

The Impact of Financial Innovations on Demand for Money and Currency Outside Bank: Evidence from Nigeria

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Abstract: *This research examined how financial innovations affect the demand for money and currency outside the banking system in Nigeria. Two models were estimated for the study with the measure of broad money M2 used as proxy for Money Demand and currency outside bank (COB) as the dependent variables for model 1 and model 2 respectively. Value of ATM transactions, value of Internet Banking (web), value of Mobile Money transactions and value of POS transactions were used as proxies for financial innovations and RGDP and interest rate as control variables. Data used in the study was from the period 2010Q1 to 2021Q4, which were estimated with the cointegration and ECM technique. The findings from model 1 indicated that real gross domestic product, value of ATM transactions as well as value of mobile banking transactions exert a positive impact on money demand. Deposit interest rate, value of POS transactions and value of web (internet) transactions displayed a negative impact on demand for money. For model 2, findings showed that RGDP increase currency outside the banking system, interest rate decreases it, while VATM and VMOB have a positive impact on COB, VPOS and VWEB impact negatively on COB. The study clearly proved the significant influence of financial innovations in influencing the demand for money and currency outside the banking sector in Nigeria. In light of the foregoing, the study recommends promoting the acceptability of financial innovations in payment methods, thereby providing a secure medium through continuous engagement of Nigerians who have the means to use the various financial innovations. Also, the monetary authorities should make policies that will encourage more participants in the sector through investments in critical infrastructures that ensures hitch-free service delivery of the financial innovation. Due to the mixed influence of financial innovation on the currency outside banking system, caution must be taken by the monetary authority when advocating for the use of financial innovation especially ATM and Mobile banking apps, also we can infer from the findings that transactional and precautionary motives drives the demand for currency outside the banking system.*

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Cite as:

The journal editors will add this information after completion of the volume!

Keywords: Financial Innovations, Demand for Money, Currency Outside Bank, ECM.

1. Introduction

The modern financial system is characterized by an accelerated level of innovations, particularly taking the form of rapid and significant technological changes in the payments systems. Blach (2011) claims that the quantity and value of these innovations have had a profound effect on the global economy. What drives change owing to the introduction of financial innovations, according to Laeven et al. (2015), are new financial instruments, services and institutions. Technological innovations in Nigeria has transformed the payment system from reliance on physical cash and cheques to reliance on e-payment mechanisms including Automated teller Machine (ATM), Point of Sales (POS) and several other web-based payment systems.

Financial innovations such as the development of e-payments ensures easy access to means to pay for transactions and may thus cause changes in the demand for money and its components. Cash holdings (which defines currency outside the banking system) is about 87.5% of the total money in circulation in Nigeria as at 2023. Such high currency outside the banking system has been shown to be highly institutionalized and a foundation for currency hoarding as shown by events resulting from the recent move by the Central Bank of Nigeria (CBN) in 2023 to redesign the Nigerian naira (₦). In particular, high level of currency outside banking system contends effective monetary policy (CBN, 2023), as shown by preference for low level of currency in the hands of the public outside the banking system in developed economies. The e-payment system appears to have failed to influence demand for cash holdings in Nigeria. An important implication is the effect of e-payment systems on the motivations for demand for money. Thus, it is crucial to evaluate the impact of financial innovations in the form of e-payments on money demand in Nigeria.

Several authors who have investigated financial innovations in Nigeria such as Chukwunulu, (2019); Ozurumba and Charles (2019); Aiyedogbon et al., (2013), have been concerned with its impact in the Nigerian economy while Osadume and Aruwei (2020) investigated its impact on the maritime sector in Nigeria. Studies in Nigeria that have investigated the financial innovations and demand for money includes; Ovat, et al. (2023), Ujunwa et al., (2022), Nakorji and Asuzu (2019), Okpara (2017) and Nsikak et al. (2020), Odularu and Oladapo (2009) and Apere (2017). Although, the former used Structural Adjustment Programme (SAP) dummy for financial innovation and financial innovation was proxied by 4–6-month Commercial Paper rate by the later. Their findings however have been conflicting, amidst failure to account for income and interest rate, not using relevance proxy for financial innovation and also not accounting for currency outside the banking system in Nigeria. Because of this, the purpose of this research is to assess how new financial innovations have altered the demand for money and the makeup of that demand as measured by non-banking currency holdings in Nigeria. This research looks at how using new financial products, including ATM, POS, internet (web) banking and mobile banking transactions affects both demand for money measured by M2 and currency outside the banking system, to establish the influence of financial innovation on the magnitudes in Nigeria.

2. Review of Relevant Literature

Over the years and in recent times several studies have investigated the money demand and the role of financial innovation. There has been conflicting empirical evidence from the various studies on the impact of financial innovation on the money demand function. While some studies including (Qazi, 2009; Okpara 2017; Aliha et al, 2018; Kasekende and Nikolaidou, 2018; Nakorji and Asuzu 2019; Ovat, et al. 2023) found financial innovation to have a positive impact. Others including (Odularu and Oladapo, 2009; Apere, 2017; Safdar and Khan, 2014) found a negative impact. On the other hand, Bilyk (2006) and Nsikak et al. (2020) discovered conflicting results on the effect of financial innovation on Nigeria's demand for money. Because of recent expansion, financial innovations have been crucial in projecting the level of money demand in Malaysia (Aliha et al, 2018). Not taking financial innovation into consideration when calculating the demand for money leads to unforeseen shifts in that demand (Hafer and Kutan, 2003; Laeven et al., 2015), which in turn causes big gaps to open up between policy goals and actual results. This corroborate the findings of Cho and Miles (2011) that conflicting estimates are likely attributed to the absence of a term accounting for financial innovation. Although Kumar et al (2013), used M1 to capture money demand and found no evidence that financial sector liberalization and reforms has made the money demand function in Nigeria unstable. Qazi (2009), found a significant and positive effect of financial innovation and money demand in his study. Bilyk (2006) in his study found a long run positive impact and a negative impact in the short-run between financial innovations and money demand in Ukraine. Miller (1986) in his study found that money demand experienced three periods of gradual intercept drift-two down and one up-rather than several one-time shifts. This he asserts has been consistent with the hypothesis of financial innovation and depository-institution deregulation relationship. Cointegration and stability were seen among the generated function variables in the study by Hwang and Wen (2024), who also discovered a negative link between the e-payment variable and money demand. Compared to the one without the e-payment variable, the money demand function with it produces superior forecast results. According to Azimi's (2023) research on the stability of the money demand function in South Asia, real income, the real exchange rate, and foreign interest rates all have a positive impact on the real monetary aggregate. On the other hand, domestic interest and inflation rates have a contractionary effect, and the money demand function continues to remain stable. Using quarterly data from 1990 to 2000, Choi and Oxley (2004) evaluated the demand for money function in New Zealand and found that price, real income, and interest rate all cointegrate over the long term. Fleissig and Jones (2023) determined the degree of substitutability between U.K. monetary assets and evidence revealed there is no perfect substitution. Inelastic substitution was found to be stronger after the 2008-2009 recession and some elasticities of substitution are relatively low either following the Brexit vote or during the onset of the pandemic. Ben-Salha and Jaidi (2014) revealed from their work that there is cointegration between the broad money demand and its determinants; final consumption expenditure, the expenditure on investment goods, the export expenditure and the interest rate. The error correction model shows that interest rates and spending on investment goods are the sole short-term variables that affect money demand, whereas spending on final consumption goods and interest rates are the long-term variables.

Ovat et al. (2023) used the ARDL model to study quarterly data from 2009Q1-2020Q4 to determine how financial innovation affected money demand in Nigeria. Their findings showed that financial innovation and demand for money have a long-run relationship and

that financial innovation have a positive impact on demand for money Nigeria. Financial innovation has not altered the long-run stability of money demand, according to Ujunwa, et al. (2022), who utilized M1, M2, and M3 as indirect measures of financial innovation to investigate this relationship in Nigeria. Nakorji and Asuzu (2019) in their study found a positive short-run impacts from financial innovation on real money demand. Also, evidence of long-run relationship between money demand and financial innovation was found. Okpara (2017) conducted an empirical study in Nigeria from 1981 to 2014 using VAR to examine the relationship between financial innovations and demand for money. A relationship of short-run equilibrium was discovered. There was a favorable correlation between the demand for money and financial advancements. Utilizing quarterly time series spanning 2009–2019, Nsikak et al. (2020) discovered that financial innovation had a mixed impact on money demand in Nigeria. While Snellman et al. (2001) found that ATMs and point-of-sale terminals significantly lower money demand, our results show the opposite. Apere (2017) states that the desire for money is inversely related to financial innovation. From 2002M1 to 2006M10, Yilmazkuday and Yazgan (2009) found that the demand for Turkish currency was negatively impacted by the rise in the use of credit and debit cards. Using automated teller machines (ATMs) as a stand-in for financial innovation, Aliha et al. (2017) examined panel data from 215 nations between 2004 and 2013 and found that ATMs do not influence money demand. Using SAP as a surrogate, Odularu and Oladapo (2009) discovered that financial innovation did not have a substantial impact on the demand for money in Nigeria. In a study of 34 countries in Sub-Saharan Africa, Kasekende and Dunne (2016) found a consistent negative correlation between financial innovation and the need for money. Mannah-Blankson and Belye (2004) state that financial innovation is crucial to the long-term expansion of Ghana's money demand.

2.1 Trends in Payment Systems in Nigeria

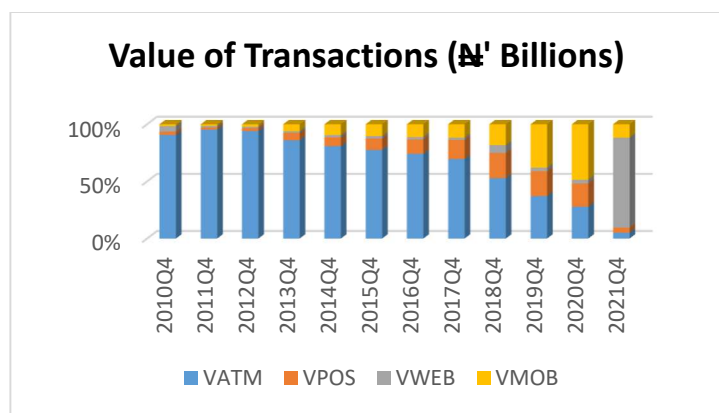


Figure 1: Value of Transactions from Payment System

Source: Graphed by Author with data from Central Bank of Nigeria Statistical Bulletin (2022)

Figure 1 above shows the value of transactions from various payment system (VATM, VPOS, VWEB and VMOB). From the figure above, the value of ATM transactions has been declining over the years. For instance, it accounted for over 80 percent of the transactions in

2010Q4 but fell to about 50 percent in 2018Q4 and further downward trend was recorded in fourth quarter of 2019, 2020 and 2021 with 33 percent, 20 percent and about 5 percent respectively. During these periods transactions done with POS have been on a steady rise. Accounting for about 10 percent in 2016, 20 percent in 2018, 25 percent in 2019 and 27 percent in 2020. Although it declined sharply in 2021 to a paltry 4 percent. MOB have also showed similar trend like that of POS, by accounting for as low as 10 percent in 2016 to as high as 50 percent in 2020 and declined in 2021 to about 9 percent. WEB (internet banking) has had minimal percentage share in the value of transactions carried out with the payment system until 2021 were it contributed over 80 percent. This can be attributed to the COVID 19 pandemic which the world experienced in 2020.

2.2 Trend of Cash Outside Bank

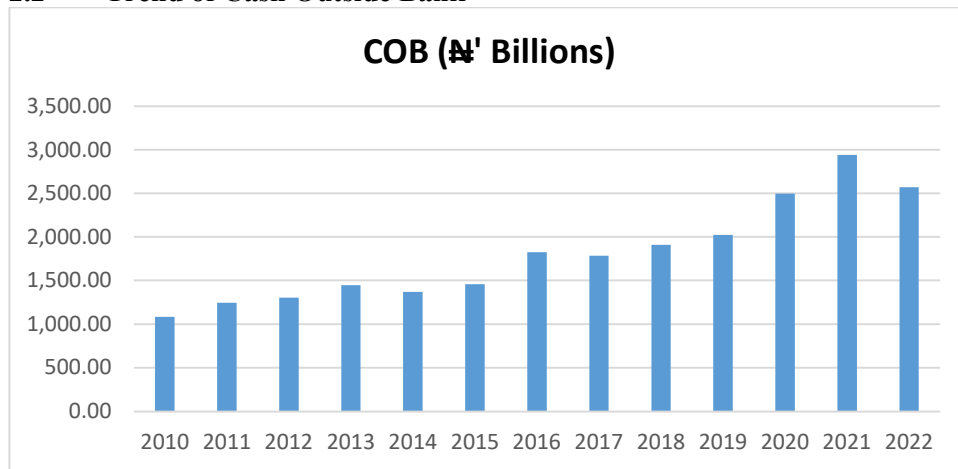


Figure 2: Annual values of Currencies outside Banks in Nigeria

Source: Graphed by Author with data from Central Bank of Nigeria Statistical Bulletin (2022)

The figure 2 above shows the trend of currency outside banks in Nigeria. From have been fluctuating over the years covered in the study. In 2010 the currency outside the banking sector was ₦1, 082.38billion, this increased to ₦1,447.61billion in 2013 but fell to ₦1,368.00billion the following year. Similar trend was noticed between 2016 and 2018. The sum of N2,938.42 billion recorded in 2021 dropped to N2,569.01 billion in 2022, following the similar pattern between 2020 and 2022. This sharp decline can be attributed to the currency change instituted by the apex bank. The data set clearly shows that the value always goes up in the year leading up to and including an election. The CBN's policies and currency changes leading up to the 2023 general elections are to blame for the decline in value in 2022.

3. Methodology

For the purpose of this study the ex-post facto research design will be adopted because it is descriptive and quantitative in nature.

3.1 Theoretical Framework

This study is hinged on the Keynesian Demand for Money Theory. Keynes opined that individual demand for money majorly for three reasons namely; transaction motive, precautionary motive and speculative motive (Laidler, 1977). According to Keynes transactionary and precautionary motives are determined by the income of an individual. The depreciation of alternative asset markets is crucial to the speculative drive, though. Since the goal of maximizing wealth is directly related to the interest rate, the rate of interest plays a pivotal role in driving the speculative drive to keep money (Laidler, 1977).

Thus, Keynes money demand function is given as:

$$M^D = kY + L(r) \dots\dots\dots (1)$$

Where M^D is money demand, k represents money demanded for transactional and precautionary purposes which is determined by income (Y), L represents money demanded for speculative purpose which is determined by the interest rate (r). Keynes further stated that the money demand is negatively related to interest rates and positively related to real income.

3.2 Model Specification

Based on equation (1) in the theoretical framework and the reviewed empirical literature we specify our empirical model of the demand for money function in its compact form as;

$$M2 = f(F_t, X) \dots\dots\dots (2)$$

$$COB = f(F_t, X) \dots\dots\dots (3)$$

Where F_t = Financial innovation variables

X = Controlling variables; RGDP and INTR.

Their functional form is:

$$M2 = f(VATM, VPOS, VMOB, VWEB, RGDP, INTR) \dots\dots\dots (4)$$

$$COB = f(VATM, VPOS, VMOB, VWEB, RGDP, INTR) \dots\dots\dots (5)$$

The model is specified in an econometric form thus;

$$M2 = \beta_0 + \beta_1 RGDP + \beta_2 INTR + \beta_3 VATM + \beta_4 VPOS + \beta_5 VMOB + \beta_6 VWEB + \varepsilon_1 \quad (6)$$

$$COB = \beta_0 + \beta_1 RGDP + \beta_2 INTR + \beta_3 VATM + \beta_4 VPOS + \beta_5 VMOB + \beta_6 VWEB + \varepsilon_1 \quad (7)$$

The Error Correction Model (ECM) for cointegrated data is in the form:

$$\begin{aligned} \Delta M2_t = & \alpha_0 + \sum_{i=1}^q \eta_i \Delta RGDP_{t-i} + \sum_{i=1}^q \theta_i \Delta INTR_{t-i} + \sum_{i=1}^q \varphi_i \Delta VATM + \sum_{i=1}^q \phi_i \Delta VPOS_{t-i} \\ & + \sum_{i=1}^q \beta_i \Delta VMOB_{t-i} + \sum_{i=1}^q \omega_i \Delta VMOB_{t-i} \\ & + \gamma ECT_{t-1} + e_t \end{aligned} \quad (8)$$

$$\begin{aligned} \Delta COB_t = & \alpha_0 + \sum_{i=1}^q \eta_i \Delta RGDP_{t-i} + \sum_{i=1}^q \theta_i \Delta INTR_{t-i} + \sum_{i=1}^q \varphi_i \Delta VATM + \sum_{i=1}^q \phi_i \Delta VPOS_{t-i} \\ & + \sum_{i=1}^q \beta_i \Delta VMOB_{t-i} + \sum_{i=1}^q \omega_i \Delta VMOB_{t-i} \\ & + \gamma ECT_{t-1} + e_t \end{aligned} \quad (9)$$

Where;

M2 is Broad Money Demand, COB is currency outside bank, RGDP is Real Gross Domestic Products, VATM is value of ATM transactions, VMob is value of Mobile Money transactions, Vweb is value of Internet Banking (web), VPOS is value of POS transactions, INTR is Deposit Interest Rate, ε_t is the Random Error Term, Δ is a difference operator and (γECT_{t-1}) , is the error correction term that captures the speed of adjustment of money demand to its equilibrium level. $\eta, \theta, \varphi, \emptyset, \beta, \omega$ and γ are the parameters for measuring the impact of the respective variables.

Data used for analysis in the study came from the World Bank (2023) and the Central Bank of Nigeria Statistical Bulletin (2022) and covered the period from 2010Q1 to 2021Q4.

4. Discussion of Findings and Policy Implications

4.1 Descriptive Statistics

Table 1 shows the descriptive statistics of the variables used in the study. We have 48 observations considering we used quarterly data from 2010Q1 to 2021Q4. As observed from the descriptive statistics result, broad money demand (M2), real gross domestic product (RGDP) and deposit interest rate (INT) displayed a normal distribution. Based on the Jarque-Bera probability value we can infer that they are normally distributed since their probability value is clearly greater than the 5% level of significance. In addition, value of ATM transactions (VATM), value of Mobile Money transactions (VMOB), value of Internet Banking (VWEB) and value of POS transactions (VPOS) were leptokurtic, while broad money demand (M2), real gross domestic product (RGDP) and deposit interest rate (INT) had low kurtosis values, suggestive of platykurtic distributions, implying it has lower values than its mean values and Currency Outside Bank (COB) is mesokurtic based on its kurtosis value of 3.02. All variables except real gross domestic product (RGDP) and deposit interest rate (INT) displayed a positive skewness.

Table 1: Descriptive Statistics of the Data used

	M2	COB	RGDP	INT	VATM	VMOB	VPOS	VWEB
Mean	21808.98	1739.361	16488.89	7.629463	1350.912	1387.948	712.5606	6165.757
Median	19838.63	1650.674	16444.46	7.914453	1064.185	127.3600	139.9750	27.82500
Maximum	43817.57	2968.386	20329.06	9.908236	5469.487	13035.59	6423.603	84296.67
Minimum	10907.30	998.0876	12583.48	3.775811	62.59000	0.870000	1.870000	3.370000
Std. Dev.	8577.011	532.6700	1788.996	1.918754	1192.796	3330.349	1452.473	20614.33
Skewness	0.853832	0.928557	-0.094844	-0.643622	2.235605	2.830524	2.861280	3.076236
Kurtosis	2.954585	3.020139	2.545128	2.117217	8.110837	9.461781	10.09478	10.61156
Jarque-Bera	5.836351	6.898554	0.485781	4.872603	92.22474	147.6041	166.1671	191.5776
Probability	0.054032	0.031769	0.784357	0.087484	0.000000	0.000000	0.000000	0.000000
Obs.	48	48	48	48	48	48	48	48

Source: Author's computation with EVIEWS 12

4.2 Stationarity Test

Testing for stationarity in time series data is crucial because of its propensity for non-stationarity, which may result in false regression outcomes (Granger and Newbold, 1977). The Augmented Dickey-Fuller (ADF) test was utilised to test for stationary. The results are displayed in Table 2.

Table 2: The Augmented Dickey-Fuller Unit Root Test

Variables	ADF Test Statistics Levels	ADF Critical Values @5%	ADF Test Statistics 1st diff.	ADF Critical Values @5%	Remark	Prob. Value
M2	3.875381	-2.925169	-4.301780	-2.926622	I(1)	0.0013
COB	0.136204	-2.926622	-3.452577	-2.926622	I(1)	0.0140
RGDP	-1.722779	-2.928142	-21.80244	-2.929734	I(1)	0.0001
INT	-2.275335	-2.926622	-3.493841	-2.926622	I(1)	0.0126
VATM	1.564827	-2.925169	-4.757907	-2.926622	I(1)	0.0003
VMOB	0.397478	-2.936942	-6.253698	-2.926622	I(1)	0.0000
VPOS	-1.367798	-2.926622	-5.751611	-2.929734	I(1)	0.0000
VWEB	0.966017	-2.925169	-6.081149	-2.926622	I(1)	0.0000

Source: Author's computation with EVIEWS 12

The Augmented Dickey Fuller test is shown from table 2 above. All the variables are stationary at the first difference, meaning they are integrated at order one I(1). We subsequently examine the existence of a long-term link among the study variables using the Johansen cointegration technique.

4.3 Cointegration Test

As such, this study makes use of the method proposed by Johansen (1988) and Johansen and Juselius (1990) to ascertain exactly how many cointegrating equations there are with the help of the Max-Eigen and Trace tests.

Therefore, the study's variables have a long-term link among them. This long-term relationship is fundamental in the field of monetary policy development and how financial innovation is used in the money demand specification.

Table 3: Johansen Cointegration Test results

Null Hypothesis	Trace Statistics	Critical Value at 5%	Max-Eigen Statistics	Critical Value at 5%
$P = 0$	309.4029	159.5297	99.52348	52.36261
$\rho \leq 1$	209.8794	125.6154	86.75423	46.23142
$\rho \leq 2$	123.1252	95.75366	58.23287	40.07757
$\rho \leq 3$	64.89231	69.81889	25.00942	33.87687
$\rho \leq 4$	39.88289	47.85613	18.27395	27.58434
$\rho \leq 5$	21.60894	29.79707	12.88654	21.13162
$\rho \leq 6$	8.722401	15.49471	8.712737	14.26460
$\rho \leq 7$	0.009664	3.841465	0.009664	3.841465

Note: ρ represents number cointegrating vectors (*) denotes rejection of the hypothesis at the 0.05 level

Source: Author's computation with EVIEWS 12

4.4 Error Correction Model Estimates

Based on the findings of the cointegration test, the long run and error correction models would be estimated to represent the long run and short run dynamics, respectively. The estimates of the models are presented in Table 4 and 5 for model 1 and table 6 and 7 for model 2.

Table 4: Long Run Model Estimates for model 1

Dependent variable: M2				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1808.792	1281.009	-1.412006	0.1659
M2(-1)	0.907348	0.054044	16.78904	0.0000
RGDP	0.326556	0.089254	3.658712	0.0007
INT	-279.9525	96.23361	-2.909093	0.0060
VATM	1.062274	0.504370	2.106141	0.0417
VMOB	0.795326	0.524520	1.516293	0.1375
VPOS	-1.157165	0.601787	-1.922882	0.0618
VWEB	-0.086368	0.054751	-1.577462	0.1228
R-squared	0.672			
Adjusted R-squared	0.601	Durbin-Watson stat		1.60
F-statistic	1296.609			
Prob(F-statistic)	0.000			

Source: Author's computation with EVIEWS 12

As highlighted above, the residual from the long run model above is used as the error correction term in order to estimate the error correction model which is presented in table 5 below.

Table 5: Error Correction Model Estimates for model 1

Dependent variable: M2				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.250	139.025	0.1240	0.901
D(M2(-1))	0.901	0.164	5.498	0.000
D(RGDP)	0.280	0.072	3.887	0.000
D(INT)	-380.106	150.343	-2.528	0.016
D(VATM)	0.991	0.371	2.672	0.011
D(VMOB)	1.082	0.517	2.093	0.043
D(VPOS)	-1.738	0.494	-3.517	0.001
D(VWEB)	-0.098	0.055	-1.787	0.082
ECM(-1)	-0.906	0.208	-4.363	0.000
R-squared	0.672			
Adjusted R-squared	0.601	Durbin-Watson stat		1.832

F-statistic	9.456			
Prob(F-statistic)	0.000			

Source: Author's computation with EViews 12

The empirical finding from the estimates in table 5 shows that RGDP have a positive influence on money demand which is in line with economic theory. It therefore has an influence in the money demand function. Value of ATM transactions as well as value of mobile banking transactions also showed a positive impact on money demand. This implies that an improvement in real gross domestic product, value of ATM transaction and value of mobile banking transactions will not only increase the demand for money in Nigeria but also ensure it stability. Deposit interest rate displayed a negative impact on demand for money which is in tandem with theory. Similarly, both value of POS transactions and value of web (internet) transactions impact demand for money negatively. This is quite expected as they are mostly used as a payment channel, which implies that less cash is demanded with them. In addition, real gross domestic product and value of POS transactions were found to be significant at 1 percent, deposit interest rate, value of ATM transactions as well as value of mobile banking transactions were all significant at 5 percent, while value of web (internet) transactions was is significant at 10 percent level.

Consistent with the results of Hamid and Hosein (2007), Bahmani-Oskooee and Sahar (2015), Orubu and Oriavwote (2010) as well as that of Kasekende and Dunne (2018), the study found that real gross domestic product (income) had a positive and substantial effect on demand for money, whereas interest rates had a negative effect on the same variable. This study also reveals that financial innovations have a positive (VATM and VMOB) as well as a negative (VPOS and VWEB) significant influence on the demand for money. These findings corroborate previous findings of Bilyk, (2006), Snellman et al. (2001), Yilmazkuday and Yazgan, (2009), Qamrazzauman and Jianguo (2017), Apere (2017), Qazi (2009), Safdar and Khan (2014) and Kasekende and Dunne (2018). In addition, the error correction term (ECM (-1)) is negatively signed which is in line with extant econometric literature. The implication is that, about 91 percent of changes in the previous quarter demand for money is reconciled every quarter which is also significant at the one percent level of significance. Therefore, there is high velocity in correction of distortions in the demand for money function which is critical for policy formulation and analysis.

Table 6: Long Run Model Estimates for model 2

Dependent variable: COB				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RGDP(-1)	0.043416	0.013290	3.266830	0.0022
INT(-1)	-35.46904	15.33164	-2.313454	0.0259
VATM	0.386845	0.051674	7.486227	0.0000
VMOB	0.327968	0.053282	6.155300	0.0000
VPOS	-0.148983	0.088452	-1.684340	0.0999
VWEB	-0.046937	0.004148	-11.31524	0.0000
C	721.3755	178.6588	4.037726	0.0002
R-squared	0.966			
Adjusted R-squared	0.961	Durbin-Watson stat		1.20

F-statistic	188.9769			
Prob(F-statistic)	0.000			

Source: Author's computation with EViews 12

As highlighted above, the residual from the long run model above is used as the error correction term in order to estimate the error correction model which is presented in table 7 below.

Table 7: Error Correction Model Estimates for model 2

Dependent variable: COB				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RGDP(-1))	0.004057	0.005525	0.734308	0.4673
D(INT(-1))	-46.49441	11.15642	-4.167503	0.0002
D(VATM)	0.045559	0.035064	1.299304	0.2017
D(VMOB)	0.078983	0.040086	1.970341	0.0561
D(VPOS)	-0.020401	0.036223	-0.563215	0.5766
D(VWEB)	-0.007724	0.004499	-1.716887	0.0941
ECM(-1)	-0.150932	0.085152	-1.772493	0.0843
C	26.16951	7.685315	3.405132	0.0016
R-squared	0.534			
Adjusted R-squared	0.448	Durbin-Watson stat		1.84
F-statistic	6.224900			
Prob(F-statistic)	0.000			

Source: Author's computation with EViews 12

The output from model 2 which represents the currency outside bank is presented in table 7 above. From the model estimates we can deduce that in the long run RGDP have a positive effect on currency outside bank and interest rate have a negative effect which are in line with expectations. However, financial innovation has a mixed effect on currency outside bank as two proxies (VATM and VMOB) showed a positive relationship and the other two (VPOS and VWEB) displayed a negative relationship. All the variables are statistically significant at the 1% level except VPOS which is at 10%. All the variables however, are jointly significant based on the F-statistic probability value and they have a strong predictive influence on currency outside bank. In the short run error correction model, the relationship with the dependent variable is the same as displayed in the long run. However, only interest rate, VMOB and VWEB are statistically significant, although there exists a joint significance based on the F-statistic probability value. The R-squared value of 0.53 showed that the variables included in the model predict about 53% of the variations that occurs in the dependent variable and the model is free from serial correlation based on the Durbin-Watson stat of 1.84. Furthermore, the error correction term is negative and statistically significant which is in line with econometric literature. This is at variance with the findings of Teriba (2006) in his study that attempted to model the demand for currency outside banks in Nigeria. According to Kalim and Hassan (2013) statistically significant error correction term indicates long run relationship among variables in a regression model. The next step is to

conduct some diagnostic test on the estimated model and also check for stability of the model.

4.5 Diagnostic Tests

Table 8: Test for Autocorrelation and Heteroskedasticity

MODEL 1		
Test	Autocorrelation	Heteroskedasticity
F-Statistics	3.182862	0.256308
P-value	0.0828	0.9759
MODEL 2		
Test	Autocorrelation	Heteroskedasticity
F-Statistics	0.462851	0.427929
P-value	0.5005	0.8786

Source: Author's computation with EVIEWS 12

From the table 8 above, it is evident that the models formulated and estimated for the study are robust and devoid of autocorrelation based on the probability values of 0.0828 for model 1 and 0.5005 for model 2 respectively which are clearly greater than the 5% level. The null hypothesis of the presence of autocorrelation is therefore rejected. Also, from the test for heteroskedasticity it is evident that the residuals of the models are robust and devoid of heteroskedasticity based on the probability values of 0.9759 for model 1 and 0.8786 for model 2 respectively which are clearly greater than the 5% level. The null hypothesis of the presence of heteroskedasticity is therefore rejected.

4.6 Stability Test

The plots of the CUSUM and the CUSUMQ for model 1 is reported in figures (3) and (4) while that of model 2 is reported in (5) and (6) respectively. They are closely examined in order to determine stability of the money demand function as well as the function of currency outside bank. From the result we can safely deduce that the parameter is stable for both models as the plot lies within the 5 percent level of significance. Based on the report concerted efforts must be taken by the monetary authority in robust policy formulation that harnesses the benefits from financial innovations and adequately address the issue of currency outside the banking sector.

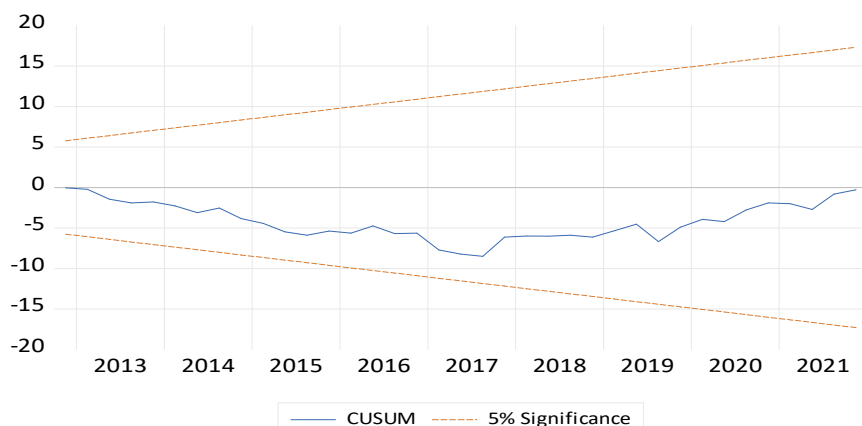


Figure3: CUSUM

Source: Author's computation with EVIEWS 12

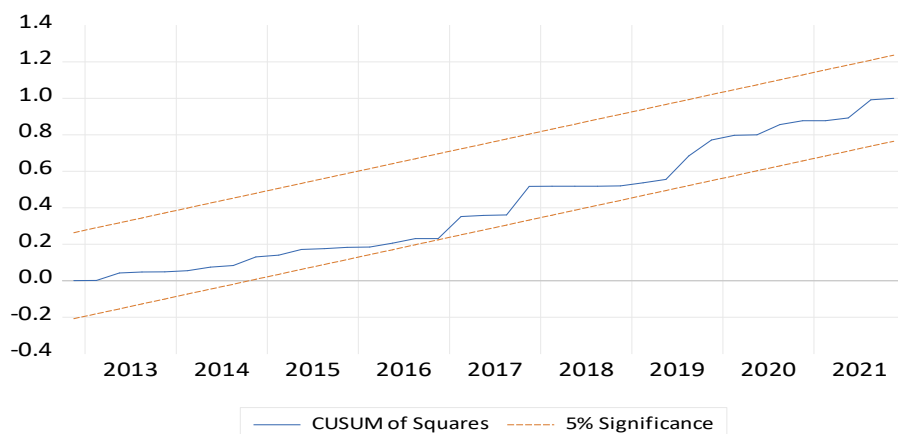


Figure 4: CUSUM of Squares

Source: Author's computation with EVIEWS 12

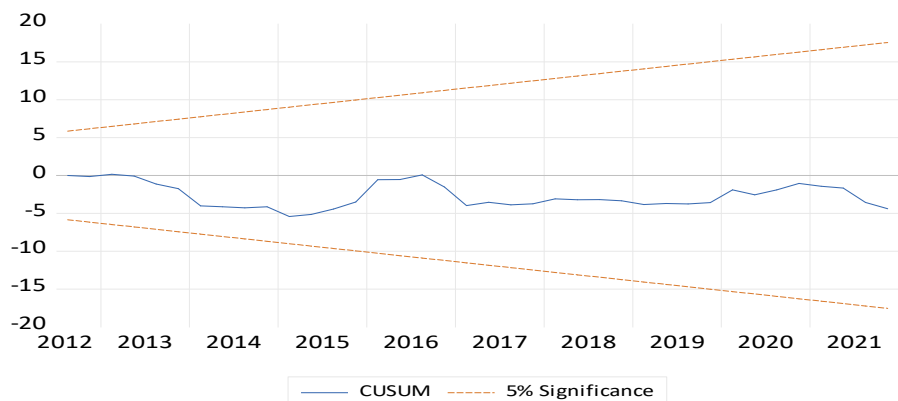


Figure 5: CUSUM

Source: Author's computation with EVIEWS 12

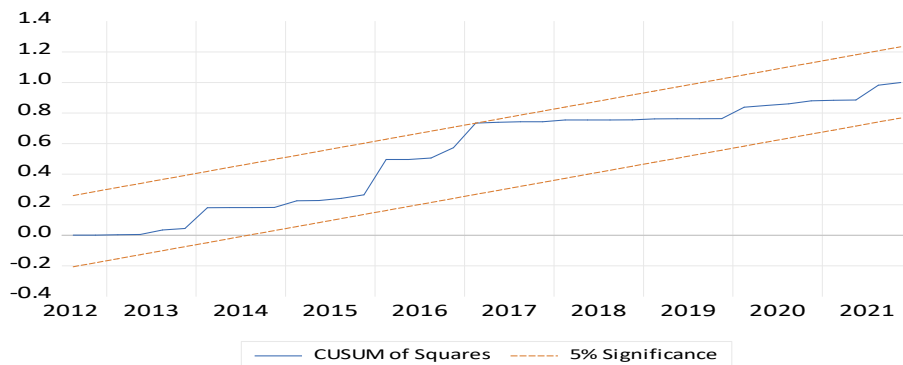


Figure 6: CUSUM of Squares

Source: Author's computation with EVIEWS 12

5. Conclusion

The impact of financial innovations on the demand for money and currency outside banking system in Nigeria was the focus in this study. Two models were estimated for the study with the measure of broad money M2 used as proxy for Money Demand and currency outside bank (COB) as the dependent variables for model 1 and model 2 respectively. Value of ATM transactions, value of Internet Banking (web), value of Mobile Money transactions and value of POS transactions were used as proxies for financial innovations and RGDP and interest rate as control variables. Data used in the study was from the period 2010Q1 to 2021Q4, which were estimated with the cointegration and ECM technique. The findings from model 1 indicated that real gross domestic product, value of ATM transactions as well as value of mobile banking transactions exert a positive impact on money demand. Deposit interest rate, value of POS transactions and value of web (internet) transactions displayed a negative impact on demand for money. For model 2, findings showed that RGDP increase currency outside the banking system, interest rate decreases it, while VATM and VMOB have a positive impact on COB, VPOS and VWEB impact negatively on COB.

The study provided empirical evidence that financial innovations significantly impacted the demand for money and currency in Nigeria beyond the banking system. Policy recommendations to increase the penetration of financial services in the nation are consequently based on the study's conclusions. Nigerians with the capacity to use the various financial innovations can help achieve these aims by accepting them as a means of payment and by offering a secure channel. Also, the monetary authorities should make policies that will encourage more participants in the sector through investments in critical infrastructures that ensures hitch-free service delivery of the financial innovation. Due to the mixed influence of financial innovation on the currency outside banking system, caution must be taken by the monetary authority when advocating for the use of financial innovation especially ATM and Mobile banking apps, also we can infer from the findings that

transactional and precautionary motives drives the demand for currency outside the banking system.

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