ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/354736698

Extending the determinants of currency substitution in Nigeria: Any role for financial innovation?

Article *in* South African Journal of Economics · September 2021

DOI: 10.1111/saje.12300

CITATION
1

READS
235

5 authors, including:

Angela Ujunwa
Teesside University International Business School
18 PUBLICATIONS **137** CITATIONS
SEE PROFILE

Augustine Ujunwa
University of Nigeria
48 PUBLICATIONS **1,055** CITATIONS
SEE PROFILE

Emmanuel Onah
University of Nigeria
4 PUBLICATIONS **40** CITATIONS
SEE PROFILE

Nnenna Nwonye
University of Nigeria
26 PUBLICATIONS **169** CITATIONS
SEE PROFILE

All content following this page was uploaded by Angela Ujunwa on 01 November 2021.

The user has requested enhancement of the downloaded file.

DOI: 10.1111/saje.12300

ORIGINAL ARTICLE

Extending the determinants of currency substitution in Nigeria: Any role for financial innovation?

Angela Ifeanyi Ujunwa[1] | **Augustine Ujunwa**[2] | **Emmanuel Onah**[1] | **Nnenna Georgina Nwonye**[1] | **Onyedikachi David Chukwunwike**[3]

[1]Department of Banking and Finance, University of Nigeria Enugu Campus, Enugu, Nigeria

[2]Financial Integration Department, West African Monetary Institute, Accra, Ghana

[3]Department of Accountancy, University of Nigeria Enugu Campus, Enugu, Nigeria

Correspondence
Angela Ifeanyi Ujunwa, Department of Banking and Finance, University of Nigeria Enugu Campus, Enugu, Nigeria.
Email: angelaujunwa.ify@gmail.com; angela.ujunwa@unn.edu.ng

Abstract
Existing literature suggests that macroeconomic and institutional factors are the drivers of currency substitution. The persistent and significant incidence of currency substitution during the period of mixed performance of macroeconomic variables suggests the existence of a knowledge gap on the drivers of currency substitution during the era of rapid technological innovation. To contribute to this literature, we augmented the traditional money demand model of the determinants of currency substitution to introduce financial innovation. We use Nigerian data from 2005Q1 to 2019Q4 and Pesaran et al. (2001, https://doi.org/10.1002/jae.616) autoregressive distributed lag (ARDL) bound test approach to cointegration to estimate the models. The results confirm the presence of short-run and long-run relationships between financial technology and currency substitution in Nigeria. In effect, the deployment of financial technology in developing payment system infrastructure creates additional incentives for economic agents to hold foreign currency deposit. Economic managers must, therefore, mainstream credible monetary and fiscal policies to moderate the effect of financial innovation on currency substitution.

KEYWORDS
ARDL, currency substitution, financial innovation, money demand function

1 | INTRODUCTION

A core policy issue is the need to understand the drivers of currency substitution. Seminal studies that strive to clarify our understanding of the subject matter focus on macroeconomic determinants (Selcuk, 2003; Vegh, 1995). IMF (2015) extended the determinants to institutional factors. Raheem and Asongu (2016) extended the institutional factors to access to foreign exchange, natural rent and trade openness as other institutional determinants. IMF (2015) and Raheem and Asongu (2016) also suggest that the macroeconomic and institutional determinants of currency substitution may evolve with the changing structure of the economies. In Nigeria, literature also documents spectra of

 © 2021 Economic Society of South Africa

macroeconomic and institutional determinants of currency substitution. The factors examined are the adoption of the Structural Adjustment Programme (SAP) in 1986 that liberalised the foreign exchange market, expected depreciation of exchange rate, high and persistent inflation, weak institutions, unfavourable macroeconomic environment, monetary policy and the financial reforms that allow citizens to operate foreign currency deposit (FCD) (Adeniji, 2013; Tule et al., 2014; Yinusa & Akinlo, 2008). Despite the explosion of theoretical and empirical literature on the subject matter, currency substitution in Nigeria remained persistent and significant since 1987 and has heightened in recent times. For instance, FCD increased from Naira 1,065,387.80 million in March 2009 to Naira 3,042,963.10 million in March 2014 and stood at Naira 7,073,785.59 million in December 2019. The increasing incidence of currency substitution raises a compelling need to re-examine the determinants of currency substitution in Nigeria.

We argue that the changing structure of the economy may have introduced other drivers of currency substitution in Nigeria not captured in extant literature. The anecdotal evidence in Figure 1 indicates sustained increase in FCD from March 2005 to December 2019. During this period, the performance of macroeconomic indicators—inflation rate (IFR), real effective exchange rate (REER) and domestic interest rate (ITR)—was mixed performance. This is consistent with the finding of Tule et al. (2014) that increasing rate of currency substitution within 2002–2013 coincided with the period of stable exchange and low domestic IFRs in Nigeria.

On the basis of the above, we argue that financial innovation may have accounted for the trend because the astronomical increase in the rate of currency substitution coincided with the period of extensive reforms in the Nigerian payment system, in terms of powering the payments system with the state-of-the-art information technology infrastructure. It also coincided with the period of rapid technological innovation in financial products. Figure 2, which presents the trend in currency substitution measured as total value of FCDs and ratio of FCD to domestic currency from 2005Q1 to 2019Q4, reveals increasing trend in financial innovation and indicates that financial innovation may be the additional driver in Nigeria, because of the comovement between currency and financial innovation.

We, therefore, extend the determinants of currency substitution to include financial innovation. We hypothesise that *the deployment of financial innovation products in the payment system, which facilitate the use of foreign currency cards for the purchase of goods and services and ease of cross-border payments, could be an additional driver of FCD in Nigeria*. The permission to operate domiciliary accounts, issuance of foreign currency credit and debit Master cards by Nigerian banks, developed payment system that promote fast and credible cross-border transactions and increase in online retail shops may have created additional incentives for economic agents to hold foreign currency. Contextually, foreign currency could simultaneously serve as store of value, unit of account and medium of exchange, while holding macroeconomic variables constant. Our proposition is consistent with IMF (2015) and Raheem and Asongu (2016) argument that institutional drivers of currency substitution changes with the changing structure of the economy. Apart from the benefits of insulating economic agents from the volatility of exchange rate and inflationary pressure, holding foreign currency eases cross-border financial transactions and investment in cryptocurrencies and foreign stocks due the development of the payment system. Studies on currency substitution have neglected this line of argument, despite its important implications to policy formulation.

Extending the drivers of currency substitution to financial technology makes important contribution to policy and literature. From policy perspective, financial technology offers considerable promises, and examining its effect on currency substitution would assist regulators to thoroughly understand and manage the risks of financial technology. Generally, countries prefer national currency as a legal tender because it assists the central banks act as lender of last resort, eliminate imported inflation, reduce vulnerabilities to external shocks, promote monetary policy effectiveness and serve as revenue source. Establishing financial technology as a driver of currency substitution expands the frontier of knowledge on the drivers, especially, given the rapid innovation in financial technology that is shrinking payments system boundaries.

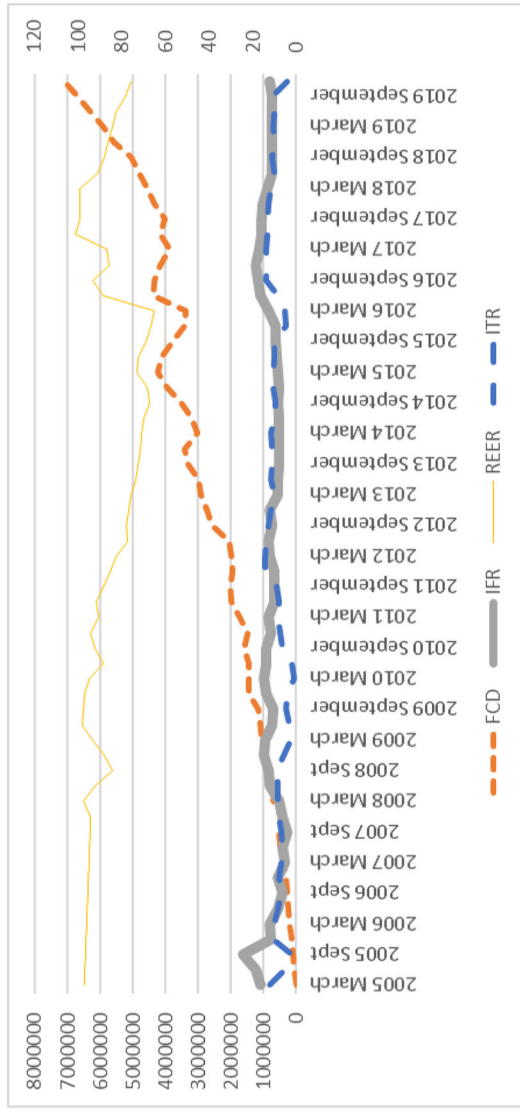


FIGURE 1 Currency substitution and traditional determinants. *Note*: FCD is the foreign currency deposits, IFR is the inflation rate, REER is the real effective exchange rate and ITR is the domestic interest rate

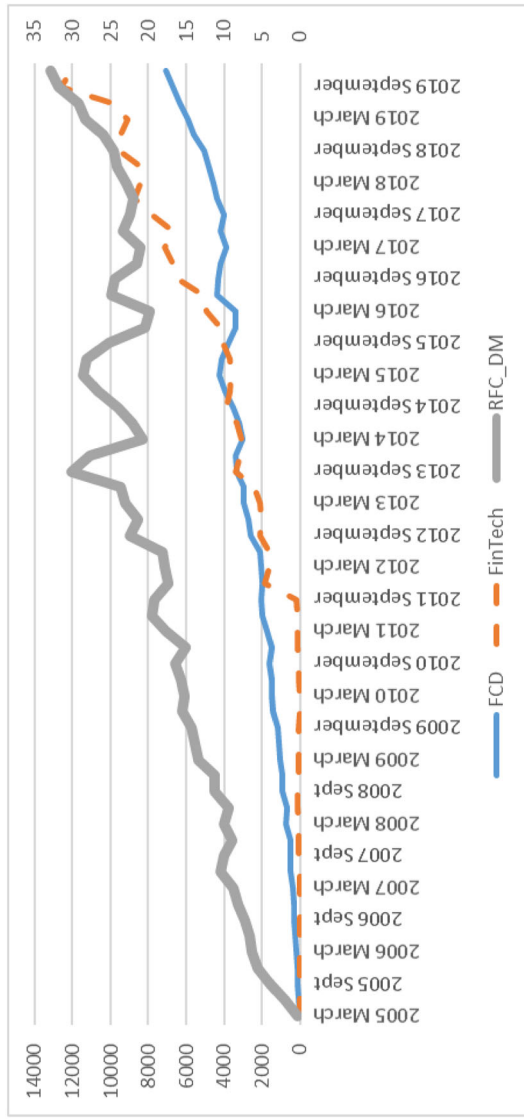


FIGURE 2 Currency substitution and financial technology. *Note*: FCD is the foreign currency deposits, FinTech is the financial innovation and RFC_DM is the ratio of foreign currency deposit to domestic currency

To examine the effect of financial innovation on currency substitution in Nigeria, the rest of the paper is structured as follows: Section 2 reviews related literature; Section 3 presents the data and methodology; Section 4 discusses the empirical results; and Section 5 concludes the paper.

2 | REVIEW OF RELATED LITERATURE

The use of foreign currency as a store of value is defined as dollarization (Calvo & Vegh, 1992; Samreth, 2011). Dollarisation is the earliest stage of currency substitution because foreign currency serves as only store of value or unit of account (Calvo & Vegh, 1992; Samreth, 2011). In high inflationary economies, foreign currency first emerged as store of value, and later as medium of exchange, usually referred to as currency substitution. Currency substitution is the last stage of dollarization[1] (Calvo & Vegh, 1992). Raheem & Asongu (2016), however, defined currency substitution as explicit government policy to adopt foreign currency as a legal tender.

Currency substitution is largely attributable to the absence of stable domestic means of payment for trade and production (Samreth, 2011). Economic agents consider national currencies as tradable goods per excellence and have the tendency to replace national currencies that display high inflationary characteristics with foreign or convertible currencies that have reputation for being relatively stable in terms of maintaining their purchasing power over time (Airaudo, 2014). Currency substitution, therefore, is a consequence of high inflationary pressure and the relative instability of the local currency. In jurisdictions where foreign exchange holdings are not restricted, the process of dollarization begins with foreign currency substituting national currency, because the national currency lacks one important characteristic of money as the store of value. Dollarisation appears apparent for some transactions such as cars, real estate and other big-ticket transactions, whereas domestic or national currency only retains its functions as a unit of account, store of value and medium of exchange for most non-durable goods.

Scholars could not reach a consensus on the desirability of currency substitution. Some scholars argue that currency substitution is beneficial in promoting effective exchange rate management through the removal of the power of government to print high-powered money, which promotes credibility in exchange rate management as against fixed exchange rate regime, fiscal discipline and commitment and policy credibility (Kildegaard & Fernandez, 2014). Government without alternative source of fund like central bank financing will naturally 'put its house in order' because discipline determines the effectiveness of policy (Calvo & Vegh, 1992), and absence of 'lender of last resort' imposes serious discipline on the domestic banking system. Other studies identify the absence of a 'lender of last resort', external vulnerabilities, liquidity shortage due to political instability, presence of imported inflation, absence of nominal anchor for monetary policy and loss of revenue from inflation tax as the disadvantages of currency substitution (Calvo & Vegh, 1992; Cukierman et al., 1994).

Studies identify exchange rate, ITR, IFR and foreign interest rate as the determinants of currency substitution (Calvo & Vegh, 1992; Uribe, 1997). Mourmouras & Russell (2000) extended the determinants of currency substitution a crime-theoretic approach and found the misuse of tax evasion, narcotics trafficking and tariffs and quotas the additional drivers. Modelling approaches on currency substitution is broadly classified into cash-in-advance model (Uribe, 1997), money-in-the-utility function (Selcuk, 2003), money demand function (Reinhart & Vegh, 1995) and a combination of transaction cost and cash-in-advance models. Cash-in-advance model assumes that the experience economic agents accumulate in holding foreign currencies as store of value and medium of exchange reduces the cost of holding foreign currencies and is widely used to examine hysteresis effect (Uribe, 1997). Money-in-the-utility-function model assume that 'preferences are additively separable in consumption and liquidity' (Selcuk, 2003). Several studies in developing economies use the money demand function (Reinhart & Vegh, 1995).

[1]Foreign currency deposit, dollarisation and currency substitution are used interchangeably in this paper to denote increasing trend in foreign currency deposit in an economy.

The money demand function assumes three fundamental motives for the money demand—unit of account, store of value and medium of exchange—and the determinants of money demand are income and the opportunity cost of holding money. In an economy with unstable exchange rate (opportunity cost of holding domestic currency), and high inflationary pressure and low interest rate (opportunity cost of holding foreign currency), economic agents will have strong preference for foreign currency (Bahmani-Oskooee & Techaratanachai, 2001; Prock et al., 2003; Whited, 2004). Transaction cost and cash-in-advance model is used to identify return differential (proxied by inflation) between foreign currency and domestic currency as the justification for the domestic foreign currencies (Uribe, 1997). Macroeconomic instability could precipitate currency substitution in an economy because the decision on which currency to hold is purely economically induced. Calvo and Vegh (1992) attribute the determinants of currency substitution to price movement and its impact on money as store of value. Fiscal imbalance leads to high inflation, and high inflation leads to dollarisation and eventually to currency substitution (Calvo & Vegh, 1992). Vetlov (2001) used the vector error correction model (ECM) to investigate the drivers of currency substitution in Lithuania from 1992 to 2000 and found negative relationship between currency substitution and interest rate spread.

Interest rate differential between two economies could also influence the decisions to switch between foreign and local currencies. This is purely a business decision, where interest rate spread and exchange rate volatility are the major determinants of currency substitution in line with the uncovered interest rate parity theory (Carlos, 2002). The demand for foreign currency increases with increase in foreign interest rate, with or without depreciation of the domestic currency. However, portfolio realignment in favour of foreign currency would be more intense during increase in foreign interest rate and higher volatility in exchange rate. The argument that monetary policy cannot correct exchange rate movement that causes deviation in retail prices and exchange rate misalignment was refuted by Chen, Zhou, et al. (2021). They demonstrated that the combination of state contingent international tax policy and monetary policies could eliminate misalignment in exchange rate and sustain a fully efficient welfare outcome. Amstad et al. (2020) investigated why sovereign debt in local currency are considered low risk relative to foreign debt and found greater financing in local currency and foreign exchange reserves as the major reason. Morvillier (2020) investigates the influence of currency devaluation on the contractionary effect of inflation on growth in 62 countries from 1980 to 2015 and found that growth is penalised in an undervalued economy, because undervalued currency is associated with supplementary inflation pressures arising from a cost-push inflation phenomenon that overheat the economy.

Regions such as Latin America, Asia and Eastern Europe were the focal points of currency substitution studies because of the macroeconomic instability in the economies in the 1970s and 1990s. In Latin America, Uruguay, Peru, Bolivia, Brazil, Argentina and Mexico experienced high degree of currency substitution between 1970s and 1990s (Kildegaard & Fernandez, 2014; Prock et al., 2003; Yoskowitz & Pisani, 2007). Argentina recorded high degree of currency substitution between 1980 and 1984, whereas Mexico experienced the same phenomenon between 1977 and 1980 (Calvo & Vegh, 1992; Raheem & Asongu, 2016). In Asia, higher degree of currency substitution was found in Japan, Korea and Singapore between 1977 and 1996 (Sharma et al., 2005). Africa was not the focal point then because the economies were not financially liberalised until late 1980s but took the centre stage after implementing the SAP in the late 1980s (Raheem & Asongu, 2016). After the liberalisation of the foreign exchange markets, institutional peculiarities and the credibility of government policies drove currency substitution due to currency devaluation and the permission for individuals to hold FCDs. Governments also resorted to central bank financing with attendant inflationary pressure in financing fiscal deficit. Other institutional factors that fuelled currency substitution include quality of regulation, access to foreign exchange, trade openness, natural resource rent and collapse of monetary regime (Aizenman et al., 2005; Doblas-Madrid, 2009).

IMF (2015) highlighted the pitfall in using only opportunity cost variables and the need to develop a broad-based model that account for wider spectrum such access to foreign exchange, portfolio, institutions and market failure. Raheem & Asongu (2016) augmented the IMF (2015) access to foreign exchange by introducing financial integration, trade openness and natural resource rent. This paper takes

a cue from IMF (2015) by investigating the impact of financial innovation on currency substitution in Nigeria. The availability of digital products like foreign currency debit and credit cards and the desire to invest in cryptocurrencies could increase demand for foreign currency. Our decision is influenced by the growing consensus extending the determinants of currency substitution, which is extremely crucial. Raheem and Asongu (2016) identified trade openness, financial integration and natural resource rent and found all proxies of access to foreign earnings, except natural resource rent as significant determinants of currency substitution among 26 Sub-Saharan Africa countries. Harasztosi and Katay (2020) found exporters' debt currency choice and supply side factors as the major determinants of currency substitution among Hungarian non-financial corporate sector.

The decision to use money demand function and autoregressive distributed lag (ARDL) approach is consistent with previous studies along this line. For instance, Samreth (2011) used ARDL approach to cointegration and money-in-the-utility function with two currencies (home and foreign) to investigate currency substitution hysteresis in Cambodia and found exchange rate depreciation as a major driver and the presence of hysteresis of the currency substitution. Carlos (2002) used the same model and found that floating exchange rate regimes seem to intensify currency mismatches in domestic financial intermediation, because exchange rate increases deposit in foreign currency but discourages credit in foreign currency. Adam et al. (2003) used demand for money function and ARDL approach to cointegration framework and found evidence of currency substitution in the long run and wealth effect in the short run in Vietnam. Iakova (2010) used money-in-the-utility function and cointegration framework and found that currency substitution decreases governments' seigniorage revenue, but welfare generating for households if domestic currency depreciates in Kazakhstan, the Kyrgyz Republic and Tajikistan.

Empirical studies on the determinants of currency substitution in Nigeria focus on macroeconomic determinants. Yinusa & Akinlo (2008) used a multiperspective unrestricted portfolio balance model and dataset from 1986 to 2005 to examine the existence of currency substitution and gauge its magnitude in Nigeria and found the existence of currency substitution due to exchange rate volatility. Adeniji (2013) used money demand function and ARDL technique to examine the effect of exchange rate and interest rate on currency substitution in Nigeria from 1970 to 2012 and established a long-run relationship between the variables. Tule et al. (2014) examined the drivers of currency substitution in Nigeria and found inflation expectation and exchange rate depreciation as the drivers. Bawa et al. (2015) examined the persistence of currency substitution using the money demand model and ARDL and identified ratchet effects, inflation expectation, exchange rate risks, exchange rate spread and expected exchange rate depreciation as the determinants of currency substitution in Nigeria. Doguwa (2014) examined the determinants of currency substitution using the money demand function and ARDL techniques and found exchange rate risks and political uncertainty as the drivers. Understanding the effect of financial innovation on currency in Nigeria is extremely crucial for policy and a major contribution to literature.

3 | DATA AND METHODOLOGY

3.1 | Data

We use quarterly data from 2005Q1 to 2019Q4 extracted from the Central Bank of Nigeria, National Bureau of Statistics database and International Financial Statistics databases. The variables are real value of financial innovation, REER, real value of FCDs, real gross domestic product, IFR, real value of domestic currency and the US Federal Reserve (Fed) policy rate. Financial innovation is measured as real total monetary value of all retail digital platform transactions in Nigeria. The retail digital platforms include automated teller machine (ATM), point of sales (POS), internet banking, Nigerian Interbank Settlement System Instant Payment (NIP), Nigerian Interbank Settlement System Electronic Fund Transfer (NEFT) and E-billsPay transactions. Transactions on these platforms are generally referred to as the direct measures of financial innovation. We argue that financial innovation improves access to FCD through foreign currency debit and credit cards for online and cross-border settlement. To derive the

natural logarithm of real financial innovation, we deflate the sum of financial innovation by the price level and take the natural logarithm of real financial innovation.

Due to the absence of reliable measure of foreign currency in circulation, most empirical studies use FCD and ratio of FCD to domestic currency as proxies of currency substitution (Dabús et al., 2016; Krupkina & Ponomarenko, 2017; Pepić et al., 2015; Selcuk, 2003; Şıklar et al., 2017). We use two measures of currency substitution. First is the natural logarithm of real foreign deposits deflated by inflation (ln*FCD*), and second is the ratio of foreign currency to domestic currency (*RFCD_DC*). Foreign currency as previously defined is the real value of FCD, whereas domestic currency is defined as broad money (M2) less FCDs. FCD and board money (M2) are evaluated at constant price. REER is the weight of a country's currency relative to a basket of major currencies of trading partners adjusted for price changes, and the foreign interest rate is the Fed monetary policy rate. Real gross domestic product serves as proxy for real income, whereas year-on-year change in consumer price index measures IFR (see Harasztosi & Katay, 2020; Sharma et al., 2005).

3.2 | Methodology

Most studies on the determinants of currency substitution use the demand for money function (Adam et al., 2003; Iakova, 2010; Samreth, 2011; Şıklar et al., 2017). We augment the money demand for currency substitution model of Bawa et al. (2015) to incorporate financial technology variable as follows:

$$(CS)_t^i = \delta_0 + \delta_1 \ln(\text{FINTECH})_t + \delta_2 \ln Y_t + \delta_3 FITR_t + \delta_4 IFR_t + \delta_5 \ln REER_t + \varepsilon_t, \tag{1}$$

where *CS* is the currency substitution, *FINTECH* is the financial technology, *Y* is the real income, *FITR* is the foreign interest rate, *IFR* is the inflation rate, *REER* is the real effective exchange rate, δ_s are the coefficients of the variables and ε is the residual term. The superscript *i* represents the two measures of currency substitution (natural logarithm of real FCD denoted as ln*FCD/P*, and ratio of FCD to domestic currency denoted as *RFCD_DC*), and *t* is time. The signs of δ_1, δ_2, δ_3, δ_4 and δ_5 are expected to be positive.

Some studies assume constant income elasticity in examining the determinants of currency substitution. However, we propose a simple respecification of the money demand function to accurately reflect the process of currency substitution. We assume income level determines the ability of economic agents to hold foreign or domestic currency deposits, by retaining income elasticity of money demand (Adam et al., 2003).

We use we the NG-Perron to test for the stationarity properties of the variables. NG-Perron is useful in circumventing the weak power associated with Augmented Dickey–Fuller (ADF) and Philip–Perron (PP) (Folarin & Asongu, 2019). We used Pesaran et al. (2001) ARDL bound test approach to examine the presence of long-run relationship among the variables. We employed the ARDL test because it does not require all variables to be integrated of the same order because the variables are integrated of I(0) and I(1). The ARDL model is specified in Equation 2 as

$$\begin{aligned}\Delta(CS)_t^i = {} & \delta_0 + \delta_1 \ln(CS)_{t-1}^i + \delta_2 \ln FINTECH_{t-1} + \delta_3 \ln Y_{t-1} + \delta_4 IFTR_{t-1} + \delta_5 IFR_{t-1} + \\ & \delta_6 \ln REER_{t-1} + \delta_7 Trend + \sum_{j=1}^{l} \tau_{1j} \Delta(CS)_{t-j}^i + \sum_{j=0}^{m} \tau_{2j} \Delta \ln FINTECH_{t-1} \\ & + \sum_{j=0}^{n} \tau_{3j\Delta \ln Y_{t-1}} + \sum_{j=0}^{o} \tau_{4j} \Delta FITR_{t-1} + \sum_{j=0}^{p} \tau_{5j} \Delta IFR_{t-1} + \sum_{j=1}^{q} \tau_{6j} \Delta \ln REER_{t-1} \varepsilon_t .\end{aligned} \tag{2}$$

To determine the optimal lag for the variables in line with ARDL test in Equation 2, we used Schwarz information criteria (SIC). We further impose restrictions on the lag value of all the level series

in Equation 2 to estimate the *F*-statistics through Wald restrictions as prescribed by Pesaran et al. (2001). The *F*-statistics value was used to evaluate the presence of long-run relationship among the variables, where $\delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$ denotes absence of long-run relationship once the null hypothesis for the Wald restriction is imposed on Equation 2.

We compared the value of the calculated *F*-statistics with Pesaran et al. (2001) upper and lower critical values. We proceed to the estimation of the ECM based on the results obtained from the cointegration test, to establish the effect of financial innovation, income, IFR, REER and interest rate on currency substitution, as well as the speed of adjustment back to long-run equilibrium after a short-run shock. This involves two major steps. First, we regress the variables on dependent variables and minus the actual value of the dependent variable from the estimated value. This is represented as

$$ECT = (CS)_t^i - (\vartheta_0 + \vartheta_1 T + \vartheta_2 \ln FINTECH_t + \vartheta_3 \ln Y_t + \vartheta_4 FITR_t + \vartheta_5 IFR_t + \vartheta_6 \ln REER_t). \quad (3)$$

To obtain the ECT results, we specify Equation 4 as follows:

$$\Delta(CS)_t^i = (\gamma_0 + \gamma_1 \ln FINTECH_t + \gamma_2 \ln Y_t + \gamma_3 FITR_t + \gamma_{34} IFR_t + \gamma_5 \ln REER_t + \tau ECT_{t-1} + \varepsilon_t. \quad (4)$$

The value of τ is expected to be negative and significant, because it is the speed of adjustment for the restoration to long-run equilibrium after external shocks. We used the CUSUM and CUSUM of square (CUSUMQ) for consistency parameter checks and conducted additional diagnostic test of the ECM result. The diagnostic tests include autoregressive conditional heteroscedasticity (ARCH), Breusch–Godfrey (BG) test for serial correlation, ARCH test and Jarque–Bera test for normality.

4 | ANALYSIS OF RESULTS

The descriptive result is presented in Table 1. The average value of financial innovation is Naira 247.31 billion, whereas the standard deviation is Naira 286.65 billion. The higher standard deviation signals increasing values of financial transactions through digital platforms. The average value of FCD is Naira 2.814 billion whereas the standard deviation is Naira 1.660 billion. Ratio of foreign currency to domestic currency averaged 18% indicating significant presence of currency substitution in Nigeria. The lower standard deviation indicates that the value of FCDs for the review period is closer to the mean. The

TABLE 1 Descriptive statistics

	Mean	Median	Maximum	Minimum	SD	Skewness	Kurtosis
Financial innovation, billion (N)	247.31	148.59	1051.07	0.31	286.65	0.99	3.03
Foreign currency deposits, billion (N)	2814.60	2955.86	6320.36	302.38	1660.69	0.46	2.01
Inflation rate (%)	11.63	11.27	24.32	4.12	3.74	0.68	3.92
Real effective exchange rate	86.75	88.83	101.76	65.42	10.54	−0.55	1.95
Fed policy rate	1.42	0.94	5.25	0.13	1.64	1.22	3.29
Real income, billion (B)	10,829.13	14,958.19	19,527.73	319.91	7824.08	−0.61	1.5
Domestic currency, million (B)	11,960.70	11,376.49	21,578.47	2561.93	5850.00	0.04	1.89
Ratio of foreign to domestic currency	0.18	0.20	0.33	0.01	0.08	−0.32	2.25

Note: % is the percentage, SD is the standard deviation and N is Naira.

average IFR is 11.63%, and the standard deviation is 4.12%. The Fed policy rate averaged 1.42% with a standard deviation of 1.64%, reflecting the near zero band during quantitative easing, and a minor due to tapering. The real negative returns between Nigeria's IFR and the Fed policy rate suggest that Fed policy rate may not be a determinant of currency substitution in Nigeria. However, experience from the US quantitative easing and tapering has made the United States a specimen for investigating how monetary policy shocks from dominant economies are transmitted to smaller economies (Tule et al., 2014). Nigeria real GDP average is Naira 11,960.70 billion with a standard deviation of Naira 5850.00 billion.

NG-Perron unit root test results are presented in Table 2. Except REER and interest rate that were stationary at level, the other variables were stationary at first difference, which satisfies the initial condition for using cointegration Bound test.

The result of the cointegration bound test is presented in Table 3. For long-run relationship to hold between currency substitution and its determinants, the null hypothesis that there is no cointegration must be rejected. The bound test results for the two models in Table 3 reveals that the two measures of currency substitution are cointegrated with its determinants. This implies the presence of long-run cointegration on the scale and opportunity cost variables.

Having established that long-run relationship holds between currency substitution and its determinants, we estimate the ARDL technique to establish the effects of financial technology, income, exchange rate, interest rate and IFR on currency substitution in Nigeria. The ARDL result is presented in Table 4. Model 1 defined currency substitution as the natural logarithm of total FCD (ln*FCD*). The results of Model 1 reveal long-run positive and significant effect of financial technology, income, foreign interest rate, IFR and REER on currency substitution in Nigeria. One per cent increase in financial innovation,

TABLE 2 NG-Perron unit root test

	MZa	MZt	MSB	MPT	Decision	Lag
ln*FCD/P*	−4.671	−1.075	0.230	16.856	I(0)	0
ln*FINTECH*	−5.305	−1.569	0.296	16.965	I(0)	0
ln*Y*	−5.079	−1.516	0.298	17.589	I(0)	0
ITR	−15.372*	−2.697*	0.175*	6.377*	I(0)	1
IFR	−9.792	−2.210	0.226	9.320	I(0)	0
ln*REER*	−16.076*	−2.778*	0.173*	6.014*	I(0)	0
FCD/DC	−9.326	−2.231	0.231	9.785	1(0)	0
Δln*FCD/P*	−28.434***	−3.756***	0.132***	3.289**	1(1)	0
Δln*FINTECH*	−28.555***	−3.778**	0.132***	3.192***	1(1)	0
Δln*Y*	−28.985***	−3.807***	0.131***	3.144***	1(1)	0
Δ*ITR*	−22.960**	−3.209**	0.140**	5.026**	1(1)	0
Δ*IFR*	−28.741***	−3.786***	0.137***	3.200***	1(1)	0
Δln*REER*	−27.247***	−3.574***	0.131**	4.025***	1(1)	0
Δ*FCD/DC*	−57.335***	−5.351***	0.093***	1.607***	1(1)	1
Critical values						
1%	−23.800	−3.420	0.143	4.030		
5%	−17.300	−2.910	0.168	5.480		
10%	−14.200	−2.620	0.185	6.670		

Note: *FCD* is the foreign currency deposit, *DC* is the domestic currency, *FCD/DC* is the ratio of foreign currency to domestic currency, *FINTECH/P* is the real value of financial technology, *Y* is the real income, *ITR* is the interest rate, *IFR* is the inflation rate, *REER* is the real effective exchange rate, ln is the natural logarithm and Δ is the difference operator.

*Significance levels of 10%.

**Significance levels of 5%.

***Significance levels of 1%.

TABLE 3 Results of the ARDL cointegration test

	ARDL structure	*F*-statistics	Normality	ARCH test (1)	BG LM test (1)
ln*FCD/P*, ln*FINTECH*, ln*Y*, ln*REER*, *ITR*, *IFR*	(2,4,4,2,1,1)	6.000**	0.342	0.181	0.568
RFCD_DC, ln*FINTECH*, ln*Y*, ln*REER*, *ITR*, *IFR*	(4,3,0,0,0,0)	3.164**	0.320	0.981	0.742

Note: The upper (lower) bounds critical value at 1% and 5% are 5.72 (4.4) and 4.57 (3.47), respectively. These critical values are obtained from Pesaran et al. (2001) with unrestricted and restricted trend. The reported values for normality test, Breusch–Godfrey serial correlation LM test (BG LM test) and ARCH test are the probability values of the *F*-statistics. ARDL is autoregressive distributive lag.
**Statistically significant at 5%.
***Statistically significant at 1%.

TABLE 4 Regression analysis

Dependent variable: Long-run estimation	**(1) ln*FCD/P***	**(2) *RFCD_DC***
Constant	1.910*** (0.433)	0.104*** (0.057)
ln*FINTECH*	0.155*** (0.100)	0.143*** (0.020)
ln*Y*	0.118** (0.032)	0.127*** (0.013)
FITR	0.024*** (0.009)	0.014*** (0.002)
IFR	0.245*** (0.104)	0.220*** (0.116)
ln*REER*	0.421*** (0.247)	0.390*** (0.191)
Dependent variable: Short-run estimation	**Δln*FCD/P***	**Δ*RFCD_DC***
Δln*FINTECH*	0.117*** (0.042)	0.105 (000)
Δln*Y*	0.104** (0.027)	0.111*** (0.005)
Δ*FITR*	0.013*** (0.009)	0.017 (0.004)
Δ*IFR*	0.203*** (0.157)	0.0211*** (0.195)
Δln*REER*	0.328*** (0.159)	0.229*** (0.112)
ECT(−1)	−0.377*** (0.054)	−0.629*** (0.136)

*Statistical significance level at 10%.
**Statistical significance level at 5%.
***Statistical significance level at 1%.

income, foreign interest rate, IFR and exchange rate increases foreign currency substitution by 15.5%, 11.8%, 2.4%, 24.5% and 42.1%, respectively. In the short run, the determinants of currency substitution are positive and significant as 1% increase in financial innovation, income, foreign interest rate, IFR and exchange rate increases currency substitution by 11.7%, 10.4%, 1.3%, 20.3% and 32.8%, respectively. The negative and significant coefficients of the ECT imply that it converges back to its long-run function whenever there is imbalance. The result reveals that financial innovation is a significant driver of currency substitution; however, exchange rate depreciation and domestic IFR exert greater impact.

Model 2 defined currency substitution as ratio of FCD to total domestic currency (*RFDC_DC*). Model 2 is consistent with Model 1 as it reveals long-run relationship between currency substitution and its determinants. In the long run, 1% increase in financial technology, income, foreign interest rate, IFR and exchange rate increases FCD by 14.3%, 12.7%, 1.4%, 22% and 39%, respectively. The determinants of currency substitution are positive and statistically significant in the short-run model. The coefficients indicate that 1% increase in financial innovation, foreign interest rate, IFR and exchange rate increases the ratio of foreign currency to total domestic currency by 10.5%, 11.1%, 1.7%, 21.1% and

22.9%, respectively. The negative and significant coefficients of the ECT imply that it converges back to its long-run function whenever there is imbalance.

The significant positive effect of financial innovation on currency substation is consistent with the anecdotal evidence in Figure 2 that financial innovation creates additional incentives for economic agents to hold FCDs. The result is consistent with the findings of Valey (2010) and Mokni and Ajmi (2021) but contracts that of Kwon (2020) and Das et al. (2020). Valey (2010) attributes the increasing incidence of currency substitution in Bulgarian to information technology, whereas Kwon (2020) and Das et al. (2020) argue that trading in Bitcoin, which serves hedging instrument, means of investment and alternative medium of exchange by investors, may discourage foreign currency holding. Our findings may be explained by the fact that the liberalisation of foreign exchange market, practice of domiciliary accounts and development of the payment system like the issuance of foreign currency cards, in addition to exchange rate depreciation, inflationary pressure and integration of the financial system to the global financial system—that allows shocks from dominate economies to have contemporaneous effect on small economies—may have accounted for the result. The emergence of digital financial products and online retail shops, coupled with the benefits of cryptocurrencies as hedge instrument against volatility domestic exchange rate, creates additional incentives for economic agents to hold FCDs in Nigeria.

Our finding also identifies income, exchange rate, foreign interest rate and inflation as macroeconomic determinants of currency substitution in Nigeria. This is consistent with Janot et al. (2021), Ongena et al. (2021), Bitar (2021a), Bitar (2021b), Chen, Zhou, et al. (2021), Chen, Devereux, et al. (2021), Galvez et al. (2021), Castle & Kurita (2021), Sui et al. (2021), Kocaarslan (2021) and Kapounek et al. (2016). The positive effect of inflation on currency substitution is consistent with the works of Selcuk (2003), Tsang and Ma (2002) and Adam et al. (2003). This implies that during periods of high inflationary pressure, economic agents either keep their wealth in FCD or investment outlets that are less sensitive to inflationary pressure (Morvillier, 2020; Ozbilgin, 2012). Our findings that foreign interest rate and exchange rate are significant determinants of currency substitution in Nigeria are consistent with the wealth effect hypothesis that households gain by increasing their demand for foreign currency during the depreciation of domestic currency (Airaudo, 2014; Heimonen, 2008; Ozbilgin, 2012; Samreth, 2011). The significant positive effect of foreign interest rate on currency substitution signal the integration of the Nigerian banking system to global market and the vulnerability of the banking system to external shocks. Financial innovation tends to increase the vulnerabilities of the economies to external shocks, due to the ease of investing in foreign financial instruments, and holding foreign currencies for transactionary and precautionary purposes.

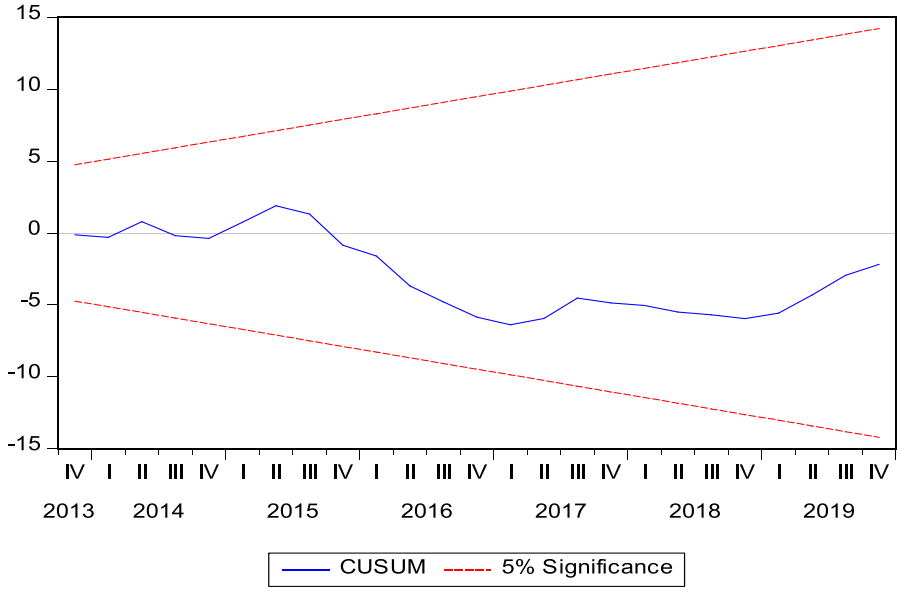
Diagnostic tests were conducted to assess the goodness of fit and stability of the models. The tests include BG test for serial correlation, Jarque–Bera test for normality, ARCH test for heteroscedasticity and CUSUM and CUSUM of square tests for stability. The diagnostic test results are presented in

TABLE 5 Diagnostic test

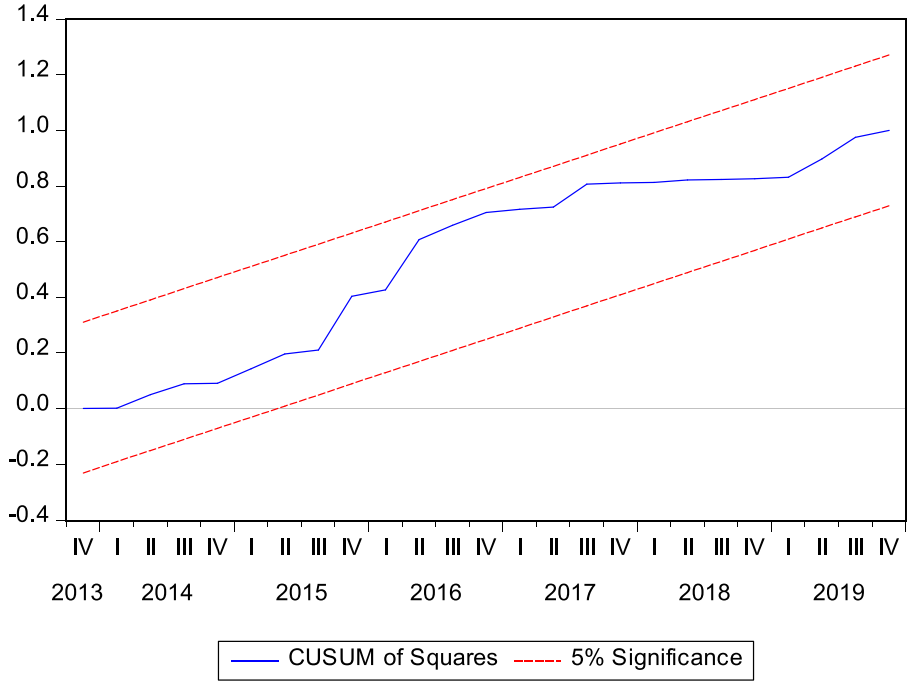
	ln*FCD/P*	*RFCD_DC*
R^2	0.994	0.984
Adjusted R^2	0.989	0.948
F-statistics (prob. value)	0.000	0.000
Jarque–Bera normality test	0.083	0.209
Breusch–Godfrey serial correlation LM test	(1) 0.121; (2) 0.131; (3) 0.136	(1) 0.787 (2) 0.923 (3) 0.279
ARCH test	(1) 0.235; (2) 0.531; (3) 0.494	(1) 0.962 (2) 0.665 (3) 0.857
CUSUM	Stable	Stable
CUSUM of square	Stable	Stable

Note: Δ is the difference operator, ECT is the error correction term and prob. value is the probability value.
*Significance levels of 10%.
**Significance levels of 5%.
***Significance levels of 1%.

Table 5. Jarque–Bera normality test residuals overwhelmingly confirmed the presence of normally distributed errors, and BG serial correlation LM test confirmed the absence of serial correlation. R^2 of Models 1 and 2 indicates that 99% and 98% of the data fit the regression model, respectively. The



(a)



(b)

FIGURE 3 (a) CUSUM test for Model 1. (b) CUSUM of square test for Model 1

adjusted R^2 also indicates that the data in the regression equation is a good fit because the high adjusted R^2 in Models 1 and 2 implies the selected determinants of currency substitution explain the variation in the currency substitution measures. The tests indicate goodness of fit of the estimated models.

We also conducted stability tests for the two models, to ascertain the stability of the models. The CUSUM and CUSUM of square of Model 1 are presented in Figure 3a,b, whereas that of Model 2 are presented in Figure 4a,b, which confirm the stability of the models.

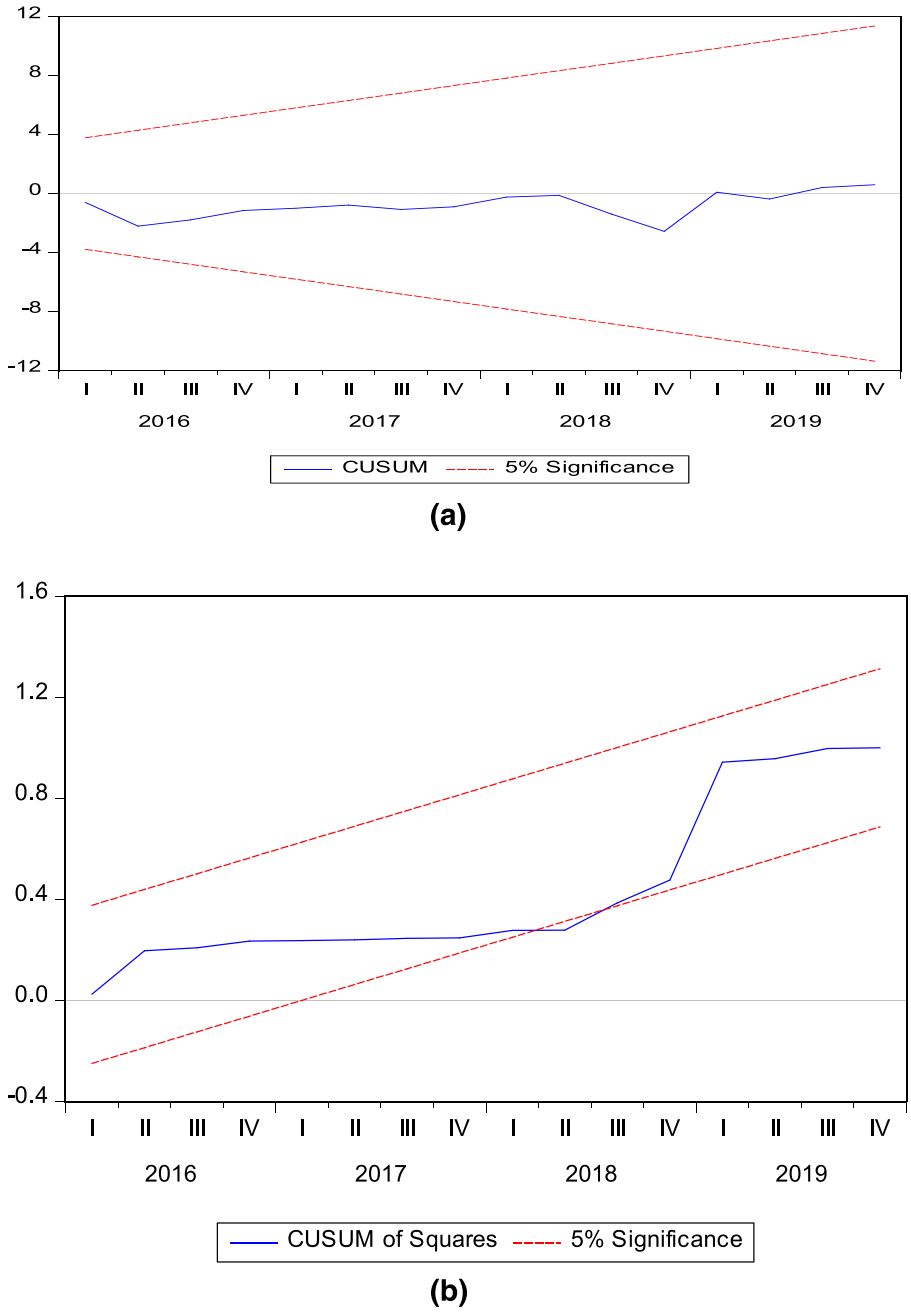


FIGURE 4 (a) CUSUM test for Model 2. (b) CUSUM of square test for Model 2

5 | CONCLUSION AND POLICY IMPLICATION

There is persistent and significant incidence of currency substitution in Nigeria. Previous studies focus on inflationary pressure, exchange rate depreciation and foreign interest rate as the drivers. The anecdotal evidence from our study did not support this assumption. Rather, the strong comovement between financial innovation and FCD suggests that financial innovation may be the additional driver. To empirically validate the anecdotal evidence, we use quarterly data from 2005Q1 to 2019Q4 and augmented money demand function to examine the effect of financial innovation on currency substitution in Nigeria. Pesaran et al. (2001) ARDL bound test approach to cointegration was used to estimate the long-run relationship between currency substitution and its determinants. Empirical results suggest the presence short-run and long-run positive effects of financial innovation on currency substitution in Nigeria. The result also validates income, IFR, exchange rate and foreign interest rates as major determinants of currency substation in Nigeria. The CUSUM and CUSUM of square tests reveal that the models stable.

Though the empirical results identified financial technology, income, foreign interest rate, IFR and exchange rate as the major determinants of FCD in Nigeria, the coefficient of REER is the highest, followed by inflation, financial technology, income and foreign interest rate. Technically, demand for foreign currency increases with the advent of financial innovation with or without depreciation of the domestic currency. However, portfolio realignment in favour of foreign currency would be more intense during increase in foreign interest rate, rise in inflation pressure and depreciation in exchange rate. Continuous depreciation of the Naira increases the incentive to hold foreign currencies relative to domestic currency (Daniels & VanHoose, 2003; Selcuk, 2003; Sharma et al., 2005; Tsang & Ma, 2002; Valey, 2010).

Monetary authorities in developing economies need to pay special attention to this development because financial innovation increases the velocity of money supply, weakens the ability of monetary authorities to monitor the relationship between price and money supply and renders render policy ineffective. Developing a policy instrument that can effectively monitor the effect of financial innovation on the velocity of FCDs is extremely crucial. Our study contributes to literature and policy by using financial innovation that is generally neglected in extant literature.

Payments system that is powered by the state-of-the-art technology is desirous for promoting credible, reliable and expeditious settlement system, suited to the needs of the economy and increases the phenomenon of currency substitution. The findings of this study should not provide justification for regulators stifle financial innovation, because it is sustainably beneficial to the public. Rather, this finding should put additional pressure on regulators in terms of promoting credible exchange rate management policy, fiscal discipline and commitment to policy consistency and credibility, in striking a delicate balance between a desirable efficient payment system and undesirable currency substitution effect. Ensuring policy credibility, favourable macroeconomic environment, and fiscal discipline may reduce the incidence of currency substitution, despite the radical financial innovation in the payments system infrastructure.

ORCID

Angela Ifeanyi Ujunwa https://orcid.org/0000-0002-2139-0306

REFERENCES

Adam, C., Goujon, M. & Jeanneney, S.G. (2003) Currency substitution and the transactions demand for money, Centre d'Etudeset de Rechercheen Droit de l'Immatériel. Working Paper Series No. E2003.04. https://www.researchgate.net/publication/4801960_Currency_substitution_and_the_transactions_demand_for_money

Adeniji, S. (2013) Investigating the relationship between currency substitution, exchange rate and inflation in Nigeria: An autoregressive distributed lag (ARDL) approach. https://mpra.ub.uni-muenchen.de/52551/1/MPRA_paper_52551.pdf

Airaudo, M. (2014) Currency substitution, risk premia and the Taylor principle. *Journal of Economic Dynamics & Control*, 48, 202–217. https://doi.org/10.1016/j.jedc.2014.09.028

Aizenman, J., Kletzer, K. & Pinto, B. (2005) Sargent-Wallace meets Krugman-Flood Garber, or: Why sovereign debt swaps do not avert macroeconomic crises. *The Economic Journal*, 115(2), 343–367. https://academic.oup.com/ej/article-abstract/115/503/343/5085666

Amstad, M., Packer, F. & Shek, J. (2020) Does sovereign risk in local and foreign currency differ? *Journal of International Money and Finance*, 101, 102099. https://doi.org/10.1016/j.jimonfin.2019.102099

Bahmani-Oskooee, M. & Techaratanachai, A. (2001) Currency substitution in Thailand. *Journal of Policy Modeling*, 23(2), 141–145. https://doi.org/10.1016/S0161-8938(00)00030-2

Bawa, S., Omotosho, B.S. & Doguwa, S.I. (2015) Ratchet effects in currency substitution: An application to Nigeria. *CBN Journal of Applied Statistics*, 6(2), 19–37. https://www.econstor.eu/bitstream/10419/142104/1/cbn-jas_v6-i2-pp019-037.pdf

Bitar, J. (2021a) Foreign currency intermediation: Systemic risk and macroprudential regulation. *Latin American Journal of Central Banking*, 2(2), 100028. https://www.sciencedirect.com/science/article/pii/S2666143821000089

Bitar, J. (2021b) The unique dollarization case of Lebanon. *Economic Systems*, 45(2), 100765. https://www.sciencedirect.com/science/article/abs/pii/S0939362520300728

Calvo, G. & Vegh, C. (1992) Currency substitution in developing countries: An introduction, IMF Working Paper WP/92/40 (Washington DC). https://books.google.com.gh/books?hl=en&lr=&id=qFEYEAAAQBAJ&oi=fnd&pg=PT2&dq=Currency+substitution+in+developing+countries:+An+introduction,&ots=4cz8iGa2Ja&sig=db0uhPJFDoqu_hTtIxeJY9l53wk&redir_esc=y#v=onepage&q=Currency%20substitution%20in%20developing%20countries%3A%20An%20introduction%2C&f=false

Carlos, A. (2002) Exchange rate regimes and financial dollarization: Does flexibility reduce bank currency mismatches? *The B.E. Journal of Macroeconomics*, 5(1), 1–30. https://escholarship.org/content/qt9jb1p0jg/qt9jb1p0jg.pdf

Castle, J.L. & Kurita, T. (2021) A dynamic econometric analysis of the dollar-pound exchange rate in an era of structural breaks and policy regime shifts. *Journal of Economic Dynamics and Control*, 128, 104139. https://www.sciencedirect.com/science/article/abs/pii/S0165188921000749

Chen, R., Zhou, H., Yu, L., Jin, C. & Zhang, S. (2021) An efficient method for pricing foreign currency options. *Journal of International Financial Markets Institutions and Money*, 16, 101295. https://www.sciencedirect.com/science/article/abs/pii/S1042443121000147

Chen, S., Devereux, M.B., Shi, K. & Xu, J. (2021) Exchange rates, local currency pricing and international tax policies. *Journal of Monetary Economics*, 117, 460–472. https://www.sciencedirect.com/science/article/abs/pii/S0304393220300210

Cukierman, A., Kiguel, M.A. & Liviatan, N. (1994) How much to commit to an exchange rate rule: balancing credibility and flexibility. In: *Varieties of monetary reforms*. Boston, MA: Springer, pp. 73–94. https://books.google.com.gh/books?hl=en&lr=&id=RCWfblHFPqYC&oi=fnd&pg=PA13&dq=How+much+to+commit+to+an+exchange+rate+rule:+balancing+credibility+and+flexibility&ots=nwnHARlbPw&sig=cPR73O2ILETTmeRsVbJ77kvmVmE&redir_esc=y#v=onepage&q=How%20much%20to%20commit%20to%20an%20exchange%20rate%20rule%3A%20balancing%20credibility%20and%20flexibility&f=false

Dabús, C., Delbianco, F. & Fioriti, A. (2016) High inflation, price stability and hysteresis effect: evidence from Argentina. *Revista de Analisis Económico–Economic Analysis Review*, 31(1), 59–74. https://www.rae-ear.org/index.php/rae/article/view/452/580

Daniels, J.P. & VanHoose, D.D. (2003) Currency substitution, seigniorage, and currency crises in interdependent economies. *Journal of Economics and Business*, 55(3), 221–232. https://www.sciencedirect.com/science/article/abs/pii/S0148619503000250

Das, D., Le Roux, C.L., Jana, R.K. & Dutta, A. (2020) Does Bitcoin hedge crude oil implied volatility and structural shocks? A comparison with gold, commodity and the US Dollar. *Finance Research Letters*, 36, 101335. https://www.sciencedirect.com/science/article/abs/pii/S1544612319306725

Doblas-Madrid, A. (2009) Fiscal trends and self-fulfilling crises. *Review of International Economics*, 17(1), 187–204. https://doi.org/10.1111/j.1467-9396.2008.00784.x

Doguwa, S.I. (2014) Currency substitution: Evidence from Nigeria. *CBN Journal of Applied Statistics*, 5(2), 1–23. https://www.econstor.eu/bitstream/10419/144778/1/86176434X.pdf

Folarin, O.E. & Asongu, S.A. (2019) Financial liberalization and long-run stability of money demand in Nigeria. *Journal of Policy Modeling*, 41(5), 963–980. https://www.sciencedirect.com/science/article/abs/pii/S0161893819300596

Galvez, J., Gambacorta, L., Mayordomo, S. & Serena, J.M. (2021) Dollar borrowing, firm credit risk, and FX-hedged funding opportunities. *Journal of Corporate Finance*, 68, 101945. https://doi.org/10.1016/j.jcorpfin.2021.101945

Harasztosi, P. & Katay, G. (2020) Currency matching by non-financial corporation. *Journal of Banking and Finance*, 113, 1–20. https://doi.org/10.1016/j.jbankfin.2020.105739

Heimonen, K. (2008) Substituting a substitute currency. *International Review of Economics and Finance*, 17(1), 66–84. https://www.sciencedirect.com/science/article/abs/pii/S1059056006000384

Iakova, A. (2010) Currency substitution in the economies of Central Asia: How much does it cost? The Bank of Finland Institute for Economies in Transition, Discussion Papers 14/2010. https://www.econstor.eu/bitstream/10419/212682/1/bofit-dp2010-014.pdf

IMF. (2015). Dollarization in Sub-Saharan Africa: Experience and lessons. IMF Working Paper Series, Washington.

Janot, M.M., Garcia, M.G. & Novaes, W. (2021) Balance sheet effects in currency crises: Evidence from Brazil. *Economia*, 22(1), 19–37. https://www.sciencedirect.com/science/article/pii/S1517758021000035

Kapounek, S., Deltuvaitė, V. & Koráb, P. (2016) Determinants of foreign currency savings: Evidence from Google search data. *Procedia-Social and Behavioral Sciences*, 220, 166–176. https://www.sciencedirect.com/science/article/pii/S1877042816305821

Kildegaard, A. C. & Fernandez, R. O. (2014) Dollarization in Cuba and implications for the future transition. https://www.ascecuba.org/c/wp-content/uploads/2014/09/v09-kil_orro.pdf

Kocaarslan, B. (2021) How does the reserve currency (US dollar) affect the diversification capacity of green bond investments? *Journal of Cleaner Production*, 307, 127275.

Krupkina, A. & Ponomarenko, A. (2017) Deposit dollarization in emerging markets: modelling the hysteresis effect. *Journal of Economics and Finance*, 41(4), 794–805.

Kwon, J.H. (2020) Tail behavior of Bitcoin, the dollar, gold and the stock market index. *Journal of International Financial Markets Institutions and Money*, 67, 101202. https://www.sciencedirect.com/science/article/abs/pii/S104244312030086X

Mokni, K. & Ajmi, A.N. (2021) Cryptocurrencies vs. US dollar: Evidence from causality in quantiles analysis. *Economic Analysis and Policy*, 69, 238–252. https://www.sciencedirect.com/science/article/abs/pii/S0313592620304586

Morvillier, F. (2020) Do currency undervaluation affect the impact of inflation on growth. *Economic Modelling*, 84, 275–292. https://www.sciencedirect.com/science/article/abs/pii/S0264999318309209

Mourmouras, A. & Russell, S. H. (2000) Smuggling, currency substitution and unofficial dollarization: A crime-theoretic approach. IMF Working Paper: WP/00/176. https://www.elibrary.imf.org/view/journals/001/2000/176/article-A001-en.xml

Ongena, S., Schindele, I. & Vonnák, D. (2021) In lands of foreign currency credit, bank lending channels run through? *Journal of International Economics*, 129, 103435. https://doi.org/10.1016/j.jinteco.2021.103435

Ozbilgin, H.M. (2012) Currency substitution, inflation, and welfare. *Journal of Development Economics*, 99(2), 358–369. https://doi.org/10.1016/j.jdeveco.2012.04.003

Pepić, M., Marinković, S., Radović, O. & Malović, M. (2015) Determinants of currency substitution in Southeast European countries. *Economic Themes*, 53(2), 162–184. https://doi.org/10.1515/ethemes-2015-0010

Pesaran, H.M., Shin, Y. & Smith, R.J. (2001) Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(1), 289–326. https://doi.org/10.1002/jae.616

Prock, J., Soydemir, G.A. & Abugri, B.A. (2003) Currency substitution: Evidence from Latin America. *Journal of Policy Modeling*, 25(4), 415–430. https://www.sciencedirect.com/science/article/abs/pii/S0161893803000139

Raheem, I. D. & Asongu, S. A. (2016) Extending the determinants of dollarisation in Sub-Saharan Africa: The role of access to foreign exchange earnings, AGDI Working Paper WP/16/033. https://mpra.ub.uni-muenchen.de/75415/1/MPRA_paper_75415.pdf

Reinhart, C.M. & Vegh, C. (1995) Nominal interest rates, consumption booms and lack of credibility: A quantitative examination. *Journal of Development Economics*, 46(2), 357–378. https://www.sciencedirect.com/science/article/abs/pii/030438789400068N

Samreth, S. (2011) An empirical study on the hysteresis of currency substitution in Cambodia. *Journal of Asian Economics*, 22(6), 518–527. https://www.sciencedirect.com/science/article/abs/pii/S0165176502002070

Selcuk, F. (2003) Currency substitution: New evidence from emerging economies. *Economics Letters*, 78(2), 219–224. https://www.sciencedirect.com/science/article/abs/pii/S0165176502002070

Sharma, S.C., Kandil, M. & Chaisrisawatsuk, S. (2005) Currency substitution in Asian countries. *Journal of Asian Economics*, 16(3), 489–532. https://www.sciencedirect.com/science/article/abs/pii/S1049007805000783

Şıklar, İ., Karagöl, V. & Şahin, S. (2017) Is there any meaningful ratchet effect in the process of currency substitution? Evidence from Turkey. *Business and Economic Research*, 7(2), 146–162. https://www.researchgate.net/profile/Veysel-Karagoel/publication/319067464_Is_There_Any_Meaningful_Ratchet_Effect_in_the_Process_of_Currency_Substitution_Evidence_from_Turkey/links/5993ec94a6fdccaded20528d/Is-There-Any-Meaningful-Ratchet-Effect-in-the-Process-of-Currency-Substitution-Evidence-from-Turkey.pdf

Sui, M., Rengifo, E.W. & Court, E. (2021) Gold, inflation and exchange rate in dollarized economies—A comparative study of Turkey, Peru and the United States. *International Review of Economics and Finance*, 71, 82–99. https://www.sciencedirect.com/science/article/abs/pii/S1059056020301830

Tsang, S. & Ma, Y. (2002) Currency substitution and speculative attacks on a currency board system. *Journal of International Money and Finance*, 21(1), 53–78. https://doi.org/10.1016/S0261-5606(01)00015-8

Tule, M.K., Bala-Keffi, L.R. & Ogiji, P. (2014) Monetary policy and currency substitution: Evidence from Nigeria. *West African Journal of Monetary and Economic Integration*, 14(1), 103–128.

Uribe, M. (1997) Hysteresis in a simple model of currency substitution. *Journal of Monetary Economics*, 40(1), 185–202. https://doi.org/10.1016/S0304-3932(97)00038-X

Valey, N.T. (2010) The hysteresis of currency substitution: Currency risk vs. network externalities. *Journal of International Money and Finance*, 29(2), 224–235.

Vegh, C.A. (1995) Inflationary finance and currency substitution in a public finance framework. *Journal of International Money and Finance*, 14(5), 679–693. https://www.econstor.eu/bitstream/10419/212482/1/bofit-dp2001-001.pdf

Vetlov, I. (2001) Dollarisation in Lithuania: An econometric approach, The Bank of Finland Institute for Economies in Transition, Discussion Papers 1/2001. https://www.econstor.eu/bitstream/10419/212482/1/bofit-dp2001-001.pdf

Whited, H.H. (2004) Currency substitution versus dollarization: a portfolio balance model. *Journal of Policy Modeling*, 26(1), 113–116. https://www.sciencedirect.com/science/article/abs/pii/S0161893801000631

Yinusa, D.O. & Akinlo, A.E. (2008) Exchange rate volatility and the extent of currency substitution in Nigeria. *Indian Economic Review*, 43(2), 161–181. https://www.jstor.org/stable/pdf/29793912.pdf

Yoskowitz, D.W. & Pisani, M.J. (2007) Risk and reward: Currency substitution and acceptance of the Mexican peso by firms in the United States southern frontier. *The Quarterly Review of Economics and Finance*, 47(3), 422–434. https://www.sciencedirect.com/science/article/abs/pii/S1062976906000032

How to cite this article: Ujunwa, A.I., Ujunwa, A., Onah, E., Nwonye, N.G. & Chukwunwike, O.D. (2021) Extending the determinants of currency substitution in Nigeria: Any role for financial innovation? *South African Journal of Economics*, 1–18. Available from: https://doi.org/10.1111/saje.12300

View publication stats