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Impact of Digital Currency Adoption on Exchange Rate in Nigeria

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Abstract

Nigeria has witnessed rapid growth in the use of digital currencies, particularly cryptocurrencies and dollar-denominated stablecoins, alongside the introduction of the eNaira, increasing the ability of individuals and businesses to convert naira holdings into digital assets and conduct cross-border transactions outside conventional banking channels which raised concerns about possible effects on the demand for the naira, capital movements and exchange-rate stability. This study, therefore, examined the impact of digital currency adoption on exchange rate in Nigeria. The study specifically seeks to examine the trend and pattern of digital currency adoption and exchange rate in Nigeria; to determine the impact of digital currency adoption on the exchange rate in Nigeria; and to examine the causal relationship between digital currency adoption and exchange rate in Nigeria. Secondary monthly time-series data on exchange rate and other macroeconomic data were obtained from relevant national and international sources such as the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), International Monetary Fund (IMF). The data were analyzed using correlation analysis, Augmented Dickey-Fuller unit root testing, ARDL estimation, Bounds Test for cointegration, estimation of long-run coefficients, Error Correction Model, and post-estimation diagnostic and stability tests. Findings of the study revealed that digital currency adoption did not exert a statistically significant individual effect on the exchange rate in the long run leading to the conclusion that digital currency adoption is relevant to exchange-rate dynamics in Nigeria, although its influence is predominantly a short-run and dynamic phenomenon rather than a statistically significant independent long-run effect. Based on the findings, the researcher proffered the following recommendations among others; the Central Bank of Nigeria and relevant financial regulators should strengthen the monitoring of digital currency transactions, particularly transactions involving naira conversion into foreign-currency-denominated digital assets; and that digital currency indicators should increasingly be incorporated into the country's foreign-exchange market surveillance framework.

Keywords: *Digital currency, Adoption, Exchange rate, Bitcoin, Stablecoin, cryptocurrency.*

1.0 INTRODUCTION

The rapid advancement of financial technology has significantly transformed the global monetary and financial system, particularly in the areas of payments, savings, investment and cross-border transactions. One of the most prominent outcomes of this transformation is the emergence of digital currencies, which provide alternative means of storing and transferring monetary value electronically. Digital currencies encompass several forms of digitally represented value, including privately issued cryptocurrencies such as Bitcoin and Ethereum, stablecoins whose values are linked to conventional currencies or other assets, and central bank digital currencies (CBDCs) issued by monetary authorities. The growing relevance of these instruments has attracted considerable attention because their adoption has implications for financial intermediation, payment systems, monetary policy and the demand for conventional currencies (Auer & Böhme, 2020; BIS, 2021; IMF, 2022; Ree, 2023).

Cryptocurrencies constitute one of the most visible components of the digital currency revolution. The introduction of Bitcoin by Nakamoto (2008) provided a decentralised peer-to-peer payment system in which transactions could be undertaken without conventional financial intermediaries. Since then, cryptocurrency markets have expanded considerably, accompanied by the development of Ethereum and numerous other digital assets. Unlike sovereign currencies, cryptocurrencies are generally not issued or guaranteed by central banks, and their values are determined largely by market forces. Their increasing integration into conventional financial markets has consequently generated debates

concerning whether they primarily function as currencies, speculative assets, stores of value or alternative investment instruments (Baur et al., 2018; Corbet et al., 2019; Bolt & van Oordt, 2020). Research has also established that the values of cryptocurrencies increasingly respond to economic fundamentals and wider financial-market conditions as cryptocurrency markets mature (Li & Wang, 2017).

Digital currency adoption can potentially influence exchange rates through several mechanisms. Where cryptocurrencies or foreign-currency-backed stablecoins provide an alternative store of value, economic agents may shift part of their wealth from domestic currency into digital assets, particularly during periods of inflation or expected currency depreciation. Such portfolio substitution can reduce demand for the domestic currency while increasing effective demand for foreign-currency-linked assets. Digital currencies may also facilitate cross-border transactions, capital movements and remittances outside traditional banking channels. Consequently, their adoption can influence foreign-exchange demand and supply, expectations and capital flows. At the same time, efficient digital payment systems may lower remittance costs and improve cross-border transactions, potentially increasing foreign-currency inflows and improving foreign-exchange liquidity. The theoretical effect of digital currency adoption on exchange rates is therefore not necessarily unidirectional.

Despite the growing literature, an important empirical gap remains. A considerable proportion of Nigerian studies has examined cryptocurrency prices, returns or volatility, particularly Bitcoin, rather than digital currency adoption itself. Cryptocurrency price movements are not synonymous with adoption. A rise in the global price of Bitcoin, for instance, does not necessarily indicate an increase in the number of Nigerians using digital currencies or the volume and value of transactions undertaken within the country. Adoption is more closely reflected by measures such as transaction volume or value, active users, wallet usage, stablecoin flows and other indicators of actual participation. This distinction is particularly important given the substantial expansion of stablecoin-based transactions in Nigeria.

Against this background, examining the impact of digital currency adoption on the exchange rate in Nigeria has become increasingly important. The rapid growth of cryptocurrency and stablecoin transactions, persistent concerns about naira stability and the changing regulatory environment create a strong basis for empirical investigation. Although existing studies provide evidence of connections between cryptocurrency markets and exchange-rate behaviour, their findings remain mixed and many focus on cryptocurrency prices rather than adoption. This study therefore seeks to determine the extent to which digital currency adoption influences exchange-rate behaviour in Nigeria. Establishing this relationship will contribute to the literature on digital finance and provide evidence that may assist the Central Bank of Nigeria and other financial regulators in balancing the benefits of digital financial innovation with the objectives of exchange-rate stability, effective monetary-policy transmission and broader macroeconomic stability.

1.1 Statement of the Problem

Nigeria has experienced persistent exchange-rate instability in recent years, reflected in substantial depreciation of the naira, widening pressures in the foreign-exchange market and recurring difficulties in meeting the demand for foreign currency. At the same time, the country has witnessed rapid growth in the use of digital currencies, particularly cryptocurrencies and dollar-denominated stablecoins, alongside the introduction of the eNaira. The increasing ability of individuals and businesses to convert naira holdings into digital assets and conduct cross-border transactions outside conventional banking channels has raised concerns about possible effects on the demand for the naira, capital movements and exchange-rate stability. Although digital currencies may improve payment efficiency and reduce transaction costs, their growing adoption may also encourage currency substitution and increase pressure on the domestic currency.

Despite these concerns, the actual effect of digital currency adoption on Nigeria's exchange rate remains unclear. Existing empirical studies have largely concentrated on the prices, returns and volatility of major cryptocurrencies such as Bitcoin and Ethereum rather than on the extent of digital currency adoption itself. This creates an important measurement problem because movements in

cryptocurrency prices do not necessarily reflect the actual level of usage, transaction activity or adoption within Nigeria. Furthermore, recent developments such as the rapid expansion of stablecoin transactions, increased peer-to-peer cryptocurrency trading, changes in digital-asset regulation and major reforms in Nigeria's foreign-exchange market have altered the financial environment considerably. Consequently, findings from earlier studies may not sufficiently explain the emerging relationship between digital currency adoption and exchange-rate behaviour.

The absence of clear empirical evidence on this relationship creates a policy challenge for monetary and financial authorities. Without adequate knowledge of whether and to what extent digital currency adoption contributes to naira depreciation or exchange-rate volatility, regulatory responses may either unnecessarily restrict beneficial financial innovation or fail to address emerging risks to monetary and exchange-rate stability. There is therefore a need for an empirical investigation that directly examines the impact of digital currency adoption on the exchange rate in Nigeria while taking relevant macroeconomic factors into consideration. This study seeks to fill this gap by determining the nature and magnitude of the relationship between digital currency adoption and exchange-rate movements in Nigeria. Consequently, the study seeks to answer the following questions; what are the trends and patterns of digital currency adoption and exchange rate in Nigeria? What impact does digital currency adoption have on the exchange rate in Nigeria? What is the causal relationship between digital currency adoption and exchange rate in Nigeria?

2.0 LITERATURE REVIEW

2.1 Concept of Digital Currency

Digital currency broadly refers to monetary value that is represented, stored and transferred electronically and can be used for payment, settlement, investment or other financial purposes. Unlike physical notes and coins, digital currency does not necessarily have a tangible form, although it may perform some of the traditional functions of money, including serving as a medium of exchange, store of value and unit of account. The concept has expanded considerably with technological innovations in payment systems, cryptography and distributed ledger technology. Consequently, digital currency now encompasses instruments that differ significantly in their institutional arrangements, technological foundations and relationships with conventional fiat currencies (Adrian & Mancini-Griffoli, 2021; IMF, 2024). The term digital currency is sometimes used interchangeably with digital money, virtual currency and cryptocurrency, although these concepts are not identical. Digital money represents the broader electronic representation of monetary value, while cryptocurrency generally refers to privately issued digital assets that rely primarily on cryptography and distributed ledger technology. The IMF (2023) defines crypto-assets as privately issued digital representations of value that are cryptographically secured and deployed using distributed ledger technology or similar technologies. Bitcoin and Ether are prominent examples of unbacked crypto-assets. Digital money, however, can also include instruments backed by identifiable issuers or conventional monetary assets, such as electronic money, stablecoins and CBDCs (IMF, 2023; IMF, 2024).

2.2 Types of Digital Currency

Digital currencies can be classified into several categories according to their issuer, backing, technological structure and relationship with conventional currencies. The IMF (2024) identifies electronic money, stablecoins and CBDCs among the principal forms of digital money while distinguishing these instruments from unbacked crypto-assets. Adrian and Mancini-Griffoli (2021) similarly argue that digital forms of money differ according to whether they are publicly or privately issued, their denomination, convertibility, backing and settlement technology. For the purpose of this study, the most relevant categories are cryptocurrencies, stablecoins and central bank digital currencies. Cryptocurrencies are privately created digital assets that rely primarily on cryptographic techniques and distributed ledger technology for recording and validating transactions. Unlike conventional fiat currencies, most cryptocurrencies are not direct liabilities of governments, central banks or conventional financial institutions. Stablecoins constitute another important category. Stablecoins are crypto-assets designed to maintain a relatively stable value against a specified asset or group of assets. The reference asset is frequently a sovereign currency, particularly the US dollar.

Examples include Tether (USDT) and USD Coin (USDC), which seek to maintain values close to the US dollar. According to the IMF (2023), stablecoins differ from unbacked crypto-assets because their design explicitly seeks to stabilise their value relative to a reference asset.

Central Bank Digital Currency (CBDC) represents another distinct form of digital currency. A CBDC is digital money denominated in a country's national unit of account and issued as a direct liability of its central bank. BIS (2021) describes CBDCs as advanced representations of central-bank money capable of providing settlement finality, liquidity and integrity in digital form. Unlike cryptocurrencies, therefore, CBDCs are sovereign monetary instruments backed by the issuing monetary authority. They are intended to preserve the fundamental characteristics of central-bank money while adapting it to an increasingly digital economy (Auer & Böhme, 2020; BIS, 2021). Nigeria's eNaira is an example of a retail CBDC. It was launched in October 2021 as a digital form of the Nigerian currency and was intended to complement existing forms of naira.

2.3 Concept of Digital Currency Adoption

Digital currency adoption refers to the process and extent to which individuals, households, businesses and other economic agents accept and actually use digital currencies for economic and financial purposes. Adoption goes beyond awareness of digital currencies or the mere existence of digital currency infrastructure. It involves actual participation through activities such as acquiring digital currencies, maintaining digital wallets, undertaking transactions, receiving payments, making transfers, investing, saving or using digital currencies for cross-border transactions. In this sense, digital currency adoption reflects the integration of digital monetary instruments into the financial behaviour of economic agents. The concept of adoption is particularly important because the introduction or availability of a digital currency does not automatically guarantee its widespread use. The IMF's CBDC Virtual Handbook notes that jurisdictions that have introduced CBDCs or conducted large-scale pilots have often experienced relatively slow adoption. Successful adoption depends not merely on technical functionality but also on participation by consumers, merchants and financial intermediaries, as well as regulatory strategies, communication, system design and appropriate incentives (IMF, 2024).

2.4 Concept of Exchange Rate

Exchange rate refers to the price of one country's currency expressed in terms of another country's currency. It indicates the amount of one currency that must be given up to obtain a unit of another currency and therefore serves as an important relative price linking domestic and international markets. For instance, the naira–US dollar exchange rate indicates the amount of Nigerian naira required to obtain one United States dollar. When more naira is required to purchase one dollar, the naira is said to have depreciated, while a reduction in the amount of naira required indicates appreciation (CBN, 2025). In this study, exchange rate is conceptualised primarily as the value of the Nigerian naira relative to the United States dollar. Since the study seeks to determine whether digital currency adoption affects the naira, changes in the naira–dollar rate provide an appropriate indicator of foreign-exchange conditions. An increase in the number of naira required to purchase one dollar represents depreciation, while a decline represents appreciation.

2.5 Digital Currency Adoption and Exchange Rate

The relationship between digital currency adoption and exchange rate can be understood through the manner in which digital currencies affect the demand and supply of domestic and foreign monetary assets. Traditionally, individuals seeking to hold foreign currency obtain it through commercial banks, bureaux de change or other authorised foreign-exchange channels. Digital currencies, particularly cryptocurrencies and dollar-backed stablecoins, provide additional channels through which economic agents can transfer or store value. As adoption increases, these instruments may influence domestic money demand, foreign-currency demand, capital flows and exchange-rate expectations. This relationship may become stronger during periods of inflation and exchange-rate instability. When households and businesses expect the naira to depreciate, they may increase their holdings of digital assets as a hedge against loss of purchasing power. In such circumstances, exchange-rate depreciation itself can encourage digital currency adoption. At the same time, large-scale conversion

of naira into dollar-linked digital assets may contribute to additional pressure on the naira. The relationship may therefore be bidirectional: depreciation can stimulate digital currency adoption, while increased adoption may subsequently influence exchange-rate behaviour.

2.6 Theoretical Framework

This study is anchored on the Currency Substitution Theory, associated with the contributions of Calvo and Rodriguez (1977), Miles (1978), and Girton and Roper (1981). The theory explains the behaviour of economic agents who allocate their monetary holdings between domestic and alternative currencies according to their relative attractiveness. It proposes that households and firms may reduce their holdings of domestic currency and increase their holdings of foreign or alternative currencies when they expect domestic currency depreciation, high inflation or deterioration in its ability to preserve purchasing power. Consequently, currency substitution can affect domestic money demand and ultimately influence exchange-rate behaviour (Calvo & Rodriguez, 1977; Miles, 1978; Girton & Roper, 1981).

The theory is particularly applicable to digital currency adoption because technological innovation has expanded the range of alternatives to conventional domestic money. While traditional currency substitution primarily involved replacing domestic currency with physical foreign currency or foreign-currency deposits, cryptocurrencies and stablecoins now provide additional channels through which economic agents can hold and transfer value. In particular, dollar-denominated stablecoins such as USDT and USDC enable users to maintain digital assets linked to the United States dollar. In an economy experiencing inflation and currency depreciation, these assets may become increasingly attractive as stores of value and instruments for international transactions. Thus, digital currency adoption can be interpreted as a contemporary extension of the conventional currency-substitution process.

Within the Nigerian context, the theory suggests that persistent depreciation of the naira and inflationary pressures may encourage households, businesses and investors to shift part of their monetary holdings from naira into cryptocurrencies and, particularly, dollar-backed stablecoins. Increased substitution may reduce the relative demand for naira and potentially exert additional pressure on its exchange value. Conversely, exchange-rate depreciation may itself stimulate greater digital currency adoption as economic agents seek protection against further losses in the value of the naira. This indicates a possible feedback relationship between digital currency adoption and exchange-rate movements and provides theoretical justification for examining both the impact and causal relationship between the variables.

2.7 Review of Empirical Studies

Narayan et al. (2019) investigated the relationship between Bitcoin price growth and Indonesia's monetary system, focusing particularly on inflation, the real exchange rate and money velocity. The study examined whether developments in Bitcoin could influence conventional monetary variables in an emerging economy where cryptocurrency trading had become increasingly prominent. Their results showed strong evidence that Bitcoin price growth contributed to inflation growth, appreciation of the Indonesian currency and a reduction in money velocity. Gunay et al. (2021) examined interactions between Bitcoin and six fiat currencies drawn from both developed and emerging economies. The developed-economy currencies were the euro, pound sterling and Japanese yen, while the emerging-market currencies were the Chinese yuan, Indian rupee and Russian ruble. Using daily observations from January 2015 to November 2020, the authors employed symmetric, asymmetric and nonlinear causality tests alongside Markov regime-switching regression. Their findings demonstrated that the relationship between Bitcoin and fiat currencies differed considerably across currencies and market conditions, indicating that cryptocurrency–foreign-exchange relationships are nonlinear and country-specific rather than uniform across economies.

Chemkha et al. (2021) examined connectedness between cryptocurrencies and major conventional currencies using Bitcoin, Ripple and Litecoin together with the euro, Japanese yen and British pound. Applying canonical-vine and drawable-vine copula techniques to data covering August 2013 to August 2019, the authors found positive dependence within the cryptocurrency market and within the foreign-

exchange market, but relatively weak dependence across the two markets. Their findings suggested that cryptocurrency and conventional currency markets remained only weakly integrated during much of the study period, thereby providing diversification possibilities for investors. Palazzi et al. (2021) investigated the dynamic relationship between Bitcoin and six major currencies: the euro, British pound, Swiss franc, Chinese renminbi, Japanese yen and Russian ruble. The authors used daily observations from July 2010 to April 2020 and employed a nonlinear causality test after filtering conditional heteroscedasticity through a BEKK-GARCH framework. Their results revealed evidence of nonlinear interdependence between Bitcoin and conventional currencies. In particular, the euro was found to exert a direct influence on Bitcoin over the broader sample, whereas the Chinese renminbi became particularly relevant in the post-structural-break period.

Virk (2022) investigated Bitcoin's integration with five major conventional currencies using a Dynamic Conditional Correlation model. The study examined whether movements in Bitcoin returns and volatility were related to movements in conventional foreign-exchange markets. The findings indicated relatively weak integration between Bitcoin and fiat currencies, with changes in Bitcoin returns largely detached from changes in conventional currency returns. Conventional currencies displayed stronger interdependence among themselves than with Bitcoin. Ajayi et al. (2022) examined cryptocurrency shocks and exchange-rate behaviour in Nigeria using monthly observations on the naira exchange rate and five cryptocurrencies: Bitcoin, Ethereum, Litecoin, Ripple and Binance Coin. The study employed Augmented Dickey–Fuller tests, Johansen cointegration and vector autoregressive techniques. The results revealed evidence of a long-run relationship between cryptocurrency variables and the Nigerian exchange rate. Their error-correction results also indicated adjustment towards long-run equilibrium following short-run disturbances.

Dogo and Oladipo (2023) investigated the effect of cryptocurrency returns and volatility on the naira–US dollar exchange rate over the period 2015–2021. The study considered Bitcoin, Ethereum and Dash while controlling for economic activity and oil prices. Using GARCH-MIDAS regression and the Diebold–Yilmaz spillover framework, the authors found that cryptocurrency returns and volatility significantly affected the official naira–US dollar exchange rate. Bitcoin displayed the strongest effect among the cryptocurrencies investigated, while the impacts differed across individual digital assets. Aberu et al. (2023) shifted attention from the official market to Nigeria's parallel foreign-exchange market. Using monthly data covering January 2021 to April 2023, the authors employed an autoregressive distributed lag model and Granger causality analysis to examine whether Bitcoin and Ethereum influenced black-market exchange-rate movements. The results identified cryptocurrency trading as an important determinant of the parallel exchange rate and showed a statistically significant relationship between cryptocurrency activity and black-market exchange-rate behaviour.

Peace et al. (2023) examined the broader relationship between digital currency and Nigerian financial markets using Bitcoin, stock-market prices and treasury-bill securities within a VAR framework. Although the study did not concentrate exclusively on the foreign-exchange market, its findings are relevant to understanding the degree of financial-market integration of cryptocurrency in Nigeria. The impulse-response results suggested that Nigerian financial-market securities exhibited relatively weak responses to Bitcoin shocks, while variance decomposition indicated a small contribution of Bitcoin to changes in the conventional financial assets investigated. Udoh et al. (2024) investigated cryptocurrency prices and exchange-rate volatility in Nigeria using quarterly observations from the first quarter of 2015 to the fourth quarter of 2022. The study employed a Vector Autoregression model and impulse-response analysis. The results showed that Bitcoin prices significantly affected the naira exchange rate. Shocks arising from Bitcoin prices generated noticeable exchange-rate responses, although the magnitude and direction changed across forecasting horizons.

3.0 METHODOLOGY

The study adopts an ex-post facto research design based on secondary time-series data. This design is appropriate because the variables examined in the study have already occurred and cannot be manipulated by the researcher. Historical observations on digital currency adoption, exchange rate, consumer price index and real interest rate are therefore analysed to establish their empirical relationships. The study employs monthly observations covering the period January 2003 to April

2024. The use of monthly data provides a sufficiently large number of observations and enables the study to capture short-term variations in digital currency adoption and exchange-rate movements that may not be adequately reflected in annual data. The quantitative time-series framework further permits the examination of both short-run dynamics and long-run equilibrium relationships among the variables.

The empirical model is anchored on the Currency Substitution Theory, which suggests that economic agents may substitute domestic currency with alternative currencies or currency-like assets when the relative attractiveness of holding domestic money declines. In the context of Nigeria, increasing adoption of digital currencies may alter the demand for naira and consequently influence its exchange rate. The original methodology similarly derives the empirical relationship from the currency-substitution framework.

The functional relationship for the study is specified as:

$$EXR = f(DCC,\ CPI,\ RIR)$$ Where:

EXR = Exchange Rate;
DCC = Digital Currency Adoption;
CPI = Consumer Price Index; and
RIR = Real Interest Rate.

The estimable model is specified as:

$$LEX\,R_t = \beta_0 + \beta_1 LDC\,C_t + \beta_2 LCP\,I_t + \beta_3 RI\,R_t + \varepsilon_t$$ Where:

LEXR = Natural logarithm of exchange rate;
LDCC = Natural logarithm of digital currency adoption;
LCPI = Natural logarithm of consumer price index;
RIR = Real interest rate;
β_0 = Constant term;
β_1 - β_3 = Parameters to be estimated;
t = Time period; and
ε_t = Stochastic error term.

Digital currency adoption constitutes the principal explanatory variable, while consumer price index and real interest rate are included as control variables to account for relevant macroeconomic influences on exchange-rate behaviour. The study employs correlation and time-series econometric techniques to analyse the relationship between digital currency adoption and exchange rate in Nigeria. The procedures include correlation analysis, Augmented Dickey-Fuller unit root testing, ARDL estimation, Bounds Test for cointegration, estimation of long-run coefficients, Error Correction Model, and post-estimation diagnostic and stability tests.

4.0 PRESENTATION, ANALYSIS AND DISCUSSION OF RESULT

4.1 Correlation Analysis

Correlation analysis was conducted as a preliminary examination of the direction and strength of association among the variables used in the study. Specifically, the analysis provides an initial indication of how exchange rate (EXR) is associated with digital currency adoption (DCC), consumer price index (CPI) and real interest rate (RIR), as well as the relationships among the explanatory variables themselves. The results are presented in Table 4.1.

Table 4.1: Correlation Matrix of the Study Variables

Variable	EXR	DCC	CPI	RIR

EXR	1.0000			
DCC	-0.0829 (0.1864)	1.0000		
CPI	0.0464 (0.4596)	**-0.8261 (0.0000)**	1.0000	
RIR	0.0684 (0.2759)	0.0883 (0.1591)	**-0.2216 (0.0004)**	1.0000

Source: Researcher's computation using EViews, 2026.
Note: Figures outside parentheses are correlation coefficients, while probability values are reported in parentheses. Bold coefficients are statistically significant at the 5% level. EXR = Exchange Rate; DCC = Digital Currency Adoption; CPI = Consumer Price Index; RIR = Real Interest Rate. Observations = 256.

The results in Table 4.1 show that digital currency adoption has a weak negative relationship with exchange rate, with a correlation coefficient of -0.0829. The relationship is, however, statistically insignificant at the 5% level (p = 0.1864). This implies that increases in digital currency adoption are associated with a slight decrease in the exchange rate at the bivariate level, but the observed relationship is not sufficiently strong to be statistically established. The result should not be interpreted as evidence that digital currency adoption has no effect on exchange rate, since correlation captures only contemporaneous association and does not account for lagged effects or other explanatory variables. Consumer price index has a very weak positive correlation with exchange rate (r = 0.0464), which is also statistically insignificant (p = 0.4596). Similarly, real interest rate is positively but weakly associated with exchange rate, with a coefficient of 0.0684 and probability value of 0.2759. Therefore, none of the explanatory variables exhibits a statistically significant simple correlation with exchange rate. These findings suggest that exchange-rate movements may depend on more complex dynamic interactions that cannot be adequately captured by simple pairwise correlations.

Among the explanatory variables, digital currency adoption and consumer price index exhibit a strong negative and statistically significant correlation of -0.8261 (p = 0.0000). This indicates that the two variables moved strongly in opposite directions over the study period. The relatively high absolute correlation also suggests the possibility of multicollinearity and therefore warrants caution when interpreting their individual regression coefficients. In addition, CPI and RIR are negatively and significantly correlated (r = -0.2216, p = 0.0004), while the positive relationship between DCC and RIR is weak and statistically insignificant (r = 0.0883, p = 0.1591). Overall, the correlation analysis provides preliminary evidence concerning the relationships among the variables but does not establish causality or their dynamic time-series effects. Furthermore, since some economic time-series variables may be non-stationary, correlations in levels can sometimes reflect common trends rather than stable economic relationships. It is therefore necessary to examine the stationarity properties of the variables before proceeding with the ARDL estimation. Accordingly, the Augmented Dickey-Fuller (ADF) unit root test is conducted in the next section to determine the order of integration of each variable.

4.2 ARDL Model Estimation

The ARDL model was estimated to examine the dynamic relationship between digital currency adoption and exchange rate in Nigeria. Based on the Akaike Information Criterion (AIC), the ARDL(1,3,0,4) specification was selected as the optimal model from the alternative lag combinations evaluated. The estimated results are presented in the table below.

Table 4.2: ARDL Estimates for Digital Currency Adoption and Exchange Rate in Nigeria

Variable	Coefficient	t-Statistic	Prob.	Significance
LEXR(-1)	0.5539	10.4321	0.0000	Significant
LDCC	-0.2887	-0.7763	0.4383	Not significant
LDCC(-1)	1.0336	1.9954	0.0471	Significant
LDCC(-2)	-1.6250	-3.1299	0.0020	Significant
LDCC(-3)	0.7256	1.9027	0.0583	Not significant
LCPI	-0.1204	-0.5998	0.5492	Not significant

RIR	0.0045	0.4616	0.6448	Not significant
RIR(-1)	0.0074	0.5602	0.5759	Not significant
RIR(-2)	-0.0036	-0.2696	0.7877	Not significant
RIR(-3)	0.0112	0.8431	0.4000	Not significant
RIR(-4)	-0.0250	-2.5733	0.0107	Significant
Constant	5.1957	1.1929	0.2341	Not significant

Model Statistic	Value
Selected model	ARDL(1,3,0,4)
Observations	252
R-squared	0.4017
Adjusted R-squared	0.3742
F-statistic	14.6461
Prob. (F-statistic)	0.0000
Durbin-Watson statistic	1.9995
AIC	1.4852

Source: Researcher's computation using EViews, 2026.

The ARDL estimation selected an **ARDL(1,3,0,4)** model based on the Akaike Information Criterion. This implies that the current exchange rate is explained by one lag of its own value, up to three lags of digital currency adoption, the current value of consumer prices, and up to four lags of the real interest rate. The coefficient of the lagged exchange rate, LEXR(-1), is positive (0.5539) and statistically significant at the 5% level ($p = 0.0000$). This indicates substantial persistence in exchange-rate movements, such that previous exchange-rate behaviour significantly influences the current exchange rate in Nigeria. Digital currency adoption exhibits a dynamic rather than an immediate effect on the exchange rate. The contemporaneous coefficient of LDCC is negative (-0.2887) but statistically insignificant ($p = 0.4383$). However, its first lag has a positive and significant coefficient of 1.0336 ($p = 0.0471$), while its second lag has a negative and statistically significant coefficient of -1.6250 ($p = 0.0020$). The third lag is positive but does not attain significance at the conventional 5% level ($p = 0.0583$). These findings indicate that changes in digital currency adoption do not exert an immediate statistically significant effect on the exchange rate, but their effects emerge with a time lag and vary in direction across subsequent months. This suggests that the exchange-rate response to changes in digital currency adoption is distributed over time rather than occurring instantaneously.

Consumer prices, represented by LCPI, have a negative coefficient of -0.1204, but the effect is statistically insignificant ($p = 0.5492$). Similarly, the current value and first three lags of the real interest rate are statistically insignificant. However, RIR(-4) has a negative coefficient of -0.0250 and is statistically significant ($p = 0.0107$), indicating that changes in the real interest rate may exert a delayed effect on the exchange rate. Nevertheless, these individual ARDL coefficients primarily describe the model's dynamic structure and should not yet be treated as the final short-run or long-run effects. Those effects are better interpreted after establishing whether cointegration exists. The overall performance of the estimated ARDL model indicates a reasonable explanatory capacity. The R^2 of 0.4017 shows that approximately 40.17% of the variations in the exchange rate are explained by digital currency adoption, consumer prices, real interest rate and their selected lag structures, while the adjusted R^2 of 0.3742 accounts for the number of explanatory parameters included in the model. The F-statistic of 14.6461, with a probability value of 0.0000, indicates that the explanatory variables are jointly statistically significant in explaining variations in the exchange rate. Furthermore, the Durbin-Watson statistic of 1.9995, which is approximately 2, provides an initial indication of the absence of serious residual autocorrelation, a result subsequently assessed more formally using the Breusch-Godfrey Serial Correlation LM test.

4.3 ARDL Bounds Test for Cointegration

Following the estimation of the optimal ARDL model, the Bounds Test was conducted to determine whether a long-run equilibrium relationship exists between exchange rate, digital currency adoption, consumer prices and real interest rate in Nigeria. The null hypothesis of the test states that no long-

run relationship exists among the variables. The results of the ARDL Bounds Test are presented in the table below.

Table 4.3: ARDL Bounds Test for Cointegration

Test Statistic	Value	Significance	I(0) Lower Bound	I(1) Upper Bound	Decision
F-statistic	**14.4840**	10%	2.37	3.20	Cointegration
		5%	2.79	3.67	Cointegration
		2.5%	3.15	4.08	Cointegration
		1%	3.65	4.66	Cointegration

Source: Researcher's computation using EViews, 2026.
Note: k = 3 explanatory variables. H_0: No levels relationship exists.

The ARDL bounds test was conducted to determine whether a long-run equilibrium relationship exists between exchange rate, digital currency adoption, consumer prices and real interest rate in Nigeria. The result shows an F-statistic of 14.4840, which is substantially greater than the upper-bound critical value of 3.67 at the 5% significance level. Indeed, the F-statistic also exceeds the upper-bound critical value of 4.66 at the 1% level. The null hypothesis of no levels relationship is therefore rejected. This provides strong evidence that exchange rate, digital currency adoption, consumer prices and real interest rate are cointegrated and maintain a long-run relationship in Nigeria. Having established cointegration, it is appropriate to proceed to the long-run coefficients and short-run error-correction results.

4.4 ARDL Long-Run Estimates

Having established the existence of cointegration among the variables through the ARDL Bounds Test, the long-run coefficients were estimated to determine the magnitude, direction and statistical significance of the effects of digital currency adoption, consumer prices and real interest rate on the exchange rate in Nigeria. The estimated long-run coefficients are presented in the table below.

Table 4.4: Estimated ARDL Long-Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Decision at 5%
LDCC	-0.3462	0.5328	-0.6498	0.5164	Not significant
LCPI	-0.2699	0.4486	-0.6015	0.5481	Not significant
RIR	-0.0124	0.0092	-1.3379	0.1822	Not significant
Constant	11.6477	9.6533	1.2066	0.2288	Not significant

Source: Researcher's computation using EViews, 2026.
Dependent variable: LEXR.

Following the establishment of cointegration, the long-run estimates indicate that digital currency adoption has a negative but statistically insignificant relationship with the exchange rate. The coefficient of LDCC is -0.3462 with a probability value of 0.5164. Since both LEXR and LDCC are expressed in logarithms, the coefficient implies that, in the long run, a 1% increase in digital currency adoption is associated with approximately a 0.35% decrease in the naira/US dollar exchange rate, other factors remaining constant. A decline in the naira-per-dollar exchange rate represents an appreciation of the naira. However, because the probability value exceeds 0.05, the effect is not statistically significant. Consequently, the study does not find sufficient evidence that digital currency adoption independently influences the exchange rate in the long run.

Consumer prices and real interest rate similarly have negative but statistically insignificant long-run coefficients. LCPI has a coefficient of -0.2699 (p = 0.5481), while RIR has a coefficient of -0.0124 (p =

0.1822). Thus, neither variable independently exerts a statistically significant long-run effect on the exchange rate at the 5% level. This result should be distinguished from the Bounds Test: cointegration can exist even though individual long-run coefficients are statistically insignificant. The Bounds Test establishes a joint long-run equilibrium relationship among the variables, whereas the individual coefficients indicate that the separate long-run effects cannot be statistically distinguished from zero within the estimated model.

4.5 ARDL Error Correction Model and Short-Run Estimates

Following the confirmation of a long-run relationship among the variables, the Error Correction Model (ECM) was estimated to examine the short-run effects of digital currency adoption and the other explanatory variables on exchange rate, as well as the speed at which short-run deviations adjust towards long-run equilibrium. Particular attention is given to the error correction term, CointEq(-1), whose sign and statistical significance indicate the existence and speed of adjustment towards equilibrium. The short-run ECM results are presented in the table below.

Table 4.5: ARDL Error Correction Model — Short-Run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Decision at 5%
D(LDCC)	-0.2887	0.3557	-0.8115	0.4179	Not significant
D(LDCC(-1))	0.8994	0.3406	2.6406	0.0088	Significant
D(LDCC(-2))	-0.7256	0.3608	-2.0109	0.0455	Significant
D(RIR)	0.0045	0.0094	0.4777	0.6333	Not significant
D(RIR(-1))	0.0174	0.0094	1.8494	0.0656	Not significant
D(RIR(-2))	0.0138	0.0095	1.4630	0.1448	Not significant
D(RIR(-3))	0.0250	0.0095	2.6481	0.0086	Significant
CointEq(-1)	-0.4461	0.0520	-8.5806	0.0000	Significant

Model Statistics

Statistic	Value
R-squared	0.2761
Adjusted R-squared	0.2554
Durbin-Watson statistic	1.9995
Observations	252

Source: Researcher's computation using EViews, 2026.

Note: D denotes first difference. Statistical significance is evaluated at the 5% level.

The short-run ARDL error correction results show that the immediate effect of digital currency adoption on the exchange rate is negative but statistically insignificant. Specifically, D(LDCC) has a coefficient of -0.2887 with a probability value of 0.4179, indicating that changes in digital currency adoption do not have a statistically significant contemporaneous effect on the exchange rate. However, the first lag of digital currency adoption, D(LDCC(-1)), has a positive and statistically significant coefficient of 0.8994 (p = 0.0088). Since both variables are in logarithmic form, this indicates that a 1% increase in digital currency adoption in the preceding month is associated with approximately a 0.90% increase in the naira/US dollar exchange rate in the current month, other factors remaining constant. Given that a rise in the naira/US dollar exchange rate represents naira depreciation, the result suggests that increased digital currency adoption has a delayed short-run depreciating effect on the naira.

Interestingly, the second lag of digital currency adoption, D(LDCC(-2)), has a negative and statistically significant coefficient of -0.7256 (p = 0.0455). This indicates that the effect reverses after two months, suggesting that the relationship between digital currency adoption and exchange-rate movements is dynamic rather than consistently positive or negative over the short run. In other words, an increase in digital currency adoption initially produces no significant contemporaneous effect, is associated with naira depreciation after one month, and is subsequently associated with an appreciation effect after two months. This alternating response may reflect adjustments in digital-asset transactions, foreign-exchange demand and other market responses over time.

The real interest rate also exhibits a delayed effect on the exchange rate. Its contemporaneous value and first two lags are statistically insignificant at the 5% level. However, D(RIR(-3)) has a positive and statistically significant coefficient of 0.0250 (p = 0.0086), indicating that changes in the real interest rate exert a significant effect on the exchange rate after approximately three months. The R-squared of 0.2761 indicates that about 27.61% of short-run variations in the change in exchange rate are explained by the short-run dynamics contained in the model. The Durbin-Watson statistic of 1.9995 is also close to the benchmark value of 2, although a formal serial-correlation diagnostic test should still be conducted.

Most importantly, the error correction term, CointEq(-1), has the theoretically expected negative sign and is highly statistically significant, with a coefficient of -0.4461 and probability value of 0.0000. This confirms the existence of a stable adjustment mechanism toward the long-run equilibrium established by the Bounds Test. The coefficient implies that approximately 44.61% of any deviation from the long-run equilibrium is corrected within one month. Consequently, following a short-run disturbance, the exchange rate adjusts relatively rapidly towards its long-run equilibrium relationship with digital currency adoption, consumer prices and real interest rate.

4.6 Residual Diagnostic and Stability Tests

Following the estimation of the ARDL and error correction models, residual diagnostic and stability tests were conducted to assess the reliability and adequacy of the estimated model. Specifically, the tests examine the presence of serial correlation and heteroskedasticity, the normality of the residuals, and the stability of the estimated parameters over the study period. The results of the diagnostic and stability tests are presented in table 4.7.

Table 4.6: Residual Diagnostic and Stability Test Results

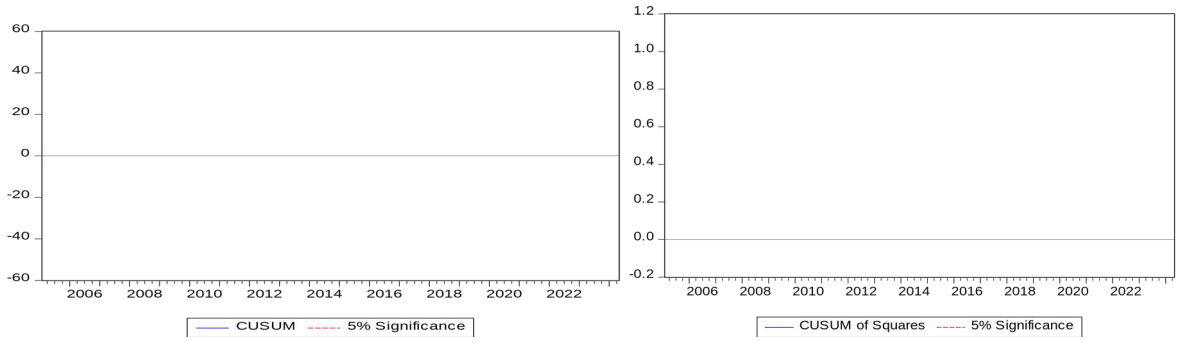
Diagnostic Test	Test Statistic	Probability	Decision at 5%	Conclusion
Breusch-Godfrey Serial Correlation LM	6.3311	0.1757	Do not reject H_0	No serial correlation
White Heteroskedasticity Test	219.7596	0.0000	Reject H_0	Heteroskedasticity present
Jarque-Bera Normality Test	174.0938	0.0000	Reject H_0	Residuals not normally distributed
CUSUM Stability Test	Within 5% bounds	—	Stable	Parameters are stable
CUSUM of Squares Test	Within 5% bounds	—	Stable	Variance/parameters are stable

Source: Researcher's computation using EViews, 2026.
Note: For the Breusch-Godfrey test, H_0 = no serial correlation; for the White test, H_0 = homoskedasticity; for the Jarque-Bera test, H_0 = normally distributed residuals. The CUSUM and CUSUMSQ models are considered stable where the plotted statistics remain within the 5% critical boundaries.

The Breusch-Godfrey LM test indicates that the estimated ARDL model does not suffer from residual serial correlation. The Obs*R-squared statistic of 6.3311 has a probability value of 0.1757, which exceeds the 5% significance level. The null hypothesis of no serial correlation is therefore not rejected. This finding is consistent with the earlier Durbin-Watson statistic of approximately 2.00 and suggests that the residuals are not systematically correlated across the tested lag periods.

The White heteroskedasticity test, however, produces an Obs*R-squared statistic of 219.7596 with a probability value of 0.0000. The null hypothesis of homoskedasticity is therefore rejected, indicating the presence of heteroskedasticity in the model. This means that the variance of the residuals is not constant over the sample period. While this does not by itself invalidate the estimated ARDL coefficients, it can make the conventional standard errors, t-statistics and probability values unreliable. Consequently, this diagnostic problem should be addressed before the statistical significance of individual coefficients is treated as final.

The Jarque-Bera test also rejects the null hypothesis of normally distributed residuals. The Jarque-Bera statistic is 174.0938 with a probability value of 0.0000. The residual distribution is negatively skewed (-0.4629) and has a kurtosis of 6.9653, substantially above the normal-distribution benchmark of 3. The residuals are therefore leptokurtic, indicating relatively heavy tails and the presence of some unusually large residual observations. Nevertheless, given the relatively large sample of 252 monthly observations, non-normality is generally less problematic for large-sample inference than heteroskedasticity, although it should still be reported transparently. Finally, the CUSUM and CUSUM of Squares plots remain within the 5% critical boundaries throughout the sample period.



The estimated ARDL model therefore passes both stability tests, indicating that its estimated parameters are broadly stable over the study period. Taken together, the diagnostics show that the model performs satisfactorily with respect to serial correlation and parameter stability, but fails the heteroskedasticity and normality tests. The most important issue to correct is heteroskedasticity.

4.7 Findings of the Study

The findings of the study reveal important evidence concerning the relationship between digital currency adoption and exchange-rate behaviour in Nigeria. The preliminary unit root analysis showed that the variables possessed mixed orders of integration. Exchange rate (LEXR) and real interest rate (RIR) were stationary at level, I(0), while digital currency adoption (LDCC) and consumer price index (LCPI) became stationary after first differencing and were therefore I(1). Since none of the variables was integrated of order two, the mixed stationarity properties justified the application of the ARDL approach. The ARDL bounds test subsequently produced an F-statistic of 14.4840, which substantially exceeded the 5% upper-bound critical value of 3.67. This confirmed the existence of a long-run equilibrium relationship among exchange rate, digital currency adoption, consumer prices and real interest rate in Nigeria.

Despite the existence of cointegration, digital currency adoption did not exert a statistically significant individual effect on the exchange rate in the long run. The long-run coefficient of LDCC was -0.3462 with a probability value of 0.5164, indicating that the estimated negative relationship was statistically insignificant. This implies that although digital currency adoption forms part of the variables maintaining a long-run equilibrium relationship with the exchange rate, there is insufficient statistical evidence to conclude that changes in digital currency adoption independently determine the long-run value of the naira. Similarly, consumer prices and real interest rates produced statistically insignificant long-run coefficients. The findings therefore suggest that the long-run behaviour of the Nigerian exchange rate cannot be attributed to digital currency adoption alone but is likely influenced by broader macroeconomic and foreign-exchange market conditions.

A different pattern emerged in the short run, where digital currency adoption exhibited significant delayed effects on the exchange rate. The contemporaneous change in digital currency adoption was statistically insignificant, indicating that an increase in adoption does not immediately affect the naira exchange rate. However, the first lag of digital currency adoption had a positive and statistically significant coefficient of 0.8994, showing that a 1% increase in digital currency adoption in the preceding month was associated with approximately a 0.90% increase in the naira/US dollar exchange rate in the current month. Since an increase in the naira-per-dollar exchange rate represents depreciation of the domestic currency, the result suggests that increased digital currency adoption may generate short-run depreciation pressure on the naira after a one-month lag. This

finding is consistent with the currency substitution argument that increased movement into alternative digital monetary assets may temporarily reduce demand for domestic currency.

The short-run results further revealed that the effect of digital currency adoption was not persistent in one direction. The second lag of LDCC recorded a negative and statistically significant coefficient of -0.7256, indicating a reversal of the depreciation effect observed at the first lag. This suggests that the relationship between digital currency adoption and the exchange rate is dynamic, with the foreign-exchange market adjusting to digital-currency-related shocks over subsequent periods. The real interest rate similarly displayed a delayed effect, becoming positive and statistically significant at the third lag. Overall, the results indicate that the influence of digital currency adoption on Nigeria's exchange rate is more evident through short-run adjustments than through a permanent long-run effect, and that the direction and magnitude of the effect vary across time periods.

Finally, the error correction mechanism provides further evidence of a stable relationship among the variables. The coefficient of the error correction term, CointEq(-1), was -0.4461 and statistically significant at the 1% level, confirming that deviations from long-run equilibrium are corrected over time. Specifically, approximately 44.61% of any short-run disequilibrium is corrected within one month, indicating a relatively rapid adjustment towards long-run equilibrium. Taken together, the findings show that digital currency adoption matters for exchange-rate behaviour in Nigeria primarily through significant but temporary short-run effects rather than a statistically significant independent long-run effect. This implies that the growing use of digital currencies may contribute to short-term movements in the naira, but the long-run trajectory of the exchange rate appears to depend on a broader combination of monetary and macroeconomic factors.

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This paper examined the impact of digital currency adoption on exchange rate in Nigeria. The growing use of cryptocurrencies, stablecoins and other forms of digital currencies has introduced an additional dimension to Nigeria's monetary and foreign exchange environment. Against the background of persistent exchange-rate instability and increasing utilisation of digital assets, the study sought to determine whether digital currency adoption contributes significantly to movements in the Nigerian exchange rate. The ARDL Bounds Test produced an F-statistic of 14.4840, which exceeded the 5% upper-bound critical value of 3.67, thereby confirming the existence of a long-run equilibrium relationship among exchange rate, digital currency adoption, consumer prices and real interest rate. However, the estimated long-run coefficient of digital currency adoption was negative but statistically insignificant. Consumer prices and real interest rate also had statistically insignificant individual long-run coefficients. The results therefore established a joint long-run relationship among the variables but did not provide sufficient evidence that digital currency adoption independently determines Nigeria's exchange rate in the long run.

The short-run Error Correction Model produced more pronounced evidence regarding digital currency adoption. Its contemporaneous coefficient was statistically insignificant, but its first lag was positive and significant, while its second lag was negative and significant. This indicates that digital currency adoption exerts delayed and changing short-run effects on exchange-rate movements rather than an immediate or persistent effect in a single direction. The error correction coefficient was -0.4461 and statistically significant, indicating that approximately 44.61% of short-run deviations from long-run equilibrium are corrected within one month. Diagnostic tests showed that the model was free from serial correlation and remained stable based on the CUSUM and CUSUM of Squares tests. However, the White test indicated the presence of heteroskedasticity, while the Jarque-Bera test showed that the residuals were not normally distributed. These limitations require caution in interpreting individual statistical significance, although the stability tests provide evidence that the estimated parameters remained broadly stable over the study period.

5.2 Conclusion

The study concludes that digital currency adoption is relevant to exchange-rate dynamics in Nigeria, although its influence is predominantly a short-run and dynamic phenomenon rather than a statistically significant independent long-run effect. While a stable long-run equilibrium relationship exists among digital currency adoption, exchange rate, consumer prices and real interest rate, digital currency adoption does not significantly determine the exchange rate individually in the long run. In the short run, however, increased digital currency adoption is associated with significant exchange-rate movements after a time lag, with the first lag exerting depreciation pressure on the naira before an opposite adjustment occurs subsequently. This suggests that the expansion of digital currency usage can temporarily influence demand and supply conditions in the foreign exchange market, but it should not be regarded as the principal explanation for Nigeria's persistent long-run exchange-rate depreciation. Consequently, policies towards digital currencies should recognise their growing relevance to short-term foreign-exchange dynamics while addressing the broader monetary, structural and external-sector factors responsible for long-term exchange-rate instability.

5.3 Recommendations

Based on the findings of the study, the following recommendations are made:

1. **Strengthen monitoring of digital currency transactions.** The Central Bank of Nigeria and relevant financial regulators should strengthen the monitoring of digital currency transactions, particularly transactions involving naira conversion into foreign-currency-denominated digital assets. This is important because the findings indicate that digital currency adoption can exert significant delayed short-run effects on exchange-rate movements.
2. **Integrate digital asset activities into foreign-exchange surveillance.** Digital currency indicators should increasingly be incorporated into the country's foreign-exchange market surveillance framework. Information on cryptocurrency transaction values, stablecoin flows and other major digital asset activities can complement conventional indicators in identifying emerging short-run pressures on the naira.
3. **Promote regulation rather than excessive restriction.** Regulatory authorities should pursue a balanced framework that facilitates legitimate digital currency activities while strengthening transparency, reporting and compliance. Excessively restrictive measures may encourage transactions to migrate to informal peer-to-peer channels, thereby reducing regulatory visibility without necessarily eliminating demand for digital currencies.
4. **Address the fundamental determinants of exchange-rate instability.** Since digital currency adoption was not found to exert a statistically significant independent long-run effect on the exchange rate, exchange-rate policy should not attribute persistent naira depreciation primarily to digital currencies. Greater policy attention should be directed towards improving foreign-exchange supply, strengthening non-oil exports, maintaining macroeconomic stability, improving domestic productive capacity and reducing structural dependence on imports.
5. **Strengthen the domestic digital financial system.** The monetary authorities should continue improving regulated domestic digital payment infrastructure and the usefulness of the eNaira and other approved digital financial innovations. Providing efficient, secure and affordable domestic digital payment alternatives could reduce some of the incentives for excessive dependence on privately issued foreign-currency-linked digital assets for payments and value preservation.

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