Impacts of Innovations in Financial Services Delivery on the Macroeconomy in Nigeria

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Abstract

This study investigates the impacts of innovations in financial services delivery on the real gross domestic product (Real GDP) and real money demand in Nigeria. The autoregressive distributive lag model (ARDL) is applied to Fisher's Equation of Exchange using data from the volume of transactions on the automated teller machine (ATM), point of sale (POS), cheque, and electronic transfer (ETR) as indices of financial innovation and control over monetary policy rate (MPR) and lending rate (LR) for 2009M1 to 2019M12. Findings reveal that financial innovations in the financial service delivery pose a significant impact on the real gross domestic product and real money demand as a proxy for macro economy performance with varying directional impacts in the short-term and long run. The study opines those financial innovations are effective for expansionary policy action on real GDP and a managed real money demand within a short-term policy framework.

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1. Introduction

The Central Bank of Nigeria, (CBN) in line with global practice is saddled with the responsibility to promote a sound financial system in Nigeria. The recent emphasis by the CBN on the transformation of the financial sector from the traditional system targets the advancement of financial innovations void of risks and drives the financial inclusion thrust (Sahay et al. 2015; Ozili 2018; CBN 2019; Crowley et al. 2022). The major innovations in financial services in Nigeria are on the reformation of the payment systems which brought about a gradual substitution of the old cash payment system with technology-enabled payment platforms, (CBN, 2018). The innovative channels comprise electronic payment instruments like cheques, Automated Teller Machines (ATM), Point of Sale (POS), Mobile Money transfers, and Web transfers. Studies opined that financial innovation especially in the payment system determines the velocity of money in circulation which has both a direct and indirect impact on the macroeconomy (Tuano-Amador 2008; Bogov 2011; Bruegel 2018). Since the introduction of technological innovation in the financial sector in Nigeria, the volume of transactions on digital payment channels increased to USD 14,250 million in 2023 from USD 8,365 Million in 2020. Likewise, digital investment has maintained an increasing growth from USD 48.81 Million in 2020 to USD 4,722 Million in 2023 (Statista 2022). The plethora of studies suggest a positive and significant correlation between financial innovation and real GDP growth rate and real money demand determination respectively (Nazir, Tan, and Nazir 2020; Domeher, Konadu-Yiadom and Aawaar 2021).

Financial innovations (FI) have not only redefined the determinants of money demand and the efficacy of monetary policy to drive macroeconomic indicators in developing economies but have boosted the performance of the financial services industry during the 1990s (Crowley et al. 2022). FI added new dimensions to research from the traditional investigation of money demand that leads to significant and structural changes in the financial market. Therefore, it becomes imperative to ask: "what is the impact of the emerging innovations in the financial service delivery on the macroeconomy?" To answer this question, the broad dimensions of the macroeconomy are proxies by the impacts of the FI on the real money demand and real GDP growth rate as macroeconomic indicators following (Nazir, Tan, and Nazir 2020). The transmission mechanism of the impact of financial innovations on the macroeconomy is multi-dimensional but much evidence is reflected through the payment system transactions (Orji et al., 2022). Since the lunch of financial innovation in 2014 the transactions have generated volumes and ATM accounted for 85.0% of transaction volume with N875.52 million worth of transactions in 2018 from N400 million in 2014 to top among other innovative channels. The respective volume of transactions through other channels includes POS (7.0%), Mobile payment (6.0%), and Web-based transactions (2.0%), (CBN 2014; 2018). (See Figure 1).

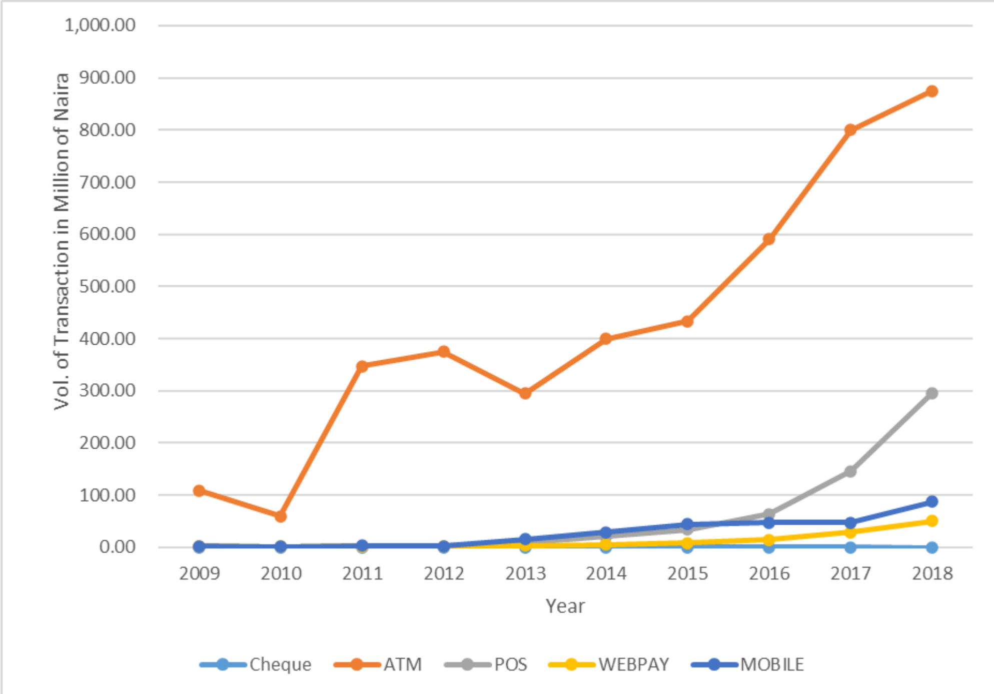

Figure 1. Payment System Patterns in Nigeria (2009 – 2018)
CBN Annual Report, 2018.

Despite the mediating role of financial innovation on the effectiveness of monetary policy in promoting economic growth, full employment, and a stable balance of payment, fewer studies considered innovations in the payment system's impact on the macroeconomy. However, with the challenges of output instability and money demand in hitherto stable countries, the effort is ongoing in the literature to ascertain the roles of financial innovations in the payment system as a major determinant of the macroeconomy (Atay 2008; Zubairu, Oyedeko 2018; Saydaliev, Kasimov and Haldrov 2022). For an instance, other financial innovations and mobile payment platforms have been shown to have in the short run and long run a positive and significant effect on economic growth (Nazir, Tan, and Nazir 2020; Adesete, et al., 2021). Earlier studies opined a bi-directional correlation between financial innovation and economic growth where FI causal causes economic growth and vice versa (Odhiambo 2005; Odeniran and Udeaja 2010; Shittu 2012). Therefore, it is against this backdrop that this study is poised to ascertain the impacts of financial innovations in payment systems on real money demand and real GDP growth rate.

2. Economic performance and Financial Innovation Mediating Role

The performance assessment of four select indicators in Nigeria: narrow money, broad money, real GDP, and inflation suggests that the monetary policy instruments appeared not to be at their best in achieving the set macroeconomic goals. Monetary policy has posed a respective impact on the realization of the outcomes of the four select indicators. In 2016, the actual outcome of monetary policy on broad money (M2) at 18.45% surpassed the target of 10.98%. Likewise, narrow money has an actual outcome of 33.05% in 2016 to surpass the target of 11.34%. Output growth maintained a consistent decline at a negative growth rate of -1.51% in 2016 against the 3.59% target. Inflation outcomes deviated significantly from the targets with actual inflation outcomes in 2016 at 18.55% against the 11.90% target (CBN, 2018).

Evidence shows that the economic performance indicators are hit by constant macroeconomic instability from 1980 to 2021. The monetary policy review document reveals deepened fluctuations in the narrow money demand from -10.75% in 2017 to -4.25% in 2018. The broad money demand growth rates faced a similar fate increasing from -7.23% in 2017 to 2.79% in 2018 (CBN, 2014, 2016, 2017). Inflation annual rate for all items ever since 1980 fluctuated with the worse spike experience between 1998 at 54% and 72% in 1995 until recently where inflation is at 16.95% in 2021. The stead fluctuation of the inflation rate correlates with a similar fluctuation of the broad money demand growth rate with the highest spike in the trend at 87.76% in 2007 but reduced in value to fall below the inflation rate by 11.63%. The percentage of the broad money to the GDP and the annual GDP remained at a stationed growth rate of around the average of 30% from 1980 to 2021(WDI 2022 and CBN 2021). This steady but no incremental growth in the broad money ratio to GDP and annual GDP faced all the inflation shocks and other macroeconomic instabilities but could not respond with subsequent growth to cushion the shocks. This implies that the concern continued to suffer from the neighborhood effects of inflation. (see Fig 2)

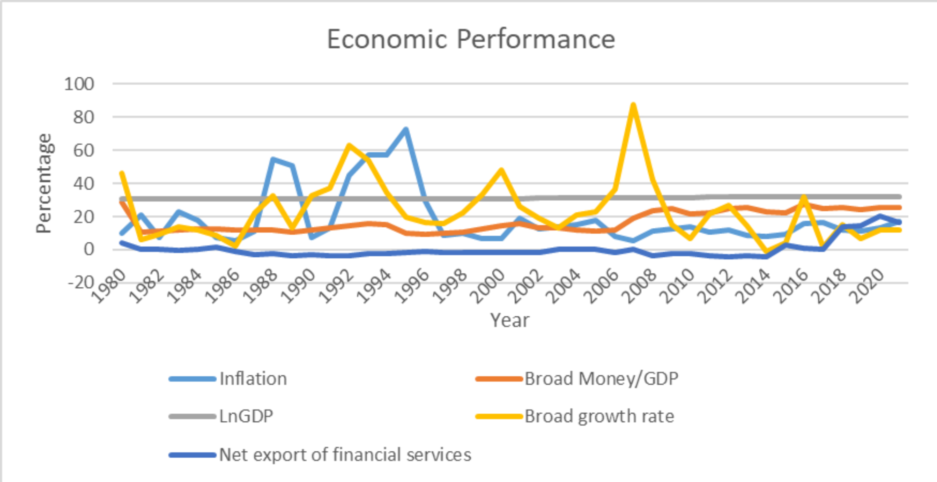

Figure 2. WDI 2021 and CBN 2021

The mediating roles of Financial innovation either with a direct or indirect impact on the macroeconomy through the financial service delivery is substantive and significant to be investigated in Nigeria following the related studies (CBN 2014; 2016; 2017; Nazir, Tan, and Nazir 2020; Domeher, Konadu-Yiadom and Aawaar 2021). POS and Web transfer from the pool of financial innovation in Nigeria have a positive impact and significant impact on economic growth when applied to a mixed ARDL model (Adesete, et al., 2021). From figure 2, the net export of financial service delivery remained low until the lunch of the financial innovation in 2007. The financial services have continued to improve from 0.22% in 2007 to 16.18% in 2021 to surpass inflation and broad money growth rate (WDI 2021; CBN 2021). Therefore, the available statistic suggests that the emergence of financial innovations correlate with the performance of the macroeconomy in Nigeria. This study is poised to examine the impacts of financial innovations on money demand and real GDP respectively that reflect the macroeconomy behavior. The remaining sections of the paper would be structured into the review of empirical studies, analytical framework, data and variable description, unit root testing, results, and discussion and conclusion.

3. Empirical Literature

The classical approach to money demand states that the market for goods clears and the relative prices are flexible to ensure that the automatic adjustment to equilibrium is achieved. However, the classical approach otherwise called the Quantity Theory of Money remained a theory generally accepted by classical economists. It builds from Fisher's equation of exchange which relates the volume of transactions at the current price to the stock of money multiplied by the turnover rate of money, (Ajayi and Ojo 2006). Similarly, the classical approach to growth takes from the role of capital and labour in wealth accumulation, (Lowe 1954)

The plethora of studies rationalized the application of the theory of money demand while some provide a basis for economic growth investigation using the classical approach to growth. Before now, Ajayi and Ojo (2006), disclosed that other recent approaches to demand for money in developing countries have aimed at enlarging the coverage of specified variables. This implies that the emergence of financial innovation as expected is not new to recent studies. Teles and Zhou (2005), further argued that M1 is not the appropriate measure of money used for transactions since the 1980s. Therefore, the study opines that the banking deregulation of the 1980s and 1990s and financial innovation in the 1990s (electronic payment and cashless policy) call for modification of the measure of transaction demand for money. Also, it was shown that there existed a stable long-run relationship between money, price as a measure of economic activity, and nominal interest. This implies that the definition of money could vary with the emergence of technology since it improves and accelerates money demand as well as provides a more precise definition for money demand.

Monetary policy through financial innovations has non-uniformed impacts on economic growth and money demand. Sanya and Olatunji, (2020) revealed a non-uniform effect of financial innovation on the sectoral economic growth rate using a panel vector error correction model. Evidence from the study showed that financial innovation has a mixture of positive and negative effect across the respective sectoral economy and also vary in the type of financial innovation in use. For example, the ATM and POS pose the most significant effects on the sectoral economy. Similarly, Mathew, Fasina, Olowe, and Adeboye, (2010) adopted the Engle and Granger two-step technique to ascertain if post-structural Adjustment Programme (SAP) financial innovations had a positive impact on money demand.

Evidence shows that money demand follows the inverse correlation theory of interest rate and implies that financial innovation has no significant impact on money demand in Nigeria. Similarly, Okafor, Ezeaku, and Anyalechi, (2017), an examination of the effectiveness of financial innovation in driving growth revealed that the impact of financial innovation varies with the channels of use. Findings show that the values of the transaction through ATM, internet and mobile payments have a positive impact on growth while POS posted a negative impact on growth. Okafor et al. (2017) empirical evidence using quarterly data from 2009:Q1 – 2014:Q4 and vector autoregressive model and Johansen cointegration test reveals a long-run relationship between financial innovation technologies and economic growth. The revelation of the long-run relationship outcome from the study is arguable because of its slight theoretical foundation. Despite the suitability of the use of an a-theoretical econometric model like VEC to investigate money demand studies but the relevance of adopting money demand theory cannot be overemphasized. Furthermore, proxy studies on financial innovation and money demand as in Anowor and Okorie (2016), applied the ordinary multiple least-squares methods and the evidence reveals that monetary policy instruments such as the cash reserve ratio have a positive impact on economic growth. Likewise, Akinjare et. al., (2016), from empirical evidence shows that the money supply has a significant positive impact on the economy.

Later literature that examined monetary policy instruments and their roles on macroeconomic indicators in Nigeria like Teriba (1974), revealed that income-elasticity for demand deposits in Nigeria remains high and significant as opposed to the interest rate outcomes which were not significant. The empirical evidence of Teriba was based on the result obtained from the application of a double-log model of static ordinary least squares (OLS) technique to the annual data from 1958-1972. Furthermore, other financial instruments and indicators, for instance, foreign interest rates revealed to be inversely related to the demand for money as opined by Arize et. al., (1990). Nwaobi (2002), further suggested the relative stability of the money demand function. Empirical evidence shows that in addition to the stable money demand function in Nigeria, money demand (M2) was found to be co-integrated with income, interest rate, and exchange rate based on the results from the Autoregressive Distributed Lag (ARDL) technique combined with CUSUM and CUSUMQ tests application, (Nwaobi 2002; Akinlo 2006; Nwafor et. al., 2007 and Omotor, 2009). In a twist of methodology, studies on Cameroon and South Africa (SA) applied the Vector Autoregressive regression model and co-integrated analysis approach and the empirical evidence revealed a stable money demand function for Cameroon and a money demand function with a long-run relationship, (Nell 1999). One of the attributed factors to the empirical outcome was the over-reliance of SA on the setting of M3 growth caused by the money-oriented monetary policy measures during 1980. M3 was stable while M1 and M2 displayed parameter instability. Hence, M3 money stock was assumed as an alternative indicator of monetary policy in South Africa.

A similar study by Kallon (1992) among other issues sought to examine the demand for money in Sierra Leone and revealed that the long-run elasticity of the demand for money is as high as expected in the case of developing economies' financial markets. Therefore, since the stability of money demand is crucial in assessing the long-term relationship between money and price, it implies that the deviations in the equilibrium relationship between money and its determinants are temporary; they can be expected to be self-correcting (Stephen et. al., 2012). In support, Bitrus (2011), examined the demand for money in Nigeria and revealed that the money demand function is stable in Nigeria for the sampled period while suggesting income as the most significant determinant of the demand for money amidst other variables like interest rate and exchange rate.

Likewise, Doguwa, et al (2014) investigation of the post-2008/2009 financial crisis and the existence of stable money demand reveals that a long-run relationship exists between real money supply, real income, monetary policy, and, exchange rate spread. Further examination of the structural breaks improves on the previous studies to show the existence of the regime shift in 2007:Q1. While Doguwa et al, (2014) is exclusively a validity study to the previous studies, the emphasis is on maintaining the stability of money demand as postulated by monetary policy thrust. Since the main focus of Doguwa et al, (2014) lies in the evaluation of the co-integration of the variable likewise the structural breaks, more frequent data could be more robust for the study. The study based the empirical evidence on the quarterly observation from 1991:Q1 to 2013:Q4 making a sample size of 48 observations. This could limit the robustness of the result in the face of the monthly observation for the same studies. Successive reforms in the banking sectors have renewed interest in the need for an improved financial system capable of ensuring macroeconomic stability.

Gidigbi, (2017) revealed that reforms in the financial system pose a different impact on economic growth and banking performance. With a real GDP growth rate as a proxy for economic growth and the growth rate of the loan to the private sector as a proxy for banking performance, the result shows that banking reform has a positive impact on economic growth while banking reform poses a negative impact on banking performance, (Gidigbi, 2017). Financial innovations remained an integral part of the financial development and product of banking reforms in recent times. This implies that the pursuit of financial innovation in the financial sector is yet to reach its full capacity of usefulness. The impact of financial innovation on macroeconomic stability as measured by RGDP growth rate remained uncertain and of a bi-directional causality, (Bara and Mudzingiri, 2016). This outcome rationalizes the need for this study to investigate the impact of financial innovation on money demand as well as economic growth.

Analytical framework

Following the Quantity theory of money expressed as:

$$MV = PT \qquad (1)$$

where M, V, P, and T are the quantity of money, the transaction velocity of money, the price index, and the volume of transactions, respectively. The Fisherian equation focuses on the total income transaction in the economy and expresses the total expenditure in the economy as:

$$\sum PQ = p_1q_1 + p_2q_2 + , \ldots, p_nq_n \qquad (2)$$

where PT = PQ from equations (1) and (2) and Q denotes the quantity of the transaction.

Therefore, Equation (2) allows us to specify the structural equation of the impact of the innovations in financial service delivery in the payment system on real money demand and real GDP growth rate as follows:

$$M2/CPIt = f(Income, Xt) \qquad (3)$$

Where income is represented by real gross domestic product and Xt represents the vector of all the innovations in the payment system such as ATMs, POS, ETR, Mobile Money, and Cheque processes.

Similarly, the impact of the innovations in the payments system on output growth is specified as:

$$RGDPt = f((M2/CPI)t, Xt) \qquad (4)$$

And RGDP is the real gross domestic product and Xi represents the innovations in financial service delivery in the payments system.

4.1. ARDL Bound Test and Error Correction Model

We adopt the ARDL analysis to explore how financial innovation affects real money demand and real growth rate. Hence, the approach allows us to determine the impacts of the financial innovations on the real money demand and real gross domestic product growth rate respectively in the short run and long-run term.

The ARDL model proposed by Pesaran et. al. (2001) and as applied in Akinlo (2006), uses a linear transformation to integrate short-term adjustment into the long-term equilibrium using the Error Correction Model (ECM). Furthermore, all the variables in the model should be integrated in order one I(1). Using the ARDL bound testing approach as in Doguwa and Alade (2015), the ARDL (p1,p2,p3,p4,p5,p6,p7,p8) representation of equations for the two ARDL models as:

$$\begin{aligned} d\log\left(RM2_t\right) = {} & \gamma_0 + \gamma_1\log\left(RM2_{t-1}\right) + \gamma_2\log\left(RGDP_{t-1}\right) + \gamma_3\log\left(ATM_{t-1}\right) + \gamma_4\log\left(\text{CHP}_{t-1}\right) \\ & + \gamma_5\log\left(POS_{t-1}\right) + \gamma_6\log\left(ETR_{t-1}\right) + \gamma_7 RIR_{t-1} + \gamma_8 MPR_{t-1} \\ & + \sum_{i=1}^{p1} a_i d\log\left(RM2_{t-i}\right) + \sum_{i=1}^{p2} b_i d\log\left(RGDPR_{t-i}\right) + \sum_{i=1}^{p3} c_i d\log\left(ATM_{t-i}\right) \\ & + \sum_{i=1}^{p4} d_i d\log\left(CHP_{t-i}\right) + \sum_{i=1}^{p5} e_i d\log\left(POS_{t-i}\right) + \sum_{i=1}^{p6} f_i d\log\left(ETR_{t-i}\right) \\ & + \sum_{i=1}^{p7} g_i \Delta RIR_{t-i} + \sum_{i=1}^{p8} h_i \Delta MPR_{t-i} + \mu_t \qquad (5) \end{aligned}$$

and

$$\begin{aligned} d\log\left(RGDPR_t\right) & \\ = {} & \beta_0 + \beta_1\log\left(RGDPR_{t-1}\right) + \beta_2\log\left(RM2_{t-1}\right) + \beta_3\log\left(ATM_{t-1}\right) \\ & + \beta_4\log\left(CHP_{t-1}\right) + \beta_5\log\left(POS_{t-1}\right) + \beta_6\log\left(ETR_{t-1}\right) + \beta_7 RIR_{t-1} \\ & + \beta_8 MPR_{t-1} + \sum_{i=1}^{p1} a_i d\log\left(RGDP_{t-i}\right) + \sum_{i=1}^{p2} b_i d\log\left(RM2_{t-i}\right) \\ & + \sum_{i=1}^{p3} c_i d\log\left(ATM_{t-i}\right) + \sum_{i=1}^{p4} d_i d\log\left(CHP_{t-i}\right) + \sum_{i=1}^{p7} e_i d\log\left(POS_{t-i}\right) \\ & + \sum_{i=1}^{p6} f_i d\log\left(ETR_{t-i}\right) + \sum_{i=1}^{p8} g_i \Delta RIR_{t-i} + \sum_{i=1} h_i \Delta MPR_{t-i} + \varnothing_t \qquad (6) \end{aligned}$$

Where γ_0 and β_0 are constants and $\gamma_1, \ldots, \gamma_8$ and $\beta_1, \ldots, \beta_8$ e the long-run parameters of the two models, respectively and a, b, c, d, e, f, g, h are the short-run coefficients. The error terms μ_t and ϕ_t are expected to be white noise. The letters p1, p2, …..p8 are the optimal lag lengths that define the ARDL (p1,p2,….p8) model. The ARDL bound test for no cointegration among the eight variables against the presence of cointegration involves testing the null hypothesis of the absence of co-integration against the alternative of cointegration as follows:

For Equation (7): H_0: $\gamma_1 = \gamma_2 = \ldots\gamma_8 = 0$ vs H_1: $\gamma_1 \neq \gamma_2 \neq \ldots\gamma_8 \neq 0$

For Equation (8): H_0: $\beta_1 = \beta_2 = \ldots\beta_8 = 0$ vs H_1: $\beta_1 \neq \beta_2 \neq \ldots\beta_8 \neq 0$

The ARDL bound test follows the F statistic whose asymptotic distribution is non-standard under the null hypothesis of no cointegration. If the computed F statistic lies above the upper bound critical value for 10%, 5%, or 1% significant levels then the null hypothesis is rejected, indicating the existence of co-integration amongst the variables in the model(s) in equations (5) and/or (6).

Once the presence of co-integration is established, and appropriate Error Correction model(s) of the underlying ARDL representation(s) of equations (5) and (6) are specified as follows:

$$\begin{aligned} d\log\left(RM2_t\right) = {} & \gamma_0 + \sum_{i=1}^{p1} a_i d\log\left(RM2_{t-i}\right) + \sum_{i=0}^{p2} b_i d\log\left(RGDP_{t-i}\right) + \sum_{i=0}^{p3} c_i d\log\left(ATM_{t-i}\right) \\ & + \sum_{i=0}^{p4} d_i d\log\left(CHP_{t-i}\right) + \sum_{i=0}^{p5} e_i d\log\left(POS_{t-i}\right) + \sum_{i=0}^{p6} f_i d\log\left(ETR_{t-i}\right) \\ & + \sum_{i=0}^{p7} g_i \Delta RIR_{t-i} + \sum_{i=0}^{p8} h_i \Delta MPR_{t-i} + \sigma\hat{\varphi}_{t-1} + \mu_t \qquad (9) \end{aligned}$$

and

$$d\log\left(RGDP_t\right) = \beta_0 + \sum_{i=1}^{p1} a_i d\log\left(RGDP_{t-i}\right) + \sum_{i=0}^{p2} b_i d\log\left(RM2_{t-i}\right) + \sum_{i=0}^{p3} c_i d\log\left(ATM_{t-i}\right) + \sum_{i=0}^{p4} d_i d\log\left(CHP_{t-i}\right) + \sum_{i=0}^{p5} e_i d\log\left(POS_{t-i}\right) + \sum_{i=0}^{p6} f_i d\log\left(ETR_{t-i}\right) + \sum_{i=0}^{p7} g_i \Delta RIR_{t-i} + \sum_{i=0}^{p8} h_i \Delta MPR_{t-i} + \sigma \hat{\in}_{t-1} + \varnothing_t \quad (10)$$

where $\hat{\varphi}_t$ and $\hat{\in}_t$ are the equilibrium correction terms lagged one period and defined as:

$$log\left(RM2_t\right) - \left\{\hat{\gamma}_0 + \hat{\gamma}_1\log\left(RGDP_t\right) + \hat{\gamma}_2\log\left(ATM_t\right) + \hat{\gamma}_3\log\left(CHP_t\right) + \hat{\gamma}_4\log\left(POS_t\right) + \hat{\gamma}_5\log\left(ETR_t\right) + \hat{\gamma}_6 RIR_t + \hat{\gamma}_7 MPR_t\right\} = \hat{\varphi}_t \quad (11)$$

and

$$log\left(RGDP_t\right) - \left\{\hat{\beta}_0 + \hat{\beta}_1\log\left(RM2_t\right) + \hat{\beta}_2\log\left(ATM_t\right) + \hat{\beta}_3\log\left(CHP_t\right) + \hat{\beta}_4\log\left(POS_t\right) + \hat{\beta}_5\log\left(ETR_t\right) + \hat{\beta}_6 RIR_t + \hat{\beta}_7 MPR_t\right\} = \hat{\in}_t \quad (12)$$

4.2 Data and Description

Automated Teller Machines (ATMs) - Teller functions in the bank branches are automated seamlessly to serve customers. Cash transactions on ATMs represent quick access of account holders to cash and the volume of such transactions represents cash preference. In other words, ATMs play significant roles in cash-dominated money demand in Nigeria. Point-of-Sale (POS): A non-cash transaction such as transfers, discourages cash transactions and operates well only with the availability of the machine around the country. ETR: Electronic transfers from account to account without cheques and are all measured in billions of Naira. The real gross domestic product measured in percentage and money demand M2 measured in billions of Naira measures the macroeconomy, and the monthly observation of the lending rate (LR) is considered a monetary indicator.

All the data are monthly frequency collected from the CBN Statistical bulletin from 2009Q1 to 2019Q4. Data were collected on the volume of the transaction on the financial services innovation such as ATMs, POS, ETR, Mobile Money, and Cheque processes. Data on real money demand were collected as annual data on broad money demand deflated with the price and further converted to monthly frequency using the quadratic equation data conversion approach. Real GDP growth is a proxy for economic growth and is expressed in percentage monthly frequency.

A graphical representation of the variables depicts the pattern of the variable over time. The outcome from the graphical representation suggests that the variables may have a fundamental stationarity problem. A variable is said to be stationary if the variable is time-invariant, that is, the variance of the variable does not change over time and has a unit root if otherwise, the graph of the innovation variables - ATM, cheque, ETR, and POS exhibit a particular pattern of the transactions. Likewise, the descriptive statistic shows the mean, median values, and normality statistics for the variables shown in table one. From descriptive statistics, all the variables follow a normal distribution as suggested by the Jarque-Bera probability value, hence is satisfactory for further analysis.

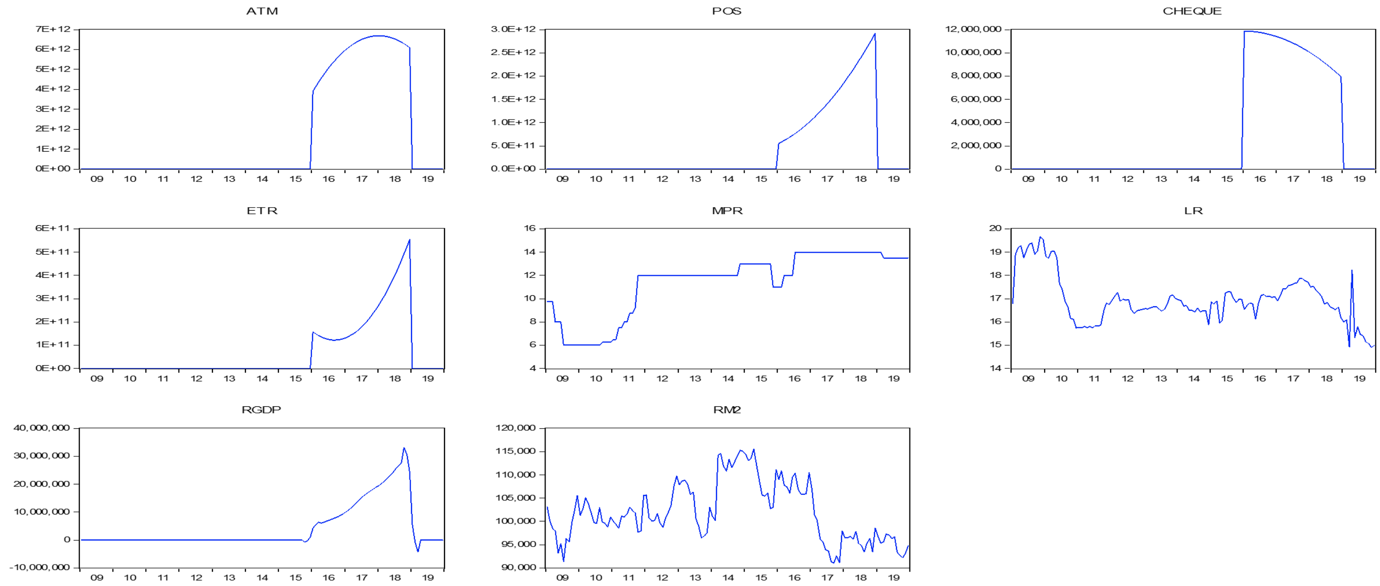

Figure 2

Table 1. Descriptive Statistics

	ATM	POS	CHEQUE	ETR	MPR	LR	RM2	RGDP
Mean	1.63E+12	4.14E+11	2868801.	6.56E+10	11.42424	16.94992	101967.4	34.45894
Median	298.5700	24.80000	1623.855	7.395000	12.00000	16.82000	100930.1	35.92166
Maximum	6.69E+12	2.92E+12	11879981	5.55E+11	14.00000	19.66000	115545.5	50.65566
Minimum	18.48000	0.040000	336.5900	0.880000	6.000000	14.91000	91023.65	18.53915
Std. Dev.	2.70E+12	7.74E+11	4743075.	1.27E+11	2.740518	1.023660	6383.908	8.901459
Skewness	1.092176	1.768533	1.076917	2.097633	-1.012895	0.709454	0.384220	-0.136643
Kurtosis	2.273531	4.925459	2.232925	6.751265	2.610739	3.481340	2.241139	1.834753
Jarque-Bera	29.14532	89.20025	28.75075	174.1974	23.40444	12.34744	6.415027	7.878676
Probability	0.000000	0.000000	0.000001	0.000000	0.000008	0.002083	0.040457	0.019461
Sum	2.15E+14	5.46E+13	3.79E+08	8.66E+12	1508.000	2237.390	13459702	4548.580
Sum Sq. Dev.	9.56E+26	7.85E+25	2.95E+15	2.13E+24	983.8674	137.2723	5.34E+09	10379.91
Observations	132	132	132	132	132	132	132	132

4.3. Unit Root/Stationarity Tests

The Augmented Dickey-Fuller (ADF) and Kwiatkowski Philips Schmidt Shin (KPSS) tests are applied to determine the stationarity of the variables. The ADF equation is stated as;

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + , \ldots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \qquad (13)$$

Where α is a constant, ε is a pure white noise error term, β is the coefficient on a time trend, and the lag order of the autoregressive process. The null hypothesis for the ADF test of stationarity states that there is a unit root in the variable as against the alternative of no unit root KPSS states the null hypothesis as stationary against the alternative of a unit root. Therefore, to obtain a series with the absence of unit root, it is expected to reject the null hypothesis for the ADF test if the absolute value of t-statistics is greater than the critical values at 1% 5%, and 10% level of significance. The KPSS decision rule takes the reverse of the ADF unit root test hypothesis and the null of the KPSS is expected not to be rejected at 1%, 5%, or 10% level of significance.

For Equation (13): H_0: $\gamma_1 = 1$ *vs* H_1: $\gamma_1 \neq 1$, (unit root vs no unit root) (14)

Table 2. Stationarity Test

Variables	ADF $-t_{cal}$*(-3.44) @ 5%	KPSS t_{cal}*(0.14) @ 5%	I(d)
Rgdpr	-6.32	0.139	I(1)
LogRM2	-5.80	0.21	I(0)
Log ATM	-6.30	0.14	I(1)
Log POS	-6.32	0.14	I(1)
Log ETR	-6.34	0.13	I(1)
Log Cheque	-6.29	0.133	I(1)
RIR	-5.76	0.27	I(0)
MPR	-4.58	0.09	I(1)

Computed by the author using EViews 9.0 Note: I(0) denotes integrated of order zero, which is stationary at the level of the series, I(1) denotes integrated of order one, which is stationary after the first differencing of the series. P-value@ 5%--2.933158

5. Interpretation of Result

The financial liberalization and the renewed efforts to ascertain the mediating roles of innovation in financial services delivery to achieving improved real GDP and stable Real money demand necessitated the need for this study. As mentioned, financial innovation is classified among the non-homogenous group in financial development which now creates gaps in understanding the impacts of innovations in payments systems on a macroeconomy (Tuano-Amador 2008; Blach 2011; Bogov 2011; Bruegel 2018). To fill the gap, this study applied the ARDL model on the quantity theory of money to ascertain the impacts of financial innovations in the payments system in financial services delivery on real money demand and real GDP.

Estimates of the impacts of financial innovation on real GDP adopt a lag length criteria and other post-estimation tests reveal that in the short run, a 1% increase in the real money demand would cause a -0.384419% significant decrease in real GDP after a first lag. Also, a 1% increase in the ETR has a 0.0146% positive impact on the real GDP while the ATM after the first lag caused a -0.022% decrease in real GDP all in the short run.

In the long run, a 1% increase in the ETR, POS, and real GDP causes negative impacts of -0.014%, -0.015%, and -0.162% respectively while ATM and Lending rates have 0.028% and 0.008. The implication is that financial innovations have a varying relationship different from the short run and long run with the macroeconomy. The empirical evidence takes to the position that financial innovation poses a significant impact on the macro economy that may not be the same in the long run and short run (Nakorji and Asuzu; 2019; Nazir, Tan, and Nazir 2020; Domeher, Konadu-Yiadom and Aawaar 2021 Sanya and Olatunji 2020). The overall performance of the model is relatively satisfied with the R-square at 59.7% and Durbin Watson. The Breusch-Godfrey serial correlation LM test in table 8 of the appendix revealed that the correlation between the real GDP and financial innovation is free from serial correlation. The decision criteria of the Breusch-Godfrey serial correlation LM do not reject the true null hypothesis and conclude that there is no serial correlation (see Table 8 of the appendix). The Durbin-Watson statistics at 1.99 suggest the absence of autocorrelation in the model (see Table 6 appendix). The bound test F statistics is less than the upper bound and implies the absence of a long-run relationship.

The model that estimates impacts of the financial innovation on real money demand reveals the existence of a short-run impact of financial innovations in the payments system on real money demand. 1% increase in the cheque payment system after the second year lag caused a -0.013% decrease but a -0.013% decrease in the ETR at the current time. Likewise, the MPR and LR show positive short-run impacts on the real money demand to the tune of 0.011% and 0.15% for every 1% increase at the current price for MPR and the second lag of LR respectively. The long-run impact of the financial innovations in the payment services at a 1% increase caused -a 0.223% decrease in the real money demand. Findings further support Ajayi and Ojo (2006) to buttress the importance of MPR among other financial innovations at a long-run impact on the real money demand.

The overall performance of the real money demand model reveals that there is no serial correlation as opined by the Breusch-Godfrey serial correlation LM test in table 11(see appendix). 32.79 variation in the real money demand is explained by the variation in the innovation in financial service delivery (see table 9 of the appendix). The ARDL bound test statistics at 3.62 was is only greater than the critical value at 5% and 10% but failed at 1% to suggest a weak long-run relationship between real demand for money and financial innovations. But the statistical significance of the error correction term at -0.22 supports the existence of a long-term relationship at 22% adjustment speed to the equilibrium (see table 13 of the appendix).

Table 3. Auto-regressive Distributive lag model output

Variable	RGDP	RM2
D(LOGRGDP)		0.096179
D(LOGRGDP(-1))	0.590925*	-0.107064
D(LOGRGDP(-2))	0.122434	-0.146053
D(LOGRM2)	0.099653	
D(LOGRM2(-1))	-0.384419*	-0.071730
D(LOGRM2(-2))	-0.063397	-0.077429
D(LOGCHEQUE)	0.030674	0.019125
D(LOGCHEQUE(-1))	0.021890	-0.008300
D(LOGCHEQUE(-2))	0.007282	-0.013624***
D(LOGETR)	-0.003926	-0.013467***
D(LOGETR(-1))	0.014689***	0.018913
D(LOGETR(-2))	0.008344	0.007671
D(LOGATM)	-0.003740	0.006804
D(LOGATM(-1))	-0.022498***	-0.014656
D(LOGATM(-2))	-0.016910	0.001381
D(LOGPOS)	-0.006058	-0.001907
D(LOGPOS(-1))	-0.001348	0.000983
D(LOGPOS(-2))	0.005947	-0.004442
D(MPR)	0.002253	0.011041**
D(MPR(-1))	0.007467	-0.000479
D(MPR(-2))	0.001297	-0.000695
D(LR)	0.002301	-0.001193
D(LR(-1))	-0.002423	2.279865
D(LR(-2))	-0.006725	0.146398*
C	-0.567653	-0.035681**
LOGRM2(-1)	0.085211	0.017419**
LOGCHEQUE(-1)	0.000915	-0.00344
LOGETR(-1)	-0.014150***	0.001377
LOGATM(-1)	0.028268**	0.000102
LOGPOS(-1)	-0.015295**	-0.000334
MPR(-1)	-0.006595	-0.223110*
LR(-1)	0.008469***	0.019125
LOGRGDP(-1)	-0.161636*	-0.008300

*The level of significance is denoted respectively as ***1%, **5%, and *10%*

Concluding Remarks

Evidence from the study reveals significant impacts of the financial innovations in the payments system (ETR, POS LR, and ATM) on the real gross domestic product in the short run and long run. The real GDP increases by 0.0146 as the transaction using ETR increases in the short run and decreases by -0.0141% in the long run. Unlike the ETR, the real GDP decreases by -0.022% for every 1% increase in the transaction through the ATM in the short run but increases by 0.028% in the long run. Related Studies in recent time ties the improved performance of small and medium enterprises to the activities of the liberalization of the financial sector and innovation with a transaction using the ATM positively correlates with economic growth (Chukwunulu, 2019; Effiom and Wdet 2020). The value of transactions through the POS showed an inverse impact on the real GDP in the long run and the lending rate also has a positive long-run impact on the real GDP.

Secondly, the importance of understanding the roles of financial innovation in the determination of real money demand is buttressed forthwith with the depletion of real money demand as the value of the transactions by cheque and electronic transfer increases in the short run. The determinants of real money demand in Nigeria are positioned to be expanded by the introduction of financial liberalization (Nakorji and Asuzu 2019). Unlike the transaction using a cheque, the real money demand increases with the increase in the monetary policy rate in the short run but with a decline in the long run. Therefore, for an expansionary target on real money demand, MPR as an instrument of target yields an effective outcome in the long run.

Following the empirical evidence presented in the study, the ETR is effective for the expansionary policy on real GDP in the short run while ATM is effective for a contractionary target in the short run. But in the long run, ATM and LR showed to be effective for an expansionary policy on real GDP while the POS and ETR were significant for a contractionary policy target. Likewise, the POS and LR showed to be effective for an expansionary target on the real money demand while cheque is effective for a contractionary target in the short run respectively. Only MPR showed to be significant but effective for contractionary policy targets in the long run. Stakeholders in the financial institution service delivery should follow the effectiveness of the financial innovation instruments in managing real GDP and real Money demand for the overall good of the macroeconomy.

Appendix

Table 5. Output model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGRGDP(-1))	0.590925*	0.091264	6.474901	0.0000
D(LOGRGDP(-2))	0.122434	0.099373	1.232060	0.2209
D(LOGRM2)	0.099653	0.102855	0.968863	0.3350
D(LOGRM2(-1))	-0.384419*	0.104980	-3.661819	0.0004
D(LOGRM2(-2))	-0.063397	0.109350	-0.579758	0.5634
D(LOGCHEQUE)	0.030674	0.028354	1.081790	0.2820
D(LOGCHEQUE(-1))	0.021890	0.032328	0.677098	0.5000
D(LOGCHEQUE(-2))	0.007282	0.028541	0.255141	0.7992
D(LOGETR)	-0.003926	0.007597	-0.516808	0.6065
D(LOGETR(-1))	0.014689***	0.008200	1.791396	0.0763
D(LOGETR(-2))	0.008344	0.007889	1.057709	0.2928
D(LOGATM)	-0.003740	0.011390	-0.328331	0.7434
D(LOGATM(-1))	-0.022498***	0.012318	-1.826372	0.0709
D(LOGATM(-2))	-0.016910	0.011170	-1.513844	0.1333
D(LOGPOS)	-0.006058	0.010991	-0.551157	0.5828
D(LOGPOS(-1))	-0.001348	0.009090	-0.148270	0.8824
D(LOGPOS(-2))	0.005947	0.008689	0.684473	0.4953
D(MPR)	0.002253	0.006677	0.337439	0.7365
D(MPR(-1))	0.007467	0.006813	1.096009	0.2758
D(MPR(-2))	0.001297	0.006783	0.191159	0.8488
D(LR)	0.002301	0.006036	0.381109	0.7040
D(LR(-1))	-0.002423	0.007222	-0.335425	0.7380
D(LR(-2))	-0.006725	0.005697	-1.180467	0.2407
C	-0.567653	0.726051	-0.781836	0.4362
LOGRM2(-1)	0.085211	0.064098	1.329386	0.1868
LOGCHEQUE(-1)	0.000915	0.015129	0.060487	0.9519
LOGETR(-1)	-0.014150***	0.008196	-1.726460	0.0874
LOGATM(-1)	0.028268**	0.012489	2.263495	0.0258
LOGPOS(-1)	-0.015295**	0.006881	-2.222712	0.0286
MPR(-1)	-0.006595	0.004646	-1.419729	0.1589
LR(-1)	0.008469***	0.004394	1.927585	0.0568
LOGRGDP(-1)	-0.161636*	0.035791	-4.516114	0.0000

Table 6. Model statistics

R-squared	0.597128	Mean dependent var	-0.005841
Adjusted R-squared	0.468375	S.D. dependent var	0.035914
S.E. of regression	0.026186	Akaike info criterion	-4.236180
Sum squared resid	0.066512	Schwarz criterion	-3.526769
Log-likelihood	305.2336	Hannan-Quinn criteria.	-3.947932
F-statistic	4.637780	Durbin-Watson stat	1.988845
Prob(F-statistic)	0.000000		

The level of significance is denoted respectively as *1%, **5%, and ***10%

Computed by the author with Eviews 9.0

Bound Test

Table 7. Null hypothesis: No long-run relationship exists

Test Statistics	Value	K
F-statistics	2.864814	7
Significance	Lower bound	Upper bound
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26

Computed by the author with Eviews 9.0

Breusch-Godfrey serial correlation LM test

Table 8. Null Hypothesis: there is no serial correlation in the residual

F-statistics	0.945272	Prob F(2, 97)	0.3922
Obs*R-squared	2.517068	Prob. Chi-square	0.2841

Table 9. Real Money demand model estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGRM2(-1))	-0.071730	0.109791	-0.653336	0.5151
D(LOGRM2(-2))	-0.077429	0.107326	-0.721438	0.4724
D(LOGRGDP)	0.096179	0.099270	0.968863	0.3350
D(LOGRGDP(-1))	-0.107064	0.106748	-1.002967	0.3184
D(LOGRGDP(-2))	-0.146053	0.097263	-1.501634	0.1364
D(LOGCHEQUE)	0.011914	0.027997	0.425531	0.6714
D(LOGCHEQUE(-1))	0.012903	0.031808	0.405654	0.6859
D(LOGCHEQUE(-2))	0.019125	0.027981	0.683486	0.4959
D(LOGETR)	-0.008300	0.007426	-1.117718	0.2664
D(LOGETR(-1))	-0.013624***	0.008070	-1.688292	0.0946
D(LOGETR(-2))	-0.013467***	0.007674	-1.754937	0.0824
D(LOGATM)	0.018913	0.011030	1.714674	0.0896
D(LOGATM(-1))	0.007671	0.012283	0.624474	0.5338
D(LOGATM(-2))	0.006804	0.011081	0.613963	0.5407
D(LOGPOS)	-0.014656	0.010711	-1.368234	0.1744
D(LOGPOS(-1))	0.001381	0.008930	0.154666	0.8774
D(LOGPOS(-2))	-0.001907	0.008555	-0.222930	0.8241
D(MPR)	0.000983	0.006563	0.149763	0.8813
D(MPR(-1))	-0.004442	0.006719	-0.661094	0.5101
D(MPR(-2))	0.011041**	0.006570	1.680452	0.0961
D(LR)	-0.000479	0.005935	-0.080753	0.9358
D(LR(-1))	-0.000695	0.007099	-0.097930	0.9222
D(LR(-2))	-0.001193	0.005636	-0.211660	0.8328
C	2.279865	0.677049	3.367356	0.0011
LOGRGDP(-1)	0.146398*	0.035712	4.099426	0.0001
LOGCHEQUE(-1)	-0.035681**	0.014415	-2.475222	0.0150
LOGETR(-1)	0.017419**	0.007981	2.182599	0.0315
LOGATM(-1)	-0.00344	0.012584	-0.273746	0.7849
LOGPOS(-1)	0.001377	0.006929	0.198701	0.8429
MPR(-1)	0.000102	0.004611	0.022086	0.9824
LR(-1)	-0.000334	0.004398	-0.076011	0.9396
LOGRM2(-1)	-0.223110*	0.059366	-3.758185	0.0003

Table 10. Model statistics

R-squared	0.327900	Mean dependent var	-0.000299
Adjusted R-squared	0.113105	S.D. dependent var	0.027316
S.E. of regression	0.025725	Akaike info criterion	-4.271661
Sum squared resid	0.064194	Schwarz criterion	-3.562250
Log-likelihood	307.5221	Hannan-Quinn criteria.	-3.983413
F-statistic	1.526573	Durbin-Watson stat	2.066191
Prob(F-statistic)	0.061365		

Table 11. Breusch-Godfrey serial correlation LM test

F-statistics	0.683296	Prob F(2, 97)	0.5074
Obs*R-squared	1.829372	Prob. Chi-square	0.4006

Bound Test

Table 12. Null hypothesis: No long-run relationship exist

Test Statistics	**Value**	**K**
F-statistics	3.635653	7
Significance	Lower bound	Upper bound
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26

ARDL Cointegrating And Long Run Form

Dependent Variable: LOGRM2

Selected Model: ARDL(3, 3, 3, 3, 3, 3, 3, 3)

Date: 12/15/21 Time: 13:27

Sample: 2009M01 2019M12

Included observations: 129

Table 13

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGRM2(-1))	-0.071730	0.109791	-0.653336	0.5151
D(LOGRM2(-2))	-0.077429	0.107326	-0.721438	0.4724
D(LOGRGDP)	0.096179	0.099270	0.968863	0.3350
D(LOGRGDP(-1))	0.038989	0.171569	0.227249	0.8207
D(LOGRGDP(-2))	-0.146053	0.097263	-1.501634	0.1364
D(LOGCHEQUE)	0.011914	0.027997	0.425531	0.6714
D(LOGCHEQUE(-1))	-0.006222	0.029011	-0.214456	0.8306
D(LOGCHEQUE(-2))	0.019125	0.027981	0.683486	0.4959
D(LOGETR)	-0.008300	0.007426	-1.117718	0.2664
D(LOGETR(-1))	-0.000158	0.008930	-0.017673	0.9859
D(LOGETR(-2))	-0.013467	0.007674	-1.754937	0.0824
D(LOGATM)	0.018913	0.011030	1.714674	0.0896
D(LOGATM(-1))	0.000867	0.012677	0.068393	0.9456
D(LOGATM(-2))	0.006804	0.011081	0.613963	0.5407
D(LOGPOS)	-0.014656	0.010711	-1.368234	0.1744
D(LOGPOS(-1))	0.003288	0.010963	0.299942	0.7649
D(LOGPOS(-2))	-0.001907	0.008555	-0.222930	0.8241
D(MPR)	0.000983	0.006563	0.149763	0.8813
D(MPR(-1))	-0.015483	0.008358	-1.852503	0.0670
D(MPR(-2))	0.011041	0.006570	1.680452	0.0961
D(LR)	-0.000479	0.005935	-0.080753	0.9358
D(LR(-1))	0.000498	0.006433	0.077355	0.9385
D(LR(-2))	-0.001193	0.005636	-0.211660	0.8328
CointEq(-1)	-0.223110	0.059366	-3.758185	0.0003
Cointeq = LOGRM2 - (0.6562*LOGRGDP -0.1599*LOGCHEQUE + 0.0781*LOGETR -0.0154*LOGATM + 0.0062*LOGPOS + 0.0005*MPR -0.0015*LR + 10.2186)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGRGDP	0.656168	0.193102	3.398049	0.0010
LOGCHEQUE	-0.159925	0.064813	-2.467480	0.0154
LOGETR	0.078076	0.045901	1.700947	0.0922
LOGATM	-0.015440	0.057621	-0.267962	0.7893
LOGPOS	0.006171	0.030909	0.199648	0.8422
MPR	0.000456	0.020694	0.022057	0.9824
LR	-0.001498	0.019739	-0.075907	0.9396
C	10.218563	0.628522	16.258084	0.0000

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