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ASYMMETRIC EFFECTS OF EXPECTED OIL WEALTH ON THE DEMAND FOR MONEY IN NIGERIA

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Abstract. The paper investigates the asymmetric effects of expected oil wealth on the demand for money in Nigeria over the period 1986:Q1–2020:Q4, by using linear autoregressive distributed lag (ARDL) and nonlinear ARDL (NARDL) approaches. The linear (ARDL) bounds testing approach shows that expected oil wealth has no significant effect both in the short and long run. However, when a NARDL model is applied, the effect of negative and positive expected oil wealth shocks on the demand for money is significant and unequal in the long run, with a higher long-term impact of negative shocks compared to positive shocks. This result highlights a long-run asymmetry in the transmission of expected oil wealth shocks. Expected oil wealth is thus rather a long-run phenomenon for the Nigerian money demand function.

1. Introduction

Studies on demand for money occupy a substantial part of finance literature. The ever-increasing empirical studies on demand for money can be attributed to its importance in the design and implementation of an optimal monetary policy. Moreover, the stability of the demand for money function is fundamental to the choice of appropriate monetary policy in any economy. In investigating the demand for money, several studies have identified the major determinants including income, domestic and foreign interest rates, exchange rate oil prices, and stock prices[1]. However, none of the existing studies has considered the role of expected oil wealth, especially in oil-rich countries like Nigeria.

The argument in the literature is that oil wealth does affect private behavior albeit, indirectly, through the confidence effect it generates in society. Essentially, oil wealth is perceived by economic agents as untapped wealth or savings that could be accessed in the future. As succinctly put by Vaez-Zadeh (1989):

> The knowledge of the existence of this source of wealth, from which eventually all the inhabitants of the country can be expected to benefit, affects the public's confidence about prospects for future income, leading to adjustment in their permanent income. This will, in turn, have an influence on savings behavior, expenditure patterns, and composition of asset portfolios (p. 346).

In particular, expected oil wealth will likely lead to increasing demand for real balances. However, from the malign perspective that natural resource abundance is a curse rather than a blessing coupled with the poor economic management that leads to inefficient oil resource allocation in Nigeria, it is argued that the 'confidence effect' could be negative with adverse

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[1]Few other studies have found oil price, uncertainty, division of wealth between humans and non-humans, financial innovation, fiscal deficits, urban, rural population among others as drivers of money demand in developing countries (Parveen et al. 2020, Hye, 2009, Oseni & Adesoye 2016).

effects on real money demand. To date, no known study has examined the effect of expected oil wealth on money demand not to talk about its asymmetric effects. There is a need to ascertain the asymmetric effect of expected oil wealth on the demand for money in Nigeria. In other words, we need to know whether negative and positive expected oil wealth have equal or unequal effects on the demand for money in Nigeria in the short and long run. Hence, the objective of this study is to fill this gap by examining the asymmetric effect of expected oil wealth on the demand for money in Nigeria.

The paper is divided into four sections. Section 2 provides a summary of the theoretical and empirical literature. Section 3 discusses the methodology. Section 4 presents the empirical results. Section 5 contains the conclusion.

2. Literature Review

In the literature, there are various theories of demand for money. These theories include transactions, precautionary, and speculative motives [2]. Generally, underlying these theories is examining the nexus between the quantity of money demand and some macro fundamentals that connect money to the real sector of the economy.

Empirical studies on demand for money are quite extensive, and we will not attempt a review of all the articles. Hence, we restrict ourselves to identifying the common features of the few African and Nigerian-related studies on demand for money. The first feature of most studies on money demand function is the inclusion of income, interest rate, and exchange rate as determinants. These studies include, among others, Domotriwizt and Elbadawi (1987), Simmons (1992), Adam (1999), Arize and Swiff (1998), Bahmani-Oskooee and Gelan (2009), Nduka and Chukwu (2013), Bahmani-Oskooee and Kones (2014), Bassey et al. (2017), Bahmani-Oskooee et al. (2019a, b), and El-Rasheed and Bala (2022). In most cases, many of the Africa-related studies reported stable money demand function, particularly with money narrowly defined.

The second feature of a few recent studies of money demand function in Africa is testing for asymmetric effects of such variables as oil price shock and exchange rate using the nonlinear model [3]. Bahmani-Oskooee and Gelan (2009) examined the asymmetric effect of exchange rates on money demand in 18 African countries, while Afangideh et al. (2021) did so for Nigeria.

In Nigeria, several studies have investigated money demand function using either cointegration or Autoregressive Distributed Lag and Nonlinear Autoregressive Distributed Lag (ARDL/NARDL) approaches. These studies include Owoye and Onafowora (2007), Anuruo (2002), Akinlo (2006), Kumar et al. (2013), Tule et al. (2018), Yamden (2011), and Manasseh et al. (2021). A common feature of all empirical studies on money demand is the non-inclusion of expected oil wealth in their models. This is a major lacuna in the existing literature, especially in an oil-rich economy like Nigeria. Hence, this study attempts to address this gap by investigating the asymmetric effect of expected oil wealth on money demand in Nigeria.

3. Methodology

3.1. **Model Specification.** In this work, we specify an open economy variant of the money demand function as applied in most existing studies [4] (Tule et al. 2018, Alsamara and Mrabet 2019, Murad et al. 2021, Barnett et al. 2022). Formally, we specify our estimated model as:

$$mob_t = f(eow_t, gdp_t, ner_t, skp_t, inf_t, int_t) \tag{1}$$

[2]For a comprehensive survey of theories of money demand see Sriram (1999)

[3]Several studies in developed and emerging economies have used the nonlinear autoregressive distributed lag model to examine the asymmetric effect of such variables as exchange rate and oil prices on money demand. These studies include Alsamara et al. (2017) and Mahmood & Alkhateeb (2018) for Saudi Arabia; Adil et al. (2020) and Murad et al. (2021) for India, Bahmani-Oskooee et al. (2019b) for 8 Asian countries, Bahmani-Oskooee et al. (2019a,) for 9 emerging economies and Durmaz and Jie (2024) for Mexico.

[4]Several existing studies have attested to the fact that an open economy money demand function performed well in many countries (Bahmani-Oskooee and Malixi 1991)

Equation (1) is stated explicitly as:

$$mob_t = \alpha_0 + \alpha_1 eow_t + \alpha_2 gdp_t + \alpha_3 ner_t + \alpha_4 skp_t + \alpha_5 inf_t + \alpha_6 int_t + \epsilon_t \tag{2}$$

where *mob* is money supply broadly defined (M2), *eow* is the expected oil wealth. This variable is introduced to test the effect of expected oil wealth on money demand. The estimated coefficient of *eow* is expected to be positive. Gross domestic product (*gdp*), the variable of scale representing the real income, is expected to be positive, while interest rate (*int*) and inflation (*inf*) are expected to be negative [5]. Intuitively, economic agents will hold less cash and more tangible assets to hedge against erosion of the value of their wealth during periods of inflation. The inclusion of interest rate and inflation is based on the fact that interest rates have been liberalized since the early 1980s. Moreover, the financial sector has witnessed relative steady growth and stability over the years. In such an environment, domestic interest rate would be an important opportunity cost of holding financial assets. Inflation is equally incorporated in our model as a measure of opportunity cost against real assets. This variable is particularly important given the high and rising level of inflation in Nigeria over the years. The nominal exchange rate variable (*ner*) is included to account for currency substitution. The coefficient can be negative or positive, depicting either currency substitution effect or wealth effect depending on the relative strength of the income and substitution effect (Friedman 1988 and Adil et al. 2020). A positive nominal exchange rate coefficient signals currency substitution effect because changes in nominal exchange rate (*ner*) impact broad money through changes in expectations rather than the wealth effect. Thus, a positive sign of the nominal exchange rate reflects the appreciation of the domestic currency (Naira). By implication, Nigerians will hold more Naira as compared to the dollar due to the expectation of further appreciation of the domestic currency. The reverse is the case for wealth effect.

The variable *skp* is the real stock prices, and the coefficient can be positive or negative depending on the relative strengths of income and substitution effect. The inclusion of real stock prices in the money demand function for Nigeria is justified by the rapid growth and diversification of the capital market, particularly equities, over the past 40 years. Indeed, investment in stocks and shares has constituted a viable alternative form of holding wealth in Nigeria.

Following Pesaran et al. (2001), the unrestricted error correction version of Equation (2) is given as:

$$\begin{aligned}\Delta mob_t =& \delta_0 + \delta_1 mob_{t-1} + \delta_2 eow_{t-1} + \delta_3 gdp_{t-1} + \delta_4 ner_{t-1} + \delta_5 skp_{t-1} + \delta_6 inf_{t-1} \\ &+ \delta_7 int_{t-1} + \sum_{i=1}^{n} \beta_1 \Delta mob_{t-i} + \sum_{i=0}^{p} \beta_2 \Delta eow_{t-i} + \sum_{i=0}^{q} \beta_3 \Delta gdp_{t-i} \\ &+ \sum_{i=0}^{r} \beta_4 \Delta ner_{t-i} + \sum_{i=0}^{s} \beta_5 \Delta skp_{t-i} + \sum_{i=0}^{q} \beta_6 \Delta inf_{t-i} + \sum_{i=0}^{v} \beta_7 \Delta int_{t-i} + \epsilon_t\end{aligned} \tag{3}$$

To account for asymmetries, the expected oil wealth is decomposed into positive and negative partial sums (eow_t^+, eow_t^-) following Shin et al. (2014). The partial sums are generated as shown in Equation (4):

$$\begin{aligned} eow_t^+ &= \sum_{j=1}^{m} \Delta eow_j^+ = \sum_{j=1}^{m} \max(\Delta eow_j, 0) \\ eow_t^- &= \sum_{j=1}^{m} \Delta eow_j^- = \sum_{j=1}^{m} \max(\Delta eow_j, 0) \end{aligned} \tag{4}$$

[5]However, the two variables can be positive. Interest rate can be positive if the (interest) income effect outweighs the substitution effect (see Bahmani-Oskooee and Maki-Nayeri 2018). Likewise, the coefficient of inflation can be positive if the current inflation is perceived as a pointer to a future rise in prices.

According to Shin et al. (2014), substituting (4) into the linear unrestricted error correction model given as Equation (3), we obtain a nonlinear ARDL (NARDL) explicitly stated as:

$$\begin{aligned}\Delta mob_t =& \delta_0 + \delta_1 mob_{t-1} + \delta_2^+ eow_{t-1}^+ + \delta_3^- eow_{t-1}^- + \delta_4 gdp_{t-1} + \delta_5 ner_{t-1} + \delta_6 skp_{t-1} \\ &+ \delta_7 inf_{t-1} + \delta_8 int_{t-1} + \sum_{i=1}^{z} \beta_1 \Delta mob_{t-i} + \sum_{i=0}^{w} \beta_2 \Delta gdp_{t-i} \\ &+ \sum_{i=0}^{x} \beta_3 \Delta ner_{t-i} + \sum_{i=0}^{r} \beta_4 \Delta skp_{t-i} + \sum_{i=0}^{y} \beta_5 \Delta inf_{t-i} \\ &+ \sum_{i=0}^{d} \beta_6 \Delta int_{t-i} + \sum_{i=0}^{s} (\beta_7^+ eow_{t-i}^+ + \beta_7^- eow_{t-i}^-) + \mu_t \end{aligned} \tag{5}$$

where z, w, x, r, y, d, and s denote the lag orders, while (eow^+, eow^-) represent the decomposed eow innovations as earlier defined. These innovations, as included in Equation (5), are used to ascertain short- and long-run asymmetric responses of money demand to changes in expected oil wealth.

To ascertain the long-run asymmetric effect of the expected oil wealth changes in Equation (5), we employ the Wald test with the null hypothesis $\delta_2^+ = \delta_3^-$. The long-run impacts of positive expected oil wealth (eow^+) and negative expected oil wealth (eow^-) on money demand are obtained as $\beta^+ = -(\delta_2^+/\delta_1)$, $\beta^- = -(\delta_3^-/\delta_1)$, respectively. In contrast, we employ the Wald test to verify the asymmetric effect of the expected oil wealth in the short run. The null hypothesis of this test is: $\beta_7^+ = \beta_7^-$.

The last step entails the use of the nonlinear ARDL model in Equation (5) to generate the two dynamic multipliers, m_h^+ and m_h^-. The dynamic multiplier m_h^+ relates to the change in eow_t^+ while m_h^- is connected with the change in eow_t^-:

$$m_h^+ = \sum_{i=0}^{h} \frac{\partial mob_{t+i}}{\partial eow_{t-1}^+}, \quad m_h^- = \sum_{i=0}^{h} \frac{\partial mob_{t+i}}{\partial eow_{t-1}^-}, \quad h = 0, 1, 2 \tag{6}$$

Note that as $h \to \infty$, $m_h^+ \to \beta^+$ and $m_h^- \to \beta^-$.

Next, the unit root properties of the variables are ascertained to preclude the inclusion of $I(2)$ variables [6]. Following this, we conduct a cointegration test. This involves testing the null hypothesis of no cointegration ($H_0 : \delta_1 = \delta_2 = \ldots = \delta_8 = 0$) against an alternative hypothesis ($H_1 : \delta_1 \neq \delta_2 \neq \ldots \neq \delta_8 \neq 0$) using the F-test. The variables are cointegrated when the computed value of the F-statistic falls outside the upper critical value of the two sets of critical values provided by Pesaran et al. (2001).

4. Empirical Results

The result of the cointegration test shows that the F-statistic values (F-pss = 4.933) for linear and (F-pss = 6.599) for nonlinear models lie above the upper bound of the critical values at a 5

The results of the linear model are presented in Table 2. The results show that the coefficient of lagged money supply (mob) is significant ($\beta = -0.995, \rho$-value = 0.034). Income carries an expectedly positive effect and significant coefficient in the long run. It supports the transaction demand for money. However, in the short run, the coefficient of income is negative and significant, especially in the second and third quarters. Inflation has a significant negative effect in the long run but a positive in the short run. The coefficient of the stock prices is positive and

[6]The results of ADF and Phillips-Perron unit root tests show that none of the variables is I(2). We do not report them here for space consideration.

TABLE 1. Bounds test for cointegration in the linear and nonlinear specifications

Dependent Variable: Δmob	**F-PSS**	**95% Lower bound**	**95% Upper bound**	**Result**
Linear ARDL	4.933	2.27	3.28	Cointegration
Non-Linear ARDLa	6.599	2.17	3.21	Cointegration
Non-linear ARDL with the imposed short-run symmetric	6.77	2.17	3.21	Cointegration

Bound test at 5%.

a The exact specification of the asymmetric ARDL model is presented in Tables 5 and 6.

F-PSS indicates the PSS F-Statistic testing the model hypothesis of no cointegration.

significant in the long run. This confirms the wealth effect, meaning that a rise in stock prices leads to an increase in money demand.

TABLE 2. Results of Linear Model

Variable	**Coefficient**	**t-statistics**	**P-value**
Constant	-0.995	-2.150	0.034
mob_{t-1}	-0.021	-1.134	0.259
eow_t	-0.041	-1.794	0.075
gdp_{t-1}	1.112**	2.356	0.020
ner_t	-0.013	-0.599	0.550
skp_t	0.046***	2.941	0.004
inf_{t-1}	-0.060***	-2.942	0.004
int_t	0.00001	0.008	0.994
Δmob_{t-1}	-0.146	-1.639	0.104
Δmob_{t-2}	-0.008	-0.086	0.932
Δmob_{t-3}	-0.198**	-2.190	0.031
Δgdp_t	0.071	1.041	0.300
Δgdp_{t-1}	-0.024	-0.355	0.724
Δgdp_{t-2}	-0.138**	-2.008	0.047
Δgdp_{t-3}	-0.061**	-2.556	0.012
Δinf_t	0.156	2.197	0.030
Statistics and diagnostic tests			
X^2_{Norm}	30.962(0.000)	X^2_{Het}	0.090(0.764)
X^2_{SC}	1.991(0.370)	X^2_{FF}	0.518(0.473)

Note: *** and ** indicate significance levels for 1% and 5%, respectively.

χ^2_{SC}, χ^2_{HET}, χ^2_{NORM} and χ^2_{FF} refer to LM test for serial correlation, normality, functionality form, and heteroscedasticity, respectively.

Concentrating on the variable of concern, the expected oil wealth, it has no short-run or long-run significant effects on the demand for money in Nigeria. Could this be attributed to avoiding nonlinear adjustment of the expected oil wealth or assuming a symmetric effect? To answer this question, we estimate the nonlinear ARDL model (Equation 5). The estimated results are shown in Table 3. The results show the acceptance of the alternative hypothesis in the long run, meaning that money demand responds differently to a decrease as compared to an increase in expected oil wealth. Specifically, the value of the Wald test is equal to 14.612 and significant at the 5% level.

In contrast, the short-run results suggest the rejection of the alternative hypothesis implying that expected oil wealth increase or decrease has the same impact on real demand for money in the short run. The Wald test shows a value of 0.0004 and is statistically not significant meaning that there is no asymmetric effect for expected oil wealth in the short run.

Arising from the results, the asymmetry in the effect of expected oil wealth shock on real money demand is a long-run rather than a short-run phenomenon in Nigeria. Thus, the best way to model the dynamic interactions between expected oil wealth and real money demand is NARDL which allows for long-run asymmetry with short-run symmetry.

Table 3. NARDL Estimation Results

Variable	**Coefficient**	**t-statistics**	**P-value**
Constant	-0.127	-0.161	0.872
mob_{t-1}	-0.064***	-3.094	0.003
eow^{+}_{t-1}	0.036	1.149	0.253
eow^{-}_{t-1}	-0.158***	-4.321	0.000
gdp_{t-1}	0.096**	2.024	0.045
ner_t	-0.094***	-3.194	0.002
skp_t	0.051***	3.361	0.001
inf_{t-1}	-0.156***	-5.002	0.000
int_t	-0.001	-0.385	0.701
Δeow^{+}_{t}	-0.010	-0.137	0.891
Δeow^{-}_{t}	-0.0125	-1.193	0.848
Δmob_{t-1}	-0.162*	-1.909	0.059
Δmob_{t-2}	-0.075	-0.858	0.393
Δmob_{t-3}	-0.263***	-3.021	0.003
Δgdp_t	0.056	0.852	0.396
Δgdp_{t-1}	-0.040	-0.633	0.528
Δgdp_{t-2}	-0.145**	-2.235	0.027
Δgdp_{t-3}	-0.067	-2.967	0.004
Δinf_t	0.153	2.219	0.029
Long run (LR) asymmetric coefficient			
LR^{+}_{eow}	0.571	(0.179)	
LR^{-}_{eow}	-2.470***	(0.004)	
Long and Short run symmetry tests			
$W_{LR,eow}$	14.612***	(0.0002)	
$W_{SR,eow}$	0.0004	(0.490)	
Statistics and diagnostic tests			
X^2_{Norm}	16.997 (0.0002)	X^2_{Het}	0.025 (0.875)
X^2_{SC}	0.973 (0.615)	X^2_{FF}	3.605 (0.165)

Note: *, **, and ***, indicate significance levels for 10%, 5%, and 1%, respectively.

W_{LR} and W_{SR} are Wald tests for the null of long and short-run symmetry, respectively.

χ^2_{SC}, χ^2_{NORM}, χ^2_{HET} and χ^2_{FF} symbolize LM test for serial correlation, normality, functional form, and heteroscedasticity, respectively.

Table 4 presents the estimation results with imposed short-run symmetry and allowance only for long-run asymmetries. The empirical results reveal that the long-run equilibrium of money demand behavior is explained by both the scale and opportunity cost variables namely, income, nominal exchange rate, stock prices, and inflation. The short-run dynamics of money demand are described by the lagged value of real money demand, lagged value of real income, and inflation. The results provide evidence of insignificant symmetric short-run dynamics and significant long-run asymmetric effects of expected oil wealth shocks. The coefficient of positive partial sums of expected oil wealth (eow^{+}) is positive but insignificant at 5%, while that of the negative partial sums decompositions is negative and significant at the 1% level. This outcome suggests that a decrease in expected oil wealth will decrease the demand for real money balances. Income has a positive effect on real money demand in the long run with an insignificant effect in the short run except in the second lag. The coefficient of the nominal exchange rate is negative in the long run supporting the substitution effect. However, stock

prices have a positive coefficient supporting the wealth effect in the literature. Inflation has a significant negative effect in the long run but a positive in the short run [7]. The significant negative effect of inflation on money demand shows that Nigerians will hold less cash and more other assets to hedge against inflation in the long run. The results show clearly that the inflation rate serves as the opportunity cost of holding money more than the interest rate since it carries a significant negative coefficient. The result is consistent with the findings of Bahmani-Oskooee and Arize (2020) for 13 African countries and Bahmani-Oskooee and Gelan (2019) for 18 African countries.

The long-run coefficient of positive change in expected oil wealth (eow^+) is 0.571, while the negative is -2.47. This result shows that a 1% positive change in expected oil wealth will lead to a 0.571% increase in demand for real money balances. However, the coefficient is not significant. Likewise, a 1% downward movement in expected oil wealth will lead to a 2.47% reduction in money demand. The result reveals that positive expected oil wealth stimulates increased demand for real balances, which is consistent with Friedman's (1959) hypothesis that demand for real balances depends on permanent rather than actual income. However, the coefficient is not significant. In contrast, negative expected oil wealth reduces demand for real balances. This outcome possibly means that a downward movement in expected oil wealth leads to a reduction in private consumption and hence, a reduction in demand for real balances.

The diagnostic tests, reported in the lower panel of tables 2, 3 and 4, reveal that the residuals of the estimated linear and nonlinear model (unrestricted and restricted) pass all the diagnostic tests. This confirms well-specified estimated models. The stability of the estimated coefficients ascertained using cumulative sum (CUSUM) test confirm model stability. The results as shown in figs. 1 for the linear model, figs. 3 for the unrestricted nonlinear model, and figs. 5 for restricted model confirm the stability of the coefficients of the models. However, the statistic for CUSUMQ in figs. 4 and 6 is not completely stable as the statistic was out of the critical bounds especially between 2008 and 2010. A plausible reason for this occurrence could be the 2008-2009 global financial crisis experienced that led the Central Bank of Nigeria (CBN) to introduced major structural changes during this period. These changes were targeted at various monetary aggregates that both the CBN and commercial banks were expected to comply with to maintain stability of the financial system.

Shin et al.'s (2014) dynamic multiplier shows how money demand adjusts asymmetrically to the long-run equilibrium owing to positive and negative shocks in the expected oil wealth. This dynamic effect is shown in figs. 7 and 8 for unrestricted and restricted nonlinear models, respectively. The size of negative and positive shocks is on the vertical axis, while the horizontal axis represents the period. The continuous blue and parrot green lines indicate positive and negative shocks, respectively, and show the effects on money demand caused by 1% positive/ negative shocks on the expected oil wealth. The two lines reveal the asymmetric adjustment to negative and positive shocks at a given forecast, respectively. The adjustment pattern shows asymmetry because negative shocks to the expected oil wealth have a greater influence on money demand than a positive shock to the expected oil wealth. This means that a reduction in the expected oil wealth has a greater impact on money demand than an expansion in the expected oil wealth [8].

[7]The significant positive effect of inflation rate on the money demand in the short run could be due to the fact since Nigeria's inflation rate has been at a high rise, the people's expectations about Nigeria's inflation have been high such that when inflation rate increases, people were more inclined to hold more cash to buy goods and services in the short run.

[8]To robust check these results, we use narrow definition of money (M1) as dependent variable. The results obtained are similar to those reported in this paper except in the magnitudes of the coefficients. However, in contrast to results from broad definition of Money, the CUSUM and CUSUMQ tests confirm stability of the model in the case narrow definition of Money (M1).

Table 4. NARDL Estimation with only long-run asymmetries

Variable	Coefficient	t-statistics	P-value
Constant	-0.131	-0.174	0.862
mob_{t-1}	-0.064***	-3.125	0.002
eow^{+}_{t-1}	0.036	1.185	0.239
eow^{-}_{t-1}	-0.158***	-4.421	0.000
gdp_{t-1}	0.096**	2.058	0.042
ner_t	-0.094***	-3.306	0.001
skp_t	0.051***	3.409	0.001
inf_{t-1}	-0.155***	-5.113	0.000
int_t	-0.001	-0.386	0.701
Δeow_t	-0.011	-0.3087	0.759
Δmob_{t-1}	-0.162*	-1.918	0.058
Δmob_{t-2}	-0.075	-0.862	0.391
Δmob_{t-3}	-0.264***	-3.041	0.003
Δgdp_t	0.056	0.856	0.394
Δgdp_{t-1}	-0.040	-0.636	0.526
Δgdp_{t-2}	-0.146**	-2.252	0.027
Δgdp_{t-3}	-0.068	-2.987	0.003
Δinf_t	0.153	2.270	0.025
Long run (LR) asymmetric coefficient			
LR^{+}_{eow}	0.571	(0.179)	
LR^{-}_{eow}	-2.470***	(0.0042)	
Long symmetry tests			
$W_{LR,eow}$	16.074***	(0.0001)	
Statistics and diagnostic tests			
X^2_{Norm}	16.823 (0.0002)	X^2_{Het}	0.023 (0.880)
X^2_{SC}	0.947 (0.623)	X^2_{FF}	3.525 (0.172)

Note: *, **, and ***, indicate significance level for 10%, 5%, and 1%, respectively.

W_{LR} is Wald test for the null of long-run symmetry.

χ^2_{SC}, χ^2_{NORM}, χ^2_{HET} and χ^2_{FF} symbolize LM test for serial correlation, normality, functional form, and heteroscedasticity, respectively.

5. Concluding Remarks

Although theoretical and empirical literature on oil (prices and revenue) and demand for money are growing, the expected oil wealth effect-demand for money nexus has not been addressed at all in the literature. To date, no known study has explored how expected oil wealth affects the demand for real balances. Thus, our study fills this lacuna by examining the symmetric and asymmetric effects of expected oil wealth on the demand for money in Nigeria for the period 2006(1) to 2020(4). The paper employed the linear and nonlinear ARDL approaches.

The estimated linear and nonlinear ARDL show that broad money, income, interest rate, exchange rate, stock prices, and expected oil wealth are cointegrated. However, our variable of concern, expected oil wealth has no short-run or long-run significant effect. Therefore, we further examine the nonlinear ARDL developed by Shin, et al (2014). The estimated results from nonlinear ARDL confirm short-run symmetry and long-run asymmetric. This simply means that the best way of modeling the dynamic interactions between expected oil wealth and the real demand for money is NARDL which allows for long-run asymmetry with short-run symmetry. Our results reveal that the long-run equilibrium of money demand behavior is mainly explained by income, negative expected oil wealth, nominal exchange rate, stock prices, and inflation rate. The short-run dynamics of money demand are determined by lagged broad money, lagged income, and inflation rate.

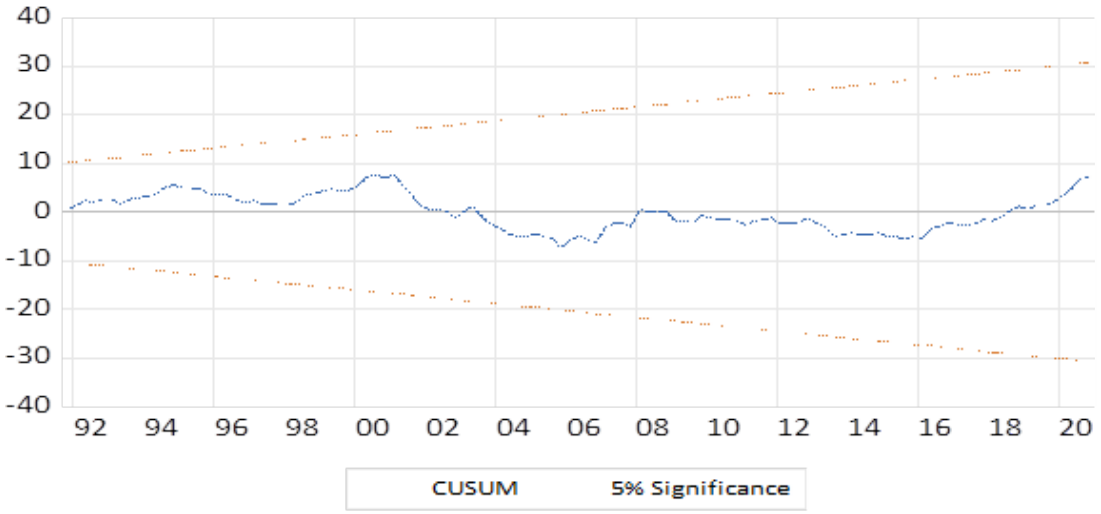

FIGURE 1. Plot of CUSUM test for the linear ARDL model

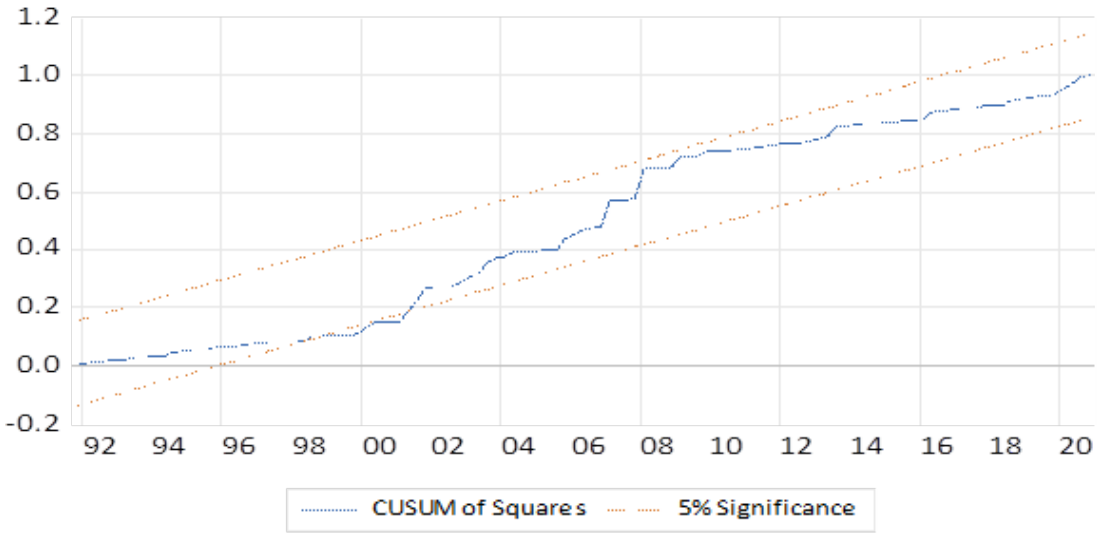

FIGURE 2. Plot of COSUMQ test for the linear ARDL model

The coefficient of positive partial sums decompositions of expected oil wealth (eow+) is positive, while the negative partial sums decompositions (eow-) is negative and significant at 1% level. This shows that positive expected oil wealth will lead to an increased demand for real money balances though not significant, negative expected oil wealth will reduce the demand for real money balances. The long-run coefficient of positive and negative changes in the expected oil wealth are 0.571 and -2.47, respectively. By implication, a 1% increase in expected oil wealth leads to 0.571% rise in demand for real money balances. In contrast, a 1% reduction in expected oil wealth will lead to a 2.47% reduction in demand for real money balances. It clearly shows that the reduction in demand for real money balances precipitated by negative expected oil wealth far exceeds the increased demand for real balances caused by positive expected oil wealth.

Few policy inferences can be drawn from our results. One, the confirmation of cointegration among the variables means that using the elasticity estimates from the M2 function will assist to provide more reliable estimates of future money balances in Nigeria. Two, since the money

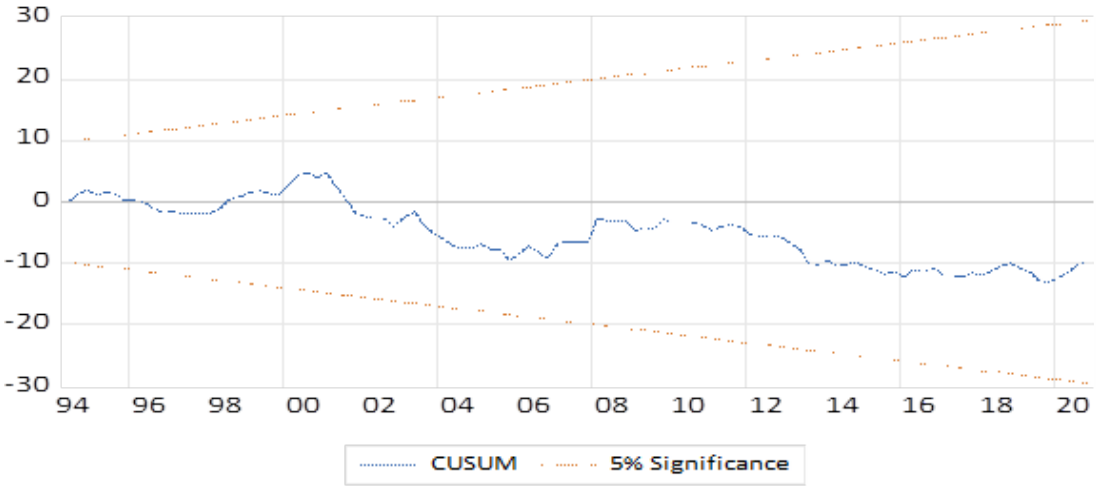

FIGURE 3. Plot of CUSUM test for the nonlinear ARDL model

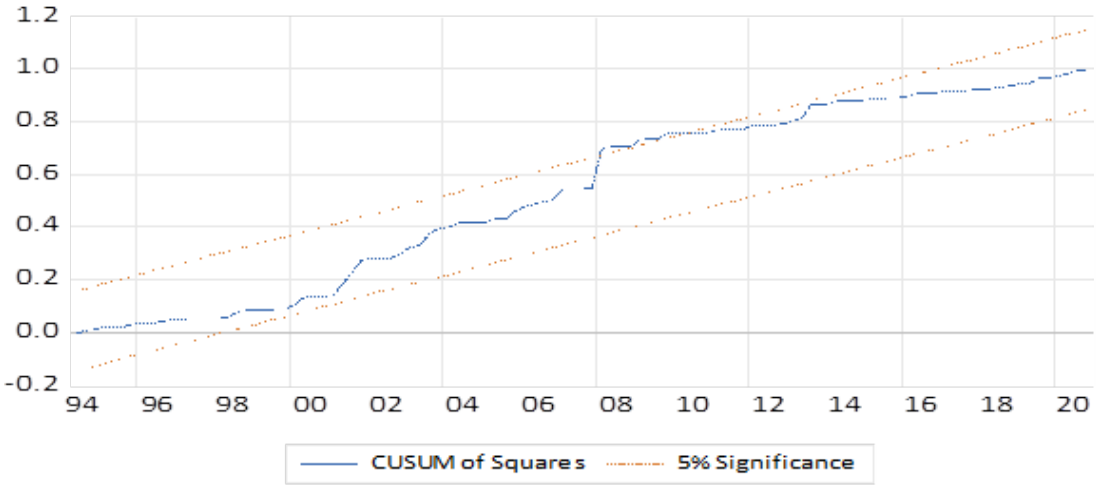

FIGURE 4. Plot of CUSUMQ test for the nonlinear ARDL model

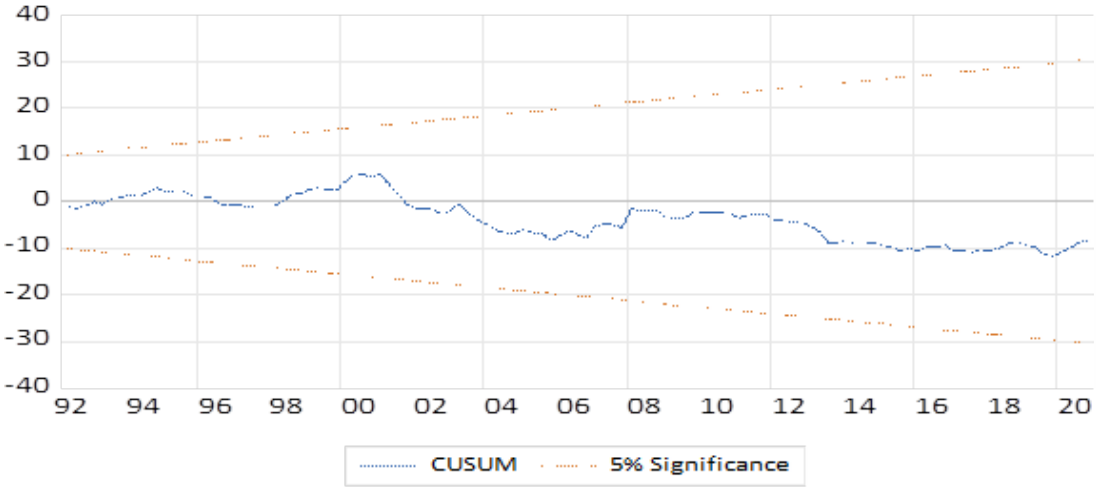

FIGURE 5. Plot of CUSUM test for the nonlinear ARDL model for long-run asymmetry only

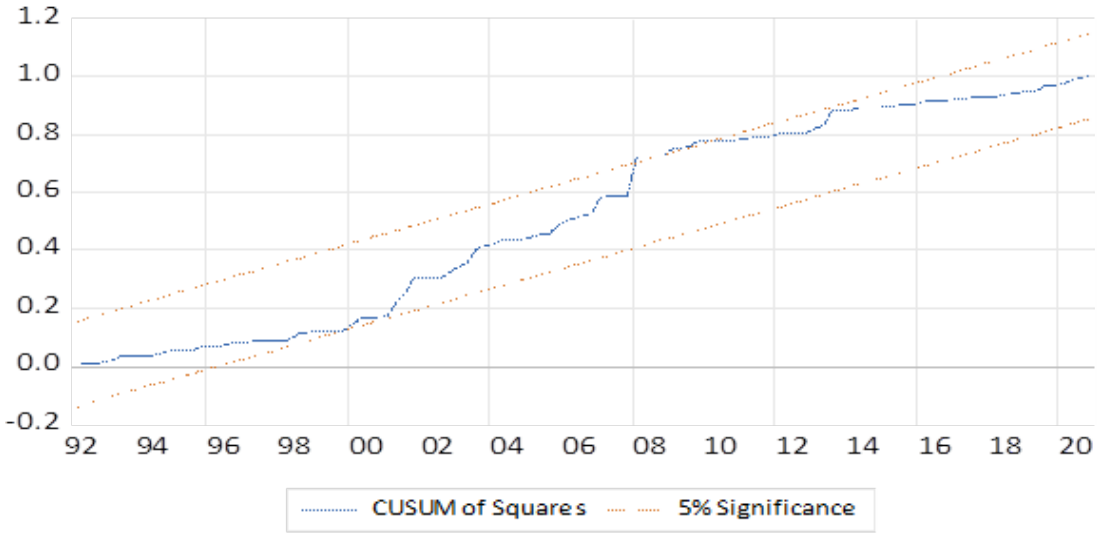

FIGURE 6. Plot of CUSUMQ test for the nonlinear ARDL model for long-run asymmetry only

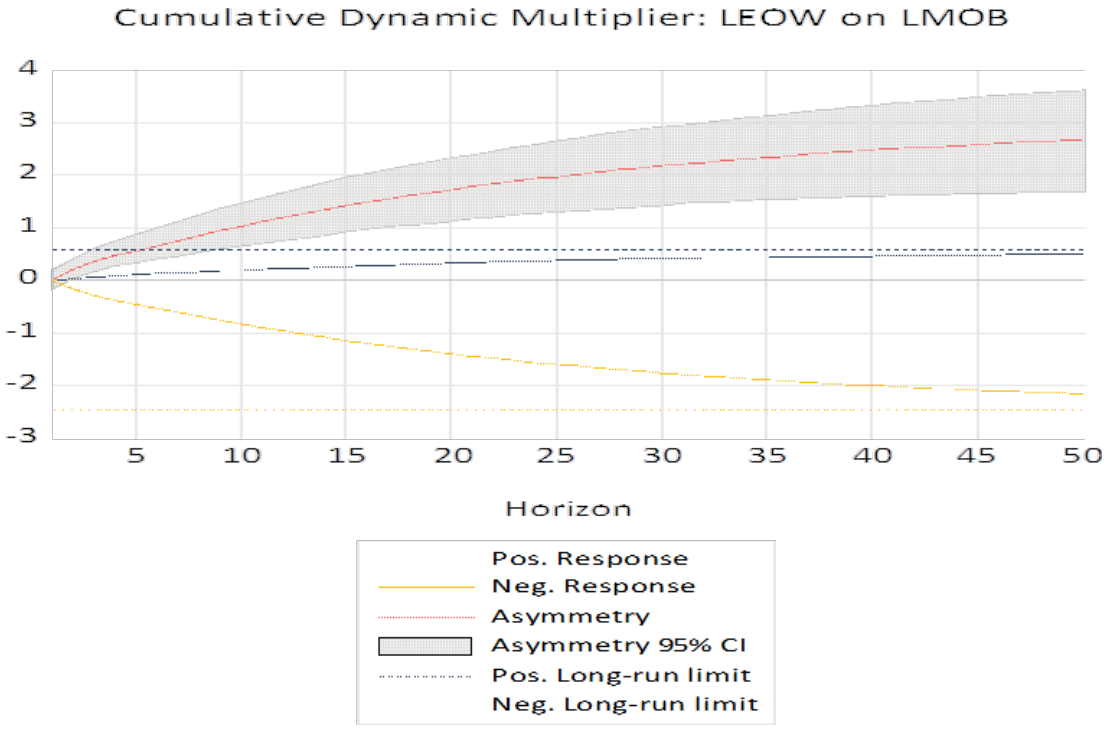

FIGURE 7. Cumulative dynamic multipliers for the unrestricted model

demand function is not completely stable based on the CUSUMQ test, the monetary authorities in Nigeria cannot rely on the use of money supply as a monetary policy instrument. Three, the income elasticity is positive but very small. This simply means that Friedman's rule is not optimal in the case of Nigeria. This suggests that the view of the monetary economists who advocate that money supply and output should be allowed to grow at the same rate cannot hold in the case of Nigeria. Four, the coefficient of inflation is negative and significant in the long run. Inflation performs better than interest rate as the opportunity cost of holding money. Arising

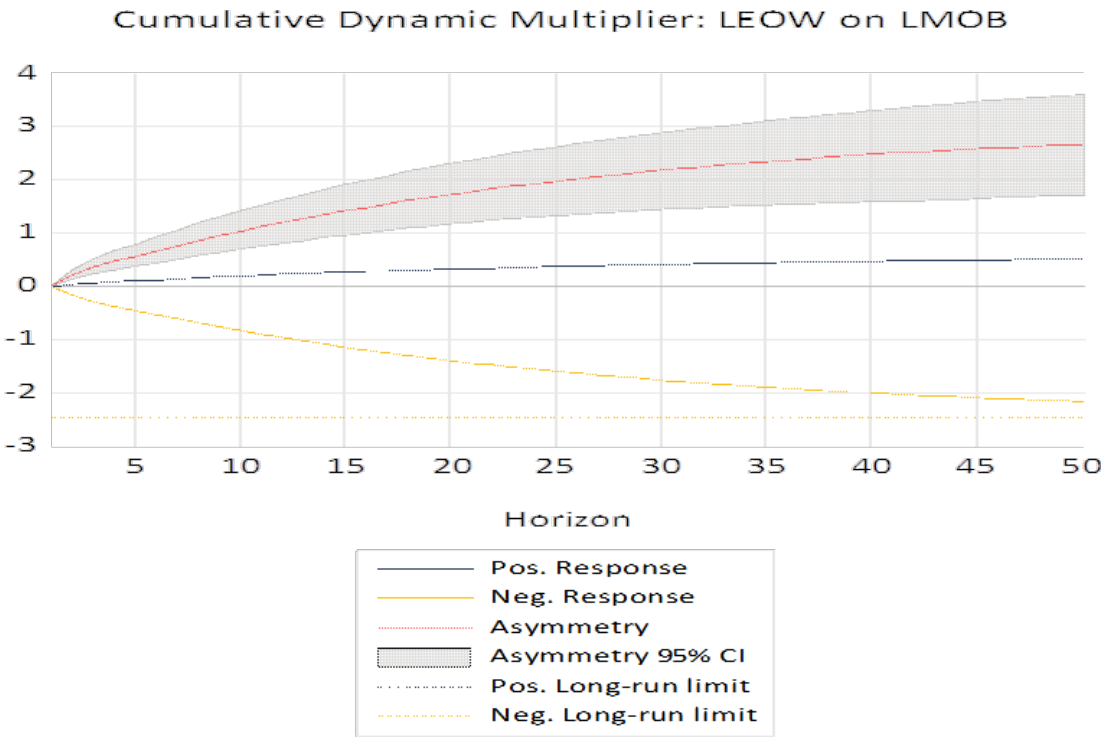

FIGURE 8. Cumulative dynamic multipliers for the restricted model

from this, money demand model should in Nigeria should include inflation rate. Moreover, the policy of inflation targeting by the Central Bank of Nigeria should be vigorously pursued. Five, the coefficient of exchange rate is negative, which implies that as Naira appreciates, the demand for M2 reduces possibly supporting the substitution effect argument in the literature. Six, the performance of real stock prices in the model shows that asset prices, most especially equity prices, is important for monetary policy in Nigeria. Hence, the Central Bank of Nigeria needs to pay more attention to asset prices in the conduct of monetary policy. A major area future research is investigating the various channels through which the large fuel subsidy impact money demand in Nigeria. Moreover, the effects of such variables as housing and land prices on the demand for money need to be explored as soon as data are available on them in Nigeria.

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Appendix A

A.1. Source of Data.

- Source (a): International Financial Statistics, IMF
- Source (b): CBN, Statistical Bulletin, Nigeria
- Source (c): OPEC, Annual Statistical Bulletin

A.2. Description and Measurement of Variables.

- **mob**: Real money supply broadly defined (M2). Narrow money (M1) plus quasi money. The real value is obtained by deflating nominal by CPI.
- **gdp**: Real gross domestic product. Nominal GDP deflated by CPI.
- **ner**: Nominal exchange rate.
- **int**: Interest rate.
- **inf**: Inflation rate.
- **skp**: Stock price.
- **eow**: Expected oil wealth. The expected oil wealth is generated following the approach of Vaez-Zadeh (1989). The value is generated by the relationship $\mathrm{EOW}_t = \mathrm{OP}_{t-1} \times \mathrm{OS}_t$, where EOW is expected oil flow, OP_{t-1} is oil price lagged one period, and OS_t is the stock of proven oil reserves at time t. The stock of oil for other periods is obtained using the standard perpetual inventory model.