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ARTICLE

Revalidation of the impact of growth in Money Supply on Inflation in Nigeria

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Abstract

This study examines the impact of money supply on inflation in Nigeria, using quarterly data series from 1980 – 2023. The Johansen cointegration approach, Autoregressive Distributed Lag (ARDL), and Granger causality test are used to identify the long-run relationship, the short-run dynamic, transmission lag, and causal relationship among the variables respectively. The variables considered are inflation, broad money supply, and real GDP. The regression results suggest that money supply has a significant impact on inflation in the short and long run. However, money supply has a higher impact in the long run compared with the short run. The result remained consistent with the classical Quantity theory of money and the monetarist hypothesis on inflation. Furthermore, the study confirmed that in the long run, the money supply growth has significant and positive impact on inflation. Moreover, the causality test result reveals that money supply growth has a unidirectional causal relationship with inflation, and the causal relationship runs from money supply growth to inflation. By implication, the monetary authority can manage the money supply to affect the level of the level of general prices (inflation).

Keywords: Inflation, monetary policy, money supply, Nigeria.
JEL: E52, E51, E31

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1. Introduction

The aim of monetary policy, a macroeconomic management segment, is to promote price stability, full employment, economic growth, and balance of payment equilibrium. In small open economies, however, exchange rate stability becomes a prime concern of the Central Bank because of its high correlation with price stability. Commercial banks, which constitute the core of the financial system, directly influence price and exchange rate stability through their domestic credit supply. At the same time, their impact on the other macroeconomic goals such as economic growth, reduction in unemployment, and balance of payment surplus is more indirect. The Central Bank formulates and implements monetary policy to ensure the achievement of those goals.

Inflation as a macroeconomic phenomenon could be inimical to achieving enduring economic growth, and managing inflation is not a simple task to handle. To handle the problem successfully, accurate and precise

evaluation of the causes of inflation is seriously needed, because wrong approaches in solving the problem will lead to unintended adverse impacts on the economy. Theoretically, the link or intermediate variable that can be used by a central bank to affect inflation is the money supply. This connection is encapsulated in the quantity theory of money (QTM). The QTM was first developed by Bodin (1566) (cited in **Malcolmn 2006**) who thought that the price level was solely a function of the quantity of money. He explained that the value of, or the purchasing power of money varies proportionally with the quantity of money in circulation in the sense that a doubling of money will double the price level and halve the value of the monetary unit. Over the years, monetary authorities have managed inflation using the monetary targeting framework. This methodology assumes and upholds the Quantity Theory of Money (QTM). In analyzing inflation, the monetarist, especially Friedman, held that "inflation is always and everywhere a monetary phenomenon". However, one of the macroeconomic challenges facing most countries of the world, especially developing countries in economic history has been the maintenance of price stability. In line with this concern, the subject matter of inflation has been widely debated in most literature.

The information available in the literature on the relationship between money and price showed contrasting evidence, suggesting an inclusive position about the current nature of the relationship. Therefore, considering the dynamic nature of the macroeconomic variables in light of the changing financial landscape, this research explored a methodology that utilizes more recent data in identifying the current nature of the relationship between money and prices as posited by the QTM. Furthermore, most previous studies on the subject, particularly, in Nigeria tend to overlook the long-run requirements of the QTM, a development that constitutes a significant gap in the literature. It is pertinent to note that the short-run disequilibrium that is often provided in the literature about the relationship in question, might not be sufficient to conclude that the model collapsed, therefore, this study intends to be rigorous in carrying out a long-run analysis in establishing the status of the relationship in Nigeria.

In the case of Nigeria, the Central Bank of Nigeria (CBN) has adopted Money Supply as its intermediate target for achieving the inflation objective. However, recent developments about inflation development have called into question the potency of this arrangement. It is against this background that this study analyzed the current situation by considering the impact of money on the general price level, to determine the relevance of the CBN monetary policy implementation framework in modern parlance.

2. Literature Review

There are conflicting arguments in the literature about the impact of money supply on inflation. A review of some of these arguments is provided, with a clear distinction between the conclusions from Nigeria versus other countries:

2.1 Theoretical Literature

The Quantity Theory of Money (QTM) has its roots in the 16th century during which classical economists such as Jean Boldin sought to know the cause of the increases in French prices. He concluded that, among other factors, increases in gold and silver which served as currencies were responsible for the rise in the demand for French-made goods and, hence, French prices, thus linking movements in prices to movements in money stock. By the 1690s, the quantity theory was further advanced by John Locke to examine the effects of money on trade, the role of interest rates and demand for money in the economy. In particular, the role of money as a medium of exchange to facilitate trade transactions was born. Economists at the time inferred that the quantum of money needed for such transactions would depend on the velocity of money in circulation and the relationship between the demand and supply of money such that where there was excess demand over supply, interest rates rose and vice versa (**Cantillon, 1755; Ajuzie et al., 2008**).

Modern classical economics school of thought, which has come to be known as the monetarists, continues in the same light as the early economists and is often concerned with explanations for changes in the price level. To them, a stable and equilibrating relation exists between the adjustments in the quantity of money and the price level. The more orthodox monetarist assumes that a rise in the quantum or variation in money supply determines the value of money, but not necessarily changes in output. In other words, they refute any form of monetary influence on real output both in the short and long run. This led to the popular paradigm that, "Inflation is always and everywhere a monetary phenomenon". For the less stringent monetarist, they agree that money influences output in the short run, but only prices in the long run.

Nevertheless, irrespective of the path of adjustment, the monetarist seems to concur that to reduce or curtail inflationary growth, money growth should be less than or equal to the growth in output. The quantity theory of money is hinged on the Irvin Fisher equation of exchange which states that the quantum of money multiplied by the velocity of money is equal to the price level multiplied by the amount of goods sold. It is often replicated as

$$MV = PQ \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.1$$

Where:

M is defined as the quantity of money,
V is the velocity of money (the number of times in a year that a currency goes around to generate a currency worth of income),
P represents the price level and
Q is the number of real goods sold (real output).

Conceptually, this equation is true. It becomes a theory based on the assumptions surrounding it. The first assumption is that the velocity of money is constant. This is because the factors, often technical, habitual, and institutional, that would necessitate a faster movement in the velocity of money evolve slowly. Such factors include population density, mode of payment (weekly, monthly), availability of credit sources, and nearness of stores to individuals. This assumption presupposes that the velocity of money is somewhat independent of changes in the stock of money or price level. However, the Keynes liquidity preference theory suggests that the speculative components of money demand affect money velocity. Friedman in his modern theory of the quantity theory of money further explores the variables that could affect the velocity of money to include human/nonhuman wealth, interest rate, and expected inflation. The second assumption guiding the QTM is that factors affecting real output are exogenous to the quantity theory itself. In other words, monetary factors do not influence developments in the real economy. The third assumption states that causality runs from money to prices. Thus, the quantity theory of money can be represented as MV = PQ → In simple terms, this states that prices vary proportionally in response to changes in the quantum of money, with velocity and real output invariant.

2.2 Empirical Literature

2.2.1 Foreign Jurisdictions

Rasool and Tarique (2020) study aims to investigate the relationships among the macroeconomic variables money supply, real income, price level, and interest rate for the period 1998–2014 in the case of India, a period when India adopted the multiple-indicator approach as its monetary policy strategy. The study uses the vector autoregression (VAR) model to examine the dynamic relationships among the variables. The Granger causality test via the VAR framework suggests that four pairs of causality exist; in particular, bidirectional causality exists between money supply and price level. Interest rate Granger causes both real income and price level and money supply Granger causes the rate of interest. However, the study could not find any causal relationship between real income and money supply in either direction. The findings that money supply causes the interest rate, and the interest rate causes real output are in line with the Keynesian theory, which argues that money supply affects output through the nominal interest rate. Finally, the results also support the arguments made in favour of a policy move from the multiple-indicator approach to the inflation-targeting framework in India.

By using the co-integration test, and vector error correction model **Sultana et al (2019)** establish that the money supply does not affect the price level in the short run, but in the long run money supply stimulates inflation in Bangladesh. The study used monthly data spanning from 2010-05 to 2017-12 and used the consumer price index as a proxy for inflation which is the dependent variable for the study. The study takes two independent variables - broad money supply and narrow money supply. For long-run relation, study used the VECM model which result suggests the long-run causality from narrow money supply and broad money supply to CPI and long-run causality from CPI to narrow money supply and broad money supply. To show the short-run causality under VECM, the study applied block Erogeneity Wald tests. The outcomes of Wald tests show that inflation causes narrow money and broad money in the short run. Narrow and broad money does not cause inflation.

Debesh (2020) sought to verify the quantity theory of money in the UK from 1844 - 2016 by applying a regression model, co-integration, and vector error correction model and found that there is unidirectional causality from money to price level and there is one co-integrating equation. Vector Error Correction Model showed long-run causality from money supply to price level and the speed of adjustment of error correction was 1.60 per cent per annum which tends to equilibrium insignificantly. The double-log regression model revealed that the relation is non-proportional, positive, and significant. The vector error correction model is stable and non-stationary. The paper concludes that the money supply of the UK from 1844 to 2016 had increased by 5.3 per cent per annum significantly whose ARIMA (3, 1, 3) was stable, non-stationary, and convergent and it had four upward structural breaks in 1969, 1916, 1943 and 1980.

On the other hand, the price level of the UK measured by the wholesale price index had risen by 2.91 per cent per annum whose ARIMA (1, 1, 3) is stable, stationary, and convergent and it consists of four structural breaks in 1884, 1915, 1946 and 1977 respectively in which 1884 is downward and the rests are upward. A double log regression model suggested that a one per cent increase in money supply revealed a 0.57 per cent increase in the price level in the UK during 1844 -2016 which is significant at 5.0 per cent level but after removing the autocorrelation problem, the rate became 1.91 per cent per annum both of which satisfied CUSUM square stability test. Granger causality assured that there is unidirectional causality from money supply to price level with lag 2. Johansen co-integration test showed one cointegrating equation in Trace and Max Eigen statistic

and unidirectional causality was verified by VECM which showed that there is long run causality from money supply to price level which was supported by co-integrating equation that tends to equilibrium insignificantly whose speed of adjustment was found as 1.60 per cent per annum where VECM is stable but non-stationary.

Acharya (2019) examined whether there is relation between money supply, income, and price level in the case of Nepal. The study used the ADF test for unit root test, bivariate Johanson co-integration tests followed by VECM for long-run causality and VEC as well as VAR Granger Causality/Block erogeneity Wald tests for short-run causality. This study used annual time series data from 1975 to July 2018. Based on the research objective, this paper used five models where real and nominal GDP, money supply, and CPI are used for regression. The study found that there is bidirectional long-run causality between the real income and both types of money supply in real terms but there is no short-run causality between variables. In addition, based on the result of test the study do not support the monetarist point of view which suggests that there is casual relationship that runs from money supply to income and price in the long run. The study also found that there is no short-run causal relationship between NCPI and the nominal broad money supply.

Bhowmik (2019) studied the quantity theory of money empirically in India during 1960 - 2015 taking both wholesale and consumer price indices and fitting the data in a double log bivariate regression model and used Johansen co-integration and VECM and found that there is no proportionality relation between the price level and money supply. Johansen's model confirmed one co-integrating equation and VECM showed unstable and non-stationary with a slow error correction process but there is unidirectional causality from money supply to price level. However, **Amassoma et al (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.

Hossain and Arwatchanakarn (2017), conducted a study on 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 M3 and currency growth) in Australia, for the period 1970 to 2015. They 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. The key result is that excess money growth has been the main determinant of Australia's inflation, although became less important during the inflation-targeting era. This implies the velocity of currency, the sine qua non of the Quantity Theory of Money, has been remarkably stable. Given the role excess currency plays in generating Australian inflation, it should be afforded greater prominence in monetary policy deliberations

Nguyen (2015) examined the effect of fiscal deficit and broad money supply on inflation in Asian countries namely Bangladesh, Cambodia, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, and Vietnam in the period of 1985 to 2012. The study applied two different methods of estimation, first is PMG estimation-based error correction model and the differenced panel GMM Arellano-Bond estimation. The variables used in this study are inflation as dependent variable and fiscal deficits (share of GDP), broad money M2 supply (share of GDP), RGDP per capita, government expenditure (share of GDP), interest rates, exchange rate (ratio of domestic currency and USD), exports (share of GDP) and imports (share of GDP) as independent variable. The estimated results show that broad money M2 supply has a significantly positive impact on inflation only in the method of PMG estimation. In the PMG estimation-based ECM model, money supply impacts inflation in both the short and long run.

Alam (2016) empirically examined the sources of inflation in India both in the long run and short run. The study covers the data from 1989-90 to 2012-13. The study used augmented Dicky–Fuller (ADF) and Phillips–Perron (PP) tests for stationarity test and bounds test technique, developed by **Pesaran, Shin, and Smith (2004)** to examine the existence of co-integration among the variables in the model. Wholesale price index is the dependent variable of the study and money supply, exchange rate of rupee, world oil price, and RGDP as independent variables. The elasticity coefficient of the money supply is positive and significant in both the long-

run and short-run. **Teles *et al.* (2016)** studied low, medium, and high-inflation countries in OECD taking 1970 - 2005 data to explain the relationship between money growth and inflation, and found that scatter data between them in the US and other countries fall in 45° from the origin. But if it spits into implicit adoption inflation targeting, the result of one-to-one relation deteriorates where the variability of inflation is reduced.

2.2.2 Nigerian Literature

In the study by **Chinezelum et al. (2023)**, the relationship between Nigeria's monetary policy and food inflation was tested using a quantitative research method based on an ex-post facto research design in a non-linear autoregressive distributed lag model approach (NARDL) to examine the impact of monetary policy on food inflation in Nigeria between the periods of 1980 and 2021. Food Inflation was employed in the study as a dependent variable while the Treasury bill rate, Exchange Rate, Monetary Policy Rate, and Broad Money Supply were used as explanatory variables. The study which used time series data from the World Bank data repository, the National Bureau of Statistics, and the Central Bank of Nigeria's (CBN) Statistical Bulletin indicated that the exchange rate significantly and negatively affects the food price in Nigeria. Similarly, the study confirmed a long-run association between Nigeria's monetary policy rates and food inflation.

Danlami and Hassan (2020) examined money supply and inflation In Nigeria, with specific attention to the myth of the monetarist theory of inflation. The authors investigate whether inflation is solely caused by the increase in money supply beyond what is required by the economy, as maintained by monetarists using Nigerian data. The Autoregressive Distributed Lag Model (ARDL) was used as the tool of econometric analysis on Nigerian time series data for 48 years. The ARDL was chosen because unit root tests were conducted. The results show that variables are not integrated in the same order. Money supply increment is demonstrated to be inflationary only in the short run. The existence of other factors that influence inflation in the country is also evident. While money supply has no significant influence on inflation, the GDP and the constant have a significant influence on inflation in the long run. Therefore, justification is provided for the myth of the monetarist theory of inflation, claiming that money supply increment is the sole source of inflation, especially in Nigeria. Even though the result of the Wald test shows that the coefficients of money supply combined have a significant effect on inflation in conformity with the monetarist theoretical arguments, such effects are limited to the short run only. The findings of the research are limited to Nigeria whose data are used, based on ARDL as the econometrics techniques applied, for a period of 48 years from 1970 to 2017. Explanations for theories regarding inflation, especially in developing nations, should not be taken for granted. The research empirically demonstrates that the monetarist theory of inflation is a myth and not reality by using Nigerian data. It also suggests that other theories should be empirically tested to check which one best explains the nature of inflation dynamics in a country to proffer a better solution to a high inflation rate problem.

Amassoma and Emma-Ebere (2018) empirically investigated if money supply is the cause of high inflation in Nigeria using annual time series data spanning from 1970 to 2016. Co-integration and Autoregressive Dynamic Error Correction Model (ADLECM) approach was utilized. The results showed that money supply does not considerably influence inflation both in the long and short run possibly because the country is in recession. The ECM has the correct sign of negative and it is significant meaning that about 21.0 per cent of the errors are corrected yearly. The Granger causality outcome demonstrates that there is no causality between money supply and inflation in Nigeria within the study period and vice-versa. The implication of this is often that different economic conditions are key determinants of inflation in Nigeria. The study recommends that the government should diversify the economy and minimize importation by encouraging local production of products and services. The CBN should guarantee an exchange rate policy that is essentially determined by the state of the economy and not by speculators being a net importation economy. Also, the CBN should look inward into the current interest rate and see how it can be regulated in such a way that will encourage private and foreign investors to be able to invest in the country. This in turn, successively increases income, infrastructure development, and economic growth at large.

Adelowokan et al. (2019) considered the impact of open market operations and money supply on inflation in Nigeria. The results of monetary policy outcomes suggest that Nigeria does not often enjoy ideal conditions to adopt a monetary policy regime aimed primarily at stabilizing prices due to increasing internal debt resulting from sales of government securities. This has also pushed up the volume of money supplied to her economy. This has made the economy particularly exposed to price and quantity-type external shocks, which renders price stabilization even more complicated. This study examines the impact of open market operations and money supply on the inflation rate in Nigeria within the period of 1981-2016. Using the vector error correction model approach, the result revealed that Treasury bills, government bonds, and money supply have a positive and significant relationship with the inflation rate in Nigeria. However, the total value of money market instruments, income per capita, and interest rate had a negative and significant impact on the inflation rate in Nigeria. The study concluded that open market operations while controlling the supply of money

had significantly impacted price stability in the long run in the Nigerian economy. The study suggests that there is a need for increased use in the open market operations as a tool for achieving stability of prices in the country.

Okotori (2019) evaluated the dynamics of monetary policy and inflation in Nigeria. The study used monthly data from 2009 to 2017 to estimate the model derived. The Augmented Dickey-Fuller (ADF) unit root test, Johansen Co-integration test, and Error Correction model (ECM) were adopted. The findings of the ADF revealed that except for money supply and exchange rate that is integrated at order two I (2), all other variables are stationary at order one 1(1). The Johansen Co-integration test reveals the presence of a long-run relationship between inflation and all the variables adopted. The ECM result for the two estimated models shows a self-equilibrating mechanism of 5.2 per cent and 9.4 per cent for the first and second models, respectively. The findings brought us to the conclusion that money supply, exchange rate, monetary policy rate, treasury bills rate, reserve requirement, and liquidity ratio have a significant and effective impact on the inflation rate. Based on the foregoing, it is recommended that the CBN stay focused on its current foreign exchange rate policy as well as making an unrestricted (see also Joseph et al., 2024).

Adodo (2018) examined the effectiveness of monetary policy and control of inflation in Nigeria. The study adopted Augmented Dickey-Fuller (ADF), Johansen Co-integration and Error Correction Model (ECM) to evaluate the effect of money supply, interest rate and exchange rate on inflation rate in Nigeria. The results of the unit root test revealed that Inflation Rate, Money Supply, Exchange Rate, and Interest were stationary at first difference while the result of the Johansen Co-integration Test revealed there is a long-run equilibrium relationship among the variables. The result of the Error Correction Model revealed that both Money Supply and Interest Rate are statistically significant in explaining variation in Inflation Rate while Exchange Rate is insignificant in explaining variation in Inflation Rate. It was however concluded that monetary policy has been partially effective in controlling in inflation rate in Nigeria. The study recommended that monetary authorities should adopt adequate indirect instruments to control the volume of money in circulation for effective and efficient control of the inflation rate in Nigeria. The interest rate in Nigeria should be liberalized to make it a strong monetary policy instrument for regulating price levels and economic activities. The money market and its instruments should be adequately developed to make it an effective control mechanism for inflation in Nigeria. A robust and effective exchange rate regime should be adopted by regulatory authorities to ensure exchange rate stability capable of controlling inflationary pressure.

Amassoma *et al*. (2018) empirically investigated the influence of money supply on inflation in Nigeria. The study was borne out of the curiosity to re-examine the immediate cause of the alarming rate of inflation in Nigeria which is adversely affecting the general welfare of the Nigerian populace. The study employed a co-integration test and error correction approach on annual time series data spanning from 1970 to 2016 to ascertain both the long-run and short-run dynamics relationship among the variables under consideration. The findings showed that money supply does not considerably influence inflation both in the long and short run possibly because the country is in recession. The error correction model has the correct sign of negative and it is significant meaning that about 21 per cent of the errors are corrected yearly. The Granger causality outcome demonstrates that there is no causality between money supply and inflation in Nigeria within the study period and vice-versa. The implication of this is often that different economic conditions are key determinants of inflation in Nigeria. The study recommends that the government should diversify the economy and minimize importation by encouraging local production of products and services. The Central Bank of Nigeria should guarantee an exchange rate policy that is essentially determined by the state of the economy and not by speculators being a net importation economy. Also, the Central Bank of Nigeria should look inward into the current interest rate and see how it can be regulated in such a way that will encourage private and foreign investors to be able to invest in the country. This in turn, successively increases income, infrastructure development, and economic growth at large.

The survey of available literature on the relationship between money and price showed that while some economists found negative relationships, other economists found positive relationships between these variables. Given these conflicting results, the present study intends to explore mix of methodology in identifying the current nature of the relationship between money and prices as posited by the QTM.

Most previous studies on money supply or monetary aggregates and inflation, particularly, in Nigeria tends to overlook the longrun requirements of the QTM. In other words, the short run disequilibrium might not be sufficient to conclude that the model collapse, therefore, this study intends to be rigorous and inadeptly carry out a longrun analysis in establishing the status of the relationship in Nigeria. Further, to the best of the researcher's knowledge, empirical findings of the studies on the money-inflation nexus did not have consensus. Thus, the lack of consensus in the findings of previous studies implies the need for more subsequent studies on a related topic to contribute to the ongoing debate in the literature.

It could also be argued that there is a methodological gap associated with previous studies. While some studies rely on the use of the Johansen Co-integration Techniques, others made an advancement of engaging the Vector Error Correction Model (VECM). VECM did not consider the order of integration of the variables of the study. In this study, the ARDL model, which does not discriminate the order of integration of variables and SVAR which will help to recover structural innovations from residuals of a reduced-form VAR were employed. In this way, the current study has addressed methodological gaps in the literature. In addition, for the scope of the study, it also used current data to show the realities on the ground in Nigeria.

3. Data and Methodology

The data used in this empirical analysis was mainly secondary data collected from the period, the first quarter of 1980 to the fourth quarter of 2023 amounting to 172 quarterly observations for each variable. The observed macroeconomic variables namely, inflation rate, money supply growth rate and the real GDP growth rate were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin for 2023, CBN Database, and the National Bureau of Statistics inflation reports (2023). The choice of these variables was strictly based on the equation of exchange propounded by the classical school of economic thought.

2.3 Model Specification

The QTM identity simply shows the relationship between inflation and the supply of money. We can therefore restate the identity to derive a testable model. This process was guided by the empirical work of **Regret and Simbisai (2020)** as follows:

The originating identity of the QTM is stated as:

$$MV = YP \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

When equation 3.1 is transformed to show the variables in term of growth rates, the equation is represented as follows:

$$m + v = y + p \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

The lowercase expressions in equation 3.2 can now be represented to show clearly the inflation or the growth rate price as a function growth in money supply, real GDP growth rate and velocity of money:

$$p = m + v - y \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

Lastly, the quantity theory which can be subjected to empirical analysis can be specified based on the proportionality assumption between inflation and the growth rate of money that expects the coefficient of money supply to be 1 in a regress equation. Further, the orthogonality assumption that demands that output and velocity changes will be neutral to growth in money supply in the long run forms the basis for our model.

Based on these assumptions the econometric model for this study is stated as follows:

$$p_t = \beta_0 + \beta_1 m_t + \beta_2 y_t + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Where:
p = growth of Price Level (Inflation)
m = growth in Money Supply (say broad money supply (M3))
y = Real Output (RGDP)
t = Time Period
μ = Error term
B - B2 are parameters to be estimated.

2.4 Model Justification

The model specified in this study was estimated using the Auto-Regressive Distributed Lag (ARDL) approach implicitly introduced by **Davidson et al (1978)** and further developed and popularized by **Pesaran and Shin (1995)** and **Pesaran, *et al*. (2004)**. Estimating long-run relationships and co-integration analysis for both time series and panel data has been skewed towards the ARDL in recent years owing to its attractiveness over Vector Error Correction (VECM) and Vector Auto-Regressive (VAR). Unlike the latter, ARDL does not require variables to be integrated of the same order (**Pesaran*et al*., 1999**; **Nkoro and Uko 2016**). With the other methods, one would be forced to drop variables in case of both I(0) and I(1) variables. Testing for the presence of unit roots in data is not crucial but only serves to avoid I(2) variables, for which the approach fails (**Paul, 2014**). **Nkoro and Uko (2016)** adds that endogeneity is less likely in ARDL because it is immune to residual correlation. In addition, the approach is more efficient in small samples (**Pesaran *et al*., 2001**) whereas the Johansen approach gives efficient results for large samples (**Johansen and Juselius, 1990**). Recently, **Ghouse *et al*. (2018)** showed that ARDL reduces the risks of spurious regression. Furthermore, ARDL is a one-stop shop approach. Over and above giving long-run and short-run estimates of the model, **Pesaran *et al*. (2004)** provided for co-integration analysis using Bound Testing. `

2.5 Techniques of Data Analysis

In this section, therefore, we discussed the time series methodologies that were used in analyzing the dataset and achieving the specific research objectives.

Model One: Estimating the direction of causality between money supply and inflation rate

The method of estimating the direction of causality between money supply and inflation rate in Nigeria is the Vector Autoregressive model (VAR) and Toda Yamamota (TY). The Vector Autoregressive model is adopted for this work because it is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system variance. The VAR model sidesteps the need for structural modelling by treating every endogenous variable in the system as a function of the lagged values of all endogenous variables in the system. The Toda-Yamamota was applied to determine the causality between the variables. Toda-Yamamoto procedure is a valuable tool for analyzing Granger causality in time series data, particularly when dealing with non-stationary variables. Even where order of stationarity could be higher than one, the procedure can be applied, hence rendering the need to test for stationarity unnecessary. Its robustness, simplicity, and versatility has increased the application by many researchers, hence its application in this study. Toda-Yamamoto Model:

$INFL_t = \beta_0 + \sum \beta_1 INFL_{t-i} + \sum \beta_2 INFL_{t-i} + \sum \beta_3 MS_{t-i} + \sum \beta_4 MS_{t-i} + U_{1t}$..... 3.5

$MS_t = \beta_0 + \sum \beta_1 MS_{t-i} + \sum \beta_2 MS_{t-i} + \sum \beta_3 INFL_{t-i} + \sum \beta_4 INFL_{t-i} + U_{2t}$ 3.6

Where:
$INFL_{t-1}$ = inflation rate at time t_{-1},
MS_{t-1} = Money supply at time $t_{-1}$and
U_{t1}, and U_{t2} = are the error term

Model two for Short-run and long-run impact of money supply on the inflation rate in Nigeria.

$\Delta Infl_t = \alpha_o + \sum \alpha_1 \Delta Infl_{t-l} + \sum \alpha_2 \Delta Ms_{t-l} + \sum \beta_1 Infl_{t-1} + \sum \beta_2 Ms_{t-1} + \theta ECT_{t-1} + \varepsilon_t$ 3.7

Where:

$Infl_t$ = inflation rate at time t,

Ms= money supply at time t,

α_o= constant term,

ECT= error correction term,

θ= coefficient of error correction term,

α_1 and α_2 = coefficient of short-run variables,

$\beta_1$and β_2= coefficient of long-run variables,

ε_t= error term,

$\sum$ = summation,

Δ= difference factor, and $_{t-l}$ = lag

2.6 A Priori Expectations of the Variables

Theoretical, the expected behaviour of the variables considered in this study are as follows:

Money Supply (+): direct and positive relationship is expected (+) showing that an increase in money supply (M) leads to proportionately higher inflation (π) via the Quantity Theory of Money (MV=PQ).

Inflation (+): The QTM establishes a direct and positive relationship between the money supply (M) and the inflation rate (π). In simpler terms, an increase in the money supply will lead to a proportional increase in the price level, and vice versa.

3 DATA ANALYSIS AND PRESENTATION OF RESULTS

3.1 DATA ANALYSIS

The data presentation for the value of Money Supply, Inflation rate and Real Gross Domestic Product and other variables is presented in this Section.

4. 2 Descriptive Statistics

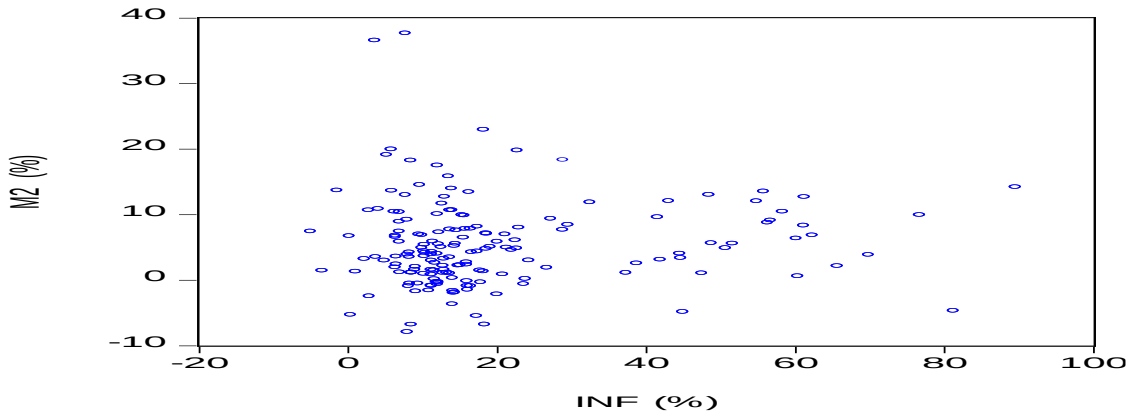

Figure 4.1: Scatter Plot (Relationship between Money Supply growth and inflation rate)

Source: E-views 13 Output

Figure 4.1 shows the scatter plot for the relationship between the money supply (MS) and inflation rate (INFL). From the scatter plot, the relationship revealed that MS and INFL are linearly related and indicated a positive and linear relationship. Therefore, specifying the relationship between MS and INFL is thus:

INFL = *f*(MS)…….4.1

Table 4.1 Descriptive Statistics

	M2 (per cent)	*INF (per cent)*	*RGDP (per cent)*	*MS*RGDP (per cent)*
Mean	5.42	19.73	3.41	20.88
Standard Deviation	6.60	17.69	4.79	50.50
Kurtosis	5.22	2.65	1.48	17.39
Skewness	1.53	1.76	-0.36	3.05
Minimum	-7.89	-4.98	-11.60	-93.55
Maximum	37.67	89.57	15.92	385.19
Count	171	172	168	172

Source: Computed by the Author

Table 4.2 Correlation Analysis

	M2 (per cent)	*INF (per cent)*	*RGDP (per cent)*	*MS*RGDP (per cent)*
M2 (per cent)	1			
INF (per cent)	0.057986	1		
RGDP (per cent)	0.093187	-0.25356	1	
MS*RGDP (per cent)	0.72086	-0.17045	0.493166	1

Source: Computed by the Author

The analysis revealed the location of the centre of distributions of the series via the average values (mean), the minimum values, and maximum values as well as how individual variable values are spread on each side of the centre via the standard deviation, thus revealing the uniformity of the items in the distribution of each variable. The peakedness of each variable is given by the kurtosis statistics.

Table 4.1 showed average values of 5.42 per cent, 19.73 per cent, 3.41 per cent, and 20.88 per cent, for MS, GDP, RGDP, and the interaction of MS*RGDP, respectively. From the table, it was observed that all the variables are skewed to the right, given the corresponding positive skewness statistics of 1.53, 1.76, and 3.05 for MS, and MS*RGDP, except for RGDP which is negatively skewed. As regarding to Kurtosis, a kurtosis with a distribution greater than 3 is a leptokurtic distribution. A leptokurtic distribution (greater than 3) has a sharper peak with a lower probability than a normal distribution of kurtosis whose value is equal to 3. A kurtosis with less than 3 is a platykurtic distribution which has a lower and wider peak with higher probability than leptokurtic and normal distribution. Notably, the kurtosis statistics revealed that MS and MS*RGDP are leptokurtic, RGDP is platykurtic while INFL is normally distributed given that the values is approximately 3. The result revealed the descriptive statistics of each of the variables. Therefore, no inference was drawn from the characteristics observed. It can also be seen that all the variables have 172 observations. This can be attributed to the availability of information on the variables used in the study.

Table 4.2 shows result of the matrix correlation for MS, INFL, RGDP and MS*RGDP. The result revealed that the relationship between MS and INFL is 5.7 per cent, implying a weak correlation. The correlation between RGDP and INFL is -25.36 per cent which indicated a weak negative correlation, finally the correlation between MS*RGDP and INFL is -17.05per cent which signifies a weak negative correlation.

3.2 PRE – ESTIMATION TEST RESULTS

The data was subjected to pre-diagnostic tests such as the unit root test. The Augmented Dickey-Fuller test unit root test with structural breaks was applied. This is to authenticate either stationarity or non-stationarity of the data before the actual estimation is conducted. Time series data are trended and therefore in most cases are non-stationary (**Asteriou & Hall, 2007**). The problem with non-stationary or trended data is that the standard ordinary least squares (OLS) regression procedures can easily lead to incorrect conclusions.

Table 4.3 Unit Root Test Results:

Augmented Dickey-Fuller

Variable	Level	Date of break	1st Diff	Date of Break
INFL	I(0) -3.6923 P-value 0.2865	1995Q2	I(1) -9.2308 P-value 0.0100	1984Q4
MS	I(0) -12.6497 P-value 0.01000	1984Q2	I(1) -23.3053 P-value 0.01000	1983Q3
RGDP	I(0) -4.4863 P-value 0.0449	1983Q4	I(1) -10.7424 P-value 0.0100	2011Q1
MS*RGDP	I(0) -11.0153 P-value 0.01000	2008Q1	I(1) -19.6030 P-value 0.0100	1984Q4

Source: E-views 13.0 Output

Table 4.3 shows the result of the unit root for the variables used for this study. The ADF p-value result for INFL at level is (0.2865) greater than the significant level of 0.05. The result of the P-value for variable MS under ADF is (0.0100) is less than the significant level of 0.05. Accordingly, the variable RGDP reveals that the p-value result of ADF is (0.04490) is less than the significant level of 0.05. The decision rule is when the P-value is higher than the level of significance of 0.05, the indication is that the variable is non-stationary i.e., there is a problem of unit root. Otherwise, it is stationary. From the result, the p-values of all the variables under ADF all are less than the significant level of 0.05, except for INFL, which has a high p-value. Hence, a stationary data for all the variables except for INFL. According to Gujarati (2004) the presence of unit root requires differencing, which is a corrective procedure, to avoid the spurious regression that may arise from regressing a non-stationary time series on one or more non-stationary time series. The transformation method depends on whether the time series are difference stationary (DSP) or trend stationary (TSP). If a time series has a unit root, the first differences of such time series are stationary. Therefore, the solution here is to take the first differences of the time series. From Table 4, the non-stationary data was transformed by differencing each of the variable. It is therefore, established that all the variables are integrated of mixed order of I(0) and I(1) the justification for Auto-regressive distributed lag model (ARDL).

3.3 Model Estimation And Evaluation Tests

Model One: Causality between Money Supply and Inflation Rate

$$INFL_t = \beta_0 + \sum \beta_1 INFL_{t-i} + \sum \beta_2 INFL_{t-i} + \sum \beta_3 MS_{t-i} + \sum \beta_4 MS_{t-i} + U_{1t} \ldots\ldots\ldots\ldots\ldots\ldots 4.2$$

$$MS_t = \beta_0 + \sum \beta_1 MS_{t-i} + \sum \beta_2 MS_{t-i} + \sum \beta_3 INFL_{t-i} + \sum \beta_4 INFL_{t-i} + U_{2t} \ldots\ldots\ldots\ldots\ldots\ldots 4.3$$

Where: $INFL_{t-1}$ = inflation rate at time $t-1$, MS_{t-1} = Money supply at time $t-1$and U_{t1}, and U_{t2} = are the error term

Table 4.4: Granger Causality (Toda Yamamoto) Model Tests Results

S/N	Variable	Direction	df	X^2	P-value	Decision
1	INFL & MS	INFL→ MS	4	6.416612	0.1701	No Causality
2	MS & INFL	MS→ INFL	4	9.6457	0.0076	Causality

Source: E-views 13 Output

Table 4.4 shows the result of the Toda Yamamoto Granger Causality result. Each hypothesis has both the null and alternate form. For Instance, the hypothesis can be stated thus:

1. H_o: INFL does not Granger Cause MS
H_1: INFL does Granger Cause MS
2. H_1: MS does not Granger Cause INFL

H_1: MS does Granger Cause INFL.

For the First hypothesis, the p-value of the X^2-test is 0.1701 which is greater than the level of significance of 0.05. The result implies that we fail to reject the null hypothesis which states that INFL does not granger cause MS. However, in the case of the second hypothesis, it was found that the p-value for MS granger causing INFL is 0.00706 which is less than the level of significance of 5%. Thus, MS does Granger cause INFL this means there is causality.

Model Two: Impact of Money Supply on Inflation Rate

$\Delta Infl_t = \alpha_o + \sum\alpha_1 \Delta Infl_{t-l} + \sum\alpha_2 \Delta Ms_{t-l} + \sum\beta_1 Infl_{t-1} + \sum\beta_2 Ms_{t-1} + \theta ECT_{t-1} + \varepsilon_t$ 4.4

Where: $Infl_t$ = inflation rate at time t, *Ms*= money supply at time t, α_o= constant term, ECT= error correction term, θ= coefficient of error correction term, α_1 and α_2 = coefficient of short-run variables, $\beta_1$and β_2= coefficient of long-run variables, ε_t= error term, ∑ = summation, Δ= difference factor, and $_{t-l}$ = lag

Bound Co-integration Test

A Bounds Test was undertaken to ascertain the presence of co-integration among the variables. The outcome of the co-integration test was displayed in Table 4.5.

Table 4.5: Bounds Test of Co-integration

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	13.96756	10.0 per cent	2.44	3.28
K	1	5.0 per cent	3.15	4.11
		2.5 per cent	3.88	4.92
		1.0 per cent	4.81	6.02

Source: E-views 13 Output

Table 4.6: Short Run and Long-Run Results Model Two

Variables	Coefficient	P-value
	SHORT-RUN	
Δ INFL (*-1*)	-0.1162	0.0000**
*Δ(*MS)	0.1633	0.0148**
ECM(-1)	-0.116	0.0000**
	LONG-RUN	
*(*MS)	3.5778	0.0000**
R^2	0.888	
Durbin-Watson	2.024	

Dependent variable: GDP *** 5.0 per cent, ***10.0 per cent and *1per cent*

Source: E-views 13 Output

The results of the limits co-integration test indicate that the null hypothesis is rejected at a significance level of 5.0 per cent. The estimated F-statistic of 13.97 surpasses the lower and upper critical bound values for significance levels of 10.0 per cent, 5.0 per cent, 2.5 per cent, and 1.0 per cent. This indicates the presence of a long-run equilibrium relationship among the variables.

Lag Length

The Lag length shown in Figure 4.2 was evaluated to identify the suitable lag at which the ARDL model was computed. The Akaike Information Criterion favours employing a maximum of 3 lag for both the dependent variable and the regressor. The chosen approach employed an ARDL (3, 2) model.

Long-Run and Short-Run ARDL Estimation

The study presents the results of the ARDL model for the long-run and short-run effects of various factors, such as money supply (MS) and Inflation rate. These results are displayed in Table 4.6.

Table 4.6 presents the outcomes of the ARDL analysis, showcasing the Error Correction Model (ECM) as well as the short-term and long-term effects. According to the error correction equation, it is anticipated to have a negative value, be less than one, and be statistically significant at a 5.0 per cent level. The ECM result fully satisfied the 100 per cent requirement for what is anticipated from the ECM. The ECM coefficient which is -0.116 showed that the model is stable and converging towards equilibrium in the long run. The adjustment process is expected to occur over the next quarter after the disequilibrium as about 11.6 per cent of disturbance or divergence is corrected.

The preceding year's INFL has a strong and substantial impact on the present INFL in Nigeria. This suggests that in Nigeria, past events have an impact on present happenings. The economy's negative inflation rate from

the previous year continued into the current year, resulting in a negative inflation for the current year compared to itself. A 1.0 per cent rise in the inflation rate will lead to an 11.6 per cent decrease in the current inflation.

The short-term analysis reveals that the coefficients of money supply (MS) are β = 0.1633 with a corresponding p-value of 0.0148. The findings indicate that the money supply (MS) has a positive and statistically significant impact on inflation rate, with a significance level of 5.0 per cent. The coefficient value of money supply (MS) aligned with the anticipated a priori expectation, demonstrating a positive and significant impact. The steady rise in Money supply (MS) has led to an increase in the inflation rate in Nigeria. In the long run, the money supply (MS) has a coefficient of β= 3.5778 and a p-value of 0.0000. The findings also demonstrate that money supply (MS) has a favourable and substantial influence on the inflation rate in Nigeria. This conclusion does align with the a priori expectation, which predicts a positive outcome.

The coefficient of determination, r2= 0.888, indicates that 88.8 per cent of the variation in the inflation rate in Nigeria can be attributed to a change in money supply.

3.4 Post-Diagnostics Tests

Post-diagnostics tests such as stability, heteroscedasticity and auto-correlation tests were conducted. The results are presented as follows:

Stability Test

The stability test is graphically represented, indicating that stability is achieved when the middle line remains within the bounds of the two parallel lines, whereas deviation from these lines implies instability. The result is depicted in

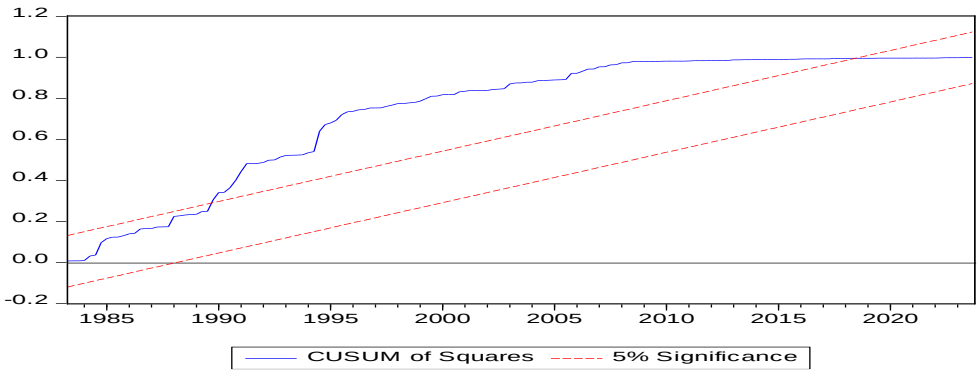

Figure 4.3: Stability Test

Table 4.8: Auto-correlation Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.424517	Prob. F(2,161)	0.6548
Obs*R-squared	0.886546	Prob. Chi-Square (2)	0.6419
Source: E-views 13 Output			

The stability test depicted in Figure 4.3 was conducted to assess the temporal consistency of the relationship between the variables. The diagram illustrates that the central line remained parallel to the two adjacent lines without any deviation. This indicates that the link between the variables remains inconsistent.

Auto-correlation Test

Auto-correlation was tested using the Breusch-Godfrey serial LM Test. The result is presented in Table 4.8.

The p-value of the Breusch-Godfrey test, as indicated in Table 4.8, was determined to be 0.6548, which exceeds the significance level of 0.05. This implies that there is no issue of autocorrelation.

4 Discussion of Findings and Recommendations

It was found from the test of hypothesis one that there is a unidirectional causality running from money supply to inflation in Nigeria. This finding was found to be inconsistent with the study of **Rasool and Tarique (2020)** who examined monetary policy approaches in India. The study was to investigate the relationships among the macroeconomic variables money supply, real income, price level, and interest rate for the period 1998 –2014. The Granger causality test via the VAR framework was tested using four pairs of causality; in particular, bidirectional causality exists between money supply and price level. Similarly, the result was not in agreement with the study of **Debesh (2020)** who examined the quantity theory of money in the UK from 1844 to 2016. Granger causality result applied assured that there is unidirectional causality from money supply

to price level with lag. It should however be noted that the divergence could be a result of jurisdictional diffreneces.

In the case of hypothesis two, where short-run and long-run impact of money supply on the inflation rate in Nigeria was tested. It was found that there is a short-run and long-run positive impact of money supply on the inflation rate in Nigeria. This outcome supported the findings in the long run but not in the short run of **Sultana et al. (2019)** who established that the money supply does not affect the price level in the short run, but in the long run money supply stimulates inflation in Bangladesh. On the contrary, the findings of this study do not agree with the findings of **Amassoma *et al*. (2018)** who empirically investigated the influence of money supply on inflation in Nigeria. The findings showed that money supply does not considerably influence inflation both in the long and short run possibly because the country is in recession.

Given that there is a short-run and long-run impact of money supply on the inflation rate in Nigeria. This finding implies that money matters in Nigeria's inflation development. The quantity theory of money has been established as the most enduring doctrine of economics. The theory has always declared that changes in the overall price level (inflation) are fundamentally due to the alterations in the amount of money available in an economy. Furthermore, **Hume (1752)** identified that the quantity theory of money is a direct relationship between inflation and money supply. Consequently, the gap in this study has been filled in that, most previous studies on money supply or monetary aggregates and inflation, particularly, in Nigeria tend to overlook the long-run requirements of the QTM. The result has laid to rest the argument that short-run disequilibrium might not be sufficient to conclude that the model collapsed. The findings of this present study have disproved the failures of QTM in the long run in Nigeria.

Given the predominant unidirectional relationship running from money supply to inflation, it is recommended for the CBN to prioritize and utilize a range of monetary policy instruments, such as open market operations, reserve requirements, and interest rate adjustments, to effectively control the money supply.

Lastly, considering the positive and statistically significant impact of money supply (MS) on inflation, the monetary authority must ensure that the money supply contracts during periods of high inflation, and could expand the money supply to counter deflation. The findings from the model also showed that the impact of money supply on inflation is higher in the long run compared short run, therefore, effort should be made to understand the policy response lag to avoid unnecessary intervention in temporary disturbances in the economy.

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