2)	8.126	3.841	0.043	Co-integrated

Source: *Gretl Software, 2025*

The Johansen co-integration test is used to determine whether there is a long-term equilibrium relationship among the variables: cryptocurrency adoption, exchange rate, financial inclusion, and remittances.

The trace statistic is compared with the critical value at a 5% significance level to determine if co-integration exists.

Key Findings:

For r = 0 (no co-integration): The trace statistic (39.821) is greater than the critical value (29.797), and the p-value (0.005) is less than 0.05, meaning we reject the null hypothesis of no co-integration. This suggests that at least one co-integrating relationship exists.

For r ≤ 1: The trace statistic (21.543) is greater than the critical value (15.494), with a p-value of 0.012. This confirms the existence of at least two co-integrating equations in the system.

For r ≤ 2: The trace statistic (8.126) is greater than the critical value (3.841), with a p-value of 0.043, meaning there is at least one more co-integrating equation.

Conclusion

The Johansen test confirms that cryptocurrency adoption, exchange rates, financial inclusion, and remittances have a long-run equilibrium relationship.

This supports the validity of the regression model, as the variables move together over time, making long-term policy recommendations meaningful.

Since the variables are co-integrated, a Vector Error Correction Model (VECM) was appropriate for further analysis to capture both short-term and long-term relationships.

This result strengthens the study's findings by showing that cryptocurrency adoption and economic indicators in Nigeria are structurally linked over time.

Table 9: VECM

Variable	Cointegration Coefficient
Cryptocurrency Adoption	1.000000
Exchange Rate (NGN/USD)	-1.614149
Financial Inclusion Index	5.850727
Remittances (USD Billion)	14.662442

Source: *Gretl Software, 2025*

Cryptocurrency Adoption (Reference Variable - Normalized to 1.000): This means all other variables are measured relative to cryptocurrency adoption.

Exchange Rate (NGN/USD) (-1.614149): A negative coefficient suggests that an increase in cryptocurrency adoption is associated with a depreciation of the Naira. This implies that as more people adopt cryptocurrencies, reliance on the Naira for transactions decreases, possibly leading to capital outflows or reduced demand for local currency.

Financial Inclusion Index (5.850727): A positive coefficient indicates that higher cryptocurrency adoption is linked to greater financial inclusion. This suggests that digital currencies help improve access to financial services, particularly for unbanked populations.

Remittances (USD Billion) (14.662442): A strong positive coefficient suggests that greater cryptocurrency adoption is associated with an increase in remittance inflows to Nigeria. This supports the idea that Nigerians abroad use cryptocurrencies to send money home more efficiently and at lower costs compared to traditional remittance services.

The VECM results confirm a long-run equilibrium relationship between cryptocurrency adoption, exchange rates, financial inclusion, and remittances. The findings suggest that:

Cryptocurrency adoption positively impacts financial inclusion and remittance flows. However, it may contribute to exchange rate depreciation, indicating potential risks for the stability of the Naira.

These insights highlight both opportunities (financial inclusion and remittances) and risks (exchange rate volatility) associated with cryptocurrency adoption in Nigeria, making it crucial for policymakers to regulate digital currencies effectively.

5. CONCLUSION

The findings of this study provide empirical evidence on the impact of cryptocurrency adoption on Nigeria's economy, particularly in relation to exchange rates, financial

inclusion, and remittance flows. These results are in line with previous studies that have examined similar relationships, offering insights into both the opportunities and risks associated with the growing use of digital currencies in Nigeria.

Cryptocurrency Adoption and Exchange Rate Depreciation

The Vector Error Correction Model (VECM) results indicate that cryptocurrency adoption is negatively associated with the exchange rate of the Naira to the US Dollar. This suggests that higher cryptocurrency adoption may contribute to Naira depreciation, possibly due to capital outflows or reduced demand for the local currency.

This finding aligns with the work of Jimoh and Oluwasegun (2020), who found that cryptocurrency adoption increases exchange rate volatility in Nigeria, particularly due to the speculative nature of digital assets and their role in capital flight. Similarly, Safiyanu et al. (2022) observed that cryptocurrency markets in Nigeria have an inverse relationship with Naira stability, as many investors convert Naira to digital assets, reducing demand for the local currency.

However, this contrasts with the argument by Corelli (2018), who found that cryptocurrencies could act as a hedge against currency depreciation, particularly in emerging economies. While this may be true in certain cases, the Nigerian context suggests that capital outflows to crypto markets may be accelerating Naira depreciation, a concern for policymakers aiming to stabilize the exchange rate.

Cryptocurrency Adoption and Financial Inclusion

The results confirm that cryptocurrency adoption has a positive and significant relationship with financial inclusion in Nigeria. This supports the hypothesis that digital currencies serve as an alternative financial system, particularly for unbanked and underbanked populations.

These findings are consistent with Ekong and Ekong (2022), who showed that cryptocurrency adoption significantly improves financial inclusion in Nigeria by providing access to financial services without the need for a traditional bank account. Similarly, Aminu et al. (2022) found that digital currencies help bridge the financial gap, particularly in rural and underserved areas where access to banks is limited.

Moreover, Ozili (2022) highlights that cryptocurrencies offer lower transaction costs and faster settlements compared to conventional banking systems, making them attractive to individuals excluded from traditional finance. This supports the argument that cryptocurrencies can enhance economic participation by providing financial services to those who were previously excluded.

Despite these benefits, Ojiakor et al. (2022) caution that while cryptocurrency improves financial inclusion, the lack of regulation poses risks, such as fraud, price volatility, and financial instability. This suggests that while cryptocurrency adoption enhances financial access, it must be properly regulated to mitigate associated risks.

Cryptocurrency Adoption and Remittance Flows

The study also finds that cryptocurrency adoption is positively associated with remittance flows, indicating that Nigerians in the diaspora increasingly use digital currencies to send money home. This aligns with research by Chris et al. (2021), who found that cryptocurrencies reduce remittance costs and increase the speed of transactions, making them an attractive alternative to traditional remittance channels such as Western Union and MoneyGram.

Similarly, Ahannaya et al. (2021) found that the use of Bitcoin and stablecoins has increased among Nigerian expatriates due to lower fees and faster processing times compared to traditional remittance systems. This trend is further supported by the World Bank (2022), which reported that Nigeria remains the largest recipient of remittances in sub-Saharan Africa, and that cryptocurrency-based transfers have contributed to the rising inflow of funds.

However, Okpalaojiego (2021) argues that the Nigerian government's restrictions on cryptocurrency transactions could disrupt this trend, as many Nigerians rely on peer-to-peer (P2P) platforms to bypass regulatory restrictions. This suggests that while cryptocurrency adoption enhances remittance flows, government policies play a critical role in determining the extent of its impact.

Long-Run Equilibrium Relationship between Cryptocurrency and Economic Growth

The Johansen co-integration test confirms a long-term equilibrium relationship between cryptocurrency adoption, exchange rates, financial inclusion, and remittances. This finding aligns with Aminu et al. (2022), who found that cryptocurrency adoption influences macroeconomic stability by integrating digital assets into economic transactions.

However, unlike traditional financial instruments, cryptocurrencies introduce both stability and volatility into financial markets. Holtmeier and Sandner (2019) noted that while cryptocurrencies can drive financial innovation, their speculative nature can also pose risks to economic stability. Thus, the long-term relationship between cryptocurrency and economic growth in Nigeria depends on regulatory policies, market development, and technological adoption.

Policy Implications and Recommendations

Based on the findings of this study, the following policy recommendations are suggested:

Regulation to Control Capital Flight and Exchange Rate Volatility: The Central Bank of Nigeria (CBN) should implement measured regulations that allow cryptocurrency transactions while mitigating capital outflows. Strategies such as taxation of crypto-related earnings could be explored to prevent excessive currency depreciation.

Enhancing Financial Inclusion Through Digital Assets: Policymakers should encourage the use of stablecoins and blockchain-based financial products to expand financial inclusion in rural and underserved areas. Collaboration between cryptocurrency platforms and financial technology (FinTech) firms can help integrate crypto-based financial services into mainstream finance.

Leveraging Cryptocurrency for Remittances: Government and financial regulators should recognize crypto-based remittances as a legitimate financial tool. Instead of banning crypto transactions, authorities should develop a framework for monitoring and regulating peer-to-peer (P2P) cryptocurrency transfers.

Long-Term Economic Integration of Cryptocurrencies: Nigeria should explore the creation of a Central Bank Digital Currency (CBDC) that integrates the benefits of cryptocurrencies while maintaining monetary control. Public awareness campaigns and financial literacy programs should be introduced to educate Nigerians on the risks and benefits of digital assets.

This study confirms that cryptocurrency adoption has significant economic implications for Nigeria. While it enhances financial inclusion and remittances, it also poses risks to exchange rate stability. These findings align with existing literature, but they also highlight the need for balanced regulation to maximize benefits while mitigating economic risks.

This study investigates the impact of cryptocurrency adoption on Nigeria's economy, with a focus on three key variables: exchange rates, financial inclusion, and remittance flows. The study adopts a quantitative research design using time series data and applies statistical tools such as VECM, unit root tests, and co-integration tests to analyze the relationships between these variables. The results show that: Cryptocurrency adoption is negatively associated with exchange rate stability, potentially contributing to the depreciation of the Nigerian Naira due to capital outflows. Cryptocurrency adoption has a positive relationship with financial inclusion, offering financial services to the unbanked and underserved populations. Cryptocurrency adoption positively influences remittance flows, as Nigerians in the diaspora increasingly use digital currencies to send money back home. Additionally, the study confirms a long-term equilibrium relationship between cryptocurrency adoption and the Nigerian economy, particularly in relation to exchange rates, financial inclusion, and remittances.

5.1. Conclusion

The findings of this study provide crucial insights into the role of cryptocurrency adoption in the Nigerian economy. While digital currencies offer significant potential for enhancing financial inclusion and remittance flows, their negative impact on exchange rate stability cannot be ignored. The study highlights that capital outflows due to increased cryptocurrency adoption might exacerbate the Naira depreciation. However, the integration of cryptocurrencies in financial services has been found to increase accessibility to banking, especially for the unbanked populations in rural and

underserved areas. Furthermore, the study emphasizes the growing importance of cryptocurrencies in cross-border remittances, which could potentially reduce transaction costs and speed up the remittance process for Nigerians abroad.

In light of these findings, while cryptocurrencies offer notable advantages, they also present challenges that need to be addressed through strategic regulation and policy development. The study underscores the need for a balanced approach in integrating digital currencies into the formal economy, ensuring their benefits are fully realized while minimizing their potential risks.

5.2. Recommendations

Regulatory Framework for Cryptocurrency Adoption: The Nigerian government should establish a clear regulatory framework for cryptocurrency transactions. This would involve setting guidelines that govern cryptocurrency exchanges, ensuring they are monitored for compliance and consumer protection. Policies should address capital flight, currency volatility, and money laundering concerns while allowing innovation to flourish.

Financial Inclusion through Cryptocurrencies: Policymakers should leverage the potential of cryptocurrencies to enhance financial inclusion, particularly in rural and underserved areas. Financial literacy programs should be developed to educate the public about digital currencies and their benefits. Additionally, partnerships between cryptocurrency platforms and financial technology firms could help integrate digital currencies into mainstream finance, thereby extending access to financial services.

Encourage Cryptocurrency Use for Remittances: The Nigerian government should explore the creation of official channels for cryptocurrency-based remittances, reducing reliance on traditional remittance services that charge high fees. By encouraging cryptocurrency adoption for remittances, Nigeria can attract more inflows, enhance the efficiency of remittance transactions, and lower costs for Nigerians in the diaspora.

Development of a Central Bank Digital Currency (CBDC): Considering the risks associated with cryptocurrencies, Nigeria could consider the development of a Central Bank Digital Currency (CBDC). A CBDC would allow for centralized control of digital currencies while benefiting from their technological innovations. It would also address some of the concerns around security, volatility, and speculation that currently surround decentralized cryptocurrencies.

Monitoring and Mitigating Exchange Rate Risks: Given the observed relationship between cryptocurrency adoption and exchange rate depreciation, policymakers should implement measures to stabilize the Naira, such as monitoring cryptocurrency transactions and imposing taxation on crypto-based earnings. Additionally, Nigeria should adopt monetary policies aimed at counteracting excessive outflows from the economy to mitigate the risk of further depreciation of the Naira.

Public Awareness and Education: Financial institutions and regulators should invest in public education campaigns to raise awareness about the risks and benefits of cryptocurrency use. This could be done through seminars, workshops, and online resources to ensure that Nigerians fully understand how cryptocurrencies work and how to use them responsibly.

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