Reconsidering the Stability of Money Demand in Nigeria

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ABSTRACT

This study attempts to investigate the long run stability of money demand in Nigeria from the period of 1980 to 2018. The data used were sourced from the World Development Indicators (WDI) and the ARDL method of cointegration analysis was used to estimate money demand function.

The empirical results provide evidence for the existence of a cointegrating relationship between the real money demand, real GDP, the real deposit interest rate, and financial development. Furthermore, it is shown that financial development plays a key role in the stability of money demand in Nigeria over the long-run.

Keywords: Money Demand, Financial Development, Nigeria, Cointegration.

ÖZ

Bu çalışma, Nijerya'daki para talebinin 1980'den 2018'e kadar olan uzun vadeli istikrarını araştırmaya çalışmaktadır. Kullanılan veriler Dünya Kalkınma Göstergelerinden (WDI) elde edilmiştir ve ARDL eşbütünleşme analizi yöntemi para talebi fonksiyonunu tahmin etmek için kullanılmıştır.

Ampirik sonuçlar, reel para talebi, reel GSYİH, reel mevduat faiz oranı ve finansal gelişme arasında eşbütünleşme ilişkisinin varlığına dair kanıt sağlar. Ayrıca, çalışmanın bulguları, finansal gelişmenin Nijerya'daki para talebindeki uzun dönemli istikrarsızlığı anlamada kilit bir rol oynadığını göstermektedir.

Anahtar Kelimeler: Para Talebi, Finansal Gelişme, Nijerya, Eşbütünleşme

DEDICATION

To My Family & Friends

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I would like to express my sincere gratitude toward Prof. Dr. Mustafa İsmihan for his consistent help and direction in the preparation of this thesis. Without his significant oversight, every one of my endeavors might have been limited.

I would also like to show my gratitude to my parents and my siblings for always being there for me, and my friends who have been there to support me through-out the completion of this project.

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INTRODUCTION

1.1 Background to the Study

The stability of the money demand is essential for an effective monetary policy (Friedman, 1959). To put it differently, the stability of the money demand function increases the central bank's probability to properly implement its monetary objectives. This issue is even more important when the monetary structure is subjected to significant structural change and external shocks (e.g., the global economic crisis of 2008/09). On this basis, money demand volatility is viewed as a critical issue for monetary policy effectiveness.

Most of the reforms that prompted the thorough assessment of Nigeria's money demand have remained mostly unchanged in recent times. In 1974, for instance, the Central Bank of Nigeria (CBN) embraced monetary targeting as the framework for monetary policy execution. Money demand stability is still one of the key prerequisites for successful monetary aggregate targeting (Khan & Ali, 1997). This confirms the fact that a stable money demand is critical in the selection of targets and instruments of monetary policy since the monetary policy transmission mechanism relies on money demand stability. Nigeria's central bank has kept monetary targeting as its principal monetary policy strategy to date (Tule et al., 2018).

Every contemporary endeavor to investigate the demand for money in Nigeria must be clearly outlined since money demand is a dynamic phenomenon. That is, the money demand function may change, as the structure of the financial system changes, e.g. due to financial development, throughout time. Numerous researchers in the past have noted the neutrality of interest rates in the money demand function and it is attributed to the underdeveloped nature of the banking sector and restricted variety of financial instruments in Nigeria, such that market participants tended to switch among cash (money) and real assets instead of between cash and other financial assets (Tule et al., 2018).

Financial development is usually and narrowly defined as the improvements in financial depth or the size of financial sector. However, it is a multi-dimensional concept which also includes other dimensions such as efficiency and access. For instance, financial development can also refer to the highest possible performance of the financial system's operations through removing market inefficiencies (Eryigit & Eryigit, 2015). It is usually claimed that financial development is an essential prerequisite for economic growth. This indicates that financial development boosts growth, e.g. by efficient use of financial resources, and most of the recent studies supported this claim (Ismihan et al., 2017). Moreover, financial development is also important determinant of money demand function (Ahad, 2017) and this is particularly important in the case of Nigeria considering the rapid improvements in the financial development over the last two decades.

This study, therefore, endeavours to analyse the long-run stability of money demand by incorporating the financial development indicator in Nigeria's money demand function over the period from 1980 to 2018. The fast rate at which institutions grow, especially the banking system, affects the way individuals carry out their economic transactions (Anthony, 2012). Therefore, it is important to include a measure of financial development in the proposed model for money demand. Indeed, several alternatives can be considered as proxy for financial development such as financial system deposit to GDP ratio, stock market capitalization to GDP ratio and total banking sector liabilities to GDP ratio. However, in the case of our study we will use the most popular measure which is the monetary sector credit to private sector as a percentage of GDP. This proxy refers to financial resources provided to the private sector by financial institutions, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment.

It is also essential from a policy standpoint to determine if there is a stable long-term relationship involving actual money balances and the determinants such as real income (Real GDP), real domestic interest rate, and financial development. It will be interesting and valuable to see how this relationship has changed as a result of latest improvements in financial development.

Therefore, the fundamental goal of this thesis is to reevaluate the stability of Nigerian money demand by considering the role of financial development. More specifically, the main goals are to:

1. Determine how real income, real domestic interest rate, and financial development influence the demand for money function in Nigeria.

2. Identify the long and short run relationship between the money demand function and the main conditioning variables of income and real domestic interest rate, and the impact of financial development on this relationship.
3. Analyze the long-run stability of the money demand function in Nigeria.

In doing so, the popular ARDL method of cointegration analysis was used to estimate money demand function and the data used were sourced from the World Development Indicators (WDI). In contrast to most of the existing studies, which mainly used standard tools and/or sophisticated techniques to analyze the stability of the money demand function, this study will carry out simple *sequential* empirical analysis to investigate the long run stability of money demand in Nigeria.

This chapter serves as an overall introduction. The second chapter examines the relevant literature (theoretical and empirical literature). Chapter 3 provides the empirical model and research methodology, while chapter 4 provides the empirical results. The study comes to an end with chapter five.

Chapter 2

REVIEW OF LITERATURE

2.1 Introduction

The first part of this chapter concerns itself with the studies of various scholars and economists who have worked on money demand. Then it goes further in providing the condensed overview of empirical studies on the topic.

2.2 Theoretical Background on the Demand for Money

There is extensive literature on the demand for money through awareness and commitment to this area throughout monetary economics and economics in general. Some of the early theories of monetary economics are briefly explained in the next subsection.

2.2.1 Keynesian Liquidity Preference Theory

The liquidity-preference theory was developed in 1936 in John Maynard Keynes's seminal book *General Theory of Employment, Interest and Money*. The focus was mainly on demand for money, that mainly emphasizing the significance of interest rates. This theory is associated with questions about why people hold money. According to Keynes, it theoretically relies on three motives as to why people wish to hold money:

- The transactions motive: Keynes underlined that notwithstanding the classical approach (which is based on Quantity Theory of Money, as explained below), where individuals are expected to hold cash since it is a mode of trade that is used to complete regular exchanges, this part of money demand is chosen fundamentally by the level of individuals' exchanges. This relies upon the level of income; as income rises, money demand rises too.

- The precautionary motive: Keynes recognized that people hold cash as an alert against an unforeseen need. This implies that cash is held for emergency situations i.e., to cater for employment loss, vehicle breakdown, sudden bills and so forth.
- The speculative motive: Keynes accepted that people likewise hold cash as a form of saving. Keynes contended that vulnerability about the future particularly the interest rate might impact the desire for money. This rationale was derived from a two-assets world where wealth is held as cash or bonds. Keynes accepted that cash is a completely liquid asset and, thus, earns no interest revenue while bonds yield a future pay. Therefore, this motive relies upon the level of interest rate; as interest rate rises, the opportunity cost of holding money rises and hence money demand falls.

Every one of the three motives can be included in a money demand equation referred to as the liquidity preference function as follows:

$M_d/P = f(i, Y)$

where:

- M_d/P is demand for real money balances
- i is interest rate
- Y is the real income

Keynes and his followers emphasized that the real money demand is related to interest rates and income. Ceteris paribus, when interest rates fall, the demand for.

2.2.2 Quantity Theory of Money (QTM)

Irving Fisher developed QTM in the notion of "equation of exchange." It can be mathematically expressed as:

$M_S V_T \equiv PT$

where:

- M_S = money supply,
- V_T = velocity of money, which is the speed of money in circulation,
- P = price level; and
- T = transaction volume (later replaced with real income, Y)

This identity simply says that the overall sum of money circulating in the economy (left hand side) should always equal the total monetary value of the transactions in the economy (right hand side). This is the Fisher’s version of QTM and it can be converted into money demand function by assuming $M^d = M_s$;

$M_d/P = K_T T$

where:

- M_d/P = demand for real money balances,
- T = transaction volume (real income).
- Kt/1Vt

2.2.3 The Cambridge Approach (QTM)

In the Cambridge method, a key factor in determining a person's money holding preference is that cash is a convenient asset because it is generally accepted in the exchange of goods and services. The more transactions a person makes the more money they want, which is similar to Fisher's idea.

The pioneers of this approach, A. Marshall and C. Pigou, contend that, other things being equal, the aggregate demand for nominal money is directly proportional to the nominal level of income of the entire economy. They proposed the money demand equation as follows:

$M_d = kPY$

Where k is the factor of proportionality, P is price level and Y is real income.

This is basically the same as the Fisher equation, we can rewrite this equation as follows:

$M_d/P = kY$

However, there are number of notable differences between Fisher's and Cambridge approach (see Laidler 1985).

Finally, it should be noted here that QTM, more recently, is related with the emergence of Monetarism, and particularly with the pioneering studies of Milton Friedman (see Snowdon and Vane, 2005, for more detail).

2.2.4 Other Approaches on Money Demand

- **Tobin's Portfolio Approach to Money Demand**

  This approach makes a valid hypothesis that individuals do prefer more wealth over less. According to this approach, an investor faces the problem of what percentage of his assets to keep in the form of available money (which would generate no interest at all) and in the form of assets (which generate interests) such as bonds. A person's portfolio can also be made up of riskier assets like stocks (Beniwal, 2020). Those who only have safe and risk-free assets such as cash or demand deposits in their asset portfolio take almost no risk.

Baumol Model of Money Demand (Inventory Approach)

Since entrepreneurs keep stocks of goods and inventories to aid transactions or exchanges in the circumstance of changes in demand, Baumol argues that individuals also have to keep an optimal inventory amount of money for transaction purposes. People incur costs as well when they have cash in hand for transactional purposes and the cost is the forgone interest rate which they may have been earned in the event that they have their wealth invested in either savings or fixed deposits or invested in stocks or bonds. The forgone cost is likewise referred to as opportunity cost (Agarwal, 2015).

There are other approaches, e.g. by Post Keynesian economists, which are not covered in this brief review (See Snowdon and Vane, 2005, for more detail and the references cited therein).

2.3 Empirical Literature

Many economists have published various papers on money demand for different countries around the world. In this sub-section, an overview of literature on money demand stability in Nigeria and in selected countries will be provided (See Tule et al., 2018 and Kumar et al., 2013, for more detailed review of literature and the references cited therein).

2.3.1 Review of Selected Empirical Literature on the Stability of Money Demand in Nigeria

More recently, Tule et al. (2018) used the Autoregressive Distributed Lag (ARDL) Bounds test approach to explore Nigeria's broad money demand stability. Their outcomes demonstrate that a stable long run relationship exists among money demand and its determinants including GDP, stock costs, real exchange rate and foreign interest rates. Overall, their research results demonstrate the continued relevance of the broad monetary aggregate as a benchmark for the implementation of Nigerian monetary policy.

Kumar et al. (2013) found in their research on the stability of the Nigerian money demand that after accounting for structural breaks, a cointegrating relationship exists between narrow real money, real income, and nominal interest rates. The results of their research indicate that Nigerian demand for money was stable between 1960 and 2008, although there is evidence that it may have been affected slightly around 1986.

Owoye and Onafowora (2007) utilized the Vector Error Correction Model (VECM) by using the time series from 1986:Q1 to 2001:Q4 to look at the stability of real money demand. Their findings suggest that broad real money, GDP growth, inflation rate, local and foreign interest rates, and trade balances have a long-term relationship. The CUSUM and CUSUMSQ tests affirmed the empirical stability of real money demand parameters in both the short and long run.

Over the quarterly period of 1991:Q1 to 2014:Q4, Nwude, Udeh, and Offor (2018) examined the effect of general money demand as well as its stability in Nigeria. The findings demonstrate that the real broad money aggregates and total earnings, local rate of interest, rate of inflation, currency exchange, and global rate of interest have a long-term relationship, according to Ordinary Least Squares (OLS) and other statistical approaches. They found that income and the exchange rate directly affect broad money balances, whereas domestic interest rates, inflation rates, and foreign interest rates negatively influence the broad money demand.

2.3.2 A Brief Review of Literature on the Stability of Money Demand in Selected Countries and Concluding Remarks

Hamori (2008) used annual data from 35 countries between 1980 and 2005 to study an empirical analysis of the role of currency demand in sub-Saharan Africa. The empirical results showed that a cointegrating relationship of money demand function within the sub-Saharan African region exists.

Ahad (2017) investigated the role of income, financial development, industrial production, and exchange rate in money demand function in Pakistan from 1972 to 2012. The results show the existence of the long-term relationship between money demand, financial development, exchange rates, industrial production, and income. The study concluded that financial development is an important determinant of long-term and short-term money demand functions.

To investigate the stability of long-term funding demand in Ghana, Dagher and Kovanen (2011) used a Bounds testing method. In a period of significant change in the financial and securities markets, empirical findings have provided powerful insights into well-identified long-term money demand structures in which fluctuations in equilibrium are relatively short-lived and stable.

Considering the above review, it can be argued that studies (particularly on Nigeria) have not sufficiently scrutinized the role of financial development on money demand function. In other words, most of the existing research focused on variables other than financial development. This study, therefore, bridges this gap and improves the existing literature by examining the impact of financial development on the long-run stability of money demand function. As noted earlier, most of the existing studies mainly used standard tools like CUSUM tests and/or sophisticated techniques (see Kumar et al., 2013 for a detailed review) to analyze the stability of the money demand function. In contrast to those studies, this study will carry out simple but useful *sequential* empirical analysis to investigate the long run stability of Nigerian money demand.

Chapter 3

MODEL AND METHODOLOGY

3.1 Introduction

This study uses annual data from the World Development Indicators (WDI) on real income, financial development, real money balances and interest rates during the period of 1980 to 2018 for Nigeria. This sample period is quite limited due to the data limitations in WDI.

3.2 Model Specification

The benchmark equation for the money demand function –which is usually expressed in terms of the two key determinants (see Section 2.1.1); namely, income (Y), and interest rate (RDIR) – can be expressed as follows:

$$M = f(\underset{+}{Y}, \underset{-}{RDIR}) \quad (1)$$

where M represents the real money stock.

In line with most of the existing literature, the benchmark (empirical) model can be reformulated as:

$$LnM_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 RDIR_t + \mu_t \quad (2)$$

where Ln denotes natural logarithm, other variables are as defined before and μ represents the disturbance term.

Taking into account the discussion in the previous chapters, the *augmented* model uses the functional relationship for the long-term demand for money as follows:

$$M = f(\underset{+}{Y}, \underset{-}{RDIR}, \underset{+}{FD}) \quad (3)$$

where:

- M = the real money demand (Broad money);
- Y = the real output (scale variable);
- RDIR = real deposit interest rate; and
- FD = Monetary sector credit to private sector (% GDP).

In addition to the above explanatory variables, other variables such as the real exchange rate and inflation can also be considered.

According to the existing literature, the empirical model can be reformulated as follows:

$$LnM_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 RDIR_t + \beta_3 FD_t + \mu_t \quad (4)$$

where Ln = natural logarithm, M = real money demand, Y = real output, RDIR = real deposit interest rate, FD = financial development proxied by monetary sector credit to private sector as a percentage of GDP.

This study makes use of broad money, which is defined by the World Bank (see section 4.1). The interest rate used in this study is the real deposit interest rate (RDIR), that is, the interest rate paid by commercial banks and financial institutions to depositors' cash deposits. This study also uses real GDP (Y) as a measure of real income. GDP is the total value of goods and services produced in a country in a year. Finally, the monetary sector's credit to the private sector as a percentage of GDP is utilized as a measure of financial development (FD).

3.3 Stationarity and Cointegration

The stationarity of variables is vital in econometric analyses, particularly when studying the relationship with other time series (TS) variables. If the mean, variance, and covariance of TS variable don't change over the time, then, the TS variable is stationary.

Stationarity is typically assumed when analysing time series data, since models with non-stationary variables can result in spurious (regression) results. This assumption can prompt erroneous conclusions and inaccurate policy making. Therefore, appropriate tools like cointegration methods must be used to analyse such non-stationary data.

Cointegration refers to the long-term or equilibrium relationship among variables. This implies that if at least two series are non-stationary, but their linear combination is stationary, the series can be considered to be cointegrated. In other words, when two or more series have similar or connected long-term trends, they are said to be cointegrated. This suggests that while individual TS variables could be unstable and diverge from each other in the short term, they may converge towards the dynamic equilibrium in the long term. Cointegration is vital as it gives a method of checking spurious regression problem in non-stationary series. It additionally helps in distinguishing both the long and short-run relationships.

3.4 Time Series Techniques Used in the Study

We conduct a unit root test and also apply the ARDL Bounds approach to estimate the long-term (equilibrium) money demand equation.

3.4.1 Unit Root Tests

Augmented Dickey Fuller (ADF) tests will be used to determine whether a unit root exists in the variables under consideration. In the simple case (with no autocorrelation), the ADF test is based on the estimation of the following regression:

$\triangle Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \varepsilon_t$

where t is the time index, $\triangle$ is the first difference operator, and ε_t is the White Noise error term. In this case, the hypotheses in a one-sided test are:

H_0: $\delta = 0$ (time series is nonstationary, or there is unit root)

H_1: $\delta > 0$ (time series is stationary, and possibly around a deterministic trend)

If the null hypothesis is rejected, the variable under consideration is stationary. Otherwise it contains a unit root.

3.4.2 ARDL Approach to Cointegration

As noted earlier, this study uses the ARDL cointegration method. The ARDL model is a model based on the Ordinary Least Squares (OLS) method, which is suitable for the mixed case of non-stationary and stationary time series variables. ARDL models can capture the short-term and long-term relationships of the variables.

The critical value of the cointegration test is divided into "upper limit" and "lower limit". The upper limit assumes that all variables contain a unit root [I(1)], and the lower limit assumes that all variables are stationary [I(0)]. To reject the null hypothesis of no long-run (or cointegration) relation, the calculated F statistics must be greater than the upper critical value. If the calculated statistic is less than the lower limit, the researcher must make the decision to not to reject the null hypothesis and to conclude that there is no cointegration. Finally, if the calculated statistics are between the upper and lower limits, the test result is uncertain.

3.4.3 Stability Checks

As indicated by Brown et al. (1975), to test the stability of the model, the cumulative sum (CUSUM) and the cumulative sum of squared (CUSUMSQ) of the recursive regression residuals are used. The model is said to be stable if the plot is within 5% of the critical limit.

3.5 An Overview of the Empirical Procedure

This study will use a number of econometric tools to investigate the stability of the money demand function for Nigeria, in the period of 1980-2018. To determine the association between each conditioning variable and real money balances, the study will utilize the multiple regression analysis (ARDL methodology). The study makes use of the Eviews software program.

To determine the TS properties of real money stock (broad money) and its conditioning/determining variables, we will use (ADF) unit root test. We conduct a ARDL Bounds approach to estimate the long-term money demand. Later, in addition to the diagnostic checks, the CUSUM & CUSUMSQ tests will be used to check the stability of the model. Finally, *sequential* empirical analysis will be implemented to investigate the long run stability of the money demand function.

Chapter 4

EMPIRICAL RESULTS

4.1 Introduction

This chapter presents the empirical results of time series analysis of the money demand function for Nigeria. More specifically, this chapter attempts to provide the answers to the questions posed in Chapter 1.

4.2 The Data

This study uses World Bank's World Development Indicators (WDI) data, sample period from 1980 to 2018. Figures 1, 2, 3, and 4 in the next section show the time plot of the log of broad money (in constant local currency unit), log of real GDP (in constant local currency unit), financial development (FD) and real deposit interest rate (RDIR). According to the World Bank, broad money is "the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper" (https://datacatalog.worldbank.org/home). Interest rate is the deposit interest rate (adjusted for inflation), this is the interest rate that commercial banks and financial institutions pay for cash deposits of account holders. This study uses real GDP as a measure of real income (Y). FD, or financial development, refers to the credit from the monetary sector to the private sector as a percentage of GDP as a proxy for financial development.

4.3 Graphical Analysis

The time plots of all variables in the augmented model can be examined from Figures 4.1, 4.2, 4.3 and 4.4. These time plots may give an idea about each variable's patterns of movements over time.

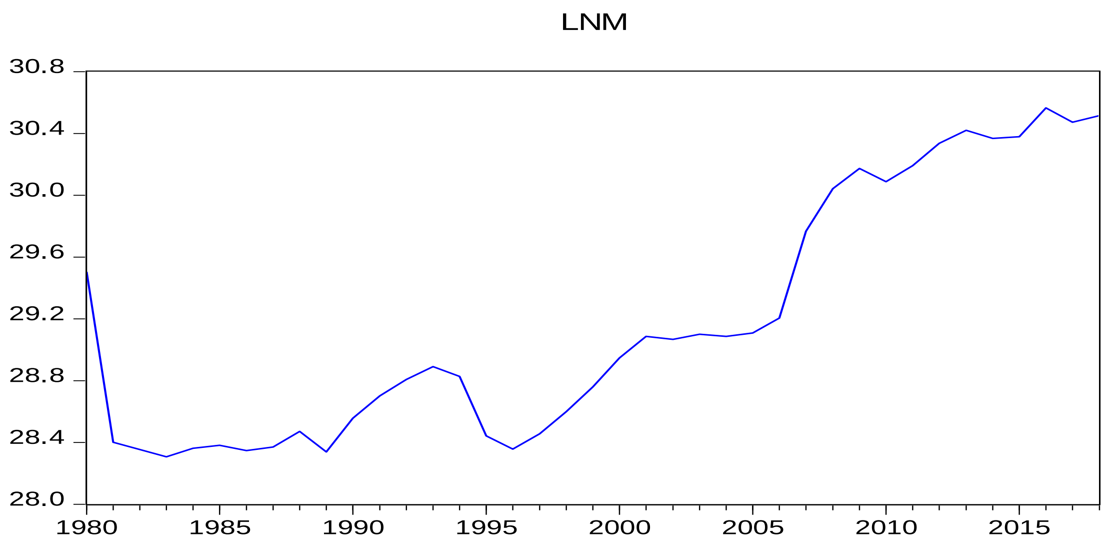

Figure 4.1: Log of Broad Money

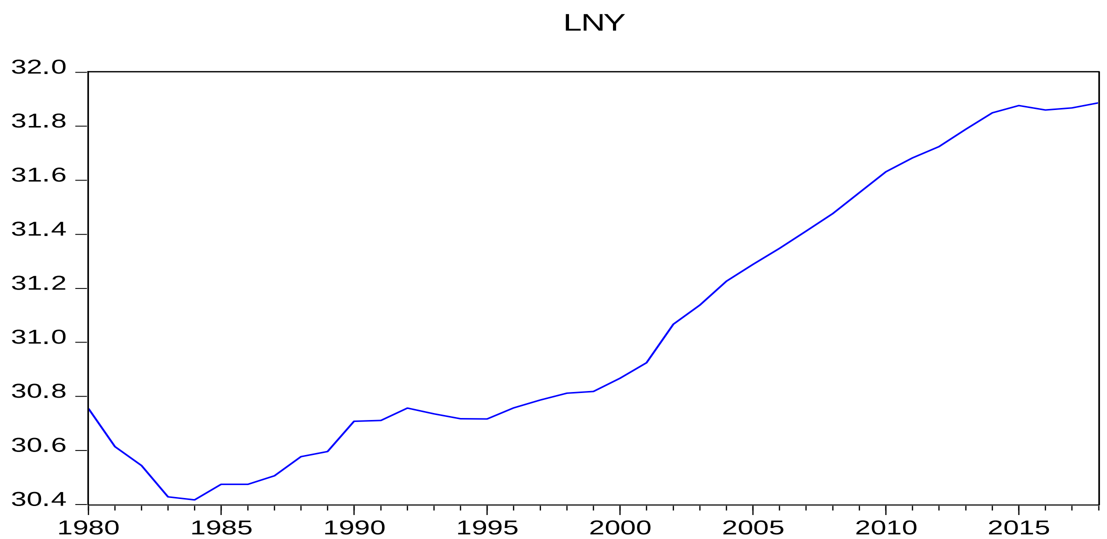

Figure 4.2: Log of Real GDP

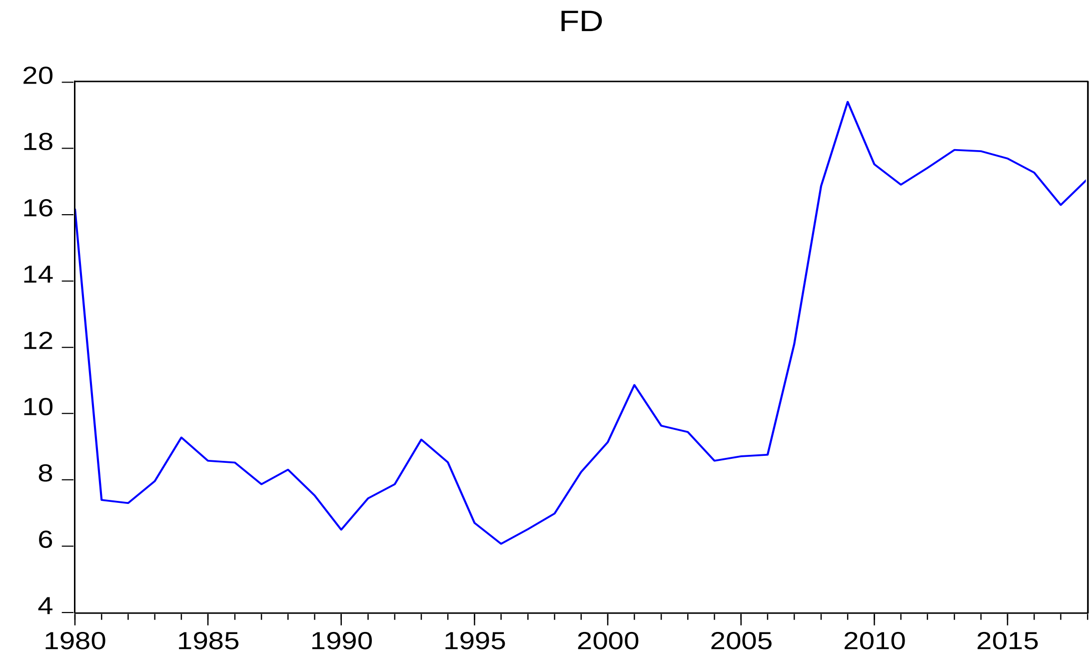

Figure 4.3: Financial Development

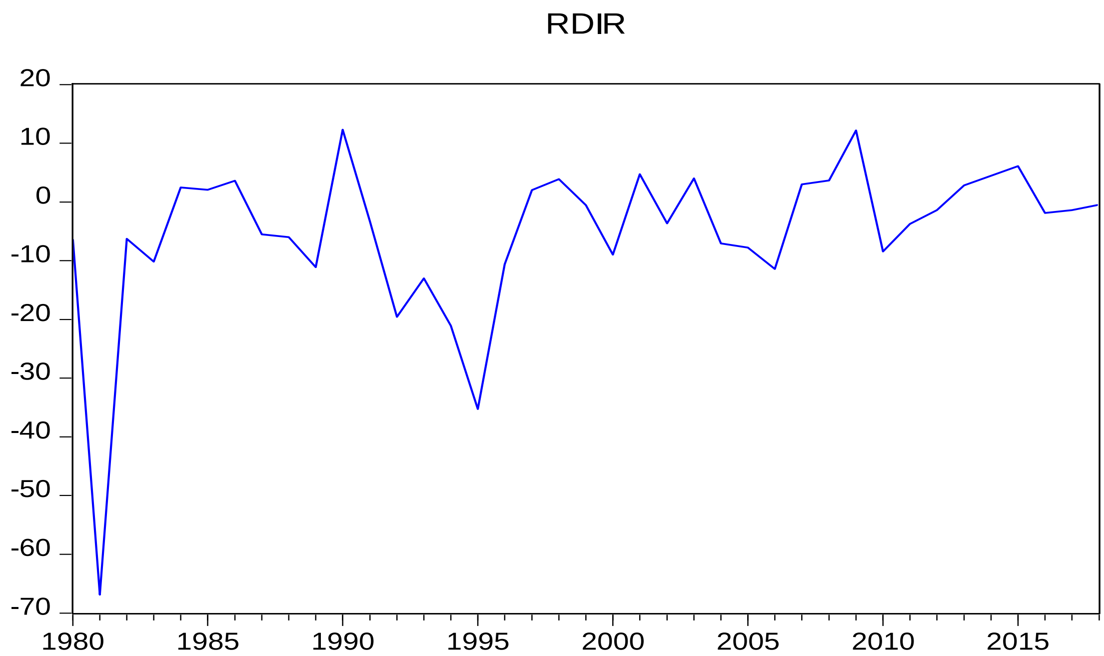

Figure 4.4: Real Deposit Interest Rate

The plots of LnM, LnY and FD suggest that these variables are non-stationary at level as they are generally increasing over time. Non-stationarity is inferred from the fact that none of the above variables fluctuate around a fixed (constant) mean (or around a deterministic trend) which is supposed to be an indicator of stationarity. Furthermore, the plot for RDIR reveals that this variable seems to have a constant mean, thereby indicating stationarity. However, this graphical analysis alone is not sufficient, hence there is a need to test for the presence of unit roots by performing a formal test. Therefore, the results of the Augmented Dickey-Fuller (ADF) test are given in the following sub-section.

4.4 Unit root (ADF) Tests

For the ADF test, recall that the null hypothesis states that a unit root exists in the time series variable and the variable is not stationary. The rejection of the null hypothesis signifies that the level of the considered variable is stationary. Table 1 shows the results of the corresponding tests for the tests with constant and constant&trend.

The above results suggest that at 5% level of significance, the ADF tests cannot reject the null hypothesis of non-stationarity for the variables tested on levels, except for RDIR. Furthermore, ADF tests for the differences of all variables reject the null hypothesis of non-stationarity. Our results indicate that while RDIR is stationary [1(0)], the remaining three variables are non-stationary and integrated of order one [1(1)]. Since there is a mixed degree of integration, this justifies the use of the ARDL method for cointegration.

Table 4.1: Unit Root Test

Augmented Dickey Fuller Test				
Variables	Level		First Difference	The order of Integration
	Without Trend	With Trend	Without Trend	
LnM	-0.172805* (0.9333)**	-1.834079 (0.6677)	-8.292110 (0.0000)	1(1)
LnY	-0.690980 (0.8364)	-2.268351 (0.4396)	-4.135115 (0.0027)	1(1)
RDIR	-4.849206 (0.0003)	-5.451662 (0.0004)	-12.48630 (0.0000)	1(0)
FD	-1.025147 (0.7341)	-1.866882 (0.6513)	-4.200912 (0.0022)	1(1)

4.5 Empirical Results

Initially, the order of the ARDL model is selected with Schwarz criterion and later the existence of long-run relationship is determined by using the Bounds test. In order to conclude that a long-term relationship exists, the critical value of the upper bound must be less than the F-statistic of the Bounds test at 5%. Fortunately, the computed F-statistics from the Bounds test is 8.0833 and this value is higher than the critical value of the upper bound at the 5 percent level of significance (see Appendix

A) and hence, the null hypothesis of no long-term relationship is rejected. Therefore, it is concluded that there is a long-term relationship between the demand for broad money and its determinants. Table 4.2 presents the estimated long-run model for money demand in Nigeria (See Appendix A for Eviews Output).

Table 4.2: Long Run Model (Dependent Variable: LnM)

Variable	Coefficient	Std. Error	t-statistic	p-value
LnY	1.185315	0.173728	6.822819	0.0000
RDIR	0.004200	0.005637	0.745144	0.4616
FD	0.050264	0.021214	2.369318	0.0240

The coefficient of the real income variable shows that the long run income elasticity for real broad money is 1.185315. This means that, while holding other variables as constant, a 1% increase in real income increases the demand for real money balances by 1.18% and it is statistically significant. Hence, an increase in real GDP leads to an increase in the demand for money as outlined in economic theory and the magnitude of the estimated parameter is broadly in line with the expected value of unity. Contrary to the theoretical expectations, RDIR is not statistically significant in the long run. However, this is consistent with the early findings and with more recent findings, e.g. by Tule et al. (2018), for Nigeria.

The financial development has a positive relationship with money demand and it is statically significant. Ceteris paribus, an increase in FD by one percentage point, would increase the money demand by 5.0%. This result is consistent with the empirical results of Ahad (2017). According to that study, the empirical results show that there is a long-term relationship between money demand and financial development. That is, from a long-term perspective, financial development is a key factor in the money demand function in Pakistan. These results indicate that with the addition of the financial development variable into the demand function, the demand function is stable in the long run. Table 4.3 presents the error correction model.

Table 4.3: Short Run Model (Dependent Variable: ΔLNM)

Variable	Coefficient	Std. Error	T-statistic	P-value
Δ(FD)	0.077220	0.007829	9.862757	0.0000
Coint Eq(-1)	-0.483850	0.167514	-2.888419	0.0069

In the error correction model FD is the only significant variable (see Table 4.3). The error correction term (CointEq(-1)) is significantly less than zero, but greater than minus one, which reveals that the error correction term is meaningful. The value of the error correction term implies that about 50% of the gap between actual and long-term (equilibrium) real money demand is explained or captured within a year in the model.

4.6 Diagnostic Tests

Table 4.4 presents the relevant diagnostic tests.

Table 4.4: Diagnostic Tests

Diagnostic Test	**P-values**
Normality (Jarque-Bera)	0.3854
Serial Correlation (LM Test)	0.1821
White Test	0.4450
Ramsey RESET test	0.5698

From the above results in Table 4, the Jarque-Bera (JB) test shows that the error term is distributed normally. This is inferred from the JB probability (p-value) of 0.3854, which implies that the null hypothesis that the error term is normally distributed cannot be rejected at 5% significance level.

The Lagrange Multiplier (LM) test for autocorrelation in the residuals presents no problem with regards to autocorrelation. The p-value is higher than 0.05 (5%) critical value, which implies that the null hypothesis of no autocorrelation cannot be rejected at the 5% significance level.

The respective p-values of White test for heteroscedasticity and the Ramsey RESET test for misspecification, also are greater than the 0.05 critical value as shown in the table above. From this analysis we can conclude that the error term is homoscedastic (there is no heteroscedasticity) and there is no evidence of misspecification.

4.7 Stability Tests

CUSUM and CUSUMQ tests are useful to identify systematic changes in the regression coefficients over the sampling period. Figures 5 and 6 show that the relevant values (squared CUSUM and CUSUM of the recursive residuals) are within the 5% critical limit (dotted line) for the CUSUM and CUSUM Squares tests, implying stability for the ARDL model.

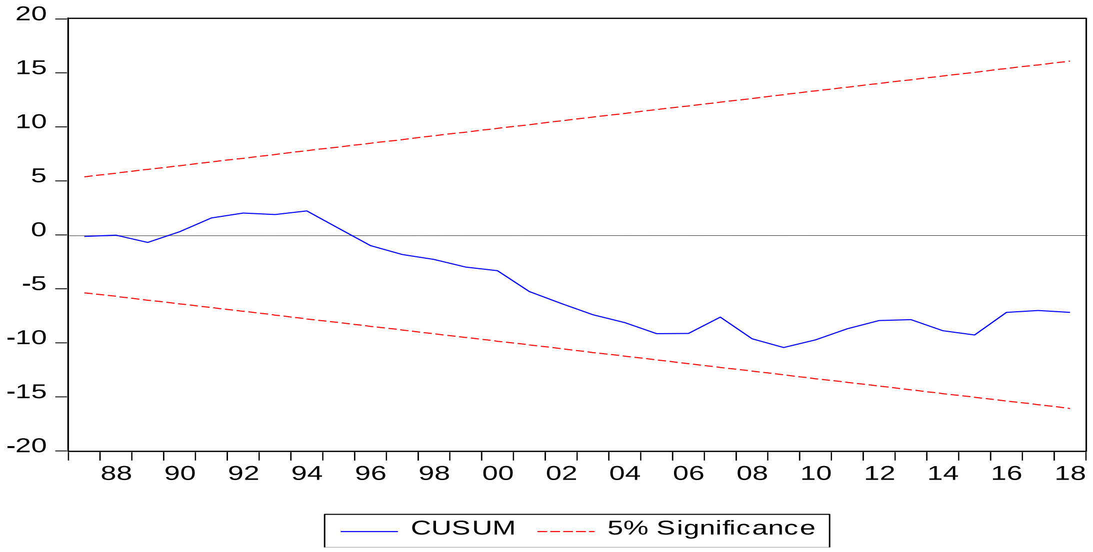

Figure 4.5: cumulative Sum of Recursive Residuals (CUSUM)

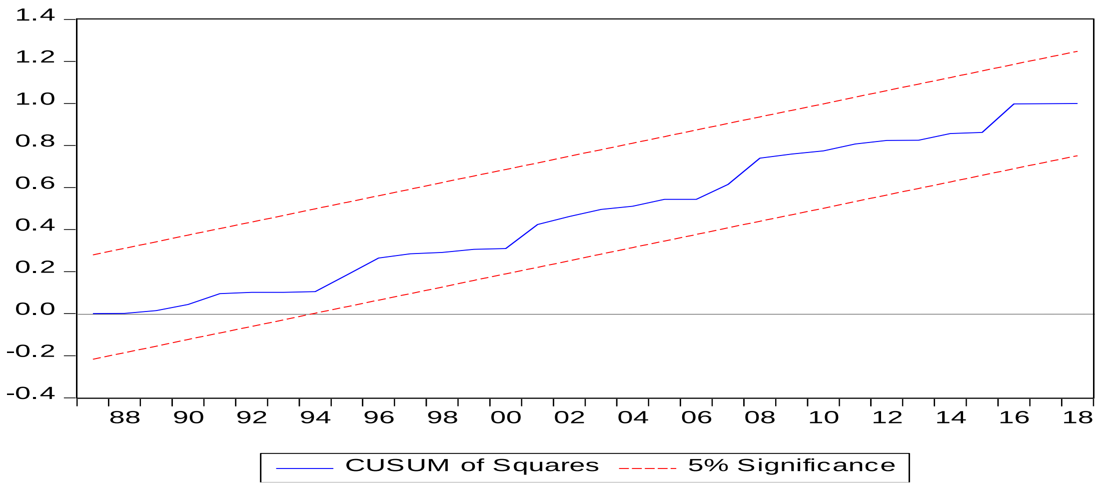

Figure 4.6: Cumulative Sum of Squares of Recursive Residuals (CUSUMQ)

4.8 Long-run Stability: Benchmark vs Augmented Model

When we carried out the empirical analysis *sequentially* for the benchmark model and the augmented model, we found out that while there is a stable long-run (equilibrium) relationship in the latter model, there is no stable long-run relationship in the former, from 1980-2018 to 1980-2014 periods (see Table 5) [see Appendix B for Eviews Output]. Similarly, Table 5 shows the sequential patterns of serial correlation and heteroskedasticity of both the benchmark and the augmented model. While the results on the augmented model reveal no problem in all periods, the results on the benchmark model indicate one or two diagnostic problems in some periods.

The lack of cointegration and hence the resulting long-run instability could arise from omitted variables (misspecification) that could have been included into the model. Therefore, it seems plausible, initially, to attempt to figure out what the omitted variables could be rather than just completely changing the equilibrium relationship (Granger & Lee, 1991) or using sophisticated methods on possibly misspecified model. In our case, financial development seems to be a good example of omitted variable in the benchmark model of the money demand function for Nigeria. This is a major weakness of the benchmark model [Furthermore, the magnitude of LnY in the benchmark model is much higher than the expected value of 1 as compared to the augmented model (see Appendix B)]. To sum up, we incorporated the financial development variable into the benchmark money demand function for Nigeria and hence obtained the augmented model; consequently, this resulted in a stable cointegration (or long-run equilibrium) relationship for the money demand function in Nigeria.

Table 4.5: Long-Run Stability: Augmented Vs Benchmark Model

	Augmented Model *LnM=f(LnY, RDIR, **FD**)*			Benchmark Model *LnM=f(LnY, RDIR)*		
Period	CI	SC	HC	CI	AC	HC

1980-2018	CI	No SC	No HC	CI	SC	No HC
1980-2017	CI	No SC	No HC	No CI	No SC	No HC
1980-2016	CI	No SC	No HC	CI	No SC	No HC
1980-2015	CI	No SC	No HC	No CI	SC	HC
1980-2014	CI	No SC	No HC	No CI	AC	HC

4.9 Further Robustness Checks

The empirical money demand function may also include inflation, exchange rate and other related variables. In this study, when the inflation and exchange rate variables were incorporated into the augmented model, although, it can be concluded that there is a long-term relationship between the demand for broad money and its determinants with the inclusion of these two variables, they were ultimately found to be insignificant, and subsequently dropped from the model (see Appendix C). This indicates that these variables are not helpful in explaining the demand for money in Nigeria in the long run. Nevertheless, this is in contrary to the theoretical expectations and the empirical results from a number of previous studies. Finally, it should be noted that this result may potentially arise from multicollinearity problem.

Chapter 5

CONCLUSION

5.1 Discussion

The main objective of this study is to analyze the long-run stability of broad money demand function in Nigeria from 1980 to 2018.

Our results suggest that there is a strong relationship between real money demand, real income, and financial development. The real deposit interest rate was found to be insignificant, which is in line with the existing empirical literatures, e.g. by Tule et al. (2018) for Nigeria. The fact that we failed to establish a statistically significant relationship between interest rates and money demand is worth pointing out because, this could suggest that the financial markets are yet to play an important role in the public's financial decisions. This is obviously an approach that would be worth considering for further studies in the future.

This study augmented the standard (or benchmark) money demand function by incorporating the financial development variable into the benchmark function. The sequential cointegration tests show that the long-run money demand function of Nigeria, augmented with financial development, contains a stable long-run equilibrium relationship throughout the period under consideration.

The stability of broad money demand with the inclusion of the financial development variable may justify the claim that the Central Bank of Nigeria should respond to the changes in financial development carefully while designing and implementing monetary policy. This is the main policy implication for Nigerian policymakers. That is, considering the fact that financial development leads to the growth of the total money demand, it should be one of the main drivers in the formulation and implementation of monetary policy in Nigeria. This is important, given the fact that the CBN has mentioned that ensuring monetary and price stability as well as promoting a sound financial system are parts of its core mandates.

Lastly, it should be noted again that the empirical money demand functions formulated for developing countries usually contain variables like exchange rate and inflation rate, in addition to real income and interest rate; therefore, this study is limited in the sense that the inflation and exchange rate variables were found to be insignificant, and subsequently dropped from the model.

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APPENDICES

Appendix A: Empirical Results Based on Augmented Model

This Appendix presents the empirical results for the augmented model obtained by ARDL method with EViews software.

Table A1. Augmented Model: Long run Form and Bounds Test

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 19:29
Sample: 1980 2018
Included observations: 38

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.945689	1.833956	-2.151464	0.0391
LNM(-1)*	-0.483850	0.167514	-2.888419	0.0069
LNY**	0.573515	0.152044	3.772039	0.0007
RDIR2**	0.002032	0.002176	0.933945	0.3573
FD(-1)	0.024320	0.017397	1.397928	0.1718
D(FD)	0.077220	0.014006	5.513219	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.185315	0.173728	6.822819	0.0000
RDIR2	0.004200	0.005637	0.745144	0.4616
FD	0.050264	0.021214	2.369318	0.0240
C	-8.154770	5.151514	-1.582985	0.1233

EC = LNM - (1.1853*LNY + 0.0042*RDIR2 + 0.0503*FD - 8.1548)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.083303	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	38		Finite Sample: n=40	
		10%	2.592	3.454
		5%	3.1	4.088
		1%	4.31	5.544
			Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816

Note: RDIR2=RDIR, D =Δ=Difference

Table A2. Augmented Model: ECM Form

ARDL Error Correction Regression
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 19:35
Sample: 1980 2018
Included observations: 38

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FD)	0.077220	0.007829	9.862757	0.0000
CointEq(-1)*	-0.483850	0.071756	-6.743039	0.0000

R-squared	0.893545	Mean dependent var	0.026613
Adjusted R-squared	0.890588	S.D. dependent var	0.238051
S.E. of regression	0.078741	Akaike info criterion	-2.194104
Sum squared resid	0.223206	Schwarz criterion	-2.107915
Log likelihood	43.68798	Hannan-Quinn criter.	-2.163439
Durbin-Watson stat	1.688248		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	8.083303	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Appendix B: Sequential ARDL Results

This appendix provides the sequential ARDL results for the augmented and benchmark models from 1980-2018 to 1980-2014 periods.

Table B1. ARDL Results for the Augmented Model [LNM=f(LNY, RDIR2, FD)]: 1980-2018.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 19:29
Sample: 1980 2018
Included observations: 38

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.945689	1.833956	-2.151464	0.0391
LNM(-1)*	-0.483850	0.167514	-2.888419	0.0069
LNY**	0.573515	0.152044	3.772039	0.0007
RDIR2**	0.002032	0.002176	0.933945	0.3573
FD(-1)	0.024320	0.017397	1.397928	0.1718
D(FD)	0.077220	0.014006	5.513219	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.185315	0.173728	6.822819	0.0000
RDIR2	0.004200	0.005637	0.745144	0.4616
FD	0.050264	0.021214	2.369318	0.0240
C	-8.154770	5.151514	-1.582985	0.1233

EC = LNM - (1.1853*LNY + 0.0042*RDIR2 + 0.0503*FD - 8.1548)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.083303	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	38		Finite Sample: n=40	
		10%	2.592	3.454
		5%	3.1	4.088
		1%	4.31	5.544
			Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816

Note: RDIR2=RDIR, D =Δ=Difference

Table B2. ARDL Results for the Benchmark Model [LNM=f(LNY, RDIR2)]: 1980-2018.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(2, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 19:08
Sample: 1980 2018
Included observations: 37

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.461179	2.055773	-2.656508	0.0124
LNM(-1)*	-0.301490	0.091737	-3.286466	0.0025
LNY**	0.460029	0.145019	3.172203	0.0034
RDIR2(-1)	0.003472	0.002679	1.295928	0.2046
D(LNM(-1))	0.360060	0.127914	2.814866	0.0084
D(RDIR2)	0.007869	0.002130	3.695421	0.0008

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.525849	0.126519	12.06025	0.0000
RDIR2	0.011516	0.010031	1.148023	0.2597
C	-18.11395	3.944056	-4.592721	0.0001

EC = LNM - (1.5258*LNY + 0.0115*RDIR2 - 18.1140)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.320502	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	37		Finite Sample: n=40	
		10%	2.835	3.585
		5%	3.435	4.26
		1%	4.77	5.855
			Finite Sample: n=35	
		10%	2.845	3.623
		5%	3.478	4.335
		1%	4.948	6.028

Table B3. ARDL Results for the Augmented Model [LNM=f(LNY, RDIR2, FD)]: 1980-2017.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:34
Sample: 1980 2017
Included observations: 37

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.009690	1.907486	-2.102081	0.0438
LNM(-1)*	-0.475462	0.178471	-2.664083	0.0121
LNY**	0.568017	0.158411	3.585717	0.0011
RDIR2**	0.002096	0.002247	0.932554	0.3583
FD(-1)	0.023501	0.018437	1.274702	0.2119
D(FD)	0.076923	0.014353	5.359374	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.194663	0.191915	6.224952	0.0000
RDIR2	0.004408	0.006042	0.729486	0.4712
FD	0.049428	0.022810	2.166928	0.0380
C	-8.433246	5.693108	-1.481308	0.1486

EC = LNM - (1.1947*LNY + 0.0044*RDIR2 + 0.0494*FD - 8.4332)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.792637	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	37		Finite Sample: n=40	
		10%	2.592	3.454
		5%	3.1	4.088
		1%	4.31	5.544
			Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816

Table B4. ARDL Results for the Benchmark Model [LNM=f(LNY, RDIR2)]: 1980-2017.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(2, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:35
Sample: 1980 2017
Included observations: 36

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.384700	2.085145	-2.582410	0.0149
LNM(-1)*	-0.307252	0.093462	-3.287455	0.0026
LNY**	0.462874	0.146834	3.152356	0.0037
RDIR2(-1)	0.003318	0.002727	1.216926	0.2331
D(LNM(-1))	0.375813	0.132821	2.829465	0.0082
D(RDIR2)	0.007904	0.002156	3.666604	0.0009

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.506497	0.130783	11.51906	0.0000
RDIR2	0.010799	0.009947	1.085685	0.2863
C	-17.52536	4.071866	-4.304012	0.0002

EC = LNM - (1.5065*LNY + 0.0108*RDIR2 - 17.5254)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.139024	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	36		Finite Sample: n=40	
		10%	2.835	3.585
		5%	3.435	4.26
		1%	4.77	5.855
			Finite Sample: n=35	
		10%	2.845	3.623
		5%	3.478	4.335
		1%	4.948	6.028

Table B5. ARDL Results for the Augmented Model [LNM=f(LNY, RDIR2, FD)]: 1980-2016.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:40
Sample: 1980 2016
Included observations: 36

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.778722	2.071070	-1.824527	0.0780
LNM(-1)*	-0.512656	0.216465	-2.368311	0.0245
LNY**	0.594073	0.180946	3.283155	0.0026
RDIR2**	0.001705	0.002599	0.656003	0.5168
FD(-1)	0.027195	0.022106	1.230205	0.2282
D(FD)	0.079293	0.016408	4.832551	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.158814	0.201604	5.747973	0.0000
RDIR2	0.003325	0.006249	0.532179	0.5985
FD	0.053047	0.023143	2.292199	0.0291
C	-7.370874	5.981330	-1.232314	0.2274

EC = LNM - (1.1588*LNY + 0.0033*RDIR2 + 0.0530*FD - 7.3709)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.581678	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	36		Finite Sample: n=40	
		10%	2.592	3.454
		5%	3.1	4.088
		1%	4.31	5.544
			Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816

Table B6. ARDL Results for the Benchmark Model [LNM=f(LNY, RDIR2)]: 1980-2016.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(2, 2, 2)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:46
Sample: 1980 2016
Included observations: 35

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.660249	2.337521	-4.132690	0.0003
LNM(-1)*	-0.467210	0.101592	-4.598892	0.0001
LNY(-1)	0.753255	0.164118	4.589708	0.0001
RDIR2(-1)	0.007106	0.002762	2.572865	0.0161
D(LNM(-1))	0.541924	0.124445	4.354721	0.0002
D(LNY)	-0.260851	0.452891	-0.575968	0.5696
D(LNY(-1))	-0.974405	0.467940	-2.082332	0.0473
D(RDIR2)	0.008361	0.001910	4.377828	0.0002
D(RDIR2(-1))	-0.003141	0.001399	-2.244575	0.0335

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.612239	0.087604	18.40370	0.0000
RDIR2	0.015209	0.006420	2.368862	0.0256
C	-20.67645	2.711123	-7.626524	0.0000

EC = LNM - (1.6122*LNY + 0.0152*RDIR2 - 20.6764)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.010504	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	35		Finite Sample: n=35	
		10%	2.845	3.623
		5%	3.478	4.335
		1%	4.948	6.028

Table B7. ARDL Results for the Augmented Model [LNM=f(LNY, RDIR2, FD)]: 1980-2015.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:53
Sample: 1980 2015
Included observations: 35

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.107345	1.972103	-1.575650	0.1260
LNM(-1)*	-0.544218	0.204163	-2.665606	0.0124
LNY**	0.600848	0.170273	3.528742	0.0014
RDIR2**	0.001309	0.002452	0.533801	0.5975
FD(-1)	0.029875	0.020834	1.433925	0.1623
D(FD)	0.082592	0.015510	5.325211	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.104057	0.164681	6.704221	0.0000
RDIR2	0.002405	0.005255	0.457627	0.6506
FD	0.054894	0.019983	2.747052	0.0102
C	-5.709740	4.881728	-1.169614	0.2517

EC = LNM - (1.1041*LNY + 0.0024*RDIR2 + 0.0549*FD - 5.7097)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.910822	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	35		Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816

Table B8. ARDL Results for the Benchmark Model [LNM=f(LNY, RDIR2)]: 1980-2015.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(2, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:49
Sample: 1980 2015
Included observations: 34

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.913779	1.970952	-2.493099	0.0188
LNM(-1)*	-0.295570	0.090294	-3.273416	0.0028
LNY**	0.436404	0.139080	3.137778	0.0040
RDIR2(-1)	0.002319	0.002592	0.894583	0.3786
D(LNM(-1))	0.460724	0.129678	3.552841	0.0014
D(RDIR2)	0.008407	0.002035	4.131646	0.0003

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.476483	0.139035	10.61950	0.0000
RDIR2	0.007844	0.009430	0.831843	0.4125
C	-16.62478	4.318671	-3.849512	0.0006

EC = LNM - (1.4765*LNY + 0.0078*RDIR2 - 16.6248)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	3.712192	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	34		Finite Sample: n=35	
		10%	2.845	3.623
		5%	3.478	4.335
		1%	4.948	6.028
			Finite Sample: n=30	
		10%	2.915	3.695
		5%	3.538	4.428
		1%	5.155	6.265

Table B9. ARDL Results for the Augmented Model [LNM=f(LNY, RDIR2, FD)]: 1980-2014.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:56
Sample: 1980 2014
Included observations: 34

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.264071	2.032142	-1.606221	0.1194
LNM(-1)*	-0.531530	0.209101	-2.541977	0.0168
LNY**	0.594467	0.173316	3.429956	0.0019
RDIR2**	0.001542	0.002543	0.606211	0.5493
FD(-1)	0.028781	0.021279	1.352532	0.1870
D(FD)	0.081199	0.016051	5.058911	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.118408	0.178387	6.269555	0.0000
RDIR2	0.002901	0.005742	0.505114	0.6174
FD	0.054147	0.021053	2.571932	0.0157
C	-6.140902	5.290997	-1.160632	0.2556

EC = LNM - (1.1184*LNY + 0.0029*RDIR2 + 0.0541*FD - 6.1409)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.691223	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	34		Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816
			Finite Sample: n=30	
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

Table B10. ARDL Results for the Benchmark Model [LNM=f(LNY, RDIR2)]: 1980-2014.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(2, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 09/10/21 Time: 23:58
Sample: 1980 2014
Included observations: 33

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.940402	2.023093	-2.442005	0.0214
LNM(-1)*	-0.294367	0.092662	-3.176773	0.0037
LNY**	0.436166	0.141623	3.079771	0.0047
RDIR2(-1)	0.002397	0.002747	0.872918	0.3904
D(LNM(-1))	0.455945	0.139851	3.260213	0.0030
D(RDIR2)	0.008416	0.002074	4.058590	0.0004

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.481710	0.150914	9.818268	0.0000
RDIR2	0.008145	0.010105	0.805967	0.4273
C	-16.78315	4.674243	-3.590561	0.0013

EC = LNM - (1.4817*LNY + 0.0081*RDIR2 - 16.7832)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	3.564657	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	33		Finite Sample: n=35	
		10%	2.845	3.623
		5%	3.478	4.335
		1%	4.948	6.028
			Finite Sample: n=30	
		10%	2.915	3.695
		5%	3.538	4.428
		1%	5.155	6.265

Appendix C: Empirical Results Based on AEDL Method

This appendix presents the empirical results based on the ARDL method, for the augmented model with the inclusion of inflation and exchange rate variables.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNM)
Selected Model: ARDL(1, 0, 0, 1, 0, 0)
Case 2: Restricted Constant and No Trend
Date: 10/02/21 Time: 14:30
Sample: 1980 2018
Included observations: 38

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.535556	2.004352	-0.766111	0.4496
LNM(-1)*	-0.473816	0.167880	-2.822341	0.0084
LNY**	0.494075	0.157685	3.133312	0.0038
RDIR2**	0.001654	0.002885	0.573487	0.5706
FD(-1)	0.029459	0.017039	1.728905	0.0941
INF**	-0.000489	0.001213	-0.402812	0.6899
LNRER**	-0.058842	0.024389	-2.412669	0.0222
D(FD)	0.073640	0.014277	5.157883	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	1.042757	0.151006	6.905415	0.0000
RDIR2	0.003491	0.006508	0.536467	0.5956
FD	0.062173	0.018487	3.363071	0.0021
INF	-0.001031	0.002704	-0.381406	0.7056
LNRER	-0.124189	0.067515	-1.839416	0.0758
C	-3.240829	4.514387	-0.717889	0.4784

EC = LNM - (1.0428*LNY + 0.0035*RDIR2 + 0.0622*FD -0.0010*INF
-0.1242*LNRER -3.2408)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.310772	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15
Actual Sample Size	38		Finite Sample: n=40	
		10%	2.306	3.353
		5%	2.734	3.92
		1%	3.657	5.256
			Finite Sample: n=35	
		10%	2.331	3.417
		5%	2.804	4.013
		1%	3.9	5.419

Note: RDIR2=RDIR, D =Δ=Difference