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Article

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MONEY SUPPLY AND INFLATION IN A GROWING ECONOMY: THE NIGERIAN EXPERIENCE

Abeng, Magnus Okoi; Itodo, Idoko Ahmed and Nwafor, Nwamaka Georgina¹

Abstract

This study revisited the traditional money supply - inflation nexus, presented in Fisher's equation, but relaxed its basic assumption of constant level of output, within the context of the Nigerian economy. The idea was to reveal the level of asymmetry in this relationship under conditions of varying levels of economic growth, at every given level of money supply growth. The study drew inferences from the estimate of a two-regime Threshold Autoregressive Distributed Lag (TARDL) Model, and concluded that, while money supply has positive and statistically significant impact on inflation during periods of "low economic growth", the impact is, however, negative and statistically significant in a regime of "high economic growth".

KEYWORDS: Money Supply, Inflation, Economic Growth, Regime-switching, Threshold Regression.

JEL CLASSIFICATION: C24, C50, E31, E51 E52.

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1.0 INTRODUCTION

A growing economy is characterised by poverty reduction, employment generation, and improved standard of living, among others. In the macroeconomic literature, several factors, including the effective management of money supply and moderate inflation, have been identified as the prime facilitators in the economic growth process (Kaldor, 1959; Moser, 1995; Levine, 1977; Gosh and Philips, 1998; Lucas, 2000; and Teriba, 2006), even though the direction and magnitude of the impact has remained a subject of debate. Two major protagonists in this debate are the structuralists school of thought, led by Tobin (1965) and the monetarists, led by Friedman (1956). To the structuralists, some level or threshold of inflation (in an environment of macroeconomic stability) is necessary and essential to foster economic growth, as it brings about price and wage flexibility (Lucas, 1973; Gregorio, 1993; and Khan and Senhadju, 2001). The monetarists, on the other hand, consider inflation as a negative and inhibitor of economic growth. They contend that apart from adversely distorting the allocation of resources and interfering with the economy's efficiency, inflation heightens uncertainty about future profitability of investments, reduces a country's international competitiveness by making exports relatively more expensive, and twists domestic credit (Mallik and Chowdhury, 2001; Bruno and Easterly, 1998; and Kremer, et al., 2009).

Given these divergent views, it behoves economic managers to strive to achieve and maintain the delicate balance of keeping money supply at a level consistent with the overall goal of attaining non-inflationary economic growth. This implies maintaining an optimal quantum of money supply in the system (threshold) that would promote and ensure sustained output growth without compromising the general price level. The achievement of this threshold depends largely on the nature and structure of the economy and the prevalent credit and monetary policy regimes in operation. To achieve this balance, researches have employed several techniques to understand the money supply, inflation and economic growth relationship, taking into consideration the peculiarities of the economy in question [De Gregario (1992), Barro (1995), Bruno and Easterly (1998), Paul et al. (1997) and Sattarov, 2011)].

In Nigeria, several studies have attempted to examine the nexus between inflation, money supply and economic growth. Some of these studies focused on assessing the short-run impact, while others considered how monetary policy influences the long-run behaviour of economic growth trajectory (for example, Taiwo (2011), Adesoye (2012), and Osuala et al., (2013)). Furthermore, most of these studies estimated inflation threshold using such methods as ECM, ARIMA, VAR and ARDL, (Doguwa, 2012; Salami and Kelikume 2010; Umaru and Zubairu, 2012; Bassey and Onwioduokit, 2011; Bawa and Abdullahi; 2012; and Adeleke, 2012).

This study differs from others in two significant perspectives. First, we relax the basic assumption of constant level of output associated with the traditional Fisher's money supply-inflation nexus equation, a common feature in previous studies. This modification enables the determination of asymmetry in the relationship under different levels of money supply changes. Second, we use a two-regime Threshold Autoregressive Distributed Lag (TARDL) model, which has the advantage of determining the impact of various lags of different regressors on a given regress and, compared with the traditional linear ARDL technique (Lanne and Saikkonen, 2002). Thus, this study investigates the impact of money supply on inflation in Nigeria under the condition of changing level of output.

The rest of the study is structured as follows. Following the introduction, section two briefly reviews relevant extant theoretical and empirical literature. Section three presents the methodology where the data and technique of analysis are discussed, while Section four presents the results. Section five covers robustness checks while section six contains the conclusion, policy implications and recommendations.

2.0 LITERATURE REVIEW

2.1 Theoretical Review

Fisher (1922, 1993) developed the traditional quantity theory of money (QTM) which simply explains that the greater the money supply, the higher the price level and vice versa, amid some assumptions. These include: constant velocity of money and output, transactions take place through money and full-employment. However, Keynes (1956) argued that the quantity of money is determined by purchasing power or aggregate demand only. Keynes also observed that velocity and output vary, thus implying the quantity of money can hardly drive prices. Also, Marx (2000) proposed that the quantity of money is instead a function of the total amount of goods produced. Thus, Marx, Keynes and Fischer highlighted different drivers of prices. Marx (2000) emphasised production, Keynes emphasised income and demand while Friedman emphasised the quantity of money. A further proposition to the quantity theory of money is with regards to the 'Fiscal theory of price level', proposed by Leeper (1991). This explained that the government's fiscal policy affects the price level through government finances (expenditure).

Largely, the famous dictum - *Inflation is always and everywhere a monetary phenomenon* - by Friedman (1956) summarises the relationship between money supply and inflation through the quantity theory of money (QTM), in that, a necessary condition for sustained inflation is a sustained increase in the quantity of money. This gives further backing to the theoretical foundations of the QTM, which has two variants, the Transaction Approach which was proposed by Fisher, and the Cash Balance Approach (CBA) which describes the popular Cambridge economist's² version. The transaction and cash balance approach to the Quantity Theory of Money are specified below.

2.1.1 The Transaction Approach

Following the spirit of classical monetary theory, this section specifies a monetary model of inflation that relates inflation and money growth. The QTM is most commonly stated as:

$$MV = PY \dots\dots\dots (2.1)$$

which holds after full-employment, where M is the currency and other forms of money in circulation (M1, M2, M3), V is the velocity of money, which is the number of times money changes hands, P is the prevailing price level and Y is the total volume of goods and services produced in an economy (GDP). The left-hand side of the equation represents money supply while the right-hand side denotes demand for money, which arises from transactions. This equation is often referred to as the equation of exchange.

Eq. (2.1) can be expressed in percentage change terms as:

$$\Delta M + \Delta V = \Delta P + \Delta Y \dots\dots\dots (2.2)$$

Rearranging, we obtain an expression for inflation as:

$$\Delta P = \Delta M - \Delta Y + \Delta V \dots\dots\dots (2.3)$$

Assuming that the velocity of money and output are constant, so that $V = 0$, and $Y = 0$, get:

$$\Delta P = \Delta M \dots\dots\dots (2.4)$$

² These include: Marshall(1923); Pigou(1917), among others.

On the assumption that DV is constant, if ΔM is positive DP will rise, and where ΔM is negative DP will fall. That is, if the velocity of money is constant, the inflation rate should be equal to the excess of the growth rate of money, thus providing a direct and proportional relationship.

2.1.2 The Cash Balance Approach

The cash balance approach places emphasis on the function of money as a store of value or wealth and explains the determination of value of money in line with the determination of value in general. It is generally assumed that the amount of money individuals wish to hold as a temporary store of purchasing power which would be related to the real income of an economy as this limits the volume of potential purchases available to the economy.

Therefore, the equation is specified as:

$$\pi = \frac{kY}{M} \dots\dots\dots (2.5)$$

Where the purchasing power of money is denoted as π ; Y is the real income; k is the proportion of income Y that individuals hold as cash balances; M is the stock of supply of money in a country.

π is the reciprocal of the general price level ($\pi = \frac{1}{P}$), therefore, equation 2.5 can be rewritten as:

$$\frac{1}{P} = \frac{kY}{M} \dots\dots\dots (2.6)$$

Rearranging, we obtain an expression for price level as:

$$P = \frac{M}{kY} \dots\dots\dots (2.7)$$

$$\frac{dP}{dM} = \frac{1}{kY} \dots\dots\dots (2.8)$$

Thus, the growth in prices varies directly with money supply, as the relation between money and income is behavioural. An increase in the stock of money is accompanied by a proportional increase in the price level.

Variants of the CBA QTM were presented by the various Cambridge economists, however, the benchmark approach was set by Marshall (1923), on which others were formulated.

The notable differences between the transaction and cash-balance approach are that, first there are different interpretations to the demand for money. The former regards money as transactional as it used for exchange, while the latter ignores the speculative demand for money. Furthermore, Fisher's equation explains the value of money over a period of time, while the Cambridge equation explains the value of money at a particular moment of time. Second, there is emphasis placed on a constant velocity of money (V) in the transactional approach, while the cash-balance theory highlights idle balances kept as a part of national income (K). Both, versions amount to the same conclusion of a direct relationship between the price level and money supply; however the Cambridge version places emphasis on cash balance

instead of transactions. Theoretically, the classical approach of the QTM has proven flawed assumptions such as: constant rate of velocity of money; holds under full employment only and an increase in the price level is as a result of only changes in the money supply, among others. However, this study does not aim to justify the assumptions of the theory nor evaluate its implications, but to test evidence of QTM in Nigeria in a two-regime framework. Thus, the study builds upon the framework of the classical Fischer QTM theory.

2.2 Empirical Review

2.2.1 Effect of Money Supply on Inflation

Most empirical studies confirm the strong impact of money supply on inflation as the long-run co-movement of money growth and inflation has been well-established empirically across countries and over different time periods. For example, Walsh (2003) confirms that the growth of money supply leads to an equal rise in the price level. Similarly, in an extensive study which involved 110 countries. McCandless & Weber (1995), examine the impact of money supply on inflation over a 30 year period. The study shows that there is a high positive correlation (almost unity) between money supply growth rate and inflation. However, King (2002) made a distinction in the relationship and stated that across the time horizon, the correlation weakens due to changes in real variables.

With regards the short- or long-run effects of money supply on inflation, several studies have tested this relationship with varying results. In the study by Nassar (2005), using a two-sector model, the relationship of exchange rate, prices and money in Madagascar was examined over the period 1982-2004. The results revealed a significantly positive impact of money supply on inflation. The inclusion of exchange rate takes cognisance of Madagascar as a small-open economy. The behaviour of broad money demand in Bangladesh is investigated using the Johansen co-integration technique and ECM on annual data over the period 1973 to 2008. The results suggest a positive causal relationship between inflation and money supply growth (Hossain 2010).

The impact of money demand on inflation was investigated by Oomes and Ohnsorge (2005) using an error correction model and monthly data over the period 1996M04 to 2004M01 for Russia. The results suggest that effective broad money growth is persistently inflationary in the short-run. However, the study confirmed that other excess money measures do not significantly impact inflation. Using real money demand functions, Pelipas (2006) investigated the relationship between inflation and demand for real money balances in Belarus using quarterly data between 1992 and 2003 and applying a dynamic equilibrium correction model. The results indicate that money supply is significantly and positively correlated with inflation.

Amisano and Fagan (2010) modelled the relation as a Markov-Switching process using a Bayesian Markov Switching framework for the euro area, Germany, the US, the UK and Canada from 1960 to 2010. They assumed that the inflation rate is governed by a regime-switching process, in which inflation shifts from low to high regimes and vice versa. The results revealed that money growth provides an important early warning indicator for risks to price stability. Also, Nguyen (2015) employed the pooled-mean group (PMG) estimation and the differenced panel generalised method of moments (GMM) Arellano-Bond estimation procedure. The study analysed the effects of fiscal deficit and broad money supply M_2 on inflation in the Asian countries for the period 1985 to 2012. Results showed that broad money supply M_2 , fiscal deficit, government expenditure and interest rate are positively correlated with inflation.

Hossain and Arwathanakarn (2017), conducted a study for the Thai economy using quarterly data for the period 1991Q1 to 2014Q4. Employing the autoregressive distributed-lag (ARDL) bounds-test, the

results revealed that the Thai money stock (narrow or broad), real output, prices, interest rates and exchange rates maintained a long-run equilibrium relationship, with a significant distributed-lag impact on inflation. They further noted that the causal relationship between money growth and inflation holds in Thailand under inflation targeting when the Bank of Thailand deploys a short-term policy interest rate, rather than a monetary aggregate, as the instrument of monetary policy and that this relationship is not conditional on the stability of the money-demand function.

Makin et al. (2017) employed various econometric techniques to investigate the relationship between inflation and excess money supply growth (measured as M_3 and currency growth) in Australia, for the period 1970 to 2015. They also highlighted the operation of monetary policy and distinguished the effects before and after the adoption of inflation targeting. The empirical findings revealed that there is a strong nexus between excess currency growth and Australia's inflation, however, currency growth, although still significant, became less important after inflation targeting.

In Africa, Wolde-Rufael (2008) investigated the relationship between inflation and excess money supply in Ethiopia, using a Toda and Yamamoto model and granger causality test. The study found a one-way causality from the money supply to inflation, thereby indicating that controlling the money supply is an important policy to preserve the long-term macroeconomic stability in Ethiopia. Also, in Africa, (Ofori, Danquah, & Zhang (2017) examined the impact of money supply on inflation in Ghana, using OLS technique and annaul data spanning 1967 – 2015. The sudy found tha long-run positive relationship exists between the variables.

Specifically, in Nigeria, Omanukwue (2010) examined the modern quantity theory of money using quarterly time series data for the period 1990Q1 to 2008Q4 and employed the Engle-Granger two-stage test for cointegration to examine the long-run relationship between money, prices, output and interest rate and ratio of demand deposits/time deposits (proxy for financial development. The study finds evidence of a long-run relationship in line with the quantity theory of money. Also, Alimi (2012) found a unidirectional causal relationship running from money supply to inflation which provides evidence in support for monetarist's view, by applying the Granger causality test. Other studies which establish the validity of the quantity theory of money in Nigeria include: Anoruo (2002), Nwaobi (2002) and Nwafor (2007), among others.

However, Amassoma, Keji, & Emma-Ebere (2018) found that money supply does not considerably influence inflation both in the long- and short-run; however, they attributed these results possibly because the country was in a recession. The study employed co-integration and an Autoregressive Dynamic Error Correction Model (ADLECM) approach with annual time series data spanning from 1970 to 2016.

Overall, there are several seminal works in Nigeria that have established the quantity theory of money, however, this study aims to fill the gap in Nigeria by estimating a two-regime Threshold Autoregressive Distributed Lag (TARDL) Model to test the validity of the QTM in both high and low economic growth regimes.

3.0 DATA AND METHODOLOGY

3.1 Data

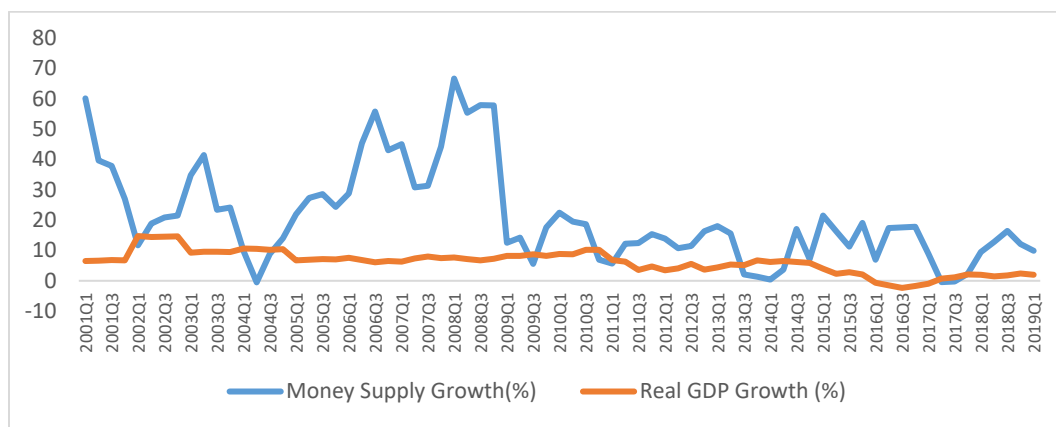
The variables used in this study include inflation rate (INF); growth of money supply, proxied by the growth of M1 (M2G) and M2 (M2G); nominal Naira/USD exchange rate returns (DUSD), measured as change in exchange rate; and the growth of real gross domestic product (RGDPG). These variables

are quarterly frequency, between 2001Q1 and 2019Q1, sourced from the statistical database of the Central Bank of Nigeria (CBN). In addition, the study used Nigeria's nominal effective exchange rate, sampled over the same period, and sourced from the database of the International Monetary Fund (IMF).

3.1.1 The Graphical Plots of Money Supply Growth and Real GDP Growth

The graphical plots of money supply growth and real GDP growth are presented in Figure 1. This chart reveals two main scenarios in the relationship between money supply growth (M2G) and real GDP growth (RGDPG). From the plot, M2G appeared to lie above RGDPG for most of the period. However, this relationship was reversed in 2004, 2009, 2010, 2013 and around 2017, where RGDPG rose marginally above M2G. Clearly, this is reflective of a threshold behaviour with two regimes; one being the regime where M2G is greater than RGDPG, and the other, which is the regime where M2G is less than RGDPG, over the sample the period.

Figure 1: Graphical Plot of M2G and RGDPG.



Source: Authors' Estimate

3.2 Technique of Analysis

This study is developed on the methodology of a two-regime threshold autoregressive distributed lag model (TARDL) model. It is a regime switching model in which the response of the dependent variable to changes in the independent variable(s) varies under two states. For example, the response of the dependent variable may vary when the independent variable(s) is (are) high or low; greater than a given number, or higher than it. The traditional specification of this two-state ARDL model, with a single lag in both regimes, is a self-exciting threshold autoregressive (SETAR) model (Enders, 2008). Here, the time path of a series y_t follows the order;

$$y_t = \begin{cases} a_{10} + a_{11}y_{t-1} + e_{1t} & \text{if } y_{t-1} > \tau \\ a_{20} + a_{21}y_{t-1} + e_{2t} & \text{if } y_{t-1} \leq \tau \end{cases} \dots\dots\dots(6)$$

where, τ is the given threshold value for y_t ; e_{1t} and e_{2t} are the error terms in regime one and two, respectively; and a_{10} and a_{20} are the constants in both regimes, respectively. The time-path of y_t , therefore, develops according to how previous values of y_t switches across the threshold value. If $\tau =$

0, the variance of the error terms are not equal (that is, $\text{var}(e_{1t}) \neq \text{var}(e_{2t})$). Also, if y_t is stationary, the future realizations of y_t is determined by a_{10} when $y_t > 0$, and a_{20} when $y_t \leq 0$ plus shock to e_{1t} , which causes y_t to switch across regimes. For example, given an initial value for $y_{t-1} > 0$, we expect y_t , being in regime one and governed by the equation $y_t = a_{10} + a_{11}y_{t-1} + e_{1t}$, to decay towards $\frac{a_{10}}{1-a_{11}}$ in the long-run at the rate, a_{11} . (That is, since y_t is a stationary series, in the long-run, its value converges to $\frac{a_{10}}{1-a_{11}}$ in regime one, and $\frac{a_{20}}{1-a_{21}}$ in regime two). However, the value of e_{1t} can cause y_{t-1} to rise or fall, crossing the threshold value of $\tau = 0$, to a value equal to or lower than 0, and switching y_t to regime two, where y_t realization would now depend on equation $y_t = a_{20} + a_{21}y_{t-1} + e_{2t}$, and converging towards the value $\frac{a_{20}}{1-a_{21}}$, in the long-run, at the rate of a_{21} .

Another version of the simple TAR model is to assume the variance of the error terms in both regimes are the same. That is, $\text{var}(e_{1t}) = \text{var}(e_{2t})$. Based on this assumption, the TAR model can be rewritten as;

$$y_t = a_0 + a_1 I_t y_{t-1} + a_2 (1 - I_t) y_{t-1} + e_t \dots \dots \dots (7)$$

Here, I_t is a dummy or an indicator variable, such that $I_t = 1$ if $y_{t-1} > \tau = 0$ and $I_t = 0$ if $y_{t-1} \leq \tau = 0$. From Equation 7, therefore, y_t is governed by $a_0 + a_1 I_t y_{t-1} + e_t$ whenever $y_{t-1} > 0$, and $a_0 + a_2 (1 - I_t) I_t y_{t-1} + e_t$, whenever $y_{t-1} \leq 0$.

The estimation procedure for the two variants of the TAR model is the application of a simple ordinary least squares (OLS) technique. This is possible after first constructing two new variables, $I_t y_{t-1}$ and $(1 - I_t) y_{t-1}$, to replace y_{t-1} in states 1 and 2, respectively.

The two state TAR models presented so far are simple forms of more general TAR models. Equations 6 and 7, with p lags, can be rewritten, more generally, as Equations 8 and 9, respectively.

$$y_t = \begin{cases} a_{10} + \sum_{i=1}^p a_{1i} y_{t-i} + \sum_{i=1}^p b_{1i} x_{t-i} + e_{1t} \text{ if } z_{t-d} > \tau \\ \dots \dots \dots (8) \\ a_{20} + \sum_{i=1}^p a_{2i} y_{t-i} + \sum_{i=1}^p b_{2i} y_{t-i} + e_{2t} \text{ if } z_{t-d} \leq \tau \end{cases}$$

$$y_t = a_0 + \sum_{i=1}^p a_{1i} I_t y_{t-i} + \sum_{i=1}^p b_{1i} (1 - I_t) y_{t-i} + \sum_{i=1}^p a_{2i} I_t x_{t-i} + \sum_{i=1}^p b_{2i} (1 - I_t) x_{t-i} + e_t \dots \dots (9)$$

Where, $I_t = 1$ if $z_{t-d} > \tau$ and $I_t = 0$ if $z_{t-d} \leq \tau$.

The variables and parameters are as defined in Equations 2 and 3, except for d, z, x and parameter b . The variable d , called the delay parameter, tells the timing of the adjustment process; it is the period upon which the regime switch occurs. d can be 0, 1, 2 ... The model will be in state 1 if $z_{t-d} > \tau$, and state 2 if $z_{t-d} \leq \tau$. Selecting the most optimal value of d requires estimating the y_t model with different values of d , and selecting the model with the least Residual Sum of Squares (RSS), or the least akaike info criteria (AIC) and Schwarz Info Criteria (SIC). z_t is the threshold variable, which can be y_t , x_t or

even a variable outside the model. x_t represents other explanatory variables. These explanatory variables can also be the threshold variable, upon which the states in the system is dependent, or themselves dependent on the states of the system (Enders et al 2008).

In this study, we adopt the threshold relationship presented in Equation 9 with little modifications. In our case, the threshold variable z_{t-d} is the difference between growth rates of money supply (M2G) and real GDP (RGDPG)³. It variable is a self-constructed variable, defined as the linear difference between M2G and RGDPG (M2G-RGDPG). To this end, when the variable is negative, money supply growth is less than real GDP growth; and when it is positive, money supply growth is higher than real GDP growth. The implication of this construction is that, the threshold number τ , is equal to zero, and the dummy or indicator variable I_t will take the value one (1), when the economy is growing at a level lower than the growth in money supply (thus, $z_{t-d} > 0$); and the value of zero (0), when the level of economic growth is higher than the growth of money supply (here, $z_{t-d} \leq 0$). This is in line with the use of a threshold variable in the threshold models presented by Enders (2008).

For convenience, the former regime, when $z_{t-d} > 0$, is designated as the “low economic growth” regime, and the latter, the “high economic growth” regime. d is further assumed to be 1, implying that the switch across regimes occurs with a lag in the threshold variable z_{t-d} . This means that the impact of money supply, and other regime dependent regressors, on inflation, in a given quarter, depends on the state of the regime in the previous quarter. Also, the autoregressive component of inflation is assumed to be state dependent. For, these reasons, the threshold model for the study, therefore, is of the form:

$$\begin{aligned} INF_t = & a_0 + \sum_{i=1}^{p1} a_{1i} I_t INF_{t-i} + \sum_{i=0}^{p2} a_{2i} I_t M2G_{t-i} + \sum_{i=0}^{p3} a_{3i} I_t DUSD_{t-i} \\ & + \sum_{i=1}^{q1} b_{1i} (1 - I_t) INF_{t-i} + \sum_{i=0}^{q2} b_{2i} (1 - I_t) M2G_{t-i} + \sum_{i=0}^{q3} b_{3i} (1 - I_t) DUSD_{t-i} \\ & + e_t \dots \dots \dots (10) \end{aligned}$$

From Equation 10, $I_t = 1$ if $z_{t-d} \leq 0$ and $I_t = 0$ if $z_{t-d} > 0$. When in regime 1, where money supply growth is lower than growth of real output, the system is governed by the parameters a_{1i} to a_{3i} . In the second regime, where money supply growth is higher than economic growth, the behaviour of inflation is determined by the parameters b_{1i} to b_{3i} . Parameters a_{1i} and b_{1i} are expected to be positive, consistent with the “clustering nature” of inflation, and predicated on the adaptive expectation of the general public as it relates to inflation. Meanwhile, parameters a_{2i} and b_{2i} , were expected to be positive and negative, respectively. This was because, when money supply growth falls short of the growth of real output, prices are expected to fall, and where the reverse is the case, prices are expected to rise.

Finally, before estimating equation 10, to avoid estimating a “spurious regression”, the unit root properties of all variables, INF_t , $M2G_t$ and $DUSD_t$, were first determined. Following the application of the Augmented Dickey-Fuller (ADF, 1979), Phillips-Perron (PP, 1988) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) tests for unit root, the study found all three variables to be stationary, therefore, justifying their inclusion in the proposed threshold regression.

³That is, $M2G-RGDPG$.

The result of the unit root tests are presented in Table 1. Here, while the ADF and PP tests are conducted under the null hypotheses of unit root, the KPSS test has a null hypothesis of “Stationarity”. This result showed that the null hypotheses are rejected in both the ADF and PP tests for all three variables, suggesting that they are all stationary at levels. Similarly, the KPSS test suggest the variables are stationary at levels as the null hypothesis could not be rejected at 5% level of significance for all the variables.

Table 1: Unit Root Tests

	ADF Test		
	INF	M2G	DUSD
t-Statistic	-2.9647*	-1.7639*	-3.7386*
	PP Test		
	INF	M2G	DUSD
t-Statistic	-3.2772*	-3.4663*	-5.8879*
	KPSS Test		
	INF	M2G	DUSD
t-Statistic	0.2011^	0.5749^	0.1811^

**significant at 5%; ^Insignificant even at 5%*

4.0 RESULT AND ANALYSIS

4.1 Descriptive Statistics

The descriptive statistics of the variables of the baseline model (equation 10) are presented in Table 2. This result revealed that the Nigeria’s inflation rate (INF) averaged 12.5 per cent between 2001Q1 and 2019Q1, with a maximum and minimum values of 24.3 and 4.1 per cent, respectively. The Jarque-Bera statistics (4.1) was statistically insignificant at 5 per cent, with a p-value of 0.1, indicating that INF was normally distributed. Similarly, the growth rate of money supply (M2G) averaged 20.8 over the sample period, with a maximum and minimum value of 66.7 and -0.5 per cents, respectively. However, with a Jarque-Bera statistic of 13.4, which is statistically significant at 5 per cent, with a p-value of 0.00, M2G appeared not to be normally distributed. Finally, the nominal exchange rate returns (DUSD) was found to average 3.3 per cent, with 75.0 and -91.3 per cent maximum and minimum values, respectively. Also, the statistically significant Jarque-Bera statistic 382.2 suggested that DUSD was not normally distributed.

Table 2: Descriptive Statistics

	INF	M2G	DUSD
Mean	12.3	20.8	3.3
Maximum	24.3	66.7	75.0
Minimum	4.1	-0.5	-91.3
Std. Dev.	4.3	15.6	18.8
Jarque-Bera	4.5	13.4	382.2
Probability	0.1	0.0	0.0

Source: Authors’ Estimation

4.2 Result of the Estimated Threshold Model

The result of the estimated model is presented in Table 3. In the regime of high economic growth, the regime in which money supply growth is higher than the growth of real GDP in the immediate past quarter, the growth of money supply was found to have a negative and statistically significant impact on inflation in its first lag. More specifically, when money supply rises by one percentage point in a given quarter, inflation rate falls by 0.26 percentage points in the next quarter, and vice versa. However, the second lagged impact of money supply growth on inflation (0.04) was positive but statistically insignificant. The autoregressive components in the regime of high economic growth were positive, negative and positive in the first, second and third lag, respectively. Also, in all three lags, the parameters were statistically significant. Exchange rate returns was found to have a negative but statistically insignificant contemporaneous impact on inflation rate in the high economic growth regime.

Estimates from the “low economic growth-regime”, the regime in which money supply growth is higher than the growth of real GDP in the immediate past quarter, revealed a positive and statistically significant relationship between the first lag of money supply growth and inflation rate. With a coefficient of 0.09, a one percentage point increase in the growth of money supply, in a given quarter, will increase inflation rate by approximately 0.09 percentage point in the next quarter.

The inflationary tendencies of rising monetary aggregates as reflected in the traditional quantity theory of money, is responsive to the interactions between growth in monetary aggregates and economic growth. An increase in money supply is only expected to raise the growth in general price level when the level of economic growth is lower than the growth of money supply. This is because an increase in money supply at a rate lower than the growth of economic output would increase aggregate demand more than the rise in aggregate supply. This will lead to more money chasing fewer goods, with a resultant effect of increase in the general price level.

Table 3: Result of the TARDL Model

Dependent Variable: INF						
	High Economic Growth Regime (where M2G < RGDPG)				Low Economic Growth Regime (where M2G > RGDPG)	
	M2G	INF	DUSD		M2G	INF
Lag 0			-0.033 [^] (0.074)			-0.033 [^] (0.017)
Lag 1	-0.263** (0.085)	1.297** (0.234)			0.09** (0.031)	1.297** (0.138)
Lag 2	0.04 [^] (0.112)	-1.114** (0.417)			-0.05 [^] (0.030)	-1.114 [^] (0.125)
Lag 3		0.718** (0.205)				0.718* (0.103)
R-squared	0.58					
Adjusted R-squared	0.50					
D-W	2.1					
Breusch-Godfrey Serial Correlation LM Test: F-Statistic=1.509 [0.231]						
Heteroskedasticity Test: Breusch-Pagan-Godfrey: F-Statistic=0.847 [0.603]						

****significant at 1%; *significant at 5%; [^]Insignificant; Standard errors in parenthesis and p-values in block parenthesis**

Source: Authors' Estimation

This model appeared to have a good fit with both the R-square and adjusted R-square lying above 50 per cent, implying that more than 50 per cent of the variation in inflation rate was explained by variations in the explanatory variables in the model. Although the Durbin-Watson (D-W) statistics (2.1), which was close to 2, revealed the absence of autocorrelation in the model, the autoregressive (AR) nature of the model required that little attention be paid to it, as the AR process has the tendency to cause the D-W to converge to 2 in the long-run (see Gujarati, 2009). For this reason, the Breusch-Godfrey Serial Correlation LM test was applied to show that the estimated ARDL model was free of autocorrelation, and that adequate inferences, capturing the relationship under investigation, could be drawn from it (see the lower part of Table 3).

The Breusch-Godfrey Serial Correlation LM test is conducted under the null hypothesis of “no serial correlation”. In this case, the test statistic (F-statistic = 1.509) was insignificant, with a p-value of 0.231. The null hypothesis, therefore, could not be rejected at 5 percent level of significance. This implied the estimated model does not suffer from autocorrelation. In addition, the Breusch-Pagan-Godfrey Heteroskedasticity test, conducted under the null hypothesis of “homoscedasticity”, revealed the absence of heteroskedasticity in the residual of the estimated model. Here, the test statistic, F-statistic = 0.847, was insignificant, with a p-value of 0.603.

5.0 ROBUSTNESS CHECKS

For robustness, three versions of the baseline model were estimated. The first version (version 1), presented in Table 4, replaced the growth of M2 (M2G) and nominal exchange rate returns (DUSD) with the growth of M1 (M1G) and nominal effective exchange returns, respectively; the second excludes DUSD from the estimation of the baseline model (Table 5). The third version included the contemporaneous effects of the impact of M2G on inflation across the two regimes (Table 6). The idea was to evaluate the sensitivity of the estimated baseline model to the choice of monetary aggregates, and the different measures of the international value of the domestic currency.

Interestingly, the result of the revised TARDL (version 1) model presented in Table 4 seemed to suggest the insensitivity of the inferences drawn from the baseline model, to changes in monetary aggregates. Here, despite the impact of M1G on inflation being insignificant in the regime of high economic growth, with a p-value less than 15 percent, the negative relationship was suggestive of a deflationary impact of money supply in a growing economy. In the regime of low economic growth, however, the relationship was found to be positive and statistically significant, indicating that during periods of low economic growth, increases in money supply is consistent with rising price levels. In addition, the estimated model appeared to be free from both serial correlation and heteroskedasticity as the f-statistics of both the Breusch-Godfrey Serial Correlation LM and the Breusch-Pagan-Godfrey Heteroskedasticity were statistically insignificant at 5 percent level of significance.

Table 4: Version 1

Dependent Variable: INF							
	High Economic Growth Regime (where M2G< RGDPG)				Low Economic Growth Regime (where M2G> RGDPG)		
	M1G	INF	D(NEER)		M1G	INF	D(NEER)
Lag 0			0.019^ 0.128				0.019^ (0.063)
Lag 1	- 0.115*^ (0.077)	1.595** (0.169)			0.077* (0.038)	0.817** (0.134)	
Lag 2	-0.051^ (0.035)	-1.22** (0.332)			- 0.019^ (0.034)	0.312** (0.108)	
Lag 3		0.589** (0.178)				- 0.257** (0.083)	
R-squared	0.63						
Adjusted R-squared	0.56						
Breusch-Godfrey Serial Correlation LM Test: F-Statistic=0.338 [0.714]							
Heteroskedasticity Test: Breusch-Pagan-Godfrey: F-Statistic=1.305 [0.242]							

****significant at 1%; *significant at 5%; ^p-value less than 15%; ^Insignificant; Standard errors in parenthesis and p-values in block parenthesis**

Source: Authors' Estimation

Table 5 presents the result of the second version of the baseline model, which was estimated without the nominal exchange returns across the regimes. Again, the inferences from this model are similar to those of the baseline model. Specifically, the result revealed a negative relationship between money supply growth and inflation in the regime of high economic growth, and a negative relationship in the relationship of low economic growth, implying, again, that money supply, other things being equal, is only inflationary when the economy is growing at a rate lower than the growth of monetary aggregates.

Similarly, the tests of serial correlation and heteroscedasticity, presented in the lower part of Table 5, revealed the absence of serial correlation and heteroskedasticity in the residual of the estimated as the null hypotheses of both the Breusch-Godfrey Serial Correlation LM and the Breusch-Pagan-Godfrey Heteroskedasticity could not be rejected at 5 percent level of significance.

Table 5: Version 2

Dependent Variable: INF				
	High Economic Growth Regime (where M2G< RGDPG)		Low Economic Growth Regime(where M2G> RGDPG)	
	M1G	INF	M1G	INF
Lag 1	-0.28**	1.32**	0.09**	0.91**
	(0.09)	(0.28)	(0.03)	(0.14)
Lag 2	0.04^	-1.14**	-0.05^	0.23^
	(0.11)	(0.43)	(0.03)	(0.12)
Lag 3		0.73**		-0.23*
		(0.21)		(0.10)
R-squared	0.57			
Adjusted R-squared	0.50			
Breusch-Godfrey Serial Correlation LM Test: F-Statistic=1.948 [0.116]				
Heteroskedasticity Test: Breusch-Pagan-Godfrey: F-Statistic=0.915 [0.527]				

****significant at 1%; *significant at 5%; ^Insignificant; Standard errors in parenthesis and p-values in block parenthesis**

Source: Authors' Estimation

In the third version of the adjusted baseline model (Table 6), the contemporaneous impact of money supply growth on inflation was estimated across the two regimes. This result revealed a positive but statistically insignificant impact of money supply growth on inflation in both the high and low economic growth regimes. However, in the first lag, while the impact of money supply growth on inflation was found to be deflationary in the regime of high economic growth, it was inflationary in the low economic growth regime. This result further gives credence to the argument that financial variables affect real sector variables with a lag, as the impact of money supply growth on inflation was only statistically insignificant in contemporaneous terms.

Finally, just as the case of the baseline model, this model appeared to be stable as both the Breusch-Godfrey Serial Correlation LM test and the Breusch-Pagan-Godfrey Heteroskedasticity test clearly indicated the absence of serial correlation and heteroskedasticity, respectively, in the residual of the estimated model.

Table 6: Version 3

Dependent Variable: INF							
	High Economic Growth Regime (where M2G< RGDPG)				Low Economic Growth Regime (where M2G>RGDPG)		
	M1G	INF	D(USD)		M1G	INF	D(USD)
Lag 0	0.030^		-0.040^		0.018^		0.018^
	(0.112)		(0.090)		(0.034)		(0.015)
Lag 1	-0.281*	1.279**			0.073*^	0.891**	
	(0.135)	(0.272)			(0.042)	(0.138)	
Lag 2	0.039^	-			-0.050*^	0.227*^	
	(0.112)	1.056**			(0.030)	(0.125)	
Lag 3		0.670**				-0.212*	
		(0.186)				(0.096)	
R-squared	0.58						
Adjusted R-squared	0.48						
Breusch-Godfrey Serial Correlation LM Test: F-Statistic=1.933 [0.155]							
Heteroskedasticity Test: Breusch-Pagan-Godfrey: F-Statistic=1.305 [0.539]							

****significant at 1%; *significant at 5%; ^significant at 10%; ^Insignificant; Standard errors in parenthesis and p-values in block parenthesis**

Source: Authors' Estimation

6.0 CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

The relationship between money supply and price level embodied in the traditional Fisher's equation was conditioned on the constancy of the level of output and velocity of money. To this end, inflation had been considered a monetary phenomenon, rising proportionately with the level of money supply. However, given the breakdown of these assumptions in real life situations, the outcome of the money supply – inflation relationship is uncertain, but depending on structural factors of the economy under study.

In Nigeria, for example, inflation has been argued to depend on both monetary and structural conditions such as supply-side deficiencies and ineffective demand. To this end, the impact of money supply on inflation in Nigeria would vary with changes in real sector conditions, in this case, changes in output. This, therefore, raises the need to evaluate the role of regime change, in money supply and output growths, in predicting price level trajectory for effective monetary policy management in Nigeria. This was done, in this study, by accessing the impact of money supply on inflation under the condition changing level of output.

Following the estimate of a two-regime threshold autoregressive distributed lag model, this study found that, when the growth of real output is higher than that of money supply, money supply would be deflationary, reducing the inflation rate in the next quarter by approximately 0.26 percentage points. However, when the growth of real output is lower than the growth rate of money supply, increase in money supply will increase the rate of inflation by approximately 0.09 percentage point in the next

quarter. Money supply growth is reflective of changes in aggregate demand. Also, when money supply rises, aggregate demand also rises, leading to a rise in the general price level. However, where the increase in money supply (and by implication, increase in aggregate demand) is less than the increase in output, prices are expected to fall. This result suggested that, in Nigeria, the inflationary tendencies of money supply growth are subdued by rising levels of economic growth, and by implication, inflation in Nigeria depends on both monetary and structural conditions.

In addition, the fact that inflation falls by a higher percentage point of 0.26 in the regime of “high economic growth” than it rises in the regime of “low economic growth” (0.09), implicitly presents argument for monetary policy decisions to be cautiously contractionary when observed economic growth rates rise above money supply growth. This was because it seemed whenever money supply grew at a rate lower than economic growth, the rise in money supply would impact more on the production capacity of the economy more than it raised the level of aggregate demand for goods and services. However, in the “low economic growth” regime, excess money supply growth over the growth of real output seemed to drive aggregate demand more than it does the production base. This would reduce aggregate supply and, thereby, intensifying the inflationary pressures in the economy.

Finally, the conclusions arrived at in this study appeared to be insensitive to the choice of monetary aggregates and exchange rate returns as suggested by the robustness checks conducted.

It is therefore recommended that, the Central Bank of Nigeria, in keeping with her primary objective of price stability, target monetary aggregates in such a way as to always ensure money supply grows at a steady rate, lower than the rate of growth of real output. This would help reduce the inflationary pressures of money supply, while ensuring that credits are directed more to the productive base of the economy rather than surging the level of aggregate demand.

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