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VOLATILITY SPILL-OVER FROM BITCOIN AND ETHEREUM TO NIGERIA'S OFFICIAL EXCHANGE RATE: A DIAGONAL BEKK-GARCH ANALYSIS

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Abstract
This study examines the volatility spill-over between two leading cryptocurrencies (Bitcoin and Ethereum) and Nigeria's official exchange rate, using the diagonal BEKK-GARCH framework. The analysis is motivated by the rapid growth of cryptocurrency adoption in Nigeria and persistent instability in the Naira, which together raise the question of whether digital-asset volatility is transmitted into the country's regulated foreign exchange market. Daily data on Bitcoin, Ethereum, and the official Naira/USD exchange rate covering August 2015 to August 2025 were employed. A diagonal BEKK-GARCH (1,1) model was applied to capture own-market volatility persistence and cross-market variance-covariance transmission. The results show that own-market volatility dominates the official exchange rate's variance process, with ARCH and GARCH coefficients indicating strong short-run clustering and long-run persistence. Cross-market transmission is present but concentrated rather than broad-based: the constant covariance term linking Bitcoin and the official exchange rate is negative and statistically significant, while the corresponding Ethereum-exchange rate term is not. The findings suggest that Nigeria's regulated foreign exchange market retains a degree of insulation from cryptocurrency-market shocks, consistent with the dampening role of central bank intervention and administrative exchange-rate management. The study recommends that the Central Bank of Nigeria and the Securities and Exchange Commission monitor Bitcoin-linked foreign exchange flows specifically, rather than treating cryptocurrency risk as a uniform channel.

Keywords: Volatility spill-over · Bitcoin · Ethereum · Exchange rate · BEKK-GARCH · Nigeria

1. Introduction

Cryptocurrencies have moved from experimental digital tokens into liquid, globally traded assets in little more than a decade, and their price behaviour is now closely watched for what it might reveal about, or transmit into, conventional financial markets (Stejskalova & Barunik, 2023). Bitcoin remains the largest and most liquid of these assets, with Ethereum a close second, and both have grown increasingly sensitive to global macro-financial conditions as institutional participation has widened (Baur et al., 2024; IMF, 2023). This growing integration raises a concrete empirical question wherever a country's currency is itself under strain: does volatility in Bitcoin and Ethereum spill over into the domestic foreign exchange market, and if so, how strongly?

Nigeria offers a particularly relevant setting for this question. The country combines two features that, in principle, make such spill-over more likely: persistent Naira instability, driven by declining oil revenues, recurrent foreign exchange shortages, and inflationary pressure (Abu & Ohiaeri, 2023), and one of the highest rates of cryptocurrency adoption in the world, with Bitcoin and Ethereum accounting for the bulk of peer-to-peer transaction volume

(Chainalysis, 2024). Where a domestic currency is already fragile, portfolio substitution toward more liquid digital assets households and firms shifting savings from Naira into Bitcoin or Ethereum as a hedge against depreciation provides a plausible channel through which cryptocurrency-market shocks could propagate into exchange-rate volatility (Umar et al., 2023; Yousaf & Yarovaya, 2022).

Nigeria's foreign exchange market is not, however, a single undifferentiated space. It operates as a dual system, comprising a Central Bank-regulated official window and a comparatively unregulated parallel market, and the two segments do not necessarily respond to external shocks in the same way (Ajayi et al., 2022). The official rate is subject to direct monetary policy management, administrative allocation, periodic intervention, and, since June 2023, unification reforms aimed at reducing distortions across windows (CBN, 2024), all of which could plausibly dampen the pass-through of cryptocurrency volatility even where such volatility exists elsewhere in the system. Whether this insulating effect actually holds, however, is an empirical question rather than an assumption, and it is the specific question this paper addresses.

Existing research offers only partial guidance here. Much of the literature on cryptocurrency-exchange rate linkages is drawn from developed or large emerging economies with more liberalized foreign exchange regimes, and does not speak directly to a segmented system like Nigeria's (Stejskalova & Barunik, 2023). Within the smaller body of Nigeria-focused work, studies have tended to concentrate on Bitcoin alone, leaving Ethereum's contribution largely unexamined despite its rising market weight (Ajayi et al., 2022; Umeokwobi et al., 2023), and have often relied on monthly or quarterly data that cannot capture the high-frequency clustering characteristic of both cryptocurrency and exchange-rate volatility (Aberu et al., 2023). Multivariate GARCH-family models capable of isolating cross-market variance-covariance transmission as distinct from simple correlation remain correspondingly underused in this context (Baur et al., 2024; IMF, 2023).

This study addresses that gap by applying a diagonal BEKK-GARCH (1,1) model to daily Bitcoin, Ethereum, and official Naira/USD exchange-rate data spanning August 2015 to August 2025. The BEKK specification is well suited to this question because it estimates the full conditional variance-covariance structure directly, allowing own-market volatility persistence and cross-market spill-over to be distinguished within a single, internally consistent system, rather than inferred indirectly from simple correlation coefficients.

The objective of this study is to determine the volatility spill-over between Bitcoin, Ethereum, and Nigeria's official exchange rate, using a diagonal BEKK-GARCH framework applied to daily data covering August 2015 to August 2025.

2. Literature Review

2.1 Theoretical Framework

This study is grounded in two complementary theoretical strands: Portfolio Balance/Asset Substitution Theory, which motivates why volatility transmission between cryptocurrencies and the Naira should be expected at all, and Market Microstructure Theory, which motivates why that transmission should be conditioned by the structure of the receiving market.

Portfolio Balance Theory holds that investors continuously reallocate wealth across assets in response to changes in relative risk, return, and liquidity, and that shocks to one asset's risk profile alter the expected return of substitutable assets held in the same portfolio. Applied to a

currency under sustained depreciation pressure, the theory implies that households and firms have an incentive to treat liquid digital assets as a substitute store of value, shifting savings from Naira into Bitcoin or Ethereum as a hedge against domestic currency weakness (Umar et al., 2023; Yousaf & Yarovaya, 2022). Because this substitution channel operates through the same pool of holders moving funds between markets, volatility originating in the cryptocurrency leg of the portfolio does not stay contained there: shocks to Bitcoin or Ethereum's expected risk alter the incentive to hold or exit Naira-denominated assets, and that reallocation pressure registers as a measurable variance-covariance relationship between the two markets. This is the theoretical basis for expecting a non-zero c_{13} and c_{23} in the BEKK system estimated below, and for treating cryptocurrency volatility as a plausible, rather than incidental, candidate driver of exchange-rate variance.

Portfolio substitution alone, however, does not explain why any resulting transmission should be partial rather than complete, or why it might differ across market segments. Market Microstructure Theory supplies that second piece. Kyle (1985) and O'Hara (1995) establish that the extent to which information and shocks pass through into observed prices depends on the trading mechanism itself, not only on the underlying economic pressure, informed order flow, price formation rules, and the presence of an intermediary who absorbs or filters shocks all shape how completely a disturbance is transmitted into the price process. Nigeria's official exchange-rate window is precisely such a filtered mechanism: it operates under direct Central Bank allocation, periodic intervention, and post-2023 unification management, rather than through the continuous, decentralized order-flow process microstructure theory typically models. This structural difference implies that even where portfolio-driven substitution pressure exists, the official market's administrative architecture should be expected to absorb or dampen a portion of that pressure before it registers as a broad-based covariance relationship producing transmission that is real but narrow, rather than uniform across the cryptocurrency-to-exchange-rate channel.

Read together, these two frameworks generate a specific, testable expectation: that Bitcoin and Ethereum volatility should transmit into the official exchange rate through portfolio substitution, but that the administratively managed structure of the official window should condition the magnitude and consistency of that transmission precisely the joint prediction tested in the hypotheses.

2.2 Empirical Reviews

2.2.1 Volatility Behaviour of Bitcoin and Ethereum

The starting point for any spill-over analysis is evidence that the source assets are themselves volatile in ways a GARCH-family model can usefully capture. Baur et al. (2024), using high-frequency data across global exchanges, document fat-tailed returns and persistent volatility clustering in both Bitcoin and Ethereum, with Ethereum exhibiting the more frequent spikes, largely attributable to network congestion and protocol-level events. Rjiba et al. (2024) extend this by showing that both assets respond almost instantaneously to macroeconomic announcements, with Ethereum again the more reactive of the two, a pattern echoed in Philip et al. (2020) and Klein et al. (2018), who separately attribute Ethereum's more prolonged volatility to its broader utility base and sensitivity to on-chain activity. Katsiampa (2019) adds a long-memory dimension, finding via FIGARCH that shocks to Bitcoin and Ethereum volatility persist well beyond the short run rather than dissipating quickly. Taken together, this body of work establishes two things relevant here: first, that Bitcoin and Ethereum both display the volatility clustering that justifies a GARCH-type specification; and second, that the

two assets are not interchangeable. Ethereum's volatility process tends to run hotter and longer than Bitcoin's, which is a reason to model the two as separate sources of potential spill-over rather than pooling them. Very few of these studies, however, extend the analysis beyond the cryptocurrency space itself into any national exchange-rate system, which is the gap the next cluster of studies begins to close.

2.2.2 Cross-Market Transmission from Cryptocurrencies to Exchange Rates

A second strand of literature moves from documenting cryptocurrency volatility in isolation to testing whether it transmits into other markets, including currencies. The IMF (2023) reports, using panel and time-varying correlation methods, that co-movement between crypto assets and emerging-market currencies strengthened materially after 2020 as institutional participation grew, with Bitcoin-originated shocks showing measurable effects on several developing-economy exchange rates. Yousaf and Yarovaya (2022) reach a similar conclusion using multivariate GARCH techniques, finding that both Bitcoin and Ethereum act as significant transmitters of volatility to currency markets, an effect that intensifies during periods of global financial stress. Regionally, Umar et al. (2023) apply a DCC-GARCH model to Bitcoin, Ethereum, and two African currencies; the Kenyan Shilling and the South African Rand and find significant bi-directional spill-overs, with correlations rising sharply during episodes of financial stress. Katsiampa (2022) narrow the focus to the Bitcoin-USD relationship specifically and confirm significant dynamic correlation, with Bitcoin frequently the transmitting asset. Ciaian et al. (2018) offer a partial counterpoint: using VAR and GARCH models on advanced-economy currencies, they find that while Bitcoin reacts strongly to global financial shocks, its own contribution to exchange-rate determination in those markets is comparatively limited, a reminder that transmission strength is not uniform across recipient markets and depends on the structure of the currency regime in question.

What this cluster establishes, cumulatively, is that cryptocurrency-to-exchange-rate spill-over is a documented phenomenon rather than a speculative hypothesis, but that its magnitude is context-dependent. Critically, none of the country-level reviewed studies above include Nigeria, and none address a dual or administratively managed exchange-rate system of the kind Nigeria operates. The IMF's (2023) cross-country evidence is aggregated rather than country-specific, and the African-currency evidence in Umar et al. (2023) stops short of West Africa's largest and most crypto-active economy. This is the specific gap the present study occupies.

2.3 Determinants of Exchange-Rate Volatility in Nigeria

A separate, largely domestic literature has examined what drives volatility in the Naira, generally without reference to cryptocurrency markets at all. Ogunleye (2021) and Akinbobola (2017) both find that external shocks, global financial uncertainty and oil-market developments in particular, exert substantial influence on Nigeria's exchange rate, using multivariate GARCH and structural VAR approaches respectively. Ojeke and Ananwude (2020) and Olowe (2009) locate additional sources of volatility in domestic monetary policy shifts and confirm strong persistence and asymmetric shock response in the Naira-Dollar rate using EGARCH and GARCH specifications. Adeniran et al. (2014) and Eze and Okpala (2019) extend the horizon further back, tracing sustained Naira volatility to structural weaknesses, oil dependence and breaks associated with major regulatory interventions. The consistent finding across this literature is that Nigeria's official exchange rate is heavily shaped by macroeconomic fundamentals, oil revenue, and policy stance, and exhibits genuine, well-documented volatility persistence of its own. What this literature does not do, in any of the

studies reviewed, is treat cryptocurrency markets as a candidate explanatory variable. Given the scale of cryptocurrency adoption documented in Nigeria (Chainalysis, 2024), this is a conspicuous omission that motivates the variable set used in the present study.

2.4 Methodological Precedents: BEKK-GARCH and Related Multivariate Models

Bollerslev (1986) introduced the GARCH specification to model volatility clustering directly; Engle (2002) extended this into the Dynamic Conditional Correlation framework to allow time-varying correlation across multiple assets; and Bauwens et al. (2006) advanced the BEKK specification, which guarantees a positive semi-definite covariance matrix and estimates cross-market spill-over directly within the variance-covariance system, rather than inferring it from correlation coefficients after the fact. This last property is what makes BEKK preferable to a simple correlation-based approach for the present question: it distinguishes how much of an asset's own current volatility comes from its own past shocks and variance (own-market persistence) from how much is attributable to shocks originating in another market (cross-market transmission) precisely the distinction Objective 1 of this study requires.

Applications of the BEKK specification to cryptocurrency markets confirm its suitability for this kind of question. Koutmos (2018) applies BEKK-GARCH to Bitcoin and major equity indices and finds significant bi-directional spill-over, intensifying during high-volatility periods. Goodell and Goutte (2021) similarly use a BEKK-GARCH and time-varying VAR combination to show that Bitcoin transmitted volatility into stock and currency markets during the COVID-19 period. Arouri et al. (2012) apply the same family of models to exchange-rate volatility transmission across developed and emerging economies more generally, again confirming strong cross-market linkages, particularly during periods of financial uncertainty. Few of these applications, however, is directed at a cryptocurrency-Naira relationship is set within a market as administratively managed as Nigeria's official exchange-rate window a structural feature that, per Market Microstructure Theory (Kyle, 1985; O'Hara, 1995), could plausibly dampen the transmission mechanisms these studies otherwise document.

2.5 Synthesis and Gap Statement

Three findings from the literature reviewed above can be stated with some confidence: Bitcoin and Ethereum both display strong, persistent volatility clustering, cryptocurrency volatility has, in a range of other markets, been shown to transmit into currency markets, with effect size dependent on the recipient market's structure and Nigeria's official exchange rate has well-documented volatility drivers of its own, none of which, to date, include cryptocurrency markets. The methodological literature further indicates that a BEKK-GARCH specification is the appropriate tool for separating own-market persistence from cross-market transmission within a single system, and that this specification has not yet been applied to the Bitcoin-Ethereum-Naira relationship specifically. The objective of this study is designed to close exactly this intersection: whether, and to what extent, Bitcoin and Ethereum volatility spills over into Nigeria's official exchange rate, a market whose administrative structure may condition the transmission mechanism differently than the more liberalized currency markets examined elsewhere.

3. Methodology

3.1 Nature and Sources of Data

The study uses daily time-series data on Bitcoin (BTC), Ethereum (ETH), and Nigeria's official Naira/USD exchange rate (OEXR), covering the period August 2015 to August 2025. Official exchange-rate data were sourced from the Central Bank of Nigeria, while

cryptocurrency price series were obtained from Cap-Coin-Market and Investing.com, cross-checked for consistency across sources. Daily frequency was chosen deliberately: both cryptocurrency and exchange-rate series exhibit rapid movement and volatility clustering that lower-frequency (monthly or quarterly) data cannot capture, and daily observations improve both the statistical power of the volatility model and the precision with which spill-over dynamics can be estimated (Baur et al., 2024; Stejskalova & Barunik, 2023).

3.2 Variable Transformation

All three series are transformed into continuously compounded (log) returns prior to estimation, which stabilizes variance and brings the return distributions closer to the assumptions underlying GARCH-family models:

$$\boldsymbol{BTC_t} = ln(\boldsymbol{P_t} / \boldsymbol{P_{t-1}}) \quad (1)$$

$$\boldsymbol{ETH_t} = ln(\boldsymbol{P_t} / \boldsymbol{P_{t-1}}) \quad (2)$$

$$\boldsymbol{OEXR_t} = ln(\boldsymbol{OEXR_t} / \boldsymbol{OEXR_{t-1}}) \quad (3)$$

where P_t and P_{t-1} denote the closing price of the respective asset at time t and $t-1$ and $OEXR_t$ / $OEXR_{t-1}$ denote the official exchange-rate level at the same points in time. Each expression captures the instantaneous percentage change in the underlying series, expressed as a log return which is the standard preparation for volatility modelling in the GARCH tradition.

3.3 Preliminary Diagnostics

Before estimating the BEKK-GARCH model, each return series is tested for the presence of ARCH effects using the Lagrange Multiplier (ARCH-LM) test. This step is a standard precondition for GARCH-family estimation: a rejection of the null of no ARCH effect confirms that the variance of each series is conditionally heteroskedastic, and therefore that a constant-variance model would misrepresent the data-generating process. Only where this precondition holds is the BEKK-GARCH specification an appropriate tool, rather than an arbitrary modelling choice.

3.4 Diagonal BEKK-GARCH(1,1) Model Specification

The BEKK parameterization, developed by Baba, Engle, Kraft and Kroner and formalized by Engle and Kroner (1995), is used to estimate the conditional variance-covariance structure of the three-variable system directly. Its principal advantage over the alternative VECH specification is that it guarantees the positive definiteness of the conditional covariance matrix H_t by construction, while requiring substantially fewer parameters to estimate. For a three-variable system Bitcoin (1), Ethereum (2), and the official exchange rate (3) the model is expressed as:

$$H_t = C_0' \; C_0 + A'\varepsilon_{t-1} \; \varepsilon_{t-1}' \; A + G'H_{t-1} \; G \quad (4)$$

where H_t is the 3×3 conditional variance-covariance matrix at time t, C_0 is a 3×3 lower-triangular matrix of constants, decomposed in this form specifically to guarantee positive semi-definiteness of H_t , A is a 3×3 matrix capturing the ARCH effect, the extent to which past squared shocks (news, innovations) in one series influence current conditional variance and covariance, G is a 3×3 matrix capturing the GARCH effect, the extent to which past conditional variance and covariance persist into the present and ε_{t-1} is the 3×1 vector of lagged residuals from the mean equations of BTC, ETH, and OEXR

Following the diagonal restriction adopted in this study which is consistent with Bollerslev (1986) and standard practice in applications of this size (Sajeev & Afjal, 2022, the off-diagonal elements of A and G are restricted to zero, so that each series' own volatility depends only on its own past shocks and past variance, while cross-market transmission is captured separately through the constant covariance terms in C_0' C_0 . Written out for the three variables, the system produces three own-variance (GARCH) equations and three constant-covariance (spill-over) terms:

Variance:

$$h_{11,t} = c_{11} + a_{112}\ \varepsilon_{1,t-12} + g_{112}\ h_{11,t-1} \quad (5)$$

$$h_{22,t} = c_{22} + a_{222}\ \varepsilon_{2,t-12} + g_{222}\ h_{22,t-1} \quad (6)$$

$$h_{33,t} = c_{33} + a_{332}\ \varepsilon_{33,t-12} + g_{332}\ h_{33,t-1} \quad (7)$$

Covariance:

$$h_{12,t} = c_{12} + a_{11}\ a_{22}\ \varepsilon_{1,t-1}\ \varepsilon_{2,t-1} + g_{11}\ g_{22}\ h_{12,t-1} \quad (8)$$

$$h_{13,t} = c_{13} + a_{11}\ a_{33}\ \varepsilon_{1,t-1}\ \varepsilon_{3,t-1} + g_{11}\ g_{33}\ h_{13,t-1} \quad (9)$$

$$h_{23,t} = c_{23} + a_{22}\ a_{33}\varepsilon_{2,t-1}\ \varepsilon_{3,t-1} + g_{22}\ g_{33}\ h_{23,t-1} \quad (10)$$

The diagonal elements of A (a_{11},a_{22},a_{33}) and G (g_{11},g_{22},g_{33}) measure own-market ARCH and GARCH effects for both the short-run responsiveness and long-run persistence of each series' own volatility respectively. It is the constant covariance terms, c_{12}, c_{13} , and c_{23} and specifically their statistical significance that constitute the direct empirical test of volatility spill-over between markets. A significant c_{13} indicates a baseline contemporaneous variance relationship between Bitcoin and the official exchange rate that is not attributable to chance. It is this structure, applied to i= BTC and j= OEXR (c=13) and i= ETH and j= OEXR (c_{23}), that provides the direct empirical basis for testing Hypothesis H0i below.

Hypothesis

There is no significsnt volatility spillover effect of bitcoin and euthereum on the Nigerian official exchange rate**.** This hypothesis is tested jointly on the significance of the c_{13} and c_{23} coefficients in Equation set above, alongside the magnitude of the corresponding ARCH (a_{33}) and GARCH (g_{33}) terms governing the official exchange rate's own conditional variance.

4. Results and Discussion

4.1 Descriptive Statistics

Table 1 reports the descriptive statistics for Bitcoin, Ethereum, and the official exchange rate over the sample period.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
BTC	27,278	30,233	1.3435	1.0388	1,281.9	0.0000*
ETH	1,300.1	1,529.4	5.8325	102.46	1,642.6	0.0000*
OEXR	554.85	439.23	1.5844	0.8801	1,670.5	0.0000*

*Source: Author's computation OX-METRICS. Note p-value * indicate 5% level of significant or less*

From table 1 above two features are relevant to the question this paper asks. First, dispersion differs by an order of magnitude across the three series: Bitcoin's standard deviation (30,233) dwarfs that of the official exchange rate (439.23), confirming that cryptocurrency markets are substantially more volatile in absolute terms than Nigeria's regulated currency market a precondition, not a conclusion, since higher source volatility does not by itself imply that it transmits anywhere. Second, all three series are positively skewed and leptokurtic, with Ethereum's kurtosis (102.46) especially extreme, and the Jarque-Bera statistics reject normality for every series at the 1 percent level. The combination of fat tails, excess kurtosis and non-normality are the standard empirical signature of conditionally heteroskedastic financial data, and it motivates rather than assumes the adoption of GARCH-family model which will be used to test whether hetroskedasticity is confirmed formally next.

4.2 ARCH-LM Test Results

ARCH-LM test results test directly for the conditional heteroskedasticity which the descriptive statistics suggested.

Table 2: ARCH-LM Test Results

Variable	ARCH (5%)	Prob.	Decision
ln BTC	2.198	0.0000*	ARCH effect present
ln ETH	2.908	0.0000*	ARCH effect present
ln OEXR	2.463	0.0000*	ARCH effect present

*Source: Author's computation OX-METRICS. Note p-value * indicate 5% level of significant or less*

The null hypothesis of homoskedasticity is rejected for all three series at the 1 percent level. This confirms that each series' variance is time-varying and shock-dependent rather than constant including, notably, the official exchange rate itself, whose ARCH statistic of 2.463 indicates that its own past shocks meaningfully drive its current volatility. This result matters for what follows: it means any spill-over detected in the BEKK result will be identified against a backdrop of genuine own-market volatility clustering in the official rate, not against a flat, unresponsive series. With stationarity and ARCH effects both confirmed, the diagonal BEKK-GARCH(1,1) model specified in the model can be estimated directly.

4.3 BEKK-GARCH Results

Table 3: BEKK-GARCH Estimates (Official Exchange Rate System)

Parameter	Coefficient	Std. Error	t-Statistic	Prob.
C11 (BTC constant)	0.007	0.003	1.986	0.0471*
C12 (BTC–ETH constant)	-0.013	0.013	-0.993	0.3210
C13 (BTC–OEXR constant)	-0.020	0.010	-2.119	0.0342*
C22 (ETH constant)	0.024	0.019	1.272	0.2036
C23 (ETH–OEXR constant)	- 0.010	0.039	-0.260	0.7952
C33 (OEXR constant)	0.021	0.030	0.688	0.4917
a11 ,a22 ,a33 (ARCH)	0.679	0.047	≈14.5	0.0000*
b11 ,b22 ,b33 (GARCH)	≈0.734	0.067	≈11.0	0.0000*

*Source: Author's computation OX-METRICS. Note p-value * indicate 5% level of significant or less*

Table 3 reports the diagonal BEKK-GARCH (1,1) estimates for the three-variable system. The diagonal ARCH and GARCH coefficients are positive, of near-identical magnitude across all three series, and highly significant (p = 0.0000). Squaring these since it is a_{ii}^2 and g_{ii}^2 that enter the variance equation directly gives an ARCH effect of approximately 0.46 and a GARCH effect of approximately 0.54 for the official exchange rate, meaning that own-market shocks and own-market volatility persistence together account for essentially all of the official rate's conditional variance in a given period (0.46 + 0.54 = 1.0), consistent with the stationarity condition for a well-behaved BEKK process. In plain terms, the official exchange rate's volatility is driven predominantly by its own history i.e recent shocks and recent variance rather than by outside forces. This is the first, and in some respects the more important finding of this section, whatever cross-market spill-over is detected below operates on top of, not instead of, a strongly self-referential volatility process in the official rate.
The cross-market transmission of the three constant covariance terms, only the Bitcoin-official exchange rate term C_{13} is statistically significant (coefficient −0.020, p = 0.0342). C_{12} (Bitcoin-Ethereum) and C_{23} (Ethereum-official exchange rate) are both statistically insignificant. This is a precise, not a diffuse result, it identifies Bitcoin specifically as the transmitting asset, and finds no comparable evidence for Ethereum. The negative sign on C_{13} indicates an inverse contemporaneous association periods of intensified Bitcoin volatility coincide with movement in the official rate's own variance process, though the relationship is a baseline covariance term rather than a large dominant effect, its magnitude is modest relative to the own-market ARCH and GARCH coefficients reported above.

Thus, te evidence does not permit a clean acceptance or rejection in either direction. Bitcoin's transmission into the official exchange rate is real and statistically significant, so the null of no spill-over cannot be accepted outright. But the transmission is narrow confined to Bitcoin rather than shared with Ethereum, and small relative to the official rate's own volatility persistence as such neither can the null be rejected as though the evidence showed broad, forceful spill-over across the cryptocurrency-to-official-rate channel. The more accurate characterization is that is partially rejected: a specific, Bitcoin-only, modest-magnitude spill-over channel exists, operating against a backdrop of an official exchange rate whose volatility is still overwhelmingly self-generated.

This pattern is consistent with what Market Microstructure Theory (Kyle, 1985; O'Hara, 1995) would predict for a market of this kind where Nigeria's official exchange rate is subject to direct Central Bank management, administrative allocation, periodic intervention, and post-2023 unification reforms. The institutional features plausibly absorb a portion of external shocks before they can register as a broad-based covariance relationship. It is also consistent with the cross-country evidence by Ciaian et al. (2018) who similarly find that Bitcoin's contribution to exchange-rate determination is limited in markets with stronger institutional frameworks, even where Bitcoin itself reacts strongly to global financial conditions. The finding that Ethereum shows no comparable effect is, to the best of this review, new to the Nigerian literature, and is consistent with Ethereum's different volatility profile identified in reviews more frequent but arguably less systemically connected spikes than Bitcoin's.

5. Conclusion and Recommendations

5.1 Conclusion

This study set out to determine whether, and to what extent, volatility in Bitcoin and Ethereum spills over into Nigeria's official exchange rate. Using a diagonal BEKK-GARCH(1,1) model applied to daily data from August 2015 to August 2025, three findings emerge. First, the

official exchange rate's own volatility is highly self-referential: own-market ARCH and GARCH effects together account for essentially the entire conditional variance process, confirming that shocks and volatility persistence within the official rate itself, rather than external forces, are its primary driver. Second, cross-market transmission from cryptocurrency markets is present but narrow: Bitcoin exhibits a statistically significant, if modest, covariance relationship with the official rate, while Ethereum does not. Third, on the strength of this evidence, the null hypothesis that no volatility spill-over exists between the two cryptocurrencies and the official exchange rate (H0i) is partially, not fully rejected the data support a specific and limited channel rather than a broad-based one.

Read together, these results are consistent with the study's Market Microstructure framing: Nigeria's official exchange rate operates under direct Central Bank management, and this institutional structure appears to condition without eliminating the transmission of cryptocurrency volatility into the regulated segment of the foreign exchange market. The result also situates Nigeria within, rather than as an exception to, the broader international evidence that cryptocurrency-to-currency transmission is real but structure-dependent, stronger in more liberalized markets and comparatively contained in markets with active administrative management (Ciaian et al., 2018; IMF, 2023).

5.2 Recommendations

Two implications follow directly from these results, both scoped to the official exchange-rate segment examined here. First, because the transmission channel identified is Bitcoin-specific rather than generalized across cryptocurrencies, monetary and financial-stability authorities the Central Bank of Nigeria and the Securities and Exchange Commission in particular would gain more from monitoring Bitcoin-linked foreign exchange flows specifically than from treating cryptocurrency risk to the official market as a single undifferentiated category. A monitoring framework that weights Bitcoin more heavily than Ethereum in official-market surveillance is better aligned with what the evidence shows.

Second, the finding that own-market persistence dominates the official rate's volatility process is itself informative for policy: it suggests that the existing tools of exchange-rate management, administrative allocation, periodic intervention, and the post-2023 unification reforms are doing meaningful work in containing external volatility before it registers as a broad cross-market relationship. This is not evidence that cryptocurrency-related risk can be ignored, but it is evidence against treating the official market as acutely exposed; the more urgent transmission channel, if Nigeria's dual exchange-rate structure behaves the likely is to run through the less-regulated parallel market rather than the official one. a question this paper does not test and leaves to a dedicated companion analysis.

5.3 Suggestions for Further Research

The natural extensions of this paper is a parallel BEKK-GARCH analysis of the black-market exchange rate, to test whether the transmission channel found to be narrow in the official market is broader in the less-regulated segment; and a pre and post 2021 comparison using the Dynamic Conditional Correlation framework, to assess whether the CBN's cryptocurrency restriction altered the structure of transmission rather than merely its magnitude. Together with the present paper, these would provide a complete picture of how cryptocurrency volatility interacts with Nigeria's dual exchange-rate system.

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