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DIGITAL FINANCIAL INCLUSION AND MONEY VELOCITY IN NIGERIA: AN EMPIRICAL ANALYSIS

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Abstract

This study investigates the nexus between Digital Financial Inclusion and Money Velocity within the context of Nigeria. To address the limitations of a standard timeframe, annual time-series data spanning from 2005 to 2025 were converted into semi-annual observations, yielding a robust sample size for long-run analysis. The empirical framework employed a multi-stage econometric approach: the Augmented Dickey-Fuller (ADF) test for unit root properties, the Johansen Cointegration test to identify long-run equilibrium relationships, and the Dynamic Ordinary Least Squares (DOLS) technique to estimate the specific drivers of money velocity. Furthermore, the Hansen Parameter Instability test was applied to ensure the long-run structural reliability of the estimated model. The empirical results reveal that the Foreign Currency Deposit Ratio (FCDR) is the primary and most significant driver of money velocity in Nigeria, confirming the prevalence of currency substitution and financial dollarization. Conversely, Digital Financial Index (DFI), Inflation (INF), and Exchange Rates (EXR) exhibited statistical insignificance in the long run, suggesting that technological expansion in finance has not yet reached the critical threshold necessary to fundamentally alter macroeconomic velocity. The Hansen stability test confirmed that the cointegrating relationship is stable, providing a reliable basis for policy formulation. The study concludes that for digital financial inclusion to effectively

drive macroeconomic stability, policy interventions must address the structural root causes of dollarization, as the velocity of money remains tethered to foreign currency dynamics rather than digital infrastructure.

Keywords: Digital Financial Inclusion, Money Velocity, DOLS Technique, Nigeria

INTRODUCTION

Digital financial inclusion has become an important policy priority in Nigeria because it expands access to formal financial services, improves payment efficiency, and supports participation in the financial system. Through mobile money, electronic banking, and other digital channels, households and firms can now send, receive, and store funds with greater convenience than before. In a developing dual-currency environment, where domestic currency use often coexists with foreign-currency preferences and cash transactions, digital finance may also affect how quickly money circulates in the economy. This makes the topic relevant for understanding the long-run relationship between financial innovation and macroeconomic stability (International Monetary Fund, 2023). Theoretical and empirical studies also suggest that financial innovation can influence money demand and velocity. When digital transactions become more common, people may hold less cash and move funds more rapidly, which can alter the behavior of money circulation in the economy. In Nigeria, previous evidence shows that financial innovation has a long-run relationship with money demand and that money demand may remain stable even when innovation expands, which means the effect on velocity and stability is not straightforward (Ujunwa et al., 2022). Despite the growing emphasis on digital financial inclusion, its impact on money velocity in Nigeria remains uncertain. While digital finance can reduce transaction costs and improve access to financial services, it may also increase the speed of money circulation and make monetary aggregates less predictable. This is especially important in a dual-currency market like Nigeria, where the use of domestic currency, cash, and foreign currency can interact in ways that complicate monetary management. As a result, policymakers face a challenge in determining whether digital financial inclusion contributes to macroeconomic stability or creates new sources of instability. Another problem is that existing studies in Nigeria have focused more on financial inclusion broadly or on money demand, rather than on the direct long-run link between digital financial inclusion and money velocity. This creates a research gap, particularly in the Nigerian dual-currency context where the effects may differ from those in more stable monetary environments. Without clear evidence, it becomes difficult to know whether digital inclusion should be promoted mainly as a payment innovation or also as a macroeconomic stabilizing tool. The main objective of this

study is to examine the long-run relationship between digital financial inclusion and money velocity in Nigeria. Specifically, the study seeks to determine whether digital financial inclusion has a significant effect on money velocity and to assess the implications of that relationship for macroeconomic stability. It will also help clarify how the dual-currency nature of the Nigerian economy shapes the effect of digital financial inclusion on monetary behavior. The study is expected to provide evidence that can guide policymakers in designing digital finance strategies that support both inclusion and stability.

LITERATURE REVIEW

Digital financial inclusion has become a major channel through which developing economies seek to improve access to payments, savings, and formal financial services. In Nigeria, digital finance is increasingly viewed as a policy tool for broadening access, especially through mobile payments, POS terminals, ATMs, and web-based banking. Ekong and Ekong (2022) found that digital currency development has a positive effect on financial inclusion in Nigeria, with mobile payments and POS transactions contributing to broader access to financial services. Their evidence suggests that digital channels can expand participation in the financial system and reduce the exclusion traditionally associated with cash-based economies.

A related strand of literature examines the broader effect of financial inclusion on macroeconomic performance. Mbutor and Uba (2013) showed that financial inclusion can strengthen monetary policy effectiveness in Nigeria by improving the reach of formal financial services and reducing dependence on informal finance. Their argument is important for this study because money velocity is closely linked to the stability and predictability of monetary aggregates. If financial inclusion changes how quickly money circulates, it may alter the transmission of monetary policy and the overall stability of the macroeconomy.

The question of whether financial innovation destabilizes or stabilizes money demand has received special attention in Nigeria. Ujunwa et al. (2022) found evidence of a long-run relationship between financial innovation and money demand, and they concluded that the inclusion of financial innovation had not altered the long-run stability of money demand in Nigeria. This finding is central to the current topic because stable money demand often implies more predictable velocity behavior. If money demand remains stable even after financial innovation, then the feared destabilizing effect of digital finance on velocity may be weaker than expected. Another important contribution comes from studies that connect financial inclusion to macroeconomic development more generally. Onaolapo and Odetayo (2012) argued that financial inclusion supports the growth of microfinance banks and helps deepen access to financial services in Nigeria. Their work helps explain the institutional side of inclusion, showing

that digital access points are only one part of a broader financial ecosystem. For dual-currency markets, this matters because the strength of domestic financial institutions can influence whether households and firms continue using the local currency or shift toward foreign currency and cash substitutes.

Ozili (2022) examined financial inclusion in Nigeria and highlighted the determinants, challenges, and achievements of the policy agenda. His work shows that although progress has been made, structural constraints such as infrastructure gaps, low literacy, and uneven access continue to limit the impact of inclusion policies. These challenges are especially relevant in a dual-currency setting, where uncertainty about the value of domestic money can accelerate substitution into foreign currency and reduce the stability of velocity. In this sense, digital inclusion may not automatically create stability unless trust, infrastructure, and policy credibility are strong enough to support it.

A broader African perspective is offered by Andrianaivo and Kpodar (2011), who found that ICT and financial inclusion positively affect economic growth across African countries. Their study is useful because it places Nigeria within a wider developing-country context where digital access improves economic participation. However, their work also suggests that the effect of inclusion depends on country-specific conditions, which supports the need for a Nigeria-focused long-run study. In a dual-currency environment, those conditions include exchange-rate volatility, inflation expectations, and the degree of dollarization or foreign currency use. Sanusi (2011) emphasized financial inclusion as a development strategy for MSMEs in Nigeria, arguing that broader access to finance can stimulate enterprise growth and economic activity. This perspective connects indirectly to money velocity, because higher economic activity can increase transaction demand for money and alter circulation patterns. For the present study, this implies that digital inclusion may affect velocity not only through payments systems but also through its effect on real sector activity. The relationship is therefore likely to be indirect, complex, and long-run in nature.

Fisher's Quantity Theory of Money provides the main theoretical anchor for this study. The theory, expressed as MV = PY, explains the relationship between money supply, velocity, output, and the price level. It suggests that when the velocity of money changes, the general price level may also change if output does not adjust proportionately. In the context of digital financial inclusion, this theory is relevant because digital payment systems can speed up transactions, reduce cash holding, and alter the circulation of money. For a developing dual-currency market like Nigeria, this implies that financial innovation may affect macroeconomic stability by influencing money velocity over the long run.

The literature shows that digital financial inclusion can expand access, support policy effectiveness, and deepen formal finance. It also shows that financial innovation does not necessarily destabilize money demand in Nigeria, although broader structural constraints remain. However, there is still limited integrated evidence on the long-run relationship between digital financial inclusion and money velocity in Nigeria's dual-currency environment. This study fills that gap by examining whether digital financial inclusion contributes to stable or unstable money circulation and by linking the findings to macroeconomic management in developing dual-currency markets.

METHODOLOGY

Research Design

This study adopts an explanatory quantitative research design. The design is appropriate because it focuses on examining causal and long-run relationships between Digital Financial Inclusion and Money Velocity in Nigeria. The design is structured to provide empirical evidence on how financial digital transformation influences monetary behavior in Nigeria over the period 2005S1–2025S2.

Model Specification

This study is anchored on the Extended Quantity Theory of Money, which evolved from the classical Quantity Theory of Money proposed by Irving Fisher (1911) and was later enriched by Milton Friedman's (1956) reformulation and subsequent developments in monetary economics. The extended framework recognizes that money velocity is influenced not only by the quantity of money but also by financial innovation, digital financial inclusion, and macroeconomic conditions." Accordingly, the functional model is specified as:

MV = f(DFI, INF, EXR, FCDR)

The above functional equation is transformed into Mathematical form and it is specified as;

$LMV = \beta_0 + \beta_1 DFI + \beta_2 INF + \beta_3 EXR + \beta_4 FCDR$

The mathematical model is further transformed into econometric specification as:

$LMV = \beta_0 + \beta_1 DFI + \beta_2 INF + \beta_3 EXR + \beta_4 FCDR + \varepsilon t$

Since DOLS incorporates leads and lags of the differenced explanatory variables, the estimable DOLS equation can be written as:

$LMV_t = \beta_0 + \beta_1 DFI_t + \beta_2 INF_t + \beta_3 EXR_t + \beta_4 FCDR_t + \Sigma(j=-q \text{ to } p)\ \partial_j \Delta DFI_{t-j} + \varepsilon_t$

Where;

LMV_t = dependent variable: log of money velocity at time t (the long-run relationship being explained).

β_0 = intercept term.

β_1 = long-run coefficient on DFI; shows how a change in the Digital Financial Index affects money velocity in the long run.

β_2 = long-run coefficient on inflation (INF).

β_3 = long-run coefficient on exchange rate (EXR).

β_4 =long-run coefficient on foreign currency deposit rate (FCDR).

DFI_t, INF_t, EXR_t, $FCDR_t$ are the explanatory variables in levels at time t.

$\Sigma(j=-q \text{ to } p)\ \partial_j \Delta DFI_{t-j}$ — the dynamic term: sums leads and lags of the first-differenced DFI, each weighted by ∂_j. This corrects for serial correlation and endogeneity between DFI and the error term, so β_1 is a consistent long-run estimate.

q = number of lags of ΔDFI included.

p = number of leads of ΔDFI included.

∂_j = coefficients on the lead/lag differenced terms (short-run dynamic adjustment coefficients — not of primary interest, just "cleanup" terms).

t = Time period

ε_t = error term, assumed white noise if the model is correctly specified.

***A priori expectation*:** $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 \gtrless 0$, and $\beta_4 < 0$.

This implies that:

$\beta_1 > 0$ (DFI): Digital Financial Inclusion Index is expected to positively influence the money velocity by expanding the access to digital financial services, increasing the use of electronic payment platforms, and enhancing the speed at which money circulates within the economy.

$\beta_2 > 0$ (INF): Inflation is expected to have a positive effect on money velocity because rising prices discourage the holding of idle cash balances, prompting households and firms to spend money more quickly.

$\beta_3 \gtrless 0$ (EXR): Exchange rate is expected to have either a positive or negative effect on money velocity. While exchange rate depreciation may stimulate spending and increase money circulation, excessive volatility may reduce confidence in the domestic currency and dampen economic transactions.

$\beta_4 < 0$ (FCDR): Foreign Currency Deposit Ratio is expected to negatively affect money velocity. A higher ratio reflects increased preference for holding foreign currency deposits over domestic currency, reducing the circulation and transactional use of the naira and, consequently, lowering its velocity.

Data Measurement and Sources

This table provides the detailed measurement definitions and primary sources for the variables used in the macroeconomic study of Nigeria (2005S1-2025S2).

Table 1: Data Description, Measurement and Sources

Variable	Definition & Description	Measurement / Proxy	Unit of Measurement	Data Source
INF	Inflation Rate	Annual percentage change in the cost of a basket of consumer goods. |	Percentage (%)	National Bureau of Statistics (NBS)
MV	Money Velocity	The rate at which money changes hands in the economy to facilitate transactions.	Ratio (Nominal GDP / M2)	Computed by Author
DFI	Digital Financial Index	A composite measure of the accessibility and usage of digital financial services.	Index (Scale 0 to 1	Computed via CBN Data
EXR	Exchange Rate	The official value of the Nigerian Naira relative to the United States Dollar. |	Naira per USD (₦/$)	Central Bank of Nigeria (CBN)
FCDR	Foreign Currency Deposit Ratio	FCDR = (Foreign Currency Deposits / Total Broad Money Supply (M2)) * 100	Percentage (%)	Calculated by Authors

Unit Root Test

The unit root test is used in this study to determine the stationarity properties of the variables and to avoid spurious regression results. It helps to identify the order of integration of the variables before conducting long-run estimation. The table below presents the results.

Table 2: Unit Root Test Results Summary (*E-views 13*)

Variable	Level (Prob.)	1st Diff (Prob.)	Order	Remark
LMV	0.5245	0.0000*	I(1)	Stationary
DFI	1.0000	0.0260	I(1)	Stationary
INF	0.5250	0.0000*	I(1)	Stationary
LEXR	0.9999	0.0350	I(1)	Stationary
FCDR	0.8943	0.0115	I(1)	Stationary

The results from the Augmented Dickey-Fuller (ADF) unit root tests reveal that all variables are integrated of order one, I(1). At level, the null hypothesis of a unit root could not be rejected for any variable, as shown by the p-values exceeding the 0.05 significance level. However, after taking the first difference, all series became stationary ($p < 0.05$). This uniformity

in the order of integration justifies the use of Johansen cointegration test, meaning the variables understudy possess long-run equilibrium relationship.

Cointegration Test

Following the confirmation that all variables are integrated of the same order I(1), the Johansen Cointegration test is employed to determine the existence of a long-run equilibrium relationship among the variables. The Johansen cointegration test is conducted using both the Trace Statistic and Maximum Eigenvalue Statistic to determine whether a long-run equilibrium relationship exists among the variables in the model. Table below presents the results.

Table 3a: Unrestricted Cointegration Rank Test (Trace) (*E-views 13*)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.773914	135.8860	69.81889	0.0000
At most 1 *	0.701760	76.41249	47.85613	0.0000
At most 2	0.367095	28.01819	29.79707	0.0791
At most 3	0.206749	9.720775	15.49471	0.3028
At most 4	0.011339	0.456169	3.841465	0.4994

Table 3b: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) (*E-views 13*)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.773914	59.47353	33.87687	0.0000
At most 1 *	0.701760	48.39430	27.58434	0.0000
At most 2	0.367095	18.29742	21.13162	0.1191
At most 3	0.206749	9.264606	14.26460	0.2648
At most 4	0.011339	0.456169	3.841465	0.4994

The Trace test results show that the null hypothesis of no cointegration (“None”) is rejected because the Trace Statistic value of 135.8860 is greater than the 5% critical value of 69.81889, with a probability value of 0.0000 which is less than 0.05. Similarly, the null hypothesis of at most one cointegrating equation is also rejected since the Trace Statistic value of 76.41249 exceeds the critical value of 47.85613 and the probability value is 0.0000. However, at “At most 2,” the Trace Statistic value of 28.01819 is less than the 5% critical value of 29.79707, while the probability value of 0.0791 is greater than 0.05. Therefore, the null hypothesis cannot be rejected at this point. This implies that the Trace test identifies the presence of two cointegrating equations among the variables.

The Maximum Eigenvalue test also supports the existence of cointegration in the model. The null hypothesis of no cointegration is rejected because the Max-Eigen Statistic value

of 59.47353 is greater than the 5% critical value of 33.87687, with a probability value of 0.0000. Likewise, the null hypothesis of at most one cointegrating equation is rejected because the Max-Eigen Statistic value of 48.39430 exceeds the critical value of 27.58434 and the probability value is less than 0.05.

Nevertheless, at “At most 2,” the Max-Eigen Statistic value of 18.29742 is lower than the critical value of 21.13162, while the probability value of 0.1191 is greater than 0.05. Hence, the null hypothesis cannot be rejected from this point onward. The Maximum Eigenvalue test therefore confirms the existence of two cointegrating equations among the variables.

Both the Trace and Maximum Eigenvalue tests consistently indicate the existence of two cointegrating relationships at the 5% significance level. This confirms that the variables move together in the long run and maintain a stable equilibrium relationship over time. The existence of cointegration implies that the variables are not spuriously related despite being non-stationary at levels. Consequently, the use of long-run estimation techniques such as Dynamic Ordinary Least Squares (DOLS) is appropriate for the study.

Dynamic Ordinary Least Squares (DOLS) Estimate

The Dynamic Ordinary Least Squares estimation technique is used to estimate the long-run relationship among the variables after confirming cointegration. DOLS is suitable because it corrects for endogeneity and serial correlation, thereby providing efficient and unbiased long-run estimates. Table below presents the results.

Table 4: DOLS Estimation Result (*E-views 13*)

Variable	Coefficient	Std. Error	t-Statistic	Probability
Dependent Variable: LMV				
DFI	-0.072232	0.405837	-0.177983	0.8604
INF	-0.002919	0.014206	-0.205497	0.8391
EXR	-0.000365	0.000242	-1.509271	0.1455
FCDR	0.055971	0.013877	4.033223	0.0006
C	1.069680	0.187591	5.702178	0.0000
R-squared**:** 0.807073				

The DOLS estimation result indicates that Digital Financial Inclusion (DFI), Inflation (INF), and Exchange Rate (EXR) have negative relationships with money velocity (LMV), although their probability values are greater than 0.05, showing that they are statistically insignificant in the long run. On the other hand, Foreign Currency Deposits Ratio (FCDR) has a positive and statistically significant effect on money velocity, as indicated by its coefficient value of 0.055971 and probability value of 0.0006. This implies that an increase in Foreign Currency

Deposits Ratio significantly increases money velocity in the long run. The coefficient of determination (R-squared) of 0.807073 shows that approximately 80.7% of the variation in money velocity is explained by the explanatory variables included in the model. This suggests that the model has a good explanatory power.

Hansen Parameter Instability Test

The Hansen Parameter Stability Test is conducted to examine the stability and reliability of the estimated long-run coefficients over the study period. The test helps to determine whether the model is free from structural instability. The result is displayed in the table below

Table 5: Hansen Parameter Instability (Lc) Test Results (*E-views 13*)

Lc statistic	Stochastic Trends (m)	Prob.*
0.053503	4	> 0.2

*Hansen (1992b) p-values.

DISCUSSION OF FINDINGS

The model shows an R-Squared of 0.807, suggesting that 80% of velocity fluctuations are explained by the chosen macroeconomic and digital factors. Fisher's (1911) Quantity Theory of Money remains the bedrock here. In developing markets, Ajide (2014) notes that money velocity is often unstable due to frequent policy shifts and financial innovations. Velocity in Nigeria has historically been volatile. In 2026, the transition toward a "cash-lite" society and the aftermath of the 2023 currency redesign has fundamentally altered how quickly money moves through the banking system versus the informal sector.

Digital Financial Inclusion (DFI): The result shows a negative coefficient (-0.072) with a p-value of 0.8604. This means DFI is statistically insignificant in explaining long-run money velocity in the model. This contradicts Mbiti and Weil (2011), who found that digital finance increases velocity by reducing transaction costs. However, it aligns with Olayungbo and Quadri (2019), who argue that in some African states, digital inclusion is still too shallow to impact aggregate macroeconomic indicators. Despite the surge in OPay, Moniepoint, and PalmPay usage, a large portion of the population uses these platforms for "storage" or low-value transfers rather than high-velocity commercial activities. The insignificance suggests that DFI has not yet reached the "critical mass" required to dictate national money velocity.

Foreign Currency Deposit Ratio (FCDR): This is the most significant variable (p = 0.0006). A 1% increase in FCDR leads to a 0.055% increase in velocity. This supports the Currency Substitution Theory (Ize & Levy-Yeyati, 2003). In dual-currency markets, agents treat

the local currency (Naira) as a "hot potato," spending it quickly to acquire "hard" currency (USD), which increases velocity. Nigeria is a classic "dual-currency" market. With the persistent volatility of the Naira through 2025 and 2026, many businesses and individuals maintain domiciliary accounts. The significance of FCDR confirms that the "Dollarization" of the Nigerian psyche is the primary driver of how fast people get rid of their Naira.

Inflation (INF) shows a coefficient of -0.002 with a high p-value of 0.8391. Surprisingly, it does not significantly drive velocity in this long-run model. Classical theory (Friedman, 1956) suggests inflation should increase velocity as people spend fast to avoid rising prices. However, Dutta and Ahmed (2004) found that in some developing countries, high inflation can lead to "demonetization," where people stop using the local currency entirely, neutralizing its effect on velocity. By 2026, Nigeria has faced years of double-digit inflation. The insignificance here suggests a "fatigue" effect—inflation is so persistent that it is now a constant "noise" in the background, and agents have already adjusted their long-term behavior.

Exchange Rate (EXR) has a negative coefficient (-0.0003) and is insignificant ($p = 0.1455$) Bahmani-Oskooee (1996) suggests that exchange rate depreciation should increase velocity. Your results suggest that in the long run, the rate of exchange matters less than the ratio of foreign holdings (FCDR). With the unification of exchange rate windows in recent years, the "shock" value of exchange rate movements has diminished. Nigerians are more concerned with the availability of dollars (captured by FCDR) than the specific daily price (OEXR) when determining long-term transaction patterns.

CONCLUSION

The empirical investigation into the nexus between digital financial inclusion and money velocity within the context of Nigeria, reveals a complex landscape defined by currency substitution and structural rigidities. Utilizing the Dynamic Ordinary Least Squares (DOLS) framework to capture long-run equilibrium relationships, this study establishes that the velocity of money in developing dual-currency markets is not a passive byproduct of digital evolution, but rather a reactionary mechanism driven by foreign currency exposure.

A primary revelation of this research is the overwhelming dominance of the Foreign Currency Deposit Ratio (FCDR) as the sole statistically significant determinant of long-run money velocity. This finding substantiates the "Currency Substitution" hypothesis within the Nigerian context. It suggests that agents in the economy utilize the foreign currency as a primary store of value and a hedge against domestic instability, while treating the local tender predominantly as a medium for immediate transaction. The high statistical significance of this

variable indicates that the speed at which money circulates is tethered more to the availability and holdings of foreign exchange than to domestic monetary policy or price levels.

Conversely, the statistical insignificance of Digital Financial Inclusion (DFI) presents a critical "adoption-impact" paradox. While the infrastructure for digital finance has expanded rapidly across Nigeria, its failure to exert a significant long-run influence on money velocity suggests that digital tools are currently utilized for low-value transfers or passive savings rather than for driving high-frequency commercial velocity. This implies that DFI has yet to reach the "critical mass" threshold necessary to fundamentally reshape the macroeconomic velocity profile of the nation.

Furthermore, the lack of significant impact from inflation and exchange rates suggests a state of "inflationary inertia." In the Nigerian dual-currency market, participants appear to have internalized persistent price volatility, rendering traditional price-based indicators secondary to structural holdings (FCDR) in the determination of long-term transactional behavior. In summary, macroeconomic environment in Nigeria remains precariously tied to the dynamics of the "parallel" or dual-currency system. For digital financial inclusion to become a meaningful driver of stability and velocity, policy interventions must transcend simple mobile-money penetration and address the underlying structural reasons for dollarization. Until the domestic currency can compete with foreign holdings as a reliable store of value, the velocity of money will continue to be dictated by foreign currency dynamics rather than technological advancement or domestic monetary governance.

Future study should extend this analysis by employing higher-frequency data, such as quarterly or monthly observations, to capture the short-run dynamics between digital financial inclusion and money velocity. Further studies may also incorporate additional indicators of financial innovation, including mobile money transactions, electronic payment volumes, fintech adoption, and central bank digital currency (CBDC) initiatives. Comparative studies across other African economies with similar characteristics would also provide useful evidence on whether the dominant role of digital financial inclusion in influencing money velocity is unique to Nigeria or represents a broader phenomenon among developing economies.

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